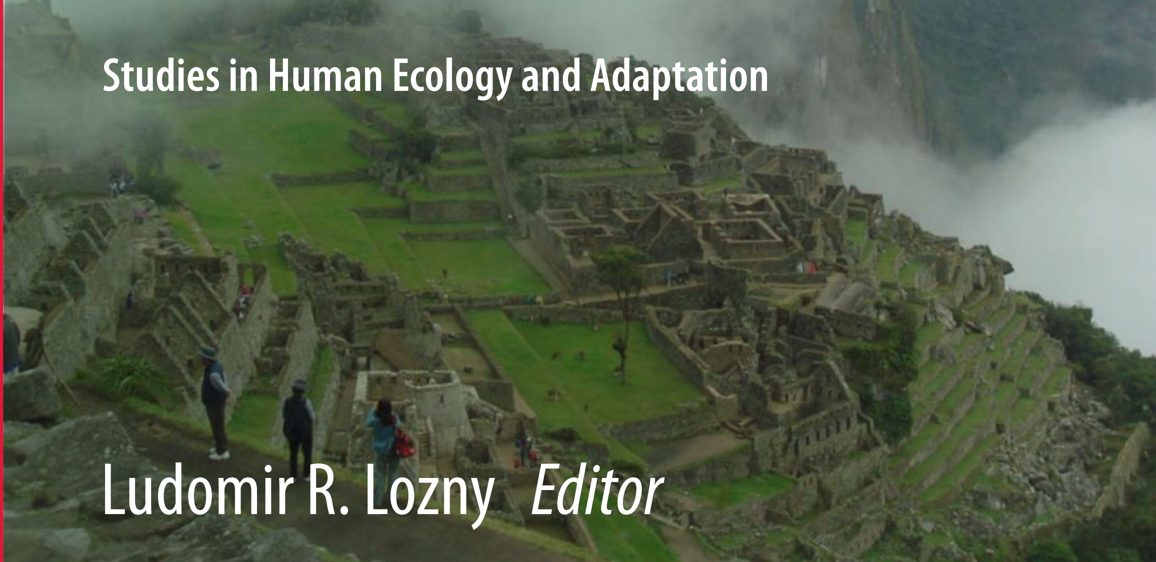
Studies in Human Ecology and Adaptation



Ludomir R. Lozny *Editor*

Continuity and Change in Cultural Adaptation to Mountain Environments

From Prehistory to Contemporary Threats

Springer

Studies in Human Ecology and Adaptation

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Editor

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From Prehistory to Contemporary Threats

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For Andrzej

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Chapter 1
Introduction

Daniel G. Bates and Ludomir R. Lozny

For a book of this nature, few introductory comments can rival the words of the pioneering geographer of mountainous regions, R. Peattie, who in 1936 wrote:

> One of the most attractive concepts in the study of mountains is the concept of zones. Travelers among mountains delight telling how their climb began amidst a splendor of tropical foliage. Then in succession they went from the evergreen broad-leafed zone to that of deciduous trees, to the evergreen conifers, to an arctic heath, and so to eternal snow. The rapid contrast of vegetation within so small a space challenges the imagination.[1]

This almost lyrical passage nicely summarizes the universal qualities of mountainous regions from a human perspective: steep altitude gradients play out in climate and vegetation, while the valleys themselves alternate in temperature and rainfall depending where they lie with respect to prevailing winds, with the upper reaches marked by seasonal frost or permanent snow fields or glaciers. Very often mountain systems present marked contrasts between steppe areas of grasslands with the potential for intensive cultivation or animal husbandry and nearby zones of intense aridity as a result of what geographers refer to as the *orographic effect*. This occurs when water-bearing clouds forced upward by the mountains, suddenly cool and thereby release their rain on selected slopes leaving neighboring valleys and lowlands with a precipitation deficit. A good example is the southern part of the Arabian Peninsula where the summer monsoons coming across the Indian Ocean strike the Green Mountain, the Jabal Akhdar of the Hadramawt and the mountains of Yemen making some of south-facing slopes extremely fertile—hence the origins of coffee—while the vast interior of Arabia is largely uninhabitable apart from oasis based settlements.

It is impossible to separate cultural or social processes from the environmental setting in which they occur. The geological or topographical configuration, the

[1] R. Peattie 1936, quoted in Brush 1976a, b, p. 126.

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climatic conditions, the distribution of water and minerals, and the occurrence of plant and animal life are fundamental to human adaptation. Much of the human settings in or near mountain highland areas are themselves products of history as much as geography. Be it via waterworks, terracing, road building, burning, mineral extraction, herding activities, and the harvesting of forests and vegetation, humans have shaped their habitats—a multifaceted and dynamic feedback process. While it is tempting to see particular mountain landscapes as "pristine" or "primeval" this is inevitably an error. What we cannot see is the diversity of land cover and animal life as it would have been without human agency. Just as savannas and prairies are increasingly understood as artifacts, so are mountain ecosystems. Selected examples of mountainous "production zones" are presented in Table 1.1 below.

Carleton Coon, an anthropologist, noted that geologically the world's oldest civilizations arose in some of the world's youngest lands (1958:10). The relative geological youth of most mountain ranges is well established and understood in terms of plate tectonics, and is evident in the steep, craggy mountain areas that so often form the spectacular backdrop to flat plains and steppes. The process of recent mountain formation has determined the distribution of critical resources, including water and minerals. Water originating in the mountains of Eurasia and Africa and flowing as exotic rivers to the sea supported the earliest towns and cities. Minerals critical to early cultural development such as iron, copper, tin, silver, and gold are often found where mountains have folded and faulted to expose older layers. Mountain regions are also important as they can provide data on past and future environmental change through, for example, analysis of the ice cores from the Andes and the Himalayas or pollen data from the Alps and the Pyrenees.

Naturally the distribution of peoples and settlements usually closely reflects the distribution of rainfall, this is obviously not the complete picture. Naturally agriculture depends on regular water supplies, these can be obtained from sources other than rainfall. In antiquity large-scale irrigation was a technological advance that allowed for the development of very complex social orders. Four or five great civilizations owed their fluorescence to the irrigation systems that developed along the river valleys of the Nile (the world's longest river at 6,669 km), the Tigris-Euphrates, the Indus, Yangesi and Yellow Rivers of China, and the Mekong—all rising in far off mountains and all ultimately brought major centers of population into indirect dependence on these distant hinterlands—a situation which still persists.

The human relationship with mountain ecosystems has a long history even prior to the Neolithic Period. Hominids inhabited high mountains 1.8 mya as evidenced by the finds of *homo erectus* in the Caucuses Mountains (recently renamed *homo georgicus*). Both *homo erectus* and the later *Neanderthals* were large bodied and seemingly extremely efficient killers of large and small prey. They most assuredly left a significant footprint on their landscapes. Pre-Neolithic *homo sapiens* were prevalent in mountainous areas—witness the impressive and widely distributed petroglyph sites in the mountains of northern Portugal, and cave art of Spain and France. From the Neolithic transition in subsistence strategies on, high altitudes were, of course, used much more intensively. Animal husbandry allowed mobile herders to make effective use of high-altitude grasslands, which would be snow-bound in

Table 1.1 Production zones in three mountain areas (after Brush 1976a, b:128, Table 1)

	Southern Switzerland		Peruvian Andes		Central Nepal Himalaya	
Production zone	Approximate altitude range (m)	Products	Approximate altitude range (m)	Products	Approximate altitude range (m)	Products
Low altitude	<1,000	Fruits, especially vineyards	<1,500	Sugar cane, coca, fruit, rice	<1,500	Rice, fruit
Mid-altitude	1,000–2,000	Cereals, hay, gardens	1,500–3,000	Cereals	2,000–3,000	Cereals, tubers
Mid/high altitude	2,000–2,300	Forest	3,000–4,000	Tubers	3,000–4,000	Forest
High altitude	2,300–3,000	Pastures	4,000–5,000	Pastures	4,000–5,000	Pastures

winter, as summer pastures thus exploiting vertical zonality to integrate animal production with farming in a more efficient food procurement system. This mix of cereal and legume production with mobile animal management is common to all major mountain regions (Table 1.1).

Given the near universality of animal husbandry in mountain ecosystems it is not surprising that much of the influential post-WWII social science environmental research focused on the roles of livestock management by nomadic, agrarian, or horticultural populations. Fredrik Barth, a Norwegian anthropologist working in southern Kurdistan, South Persia, and Swat northern Pakistan, employed ecological niche theory to interpret settlement processes and inter-ethnic exchange. Xavier de Planhol, and Wolf-Dieter Hutteroth, French and German geographers respectively, pioneered the modern study of mountain nomadism in Anatolia. Joseph A. Tosi, Jr, a geographer and Stephen Brush, an anthropologist, early on applied ecosystem theory in the Andes, as did Robert McC Netting, an ethnologist, with a number of colleagues in the Alps, and with G. and P. Stone in western Africa. John T. Hitchcock and Donald A. Messerschmidt, anthropologists, carried out fine-grained environmental studies in the Himalayan Mountains of Nepal. Perhaps most influential is the work of Andrew P. Vayda and Roy A. Rappaport in highland New Guinea whose ecological modeling and research hugely shaped the development of human ecology as an important element in American anthropology.

Of course, environmental studies almost always have geopolitical components. The tectonic activity that gave rise to mountain formation is on-going in the form of global "belts of fire" where volcanoes and earthquakes pose challenges to human occupation. Besides this geological challenge, highland regions bring their own social and political opportunities and limitations to human settlement. The nature of the terrain promotes cultural and political diversity through physical hindrance, even barriers, to communication, transportation, and population movement. Mountains all over the world offer refuge to political dissidents, bandits, and those who would defy the nominal authority of the cities or states. Often putative national frontiers fall along or through mountain ranges and very often we see a stark contrast between "lands of the governed" and the contested "lands of violence" where local leaders, political or religious, stand in opposition or rebellion. Thus, very often politics have to be factored into the ecological equation.

All of the researchers who contributed to this volume address aspects of the ways humans adapt to the zonal nature of their habitats and themselves impact these habitats. Thirty years ago social scientists participating in a symposium, "Cultural Adaptations to Mountain Ecosystems," at the Annual Meeting of the American Anthropological Association in New Orleans could fit comfortably in 1 lecture hall. Today, mountain ecosystems are understood to be critical to the health and well-being of a huge swath of populations in Eurasia, the Americas, and Africa. We are now witnessing the loss of tropical mountain forests and the increasing vulnerability of mountain ecosystems caused by human activities including mining, industry, agriculture, and even tourism. Those involved in understanding and ameliorating this could now easily fill a convention center.

The essays collected here discuss human cultural responses to key physical and cultural variables associated with mountain ecosystems, such as aridity, quality of soils, steep slopes, low productivity, as well as human impacts on mountain ecosystems, such as deforestation and erosion, and the possible effects of climate change. The contributors (cultural anthropologists, geographers, archaeologists, ecologists, and cultural resource managers, and planners) all point out that mountain populations cope with their stressors by adopting specific cultural strategies, such as seasonal migrations, integration of pastoral and agricultural production, animal crossbreeding, use of crop varieties, a mixture of communal and household control of land, trade, crop diversity, diversification of activities, often unique transportable housing construction, and innovative scheduling of productive activities. Adaptational strategies usually relate to altitudinal verticality which allows for exploitation of various ecological zones, diversification of diet, and access to a multiplicity of resources. Low productivity is mitigated through trade and exchange and seasonal migration.

The most common reoccurring themes include human impact on mountainous environments in prehistory, discussed by Didier Galop et al. (Pyrenees) and Fernand David (Alps), and in the present, as evidence by terracing reported by Lynn Kwiatkowski (Philippines), and communal management of pastures (commons) discussed by Jean-Francois Chopin et al., and Ludomir Lozny with reference to the Pyrenees and Pablo Dominguez in regard to the Berbers of Morocco. Indigenous responses to climatic change and other current threats are discussed by Lynn Kwiatkowski (Philippines) and Ana Ladio, Evert Thomas, and Julio Postigo (Andes), Jeremy Spoon (Himalaya) and Karim-Aly Kassam (Pamyr).

Specific mountain regions discussed include the Alps (David), the Pyrenees (Galop, Lévêque, Chopin, Guedon, and Lozny). Three chapters deal with the Andes (Ladio, Thomas, and Postigo). 2 articles discuss the Himalayan region (Kassam and Spoon). Other authors discuss a variety of themes related to cultural adaptation in the North American Rocky Mountains (Diggs and Brunswick), Moroccan High Atlas (Dominguez), southern China (Schoenhals), and the Central Cordillera in the Philippines (Kwiatkowski).

The book is organized chronologically and regionally. Seven chapters present the European research from the Alps and the Pyrenees. With respect to the Alps, Fernand David reports on a new methodology for the recreation of paleo-landscapes using pollen analysis. Since it can reveal differences in the changes in landscape at the scale of human activities, this methodology can be adapted to multidisciplinary programs. Didier Galop et al. discuss human impact on the Pyrenees beginning nearly eight millennia ago with the settlement of the first agro-pastoralists in the foothills. The authors summarize the paleoecological "history" based on recent data from several research programs.

The subsequent four chapters address historical archaeology in the Pyrenees. Jean-François Chopin et al. report the results of long-term research related to the exploitation of salt in the French Pyrenees, an activity that might be dated back to the Neolithic period. Frédéric Guédon presents long-term research on a series of small valleys of the upper Lavedan in the central Pyrenees. Stéphane Lévêque focuses on the analysis of architectural remains of mountain summer shelters constructed to shelter herders and their flocks, and indicates that they have been the dominant characteristics of pastoralism in the Pyrenees for the past 6,000 years.

Ludomir Lozny uses the methods of landscape archaeology to record the evidence of group cooperation and collective management of high-altitude pastures in the central Pyrenees. In Chap. 8 David M. Diggs and Robert H. Brunswig using historical archaeological data discuss Native American sites in the Rocky Mountain National Park (RMNP), which may have served religious purposes. Field and consultation data have been incorporated into successive generations of a Geographic Information System (GIS) project designed to model and predict spatial distribution of sites and ritual features believed to have constituted those long-lost landscapes.

The following three chapters present research from the Andes addressing issues ranging from local resilience and human adaptability to indigenous responses to climatic change. Julio Postigo presents a cultural-ecological approach in analyzing herders' adaptability to Andean high altitude above 4,000 m conditions. Ana Ladio discusses the indigenous populations living in arid environments such as deserts, semi-deserts, savannas, steppes, and dry forests where the scarcity of physical resources combined with detrimental historical–economical–political circumstances have created high social and environmental vulnerability. She reports on the Mapuche response to such stress through the use of different ethno-ecological units related to altitudinal gradients. Evert Thomas discusses the persistence of conservative attitudes among mountain societies, specifically the continuing practice of traditional medicine in Andean communities. He points out that traditional medicine fulfills a central role in the daily lives of both rural and urban Andean peoples.

In Chaps. 12 and 13 we move to the Himalaya region. Karim-Aly Kassam discusses communities in the Pamir Mountains of Afghanistan and Tajikistan who have been subjected to dramatic political and economic changes, not to mention threat of global warming and sees their responses as fundamentally linked to indigenous cultural values, ecological niche, and local wisdom. Jeremy Spoon explores Khumbu Sherpa livelihood adaptations in the world's highest ecosystem and assesses how ecological, political, and economic forces shaped five centuries of human-environment relationships, such as less arable land, protected area establishment, and an exploding tourism industry.

In his Chap. 14 on the Nuosu (Yi) a mountain-dwelling ethnic minority living in southwest China, Martin D. Schoenhals provides a fascinating case study of how a people apparently socially and geographically disenfranchised preserve their sense of ethnic dignity and social stability. The Nuosu directly relate the strength of their identity in the face of social and environmental adversity to their high mountain homeland. Lynn Kwiatkowski M. (Chap. 15) describes how the Ifugao people of the Philippine Cordillera Mountains have over the last century become more extensively integrated into the global market economy. Pablo Dominguez (Chap. 16) examines diverse roles of the *agdal* system, a several centuries-old Berber form of land management in the High Atlas Mountains of Morocco that prohibits access to communal pastures during certain periods in order to allow for new growth. He describes an ingenious system of agro-pastoral land rotation as closely linked to a complex and evolving cosmology reflecting certain values for the conservation of the biophysical environment, local economic performance, and the maintenance of social cohesion and cultural continuity.

Overall, this collection presents a comprehensive overview of current mountain ecosystem research drawing archaeological, ethnographic, ecological, and, in several cases, cross-disciplinary data. A number of authors present concrete suggestions for development initiatives designed to assist mountain communities currently under stress, as well as recommendation for areas of future research. The volume is thus an invaluable resource for both academic researchers in fields ranging from cultural anthropology and archaeology to botany and geography, as well as government and NGO professionals concerned with development, and cultural heritage planning.

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Chapter 2
Presenting the Evidence of Diversity in Mountain Paleo-Landscapes. The Case of the French Alps

Fernand David

Introduction

The Western Alps offer ample opportunities to study changes in vegetation cover through time, particularly those caused by human activities due to the occurrence of human settlements (Thirault 2006; Marguet et al. 2008). Archaeological research has revealed a long history of human habitation in the French Alps (Rey and Thirault 1999; Thirault 2006; Mocci et al. 2006; Walsh et al. 2007) and although archaeological excavations yielded substantial data on habitation patterns, they did not provide paleo-environmental information that might be useful to archaeologists. The integration of environmental and archaeological data in order to understand changes in the past environmental conditions and human impact on the vegetation dynamics is the first step in such analysis and is presently applied in various multidisciplinary programs such as PYGMALION (Arnaud et al. 2009). However, problems regarding the methodology used in the collection of environmental data still inspire debates. For environmentalists, it is a matter of accounting for the local ecological parameters, which are frequently accepted as conditions for premature establishment of the relationship between changes in tree cover (David 1993a, b, c) and human activities. Such overlap between the environment and human activities is still visible in the division of the territory of France into numerous naturally defined regions, as proposed by the school of geography established by Vidal de la Blache (de Martonne 1922). In order to address those methodological problems, this article discusses 2 points: first, a point on methodological solutions to account for the ecological diversity in recreations of paleo-landscapes in the French Alps, and second, on reporting of the principal results of conducted studies.

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Methodology

Palynology is the study commonly used in paleo-environmental reconstructions because it permits the modeling of vegetation at different space and time scales (Birks and Birks 1980; Delcourt et al. 1983; Berglund 1991; Punning and Koff 1997). However, certain methodological constrains should be pointed out as the quality of pollen analysis depends on ecological conditions of the sampling site, namely the origin and distribution of pollen, and site geology, which conditions the absorption and preservation of pollen in sediments, both being a function of numerous environmental variables. Thus, the selection of a paleo-ecological site highly depends upon the purpose of the study (Jacobson and Bradshaw 1981).

Selection of Sites

In a mountain environment a potential decline in diversity of pollen profile due to mixing of air masses mandates careful selection of sites for pollen sampling. Only those sites where pollen content in sediments is dominated by the contribution of local ecotones should be considered. Nevertheless, the frequencies of regional components in high-altitude sites are never negligible (Coûteaux 1981; Barthelemy and Jolly 1989). The regional pollen flow may be best detected through the study of sites that are terraced over ecologically restricted [closed] areas. This is why Beug (1975) recommended the choice of terraced sites to show the establishment of layers of vegetation in his work on the mountains of the Mediterranean. Many studies have shown the relationship between pollen, rain, and morphometric characteristics of sites (Crowder and Cuddy 1973; Peck 1973; Currier and Knapp 1974; Bonny 1976; Pennington 1979; Jacobson and Bradshaw 1981; Jackson 1990). Following this argument, I suggest that the selection of small, less than 1 ha in area, sites located in closed basins, i.e., without any contribution from streams, is the most favorable for the description of local mountain tree cover and for the need of creating an ecological reference for human past activities outside of archaeological sites (David 1993a, 1995). In addition, the influence of various sedimentary parameters on the pollen profile also involves an approach when multiple surveys of the selected site are conducted in order to determine the variability of the intra-site ecological records (Whittington et al. 1991; David 1993a, b, c).

Area of Study

The great heterogeneity of ecological zones within the French Alps necessitates limiting the locations from which a testing site can be selected. The selected zone should present a relative homogeneity of ecological parameters (David 1993a, b, c). In the Alps, the definition of homogeneous ecological zones (Fig. 2.1) rests on the work of the team

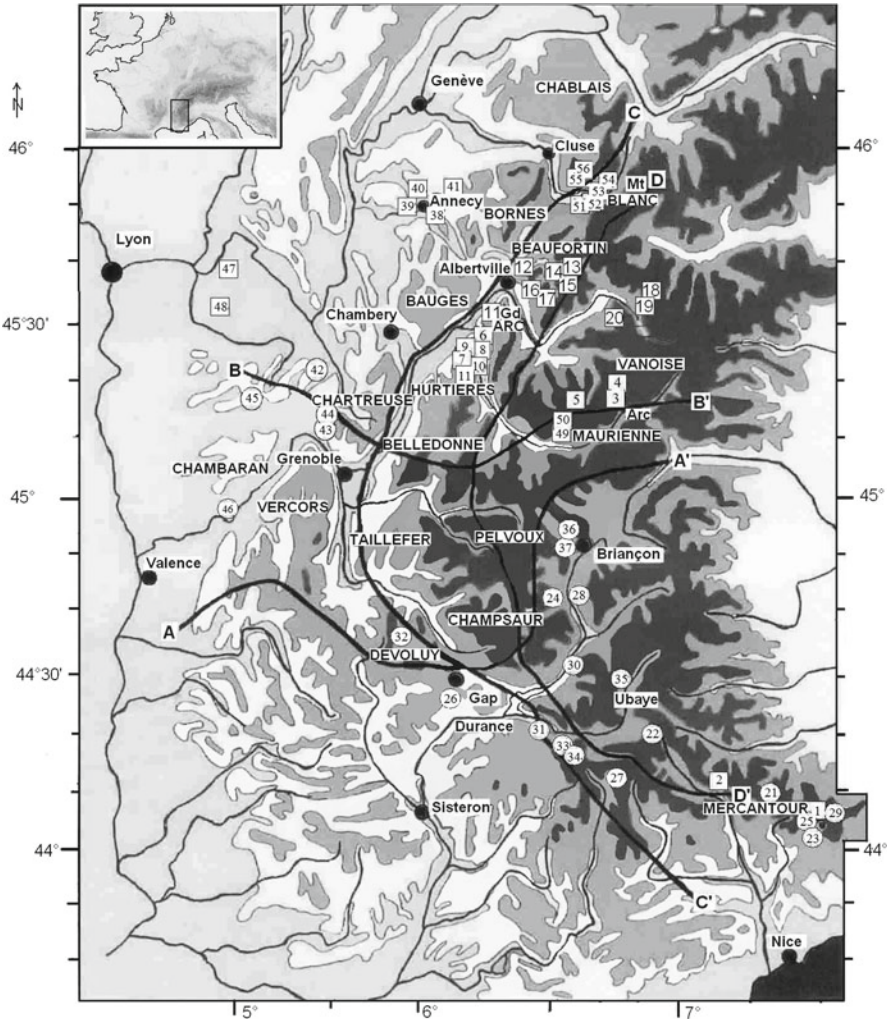

Fig. 2.1 Distribution of study sites and ecological zones (according to Ozenda 1966). AA'—limit of mountain passes between the southern and northern domains, BB'—limits of the transition zone, CC'—limit between the external and intermediate domains, DD'—limit between the intermediate and internal domains. Altitudes 500 m, 1,000 m, 2,000 m

from the vegetation biology laboratory in Grenoble, who identified four boundaries that define nine ecological zones (Ozenda 1966, 1985). Research conducted on small sites and involving various layers of vegetation and different levels of exposure (Fig. 2.2) has shown that the elementary unit of analysis of paleo-landscapes is the "massif" (David 1993a, 1995). The definition of "key massif" instead of "key-site" presents a conceptual change in the approach to study a history of vegetation in order to recreate paleo-landscapes (David 2001a). Consequently, a synthesis of paleo-landscapes at the regional level is done by integrating the localized results one by one. Making a comparison

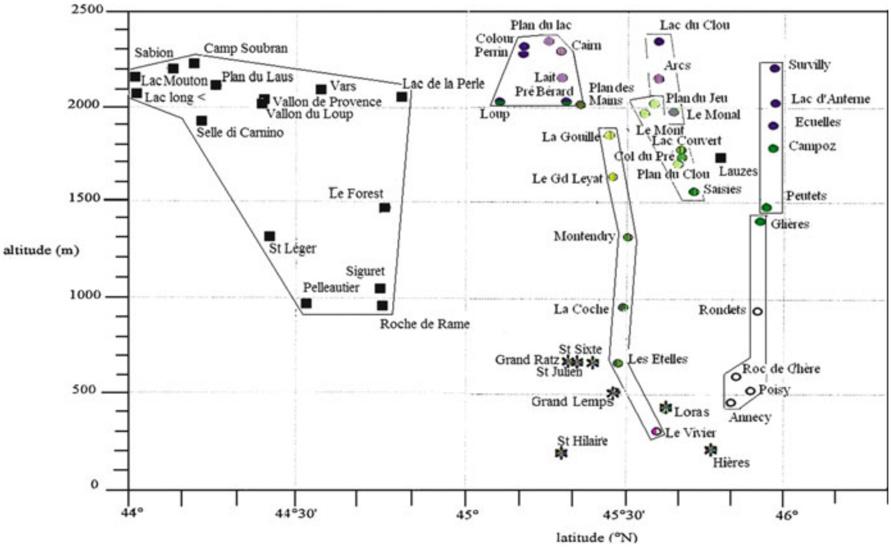

Fig. 2.2 Altitude and latitude distribution of study sites. Sites are grouped by massif or basin

concerning sites of varying altitudes makes sense only in an ecologically restricted area, and comparing sites of similar altitude is the only method that can reveal variation in the tree cover at the altitude level under consideration. It is within this methodological framework that I present the evolution of the upper tree limit in the northern part of the Alps and the diversity of paleo-landscapes at the subalpine level. Such methodological framework makes possible a reinterpretation of pollen research prior to 1990.

Results

Levels of Vegetation

The 2 key results we have obtained by changing the methodological approach from recreation of the history of vegetation to recreation of paleo-landscapes demonstrate, first, the absence of high-altitude pine forests during the Late Glacial Period, and second, the resilience of the pine forests at the bottoms of valleys during the climatic pejoration of the Younger Dryas.

Result 1. The hypothesis regarding the presence of high-altitude pine forests during the Late Glacial Period, as described by de Beaulieu (1977), was the result of the consistent approach of translating pollen percentages into tree cover on sites of altitude higher than 1,000 m where pine trees are underrepresented. Demonstration of the overrepresentation of pines by altitude (Fig. 2.3) was made by following the progress of percentages of pines, birches, and Poaceae as a function of altitude during the optimum part of the pine tree phase during the Late Glacial Period in

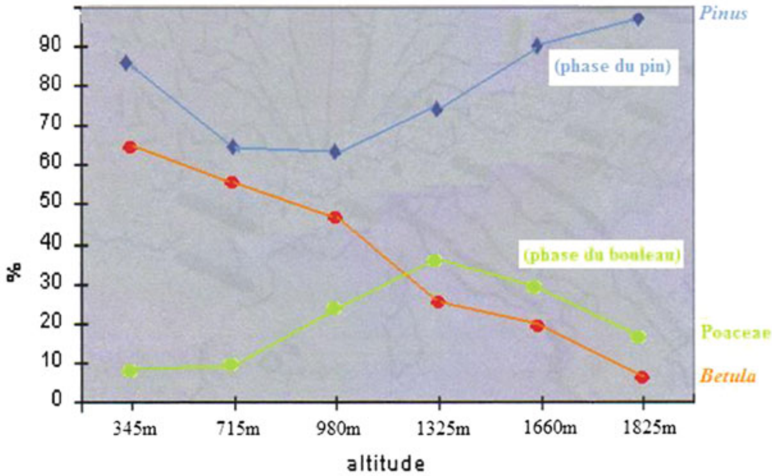

Fig. 2.3 Change in pollen percentages for Pinus, Betula, Poaceae as a function of altitude in the Late Glacial in the Hurtières massif (according to David 1993a)

the Hurtières massif (David 1993a). Percentages of pine trees decrease from the plain in the intermediate altitudes (between 700 and 1,600 m), where birches and Poaceae dominate. Above 1,600 m percentages of pines reach levels that are greater than percentages at low altitude. Simultaneous observation of the *Pinus* stomata at the lowest altitudes confirms the decline in diversity of late glacial pine forests in higher elevations (David 1993b, 2001b). Increased percentages at higher altitudes result from the incorporation of pollen from taxa that are very highly productive relative to low-pollen-producing arctico-alpine plants. In the French Alps, the subalpine layer was colonized by woody species only during the Holocene (David 1993a, b, c; de Beaulieu et al. 1993).

Result 2. Errors in interpretation resulting from the direct translation of pollen percentages in terms of tree cover are also located at lower altitudes (David 1993c; de Beaulieu et al. 1993). This is how the distribution of sites in the Lower Dauphiné (Clerc 1988) led to an incomplete vision of the history of the Late Glacial Period due to the absence of any sites from altitude greater than 700 m (Fig. 2.2). The resilience of the populations of low-altitude pines during the Younger Dryas has resulted in sustainability of high percentages. Only the observation of a decline in pollen concentrations and pollen markers such as alder and a few herbaceous steppe taxa allowed the impact of the recent Dryas to decelerate (David 1993c, 2001b).

These first 2 results allowed us to describe the changes in the upper tree limit and the singularity [specificity] of each mountain massif (David 1993a, b, c, 1995). The human exploitation of alpine ecosystems may be and should be considered within the framework of these environmental changes. Archaeological studies of marmot hunters in the Vercors in the Late Glacial Period illustrate an interest in confronting these independent archaeological and paleo-environmental data (Monin et al. 2010).

Diversity of Paleo-Landscapes

A comparison of closely similar sites within the same altitudinal segment allows for evaluation of the differences between sites and also to reveal the diversity of landscapes. This approach is particularly evident in the subalpine level [1,500–2,000 m] because it shows the diversity of ancient landscapes of this layer, currently dominated by grasslands. In this way, the different evolution of tree cover depending on whether it is on the south-facing or north-facing side was demonstrated from the beginning of the Holocene (Müller et al. 2000). The great diversity of paleo-landscapes in the Alps is illustrated by the study of three sites on either side of the Maurian Valley (Fig. 2.1). Pollen analysis of the three sites was supplemented by an analysis of macro-remains at Pré Bérard (2,020 m) and Plan des Mains (2,080 m). In these two sites, the chronology was supported by 11 AMS datings of terrestrial vegetation macro-remains (David 1997; David and Barbero 2001; Chalier 2001). Pollen analysis of the Plan du Loup is new and the chronology was supported by six AMS datings of terrestrial vegetation macro-remains. A comparison of the simplified pollen diagrams is presented in Fig. 2.4a, b. In all three sites we note the same vegetation succession corresponding to the colonization of this layer since the early Holocene (David 1993a, b, c). However, we observe considerable differences in the relative abundance of different taxa. This is how, on the south-facing slope of Pré Bérard, a mixed population of pine maple and alder ash becomes clearly distinct between 8300 and 6300 cal. BP (David and Barbero 2001). Joint study of macro-remains has shown that other taxa such as poplars, mountain ash trees, and alders have played a significant role. At this site, stone pine is also less abundant in relation to an intensification of fires starting from 5900 cal BP underscored by the particular development of birches. At this site, a lesser development of stone pine has been recorded relative to the Plan des Mains site, where stomata were recorded discontinuously in the sedimentary sequence and show that cembro pine were sustained over several millennia (David 1997). The Plan du Loup site is the only one that exhibits considerable, continuous development of larch around 4000 BP. In both sites on the north-facing side, Plan des Mains and Lac du Loup, the reduction of the stone-pine forest along with a development of green alders has been observed. The intensification of human action translates into a decrease in alders in favor of the current grassy fields, and the chronology of such decrease differs among the sites. This point was also demonstrated further north in the Chamonix region as part of the PYGMALION program (David 2010; David and Barbero 1995).

Conclusion

The various examples presented here illustrate the capacity of palynology to reveal local variations in mountain tree cover. The study of layered sites in a massif allows us to palliate potential loss of diversity in the pollen spectra as well as to follow altitude changes in ecotones and in particular those of the upper tree limit. It enables

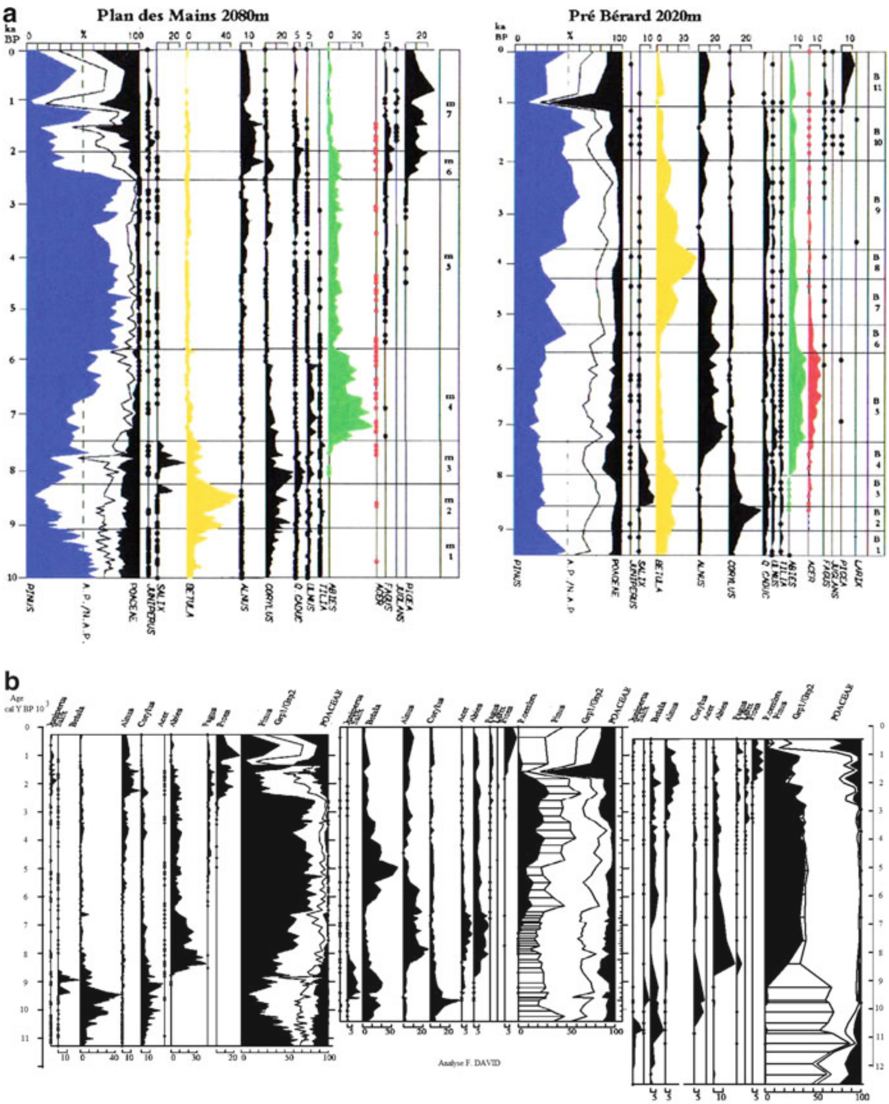

Fig. 2.4 Simplified pollen diagrams for the Plan des Mains (2,080 m), Pré Bérard (2,020 m) and Lac du Loup (2,035 m)

us to reconstruct paleo-landscapes, which have proven to be much diversified at the subalpine level, whereas in our time this level consists for the most part of heath and grasses. Data synthesis by integration in a defined ecological zone (massif or catchment area) should enable us to outline any possible future variations in the use of territories as a function of local parameters and to approach these questions at the same space and time scale as archaeologists do.

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Chapter 3
A History of Long-Term Human–Environment Interactions in the French Pyrenees Inferred from the Pollen Data

Didier Galop, Damien Rius, Carole Cugny, and Florence Mazier

Introduction

Over the last decade, several research programs have been involved in studying the socioecological history of the Pyrenean Mountains using sedimentary records preserved in lakes and bogs. Their main focus was on understanding human exploitation of natural resources and its environmental consequences. Recovering these "memories" buried for thousands of years in sediments requires interdisciplinary efforts dealing with the analysis of a large number of bio-indicators. The study of those bio-indicators has become a multi-proxy process which combines the classical study of fossil pollen and spores with macro-charcoal (size >150 μm) and non-pollen palynomorphs (algae, fungal spores, etc.) data. Those additional bio-indicators provide precise information about the historical use of fire (Whitlock and Larsen 2002; Vanniere et al. 2001; Galop et al. 2002; Rius et al. 2009) as well as trophic conditions or grazing activities respectively (van Geel 2001; Cugny et al. 2010). Along researching those biomarkers, geochemical studies of lead isotopes helped in documenting past atmospheric pollution events related to historical mining or metallurgical activities (Bindler et al. 1999; Brännvall et al. 1999; Galop et al. 2001; Monna et al. 2004). Leaving aside the technical aspects of those studies, we briefly introduce below the principles of the palynological approach as a means of tracing the impact of human past activities on the local ecosystem. This approach takes into account a series of anthropogenic pollen indicators. The most obvious signature of human activity is deforestation associated with the conquest

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of land highlighted in the pollen diagrams by lower frequencies of tree species and by the higher frequencies of herbaceous and some tree species, which prefer colonizing disturbed areas (juniper, birch, hazel, etc.). However, such events may also be caused by other factors unrelated to human activity (weather hazards, natural fires, etc.). Therefore identification of other pollen indicators undoubtedly associated with human actions is needed. We propose using the indicator-species approach derived from ethnobotanical investigations and based on modern pollen representation of cultigens and other plants characteristic of agro-pastoral practices (Behre 1981, 1986; Mazier et al. 2006, 2009). Cultivated species, arable weeds as well as ruderal plants found in areas impacted by past human activities such as fallows, waste ground, surroundings of buildings are considered to be such reliable indicators. Variations of taxon-guides can help us to understand the long-term fluctuations of human-induced pressure at a given site and allow their interpretation in terms of spread, stability, or abandonment of human activities. Such approach has been applied to identify the main phases and processes of human impact on the northern (French side) slopes of the Pyrenees (Fig. 3.1). This chapter offers an overview of the last 7,000 years of human history in those mountains with a particular focus on the arrival of the Neolithic agro-pastoralists.

The Neolithic Conquest

The introduction of agro-pastoral culture in the Pyrenees and the spread of that culture which significantly affected the local ecosystem and contributed to environmental changes cannot be disconnected from the Neolithization process that affected the entire Mediterranean Basin. The palynological data acquired during the last 30 years of research conducted on the northern slopes of the Pyrenees help us to understand environmental changes of the landscape but also provide the pollen evidence on human impacts on the ecosystem. Those impacts, namely the appearance of grains or plants associated with agro-pastoral activities, as well as signs of openings in the forest allow us to infer the chronology and the spatial extent of the early agro-pastoral activities across the mountains. The spatiotemporal analysis of the appearance of early agro-pastoralists in the region clearly indicates that the Neolithic conquest of the Pyrenees was not a uniform process (Fig. 3.2). The spread of human Neolithic activities across the Mediterranean and the Atlantic coasts was characterized by asymmetric diffusion processes regularly influenced by what was happening in the Mediterranean zone, and an arrhythmic phase of expansion, whose origin still uncertain may have been driven by sociocultural and natural phenomena (i.e., ecological thresholds).

The earliest Neolithic signs of human impact on the foothills of the Mediterranean Pyrenees are confirmed by pollen data from the seventh and the turn to sixth millennium BC, 6700–5900 cal. BC, in the lower Aude Valley (Roussillon plain), i.e., several centuries before the dates of the first Neolithic archaeological evidence assessed

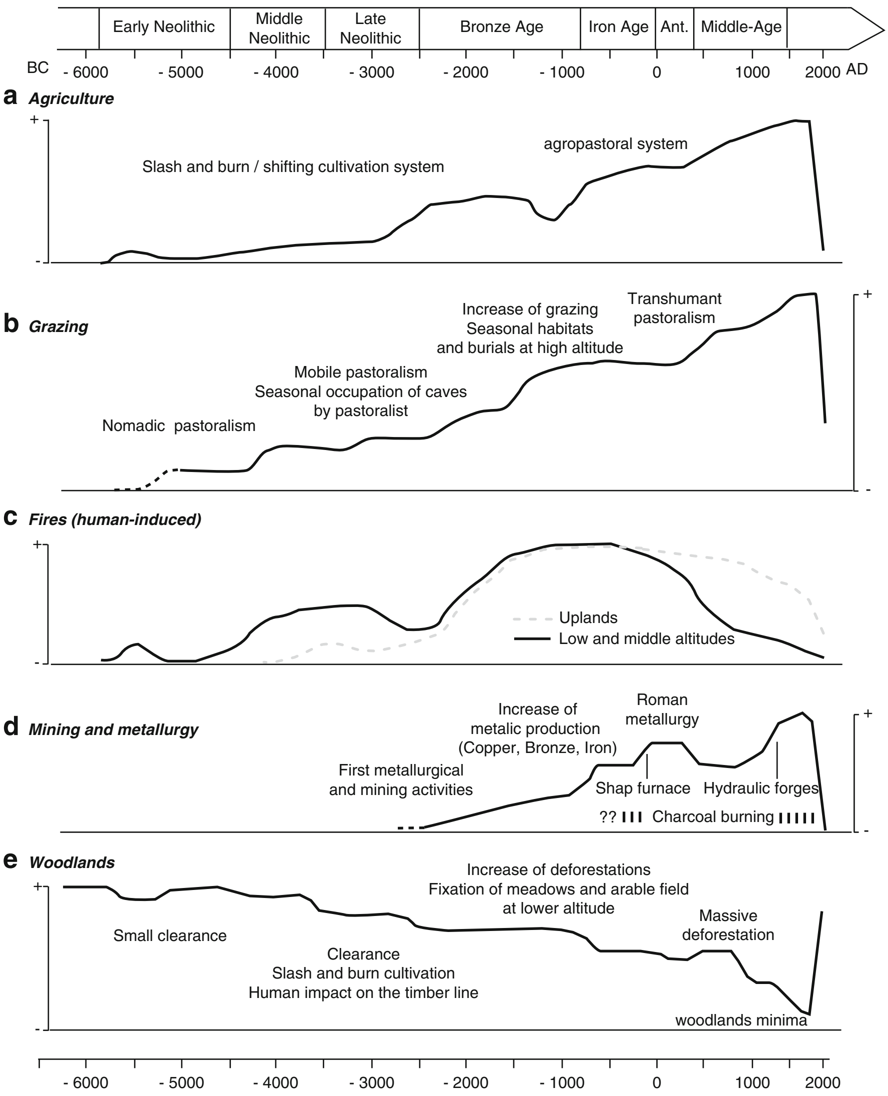

Fig. 3.1 Synthesis of long-term socio-ecological history on the northern slope of the Pyrenees during the last 8,000 years inferred from palaeoecological and archaeological data

between 6400 and 6000 cal. BC in Catalonia's lowlands (Planchais 1985; Jalut 1995; Guenet 1995; Galop and Vaquer 2004). The first discrete manifestation of the presence of the Neolithic societies linked to the appearance of the Cardial Ware groups in the Pyrenees is dated to 5800–5500 cal. BC, and reinforced by the data on an opening of the oak forest due to the emergence of agriculture. From the Mediterranean center the economy based on agricultural production gradually spread out across the Pyrenees at the end of the sixth and the beginning of the fifth millennium BC.

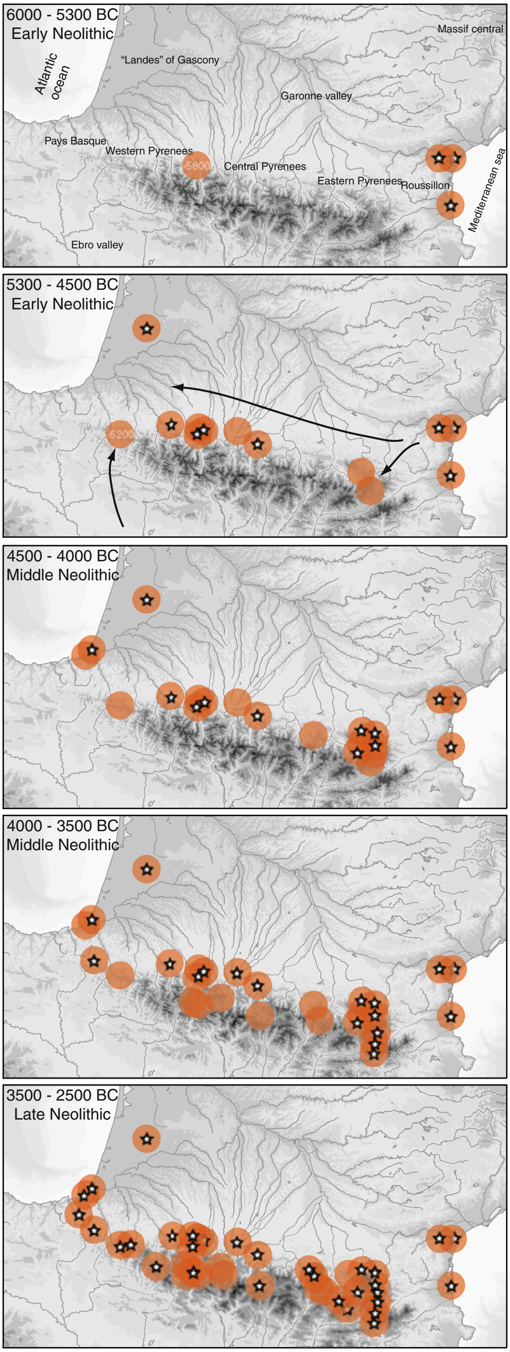

Fig. 3.2 Dissemination of agro-pastoral activities on the northern slope of the Pyrenees during the Neolithic period inferred from pollen records. Coloured discs report first evidence of grazing activities suggested by the presence pollen of nitrophilous plants while the stars indicate the first notations of cereal cultivation

The diffusion of agro-pastoral culture into the Pyrenees remains difficult to date precisely. This is especially true for the initial stages and their study requires a lot of care and attention because the anthropogenic signature loses its strength with increasing distance from the Neolithic centers located on the Mediterranean coast. The earliest agro-pastoral communities may have operated at a scale too small, or below a disturbance threshold, to be detectable by pollen analysis and thus their activities remain a "blind spot" in our history. Although such possibility is real, the pollen data suggest that human groups appeared ca. 5800 cal. BC at lower altitudes in the piedmont of the northern Pyrenees (Galop 2005; Rius et al. 2009). The southern slopes (Spanish side), however, have been colonized by the Neolithic societies more rapidly. Deforestation and cultivated crops were detected in the immediate vicinity of the archaeological site of Chaves, located in the southern part of the Pyrenees and dated between 5800 and 5300 cal. BC (Lopez-Garcia and Lopez-Saez 2000). Was the Ebro Valley an important geographical axis of cultural diffusion that allowed the rapid expansion of agro-pastoral culture on the southern side? This is likely and researching this hypothesis may also explain the appearance of anthropogenic pollen indicators ca. 5200 cal BC in the highlands of the Basque Mountains, upstream of the upper Ebro Valley. In this highland zone, slender indices of temporary occupation and pastoral opening of the oak forest are present in the pollen record obtained at Artxilondo near the Aizpea cave, where a Neolithic occupation dated to 5400–5200 cal. BC has been recorded (Barandiaran and Cava 2002; Galop et al. 2004). These activities occurred few centuries before the first evidence of human Neolithic activity on the northern slopes and are most likely linked to small groups of hunter and pastoralist nomads penetrating the high altitudes. However, such impacts remain isolated and agricultural activities in the Pyrenees seem absent in the western, Atlantic regions of the mountains during the early phase of Neolithization.

During the second half of the Early Neolithic Period human activities progressed slowly along the mountain range and are better visible in the pollen record of the northern Pyrenean foothills (Rius et al. 2009). The first traces of agriculture associated with small forest openings are identified in the western and central Pyrenean foothills ca. 4800 cal. BC. At the same time similar traits are recorded further north in Landes Department in Gascony (Faure and Galop 2011). Irregular presence of pollen grains from ruderal species recorded at several sites in the foothills of the Garonne Valley and dated between 4800 and 4500 cal. BC, attests to the emergence or intensification of agro-pastoral activities in lowland areas.

The diffusion of the agro-pastoral culture during the early Neolithization to the central and western Pyrenees appears restricted to the foothills, whereas at the same time it is well represented in the mountain areas of the eastern, Mediterranean part of the mountains. Pollen evidence of pastoral activities and forest clearings that took place between 4700 and 4500 cal. BC were observed in higher altitudes of the eastern Pyrenees (>1,500 m above sea level [m.a.s.l.]). This observation reinforces the hypothesis of the spread of agro-pastoral culture in the foothills of Catalonia along the eastern Pyrenees (Baldellou and Utrilla 1999). The data also highlight the apparent slowness of dissemination of the Neolithic culture into the central and western Pyrenees. This slow and asymmetrical diffusion could have been caused by difficulties in adaptation to different ecological conditions by communities arriving from otherwise sparse Neolithic settlements of the Mediterranean region.

Following this pioneering phase, the spread of the agro-pastoral culture across the Pyrenean Mountains becomes more evident during the Middle Neolithic. It coincides with the rise of the Chasseen culture linked to an increase of population and settlements in regions outside the Pyrenees (Guilaine 2003). The occurrence of agro-pastoral pollen indicators on the Atlantic coast at ca. 4400 cal. BC suggests the conclusion of the diffusion process of agro-pastoral lifestyle along the northern Pyrenean foothills and suggests that the highlands may have been subsequently occupied in the phase between 4200 and 3700 cal. BC.

The first palynological evidence of agricultural lifestyle such as grazing and forest disturbance in the western Pyrenees, indicated by an increase in the frequency of fire, is confirmed for the period ca. 4200–4100 BC (Galop et al. 2001; Rius et al. 2009). Further east, in the central Pyrenees and Ariege, several pollen records obtained from altitudes between 1,500 and 2,100 m.a.s.l. show some signs of deforestations and evidences of pastoral activities during the same period (Jalut et al. 2000; Galop 1998; Galop and Vaquer 2004). Nevertheless, it is in the eastern Pyrenees that the expansion of the Middle Neolithic culture is the best evidenced with several records showing the onset of human impact between 4200 and 4000 cal. BC. These records demonstrate a significant wave of human colonization of the mountain area, which continued until around 3700–3600 cal. BC.

The expansion of agro-pastoral culture into the Pyrenean highlands is not unique and is a part of a larger phenomenon which concerns all European mountain environments (Walsh et al. 2007, 2008; Walsh and Richer 2006). During the Middle Neolithic evidence of animal husbandry practiced in the mountains appeared. Pastoral practices are clearly documented for this period in the Pyrenees by both archaeological evidences and the occurrences of pollen from nitrophilous species associated with grazing (ribgrass (*Plantago lanceolata*), common nettle (*Urtica dioica*), common poppy (*Chenopodium album*), or sorrels (*Rumex* sp.)). Additionally, shepherd's huts dated to ca. 4200 cal. BC and fossilized coprolites (ca. 3800 cal. BC) including archaeozoological remains have been discovered above 2,000 m.a.s.l. in the eastern Pyrenees (Rendu 2003) and in the cave site of Mikelauen-ziloa in the Basque Country (Marembert 2000). They represent valuable evidence of pastoral exploitation of the Pyrenees at the turn of the fifth and fourth millennia BC. Whether these were true pastoral practices is still debatable. It seems, however, that they might have been associated with the beginnings of seasonal transhumance practices from low to high altitude areas. If the above evidence will be confirmed by other research, a hypothesis that the Middle Neolithic Period may represent the birth of highland pastoral lifestyle of Pyrenean societies is worth pursuing. Time investments in building shepherds huts (Rendu 2003) and the regular use of caves to shelter livestock might suggest a more sedentary way of life and not strictly nomadic, as evidenced by ethnographic data.

Based on the above evidence, we can state without much doubts that the period 4200–3700 cal. BC represents the first phase of territorial expansion of agro-pastoral culture in the Pyrenees, but we must emphasize that this period is characterized by minor human impact on the environment. Despite the fact that palaeoecological data, more precisely macrocharcoal analysis, support the existence of slash-and-burn agriculture at that time (Galop et al. 2002; Rius et al. 2009) and also the expansion of livestock, analyses of pollen data also suggest local deforestation and a rapid regeneration of the oak forest even in the subalpine pine forest. Further observations concerning the economic sustainability of this period suggest a decrease in agro-pastoral activities between 3700 and 3300 cal. BC. This retreat or abandonment of human agro-pastoral activities recorded during the transition from the Middle and Late Neolithic (ca. 3300 cal. BC) correlated with a climatic decline suggested by advances of the Pyrenean and Alpine glaciers (Gellatly et al. 1992; Haas et al. 1998). This correlation reinforces the hypothesis on the influence of climate variability on human activity and land-use in highland zones (Berglund 2003; Bonsall et al. 2002; Gobet et al. 2003; Tinner et al. 2003; Magny 2004; Galop 2005).

The phase of abandonment of agro-pastoral lifestyle (3700–3300 cal. BC) is followed by another increase registered at ca. 3300 cal. BC and visible in the majority of pollen records over the Pyrenean chain. This second expansion of Neolithization, also recorded elsewhere in Europe and the Mediterranean, represents a significant cultural change. The palynological evidences of agricultural and grazing activities of the time increased and became more regular. This indicates an intensification of pastoral pressure in high altitudes, including the areas that had not been previously exploited (Galop 1998, 2001). The increase of human activity related to land-use during this period is confirmed by pollen data and fire events linked to shifting and slash-and burn cultivation. Those activities have indeed considerably increased from 3300 cal. BC in both the piedmont and at the timber line (Galop et al. 2002, 2003; Vanniere et al. 2001; Rius et al. 2009). In addition, by the end of the Neolithic Period, geochemical analyses performed in several peat deposits show the first inputs of lead deposition at ca. 2500 cal. BC. Such deposition strongly suggests mining and metallurgical activities, which are also responsible for an increase in woodland exploitation for the production of charcoal (Galop and Jalut 1994; Galop et al. 2001; Monna et al. 2004; Beyrie et al. 2003).

The Bronze Age: A Turning Point

Pollen data demonstrates the existence of two distinct phases of mountain population growth, first in the beginning of the Bronze Age around 2000 BC, and second during the Bronze Age—Iron Age transition around 1000 BC, (Carozza et al. 2005; Galop et al. 2007; Carozza and Galop 2008). This population change is visible synchronously in all the pollen records along the mountain chain revealing a regional-scale social process that took place 4,000 years ago. An increase of the population density at this time is shown by the abundance of archaeological remains of pastoral shelters recently discovered over 2,000 m.a.s.l. in the eastern and central Pyrenees (Rendu 2003; Rendu et al. in press). The increase of human pressure on woodlands is reflected in sedimentary record for this period. They show a rise in fire events linked to land use changes (Rius et al. 2009), while geochemical data from the Basque Country and the Ossau Valley stress an intensification of metallurgical and/or mining activities.

During the Iron Age, pollen data indicates altitude-dependent trajectories of human activities. From about 800 cal. BC, pollen records from the uplands show an abandonment phase that is not recorded at low altitudes. Conversely, there seems to be a continuation of relatively stable human land-use pressure in lowlands. This apparent lack of interest in upland areas remains difficult to explain. One possibility might be climatic change as this abandonment phase corresponds with a climatic deterioration around 850 BC (van Geel et al. 1996, 1998; Galop et al. 2007). But could climate change have forced the Pyrenean populations to retreat to warmer areas as it has been shown for the northern Alps? The answering of this question still awaits archaeological data. Also, socioeconomic and/or political forces may have caused such abandonment. Without offering a definitive answer to these questions, research conducted in the central Pyrenees seems to demonstrate the existence of a short period around 850 cal. BC during which weather conditions deteriorated. The degradation of the climate was significant enough that increased snowfall and lower annual temperatures allowed the maintenance of large snowfields at 2,000 m.a.s.l. during summertime (Carozza and Galop 2008). Such conditions would have certainly been a limiting factor to the exploitation of highland pastures thereby forcing population to retreat to intermediate altitude areas where conditions would have been more favorable for livestock grazing.

From Ancient Lifestyles to the Construction of Medieval Landscapes

Contrary to common claims that the culture change associated with the Roman Period was a fundamental step in the construction of cultural landscapes, this period does not represent a major phase in the environmental history of the Pyrenees. Antiquity in general is marked by a resurgence of human activities and pollen records clearly show a wide variety of historical trajectories. The environmental changes recorded in pollen samples from the Pyrenees indicate significant local deforestation probably driven by a socioecological pressure in which economic factors and pragmatism determined the approach in the management of natural resources (Galop 2005). Export of natural resources to the growing urban centers evidenced by, for instance, the presence of timber-floating channels may have been a factor limiting the exploitation of the arable land and pastures.

Late Antiquity and the Early Middle Ages unfairly regarded as periods of cultural decline or abandonment in several parts of Europe present different trends in the Pyrenees. Recent palynological studies have shown a rise of agro-pastoral activities during those periods in the central Pyrenees. The existing evidence suggest the colonization of new lands from the sixth century AD (Galop 2000) evidenced by an increase in fire events and deforestation in the altitudes between 700 and 1,300 m.a.s.l. and the presence of shepherd huts at high altitude (Rendu et al. in press).

The agro-pastoral expansion which begun in the sixth and seventh centuries becomes even more pronounced between the ninth and the tenth centuries. Although the signs of an explosion of agro-pastoral activities do not appear with the same clarity in all records, acceleration in deforestation in all altitudes is certain. Severe deforestations are caused by the establishment of pastoral monastic estates, the increase of cultivated lands, and the massive development of metallurgical activities supported by technological advances. In some cases this has led to the complete eradication of forests as it has been demonstrated in Haut-Ariège (Galop and Jalut 1994; Bonhôte et al. 2002).

This intensification of the agro-sylvo-pastoral system—the origin of modern Pyrenean landscapes—was slowed by a phase of depopulation in the fourteenth to fifteenth centuries.[1] Palynological records showing reforestation reflect the effects of the medieval crisis linked to the plague and military conflicts. However, a closer examination of the data suggests that the consequences of this crisis were diverse in the Pyrenees. For example, reforestation does not occur in the Valley of Aston and in most of the metal-producing valleys of Haut-Ariege. Despite the existence of serious social problems such as epidemics in these valleys the valuable economy of metallurgical activities may have offset the negative effects, thus maintaining pressure on the local forests.

Following this medieval crisis, the effect of economic and demographic recoveries and new patterns of land-use are clearly detectable in the majority of pollen records from the research area. This phase, especially the Industrial Revolution, was responsible for significant deforestation which in some cases led to an ecological crisis. It was during this final phase of human expansion that Pyrenean agro-pastoral landscapes sustained the peak of human-induced pressure on the local environment. Today, an unprecedented phase of land abandonment initiated during the first half of the twentieth century has encouraged processes of ecological degradation that will gradually erase the agro-pastoral culture, but not its legacy recorded in the past.

[1] Editor's note: possibly related to the Little Ice Age in Europe.

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Chapter 4
The Pastures of the Bénou Plateau (Bilhères-en-Ossau), France. One Form of Exploitation of Salt Resources in a Mountain Environment

Jean-François Chopin, Jean-Claude Roux, and David Billon

Introduction

The Bénou Plateau is located in the Pyrénées-Atlantiques about 30 km south of Pau, in the commune of Bilhères-en-Ossau (Fig. 4.1), on the left side of the Ossau Valley, one of the primary Pyrenean valleys connecting France and Spain. The plateau forms a natural bridge, through the neck of the Marie Blanque, between the Ossau Valley and the neighboring Aspe Valley. Culminating at an average altitude of 900 m, it constitutes the first level of the low mountain range. The Bénou Plateau is subdivided into three small successive plateaus, the Houndas Plateau (Fig. 4.2), the Roland Plateau (Fig. 4.3), and the Técouère Plateau (Fig. 4.4), each with a very dense hydrographic network.

The morphology of the Bénou Plateau is shaped by the lithological characteristics of the rocks involved in its formation, namely sedimentary limestone, clay rocks, and igneous rocks. The geological structure of the region associated with the Pyrenean orogeny is masked here in large part by glacial deposits and by the action of glaciers, especially during the last glaciation. In fact, the glacial maximum that affected the region appears to be Würmian in origin. The Bénou Plateau was covered by a glacial tongue that resulted in a diffluence in the Ossau glacier. The geomorphology of the plateau is thus interpreted as a suspended paleo-polje associated with the melting of glacial ice. The action of the glacier is materialized here by moraine deposits consisting of lateral moraines, erratic blocks, and terminal moraine vallums.

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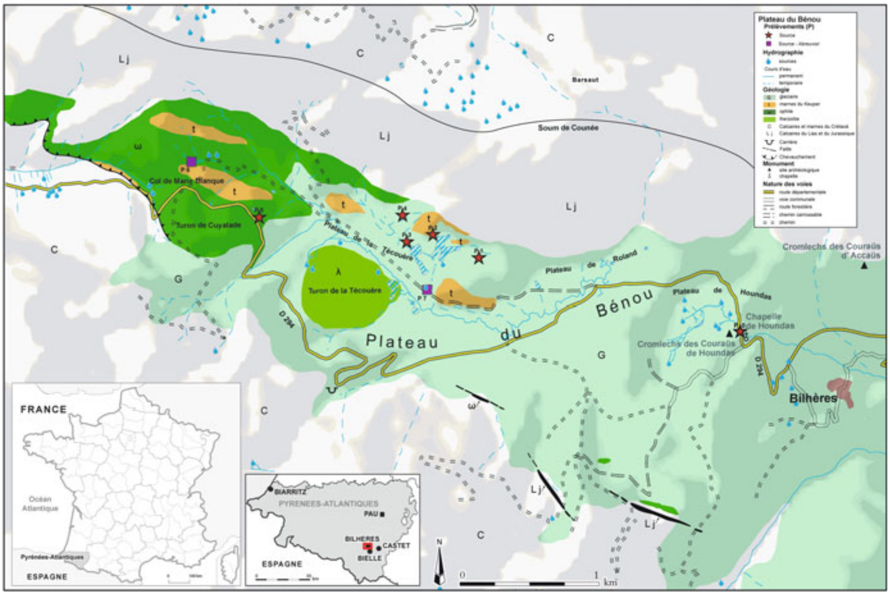

Fig. 4.1 Map of the Bénou Plateau

Fig. 4.2 Bénou, the Houndas Plateau, looking SE

Fig. 4.3 Bénou, the Roland Plateau, looking SW with Turon La Técouère in the background

Fig. 4.4 Bénou, the Técouère Plateau, showing Triassic formations, looking W

Geology of the Region

The Bénou Plateau is located between 2 limestone mountain ranges of anticline structure, general direction N120. To the north is the anticline mountain range Bielle-Lurbe or Mailh Arrouy. At the plateau, this mountain range is a fault fold that is limited by an accident that overlaps towards the south. This overlapping is underlined by the appearance of variegated Keuper clays, outcrops of serpentine of the same age, and lherzolite. To the south, the plateau is bordered by the Sarrance anticline fold. In the Aspe Valley, the Mailh Arrouy and Sarrance anticlines are separated by the Barescou synclinal, which disappears by tectonic stretching towards the east in the Bénou Plateau.

The plateau is covered with moraines consisting of clay deposits ranging from yellow to red in color and containing, among others, quartzite and granite pebbles. The red color shows that these moraines include the subjacent variegated Keuper clays. North of the Turon de Latécouère, outcrops of deposits from the Triassic period penetrate the moraine deposits. South of the plateau, other outcrops of terrains from the Liassic and serpentine also penetrate the moraines showing that in some areas, in particular at the edge of the plateau, the moraines are rather thin.

To the south, the plateau is bordered by outcroppings of limestone and marls from the Cretaceous era. The limestone from the upper Aptian (BRGM 1970, *n6*), which consists of light-colored, sub-reef limestone with abundant fauna (Urgonian features), can be distinguished here. This limestone gives way laterally to schist marls.

In the north, the Bénou Plateau is limited by the marls, limestone, and black dolomites from the Jurassic and Liassic Periods composing the anticline mountain range of the Mailh Arrouy. Erratic blocks of limestone are located at the foot of the slope of the plateau. To the south of the plateau, a few small outcroppings of this limestone appear to be in tectonic contact with the Urgonian limestone.

In a hairpin turn in the road that goes up to the neck of the Marie Blanque, there is a quarry that supplies breccias that have been identified to be from the Jurassic age and Karstic in origin. These multicolored breccias (white, yellow, purple, green, and black) contain various components such as limestone, marls, and green igneous rocks. It is called Bénou marble or Brèche Vendôme.

These terrains consist essentially of variegated Keuper clays, wine-red in color, corresponding to local lake deposits. These deposits often show veins of evaporitic rocks (gypsum or salt layers). They also comprise cellular dolomite, breccias, and Dolomite limestone of a yellowish color that can be observed on the outcrops to the north and east from Turon de la Técouère.

North of the Turon de la Técouère, on the geologic map of Oloron-Sainte-Marie (BRGM 1970), an outcrop of schist from the Ordovician era embedded in terrains from the Triassic is noted. Serpentine outcrops are essentially north of the plateau. This hard, green rock is always associated with deposits from the Triassic. A few outcrops penetrate the moraines south of the plateau. Turon de Latécouère consists of lherzolites and dominates the plateau by 167 m. This is a peridotite, originating from deep in the Earth's mantle (high temperature and high pressure). The rock, with minor transformation, is stratified, micro-folded, and mylonitized. The presence of this lherzolite outcrop shows that the subjacent tectonic structure is deep in origin. 2 ways have been proposed to explain how the massif was established: one, by uplifting of magma from the depth of 25 km in the Hercynian Era, and second, which points out the final establishment of the massif 15 km away from the Albo-Aptian.

Therefore, the Bénou Plateau owes its current morphology to the last Würmian glaciation (glacial erosion, deposit of frontal and lateral moraines). Deposits of moraines, in particular at the edge of the plateau, are not very thick because they leave outcrops of Triassic and Jurassic terrains as well as igneous rocks. The color of moraine deposits supports this remark and confirms that the "base" of the plateau probably consists primarily of variegated Keuper clays, which in turn support the salt content of some of the springs in the Bénou Plateau.

Archaeological and Historic Remains of the Region

There are several famous archaeological sites and remains of human past activities located on the Bénou Plateau and its immediate surroundings (Blanc 1989, 2000; Fabre 1994). The Neolithic Period and proto-historical times are, in particular, represented by sharpener-polishers (Blanc 2008) in form of large blocks of grooved, striated, and polished sandstones. They are indirect witnesses to the forest-cover clearing activities. The Bénou Plateau offers a dense network of sites related to sharpening-polishing in the western Pyrenees.

A large number of stone circles known as "cromlechs" (Fig. 4.1) as well as tumuli have also been recorded in the Bénou (Fabre 1994). These remains have often been interpreted as possible tombs from the proto-historic era. But if the dating of these sites is unquestionable, their functions as burials are very uncertain. Recent archaeological research has not, for that matter, enabled anyone to attest that these constructions confirm the existence of a funerary content. Also, these circles, both here and elsewhere in the Ossau Valley, were set out on elevated points, in pasture areas where even today we can still find shepherd's huts (Blanc 2000). Consequently, they could also be associated with ancient herding activities.

In 1842, an ancient site was brought to light in the commune of Bielle, immediately at the foot of the plateau. It was interpreted as a former Roman villa. However, in view of its archaeological descriptions (Fabre 1994), it could have been a thermal facility. Such interpretation is more plausible since the Romans, generally, very much appreciated the virtues of mineral waters. It should also be emphasized that Romanization is not well represented in this mountainous region with its predominant pastoral traditions, and, therefore, it is difficult to imagine why a major Roman land domain would have been installed here.

Finally, in Castet, a community near Bielle, we note the dominating presence of a feudal château (c*astellum ursalicum*[1]) whose existence was attested to the eleventh century (Raymond 1999, re-issue of 1863). The strategic position of this fortified

[1] Here we note the presence of the term *salicum* and its root *sal* or *sali* (meaning salt, salted).

Fig. 4.5 Bénou, the Houndas Plateau, chapel of Notre Dame, looking NE

site enabled it to control the Ossau Valley and a part of the Aspe Valley (neck of the Marie de Blanque). This type of site, like the previous example from antiquity, is particularly atypical in this region.

Finally, the presence of the Houndas Chapel (Fig. 4.5) at the entrance of the Bénou Plateau should be noted. This oratory supposedly have been built after the great epizootic of 1776, during which 87% of all bovines were decimated at the regional level (Desplat 1984). Nevertheless, the local tradition, by word of mouth, relates this place to a cult that celebrated water and the chapel was built at the confluence of numerous springs that cross the plateau. Therefore, it represents a place of religious syncretism inherent in the virtues of the mineral waters of the Bénou Plateau and through its location associated with the region where animal husbandry was the key economic activity.

Animal Husbandry of the Region

It should be noted that historically the Ossau Valley was strongly associated with hundreds of years of pastoral subsistence economy. Written documents mention the existence of the village of Bilhères-en-Ossau as early as the twelfth century (Raymond 1999, re-issue of 1863) and attest to the existence of pastoral practices on the Bénou Plateau at least since the Middle Ages (ADPA). It is also the case for Bielle, which shared a part of the Bénou Plateau with Bilhères-en-Ossau. It should also be pointed out that Bielle was in the Middle Ages a significant center of political and economic power in the Ossau Valley, represented by the Jurade.[2] Historic texts describe the Bénou Plateau primarily because of animal husbandry practiced here, particularly in regard to agricultural contracts, the management of grazing land, huts and barns, litigation, taxation, etc.

Animal husbandry is an integral part of the cultural identity of the Ossau Valley. The Bénou Plateau contains evidence of very ancient farming practices, documented in the texts since the Middle Ages. Animal husbandry has traditionally been organized in the Ossau Valley in a community framework (ADPA; Desplat 1984). Presently the pastures in Bénou are still undivided lands that are distributed among the communes of Bilhères-en-Ossau and Bielle, particularly in the northern half of the plateau. These "commons" are located between the La Técouère (Fig. 4.6) and Houndas plateaus; the other half of the plateau is in private hands and enclosed.

Agricultural exploitation of the region has changed very little since the historic times. In general, the documentation shows that mountain dwellers have always been very wary about perpetuating the established order, even during the eighteenth and nineteenth centuries, which were the times of major political and economic changes (ADPA; Desplat 1984, 1989). Until the second half of the twentieth century the Bénou population subscribed flawlessly to this conservative logic. This was a place of ancestral pastures in the Ossau Valley, a major site in the transhumant livestock "moving" cycle (Elissondo and Saurin 1984). Today, Bilhères-en-Ossau and Bielle are part of the Union Commission of Haut Ossau, which owns mountain summer pastures and is responsible in particular for the management of pastures. On the Bénou Plateau, animals graze in semi-freedom on about 300 ha, which are located essentially on the "commons" of the northern half of the plateau. Livestock holdings mostly include bovines, ovines, and equines. Grazing livestock aggregates on pastures that are on recent sedimentary terrains, indicated in Fig. 4.1 as "glacial." It should be noted, however, that goats are more attracted by vegetation that grows on salty clay marls, indicated as "Keuper marls." The latter, moreover, offer differentiated vegetation, which is represented primarily by gorse bushes.[3]

Salt is a vital nutritional element for all mammals, livestock included. Livestock procure salt in a natural manner through ingestion of herbaceous plants, grasses, and also through absorption of water. Animals naturally and instinctively provide for their need for salt. In the Pyrenees, shepherds traditionally gave salt to their herds by regularly throwing handfuls of salt to them (Cavaillès 2003). This practice of "salting" often included the use of a flat stone,[4] called the salt stone (Berot 1998), during summertime in mountain pastures (Besche-Commenge 1977). Addition of salt, in fact, promotes the good health of animals and increases their milk production. These virtues have been known since antiquity (Littré 1850 *Pliny the Elder*, Daubenton 1810) and presumably even since the Neolithic times. Today, breeders most often make a block of mineral salts available to animals so they can come and lick at will. A cow can consume an average of 50 to 100 g of salt per day, a ewe

[2] Representative assembly of the village communities of the Ossau Valley.

[3] Gorse bushes are the subject of swidden (burning by fire) in the spring.

[4] "Assaladou" in the West.

Fig. 4.6 Bénou, the Técouère Plateau showing Triassic formations, looking S

between 5 and 10 g and a mare between 10 and 50 g, depending on the breeder and the environment.

On the Bénou Plateau, as we learned through the survey conducted among local herders, the breeders do not give any additional salt to the animals. Only the animals that remain during the winter period may, if applicable, benefit from nutritional supplements, which are provided in the form of granules, including mineral salts mixed with their fodder. The latter are left between large blocks of stone or in natural depressions to prevent dispersion by wind. Salt supplements, therefore, are not supplied on the pastures located on the plateau. Some natural blocks of stone, which had been identified at the time of terrain prospection caught our attention because they could have been used opportunistically as loci to provide salt to herds (Fig. 4.7). In fact, these blocks offer a flat, horizontal surface, and some of them were even polished by the repeated friction caused by the passing livestock. Of course such blocks are rare, and the fact that they are in a horizontal position does not allow us to confirm that their shape is indeed the result of a deliberate human action. Moreover, there are no documents or eyewitness accounts to allow for verification of the hypothesis that these rocks were used for the addition of salt. On the contrary, it would appear that the absence of such practice may demonstrate its uselessness even here, but otherwise necessary elsewhere.

Fig. 4.7 Bénou, the Técouère Plateau, "salting" stone and fodder, looking N

Water Salinity in the Region

The salinity of the waters of the Bénou Plateau was tested using a hydrometer. These analyses were performed using springs or marshes that are located mostly in the northern part of the Técouère Plateau (Fig. 4.1). Table 4.1 presents the results of testing.

In result, we note the systematic presence of salt in the various samples of water. Such salinity, which is in the neighborhood of 1–2 g of salt per liter of water, is of course related to the presence of the Keuper salt marl outcroppings in this area (see the section on regional geology above). Salt content may vary with the season, however. The quantity of salt, which may appear to be relatively insignificant, proves in fact to be of particular interest for meeting the salt needs of livestock. In fact, the watering places of the Técouère Plateau (Fig. 4.8) and Marie Blanque provide water of salinity between 0.5 and 1.3 g of salt per liter of water. At the rate of a few dozen liters of water absorbed daily by livestock, on average, we can conclude that the Bénou watering holes are sufficient to meet the animals' needs for salt.

Conclusions

Taking the historic and archaeological contexts into account and in view of the primary results of the presented geological and water analyses, there appears to be no doubt that the salty marls contributed to the establishment of animal husbandry on

Table 4.1 Water salinity in water samples

Quantity of salt per liter of water (g/L)								
Dates	P 0	P 1	P 2	P 3	P 4	P 5	P 6	P 7
14 April 2010	1.1	1.3	1.1	1.1	1.1	0.5–1	1.1	0.5–1
11 June 2010	2	2.4	1.5	1.5	1.5	0.5–1	1.1	1.3

P: Sample

Fig. 4.8 Bénou, the Técouère Plateau, watering place for livestock, looking E

the Bénou Plateau. In fact, the existence of a causal relationship between the natural appetence of mammals for salt and the presence of salt on the Bénou Plateau means that the latter must constitute a very attractive natural environment for animals, which originated in the Holocene. The Neolithic Period correlates with the times of strong anthropization in the Pyrenees, which is well documented by archaeological and paleoenvironmental data (Galop 2000),[5] especially in agricultural context. As indicated earlier, the material evidence related to those early Neolithic and proto-historic human occupations is well represented in the Bénou Plateau. Of course, one could always object to our suggestion by saying that salt licks are not the necessary component for the development of pastoral economy, depending on the time and place, but they seem to have in fact been an essential factor in its establishment on the Bénou Plateau. Prehistoric people knew empirically how to profit from a natural context that was very favorable to animal husbandry, due to presence of water, grass, and salt.

[5] Editor's note: also see the chapter by Galop et al. in this book.

This form of human adaptation to salt resources, which is very pragmatic, is generally encountered in a coastal environment, through the Atlantic "salt meadows," but it seemed to also have existed in the mountain environment discussed here.

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Chapter 5
Archaeological Prospection of the Pyrenean Valleys in the Upper Lavedan, Hautes-Pyrénées

Frédéric Guédon

Introduction

In 1995, I started surveying the Pyrenean valleys of the upper Lavedan, a region which is an integral part of the upper Bigorre and extends upstream from Lourdes. This sprawling area covers more than 53,000 ha and occupies the extreme south-western part of the Hautes-Pyrénées (Fig. 5.1). It consists of three major "valleys," Val d'Azun, Cauterets Valley, which is also called Rivière de Saint-Savin, and the Davantaygue. The word "valley" should be taken here to mean a historical rather than geographic entity in its strictest sense.

Val d'Azun consists of three major parts, the Arrens Valley, the Estaing Valley, and the Upper Valley of Ouzom. The main part is the valley of the Arrens mountain stream. Its desolate upper part, which is carved into the granites of the Cauterets massif, is dominated by respectable summits such as the Cambalès (2,965 m) and, especially, the celebrated Balaïtous (3,144 m). Through the mountain pass of the Saint-Martin *peyre* (2,295 m) the valley offers a direct connection between Bigorre and Spain. The populated region really starts in Poueylaün (927 m), where a broad basin opens up, dominated to the east by the Cauterets Mountains and to the north-west by reliefs lower than the easily accessible mountain passes connecting the Arrens Valley with the Ouzom and Ossau Valleys (Béarn), both located to the west. The prominent one is the Soulor mountain pass (1,474 m), a wide doorway between the Arrens and Ossau Valleys. The glacier sliding from the upper massifs had deeply penetrated the schist, sandstone, and the Silurian and the Devonian limestone, causing the accumulation of fertile deposits on the surface of which evidence of human cultures and grasslands are vastly deposited. The villages are located on the left side of the valley, which is wide and with good sun exposure. We start the survey at Arrens (900 m), which is dominated by lovely grasslands studded with barns, and

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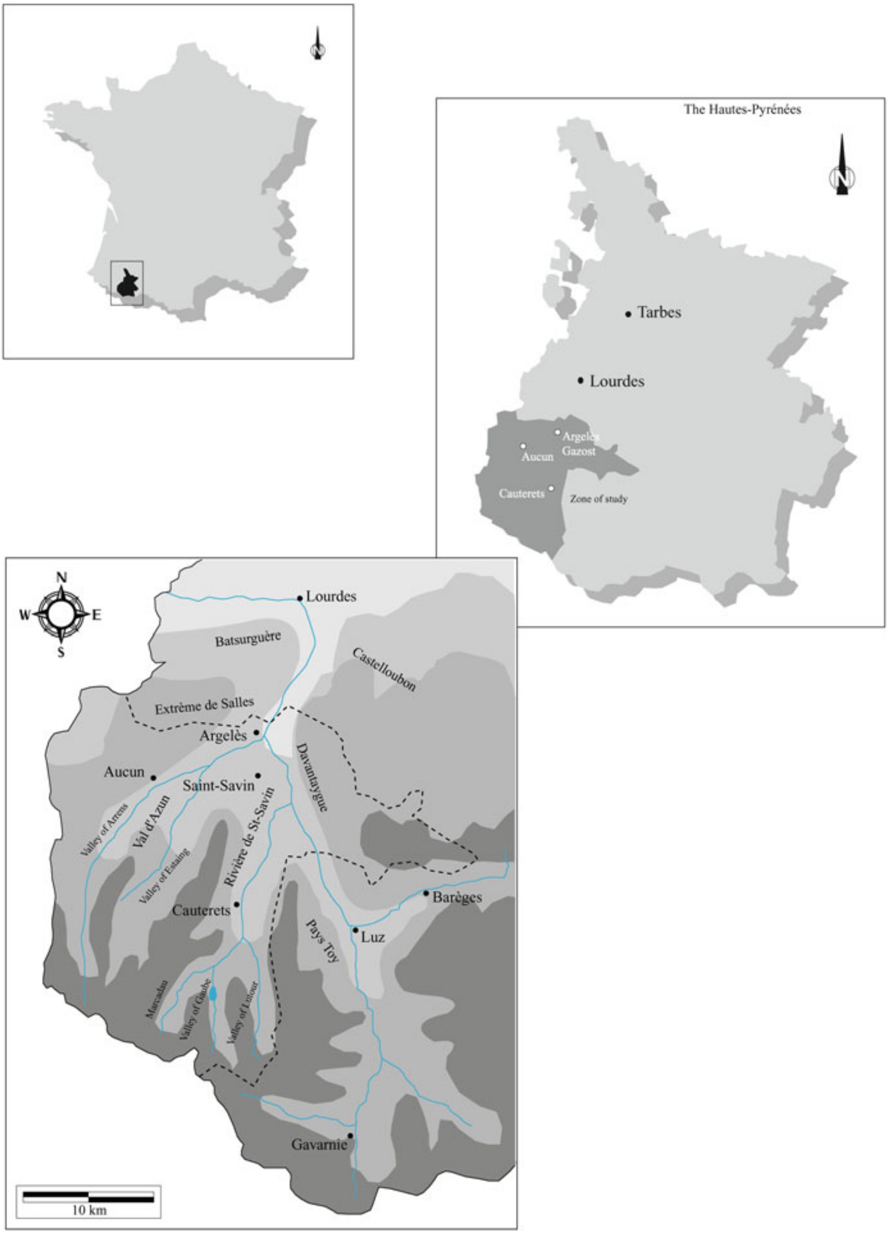

Fig. 5.1 Map of Lavedan and Hautes-Pyrénées

continue to Marsous, Aucun, Gaillagos, and Arcizans-Dessus until Arras (695 m) where the valley shrinks to the level of moraine "muds" and where it reaches its end just above Argelès-Gazost (460 m), with an abrupt break in the slope.

To the east of Arrens, the Estaing Valley develops as a narrow valley, a kingdom of rockslides and granite shambles in its upper part and sparsely populated in its lower area. From Estaing (around 1,000 m) we descend to Bun and Sireix (830 m and 707 m respectively), which close the valley in as two symmetric terraces. The Estaing Valley does not connect directly with Spain, but to the east it reaches the Cauterets through the mountain pass of Contente at 2,134 m and Ilhéou mountain pass at 2,242 m, and to the west links with the Arrens Valley by a wide mountain pass of the Bordères (1,156 m) or at higher elevation through the mountain passes of Paloumère (2,187 m) and Cambalès (2,706 m).

Finally, northwest of Val D'Azun is a small basin of the upper Ouzom. This short valley begins at the foot of the Gabizos (2,639 m) through the Litor cirque and ends in the Pau mountain stream at Nay, in the Atlantic Pyrenees. Its upper part is a rather narrow and irregular basin, framed by the Devonian dolomites of the Gabizos to the south and the limestone walls (Aptien) at Moulé de Jaout and Estibette (2,051 and 1,851 m respectively) to the north. At its center is a deep sinuous streak slashed into the folds as well as limestone bars dominated by wooded cliffs. After that, the valley grows wider on the marls and schist of the Albien covered by cultivated land and grasslands. In fact, all interests in Val d'Azun are in its geographic position and its strong historical and cultural identity. It is a border country crossed by paths connecting Bigorre and Béarn with Spain.

The Cauterets Valley is comprised of two distinct parts. The first begins after Argelès-Gazost and ends at Soulom. This is where, except for Cauterets, villages are concentrated, on the left side of the mountain stream of Lavedan, on terrains consisting primarily of alluvial soils of the Lavedan terrace and, a little higher up, moraines of quaternary origin. This zone is the connector between the Cauterets Valley and Val d'Azun near Argelès-Gazost. From Lau-Balagnas in Soulom, the villages expand at the foot or at the first foothills of the Cauterisian Mountain. Altitudes here are low between 430 m (Balagnas) and 757 m (Uz).

Soulom is where the first part of the Cauterets Valley ends and which is a mountainous zone itself. It opens up into the terrains in the anticline area of Pierrefitte (Ordovician-Silurian) where known mining operations are concentrated, both on the left bank of the mountain stream (Arrouyes Mountain)) and the right bank (mines de Soulom). Altitudes then increase and this sector is dominated by respectable summits, the peak of the Soulom (1,763 m) and the peak of the Moun Né (2,724 m) both dominating Cauterets to the west.

At Cauterets (1,000 m), we are really in the heart of the "Ribère de Saint-Savin." It is in a form of a bowl or basin and, we should note, that it is in fact located at the mouth of four smaller valleys, which collectively form the second part of the Cauterets Valley. The first is the valley of the Cambasque, oriented southwest/northeast, and it connects the spa city to the Estaing Valley through the mountain pass at Ilhéou (2,242 m). It is enclosed by the Soum de Grum (2,657 m) and the Grand Barbat (2,813 m) and on the left side of the mountain stream is dominated by the vast pastures of the Lys and the Cambasque, while on the right side, by the mountains of Péguère and Nets (high point: the peak of the Nets at 2,428 m, which overhangs Ilhéou Lake). This valley is sculpted into terrains from the Devonian–Carboniferous periods.

The second and most important one is the great Marcadau Valley which, from the Jéret Valley to the northeast, connects Cauterets with Spain through the mountain pass of the "*peyre* Saint-Martin," presently known as the Port du Marcadau (2,541 m). From the Jéret Valley, where the Marcadau and Gaube Valleys join at Pont d'Espagne, we enter into the large granite massif of the Cauterets. In fact, the "queen" valley, along with the Gaube and Lutour valleys, remains the most complete type of high granite region, distinguished by extreme slopes covered with scree, a string of glacial lakes, and a dense stream system. Past the Pont d'Espagne (1,496 m), the Marcadau Valley rises slowly in a succession of more or less broad grassy plateaus, from the Clot Plateau to the Pla de Loubosso, which precedes the ascent onto the mountain pass and the French-Spanish border. The most extensive is the Pla de la Gole, a vast pasture at the confluence of the mountain streams of Cambalès, Marcadau, and Arratille. It would not be surprising to discover that these plateaus contain rather significant concentrations of remnants of pastoral habitats.

After crossing the high mountain of Estaing, starting from the Pla de la Gole to the west, the Marcadau Valley connects with the Arrens Valley (Val d'Azun) through the Cambalès mountain pass (2,706 m). To the east we can also reach the Gaube Valley through the mountain passes of Arratille (2,528 m) and the Mulets (2,591 m) after a short passage in Spain. It is dominated by high peaks of Bernat Barrau (2,793 m), Pouey Trénous (2,810 m), and Grande Fache (3,005 m).

The third valley is the valley of the mountain stream of Gaube which, as mentioned above, connects into the mountain stream of Marcadau at the Pont d'Espagne. It is narrower than other valleys and ends at the foot of the Vignemale peak (3,298 m), one of the highest of the French Pyrenees.

The fourth is the valley of the Lutour, whose eastern crest line, which is dominated by high peaks such as Ardiden that culminates at 2,988 m, separates the "Ribère de Saint-Savin" from the "Pays Toy."

The Davantaygue, literally "at the water's front," owes its name to its location relative to the Pau mountain stream. In fact, it develops entirely to the east of this body of water. This is a small formation that is relatively "compact" and homogeneous. The hilly relief differs here considerably from what can be observed in the 2 other valleys described above. The habitat is established on late glacial alluvial cones at the borders of mountain streams, and above, on moraines of the maximum glacial extension. Altitudes are not very high and the permanent habitat is still present around 980 m (Bordes).

The mountain itself comprises essentially the Isaby gorge and is bordered by the upper Adour at Lac Bleu. It opens primarily onto lower Devonian terrains and its base is the middle Devonian (Pelites and sandstone) with limestone insertions. The pastures of Isaby are surrounded by a few respectable summits such as the Soum de Lascours (2,485 m), but overall altitudes remain relatively average (Isaby Lake is 1,558 m) with a tendency to increase toward the lovely mountain summer pastures of the Lac Bleu (1,954 m).

One cannot help but notice that archaeologists did not pay much attention to the Bigorre Mountains, as they did to other parts of the Pyrenees, where inventories of human past activities are relatively advanced. Except for some isolated, brief projects, this region has not really inspired any long-term studies of its preserved cultural domain, a patrimony that is sometimes still a living one. J. Blot's studies in Cauterets[1] present the early attempts to inventory the cultural remains of the past. Research by Christine Rendu in Enveig (Eastern Pyrenees) has shown all the benefits of a multidisciplinary approach, in which archaeology remains a fundamental part, concerning the habitat and soil occupation of the mountain ecosystem.[2] West to the discussed region, the Béarn valleys, especially Barétous and Ossau, but also those in the Basque region, offer a significant body of historic sites, which have been identified through prospecting campaigns as well as several excavations.[3] The results, although disputable at times, involve essentially protohistoric sites or sites that are at least considered to be of such provenance, and therefore offer interesting research possibilities, which in Bigorre still remain to be explored.[4] In any case, these results engage similar issues as the Spanish projects.[5]

Fortunately, during the past few years, the Hautes-Pyrénées, and more specifically Bigourdan, has caught interest from archaeologists, who tend, however slowly, to make up for the existing discrepancies in both geographic and chronological data, when compared to other Pyrenean regions. I especially would like to point out the research conducted by Stéphane Lévêque[6] (INRAP) in the Lesponne Valley, which contributes a welcome archaeological perspective to the seminal work of Georges Buisan.[7] It is in this spirit that I began my own works.

Archaeological Prospection of the Pyrenean Cultural Heritage

The National Park of the Pyrenees has already initiated several campaigns that were geared toward making inventories of the local "patrimony," and its scientific committee has supervised the work of researchers representing different scientific backgrounds.[8] Since 2003, it has begun a much more ambitious program to inventory

[1] Blot (1985).

[2] Rendu (2003).

[3] See in particular Marsan (1991, 1993, 1996).

[4] Here we need to recognize the members of the Archaeological Group of the Western Pyrenees, who have been stubbornly prospecting the Béarn Mountain for many years.

[5] In particular Rupérez (1978, 1988, 1990) and Marsan and Utrilla (1996)…

[6] Lévêque and Delaveau 1992. Editor's note: see the chapter by Stéphane Lévêque in this volume.

[7] Buisan 1991, 2002. G. Buisan remains one of the most dynamic researchers of pastoralism of the upper Adour like Dugène in the Ossau Valley.

[8] This is especially the case for the work of Jean-Pierre Dugène in the Ossau Valley. Dugène (1994), (2002). This is also the case in Cauterets with a primary archaeological and patrimonial inventories conducted by S. Lévêque in 1989/1990.

and study of the archaeological heritage, similar to some Alpine projects like those developed by the National Park of the Ecrins (Hautes-Alpes).[9]

I begin this part of the chapter by discussing several prospecting campaigns and finish with a more forceful plea for a global approach that involves a thesis regarding the present threats posed by the modern occupation and settlements in the mountains.[10] In 2003, The National Park of the Pyrenees requested the National Institute for Preventive Archaeological Research [I.N.R.A.P.] to proceed with a vast archaeological inventory of the Ossau, Azun, and Cauterets sectors.[11]

In this context, pastoralism is at the center of the research. Of course, it is not the only activity that drove humans to inhabit these valleys. Depending on the time in question, exploitation of mineral resources was also very important. What really matters, however, is that in the discussed region pastoral practices constitute the primary driving force for human settlement and use of the mountains. Therefore, approaching the pastoral habitat through archaeological research is essential in order to understand both the presently existing communities, as well as the origin of human impact and adjustments of these widespread territories. I start with discussing the remains of recent pastoral activities, but also briefly touch on those sites whose nature and function are more difficult to determine.

Recent Pastoral Structures

The first thing that a hiker would notice in the mountains is the abundance of ruins of enclosures and huts. Altogether, these structures form the characteristic elements of pastoral habitat of the mountain summer pastures. Whether isolated huts or large assemblies, they constitute an integral part of the landscape testifying of the presence of humans at high altitude (from 1,100 to 1,200 m upward).

By analyzing these generally modern and contemporary[12] sites we began to grasp the grazing and land use methods applied by pastoralists at different times. In general, no specific organization of groupings of such structures could be revealed. We can only say that they present collapsed structures some of which are grouped together. In such case, very often the enclosures are connected to each other, or even nested (Fig. 5.2).

[9] Walsh and Mocci 2003. For the Pyrenees program see Guédon (2003a, b).

[10] Guédon (2006).

[11] Guédon (2003a, b, 2005).

[12] In the absence of any excavations or even surveys, it is generally impossible to precisely point out the origins of these sites. Thus, a presently visible structure assumed to be of recent origin could very well be based on a previously existing one of ancient origin and we may not realize that by analyzing the structure without subsurface testing.

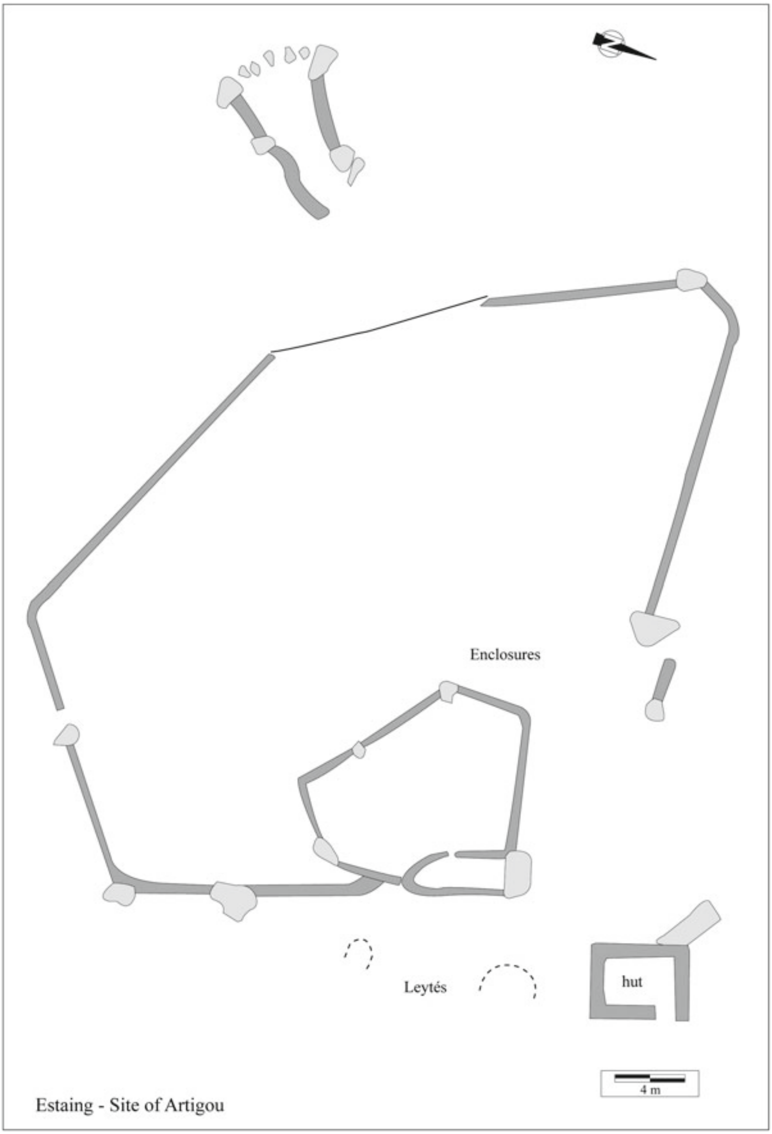

Fig. 5.2 Nested enclosures, site of Artigou, Estaing

Basic Terminology

Before I continue with the results of the survey, I must briefly discuss the basic terms related to the Pyrenean transhumance. Thus, I shall specify some essential information concerning the terms widely used in various written sources since the Middle Ages. This is of great importance because transcriptions and translations proposed by historians such as Bourdette, Meillon, and others, can sometimes lead to confusion or provoke heated discussions.

The first most frequently used term is *cuyéou*. This term is widely present especially in the toponymy of the study area. It is the equivalent of *coueyla* in Aspois, of *cujala* in the Ossau dialect, or even *courtau* from the valley of Adour.[13] It appears in historic texts starting with the eleventh century and, more certainly, in the thirteenth century, as evidenced by the 1290 settlement regarding a tract of land in the Cauterets Valley. In fact, in the medieval documents in which information related to the area appears, several of these terms are found. Presently, in Val d'Azun and Cauterets, *cuyéou* is widely used, but in Davantaygue, this term has been in competition with *cuyela* since the fourteenth century and with *courtau* for about the same time. In fact, it would seem that all of them are interchangeable even if the last two are used jointly in the context of high elevation pastures, i.e., "the status of royalties collected from the *cuyelas* by the head *coch* of the château of Castelloubon," in 1384.[14] In the Middle Ages, the "geographic" specificity of the word, therefore, is not used to its best effect because the *cuyéou* can be found pretty much everywhere, as the *courtau* is not confined to the upper Adour and the *cuyéla* is very close to *cujala* in the Ossalois dialect. It should be noted that the Saint-Savin cartulary uses the term *cortibus*, which certainly corresponds to the common *cuyéou.*[15]

Precisely what the word means remains to be defined. Overall, it appears that the *cuyéou* designates a hut and its immediate surroundings, with, in particular, enclosed areas for livestock, but also a part of the mountain and pasture in which these various structures are located. It would even seem that this "territorial" definition is predominant in many cases. The award of 1290 lists 37 *cuyéous* in Cauterets as well as other areas such as *ports* and the mountains themselves.

In this way, the *cuyéou/cuyela/courtau* is, before anything else, a space where essential human activities are conducted, including of course penning of herds. When historic writers designate a hut to shepherd, they often use just the word "hut," whereas *cuyéla* is used in the context when livestock is present. In a settlement of 1301 concerning the forests above Saint-Pastous, the right to "make a hut" (*acabanar*) is clearly pointed out in such a manner as well as the need for the livestock to stay in the *cuyéla.*[16] This is why multiple huts, and of course multiple shepherds, may be present on the same *cuyéou,* sometimes with a high number of enclosures and other associated structures. It should be noted that in Barèges Valley the distribution of pastures mentioned in the award of 1319 also concerns *fodgeso* for livestock.[17] We have not found this term elsewhere, which is perhaps merely a matter of improper reading of the original text.

[13] Berot (1998), p. 32.

[14] Balencie (1910), pp. 105–115.

[15] Tanguy 1977–1978, pp. 66–72.

[16] Bourdette 1898–1899, T. 2, pp. 12–13.

[17] Bourdette 1898–1899, T. 2, pp. 42–44.

In an assessment of 1533 concerning Houscaou Mountain in Davantaygue, it has been established that this mountain consists of several *courteous*, two of which, the *Lhens* and *Tournaboup courteous,* are used by the inhabitants of at least four communities.[18] These are in fact mountain districts. This is pointed out again in the assessment of 1612, which mentions the *courtaous* or quarters of this mountain and valley.[19] In the Napoleonic cadastre concerning the mountain summer pastures in *Cot de Bo* at Villelongue we can easily see that the *cuyéou* contains from two to five huts and that it corresponds to a "partitioning" of this mountain, which is first mentioned back in around 870 in the assessment of the properties belonging to the abbey at Saint-Orens.[20] This corresponds with what is known in Ossau, where, from the late fourteenth or early fifteenth century, the Jurade has been setting up a distribution of pastures into three *Toques*, which are themselves divided into 14 *cujalas.*[21] The above definition concerns therefore the spatial distribution of structures and can be found in other groupings in the Pyrenees that use other terms. The Souletine Mountain is divided into numerous *cayolards* (about 60), which have the same number of pastoral units shared by several livestock keepers. In Ariège and up to Catalogne, the *Orri* designates a space that is intended for the penning of ovines, as well as an area of the pasture that may contain several "barraca."[22] This brings us close enough to what we brought up earlier with regard to the *cuyéou/cuyela/courtau*, namely that the term identifies a spatial unit.

Next to the huts and *cuyéous*, historic texts often mention *formadgeres*, which Balencie translates as "cheese dairy" and Bourdette prefers to translate as "cheese maker," and the difference is not inconsequential, as we shall soon see. An appraisal from 1339 regarding the pastures of Ossere (Davantaygue) indicates that the lord of Beaucens was able to establish only one *formadgere* for a single livestock owner, unlike *formadgeres* run by convents or monasteries, military, or associated with outside livestock mixed with the local livestock.[23] It is also stipulated that the master of the Hôtel de Castelloubon had the right to dine once a year with his companions in *the said formadgere* and to take cheese with him when he went to collect royalties and survey the mountains (these mountain summer pastures belonged directly to the viscount of Lavedan). A 1384 document mentions, almost systematically, levying of cheeses per *formadgere* located on mountain summer pastures of the Davantaygue and Castelloubon.[24]

In 1482, Joan d'Anti, a knight and lord of Saint-Pastous, conceded three houses in Bier (Vier) to three primary "lords" in exchange for an annual compensation from

[18] Bourdette 1898–1899, T. 2, pp. 147–149, 540–541.

[19] Bourdette 1898–1899, T. 3, pp. 73–91.

[20] Balencie 1910, pp. 173–174.

[21] Dugene 2002, pp. 17–18.

[22] Lassure 1977, pp. 77–86.

[23] Balencie 1910, pp. 145–151.

[24] Balencie 1910, pp. 105–115. This manner of levying is found up to the Aure Valley at the Abbey of Sarrancolin in 1398. Collective 1982, p. 37.

the *formadgère* of the *port* of *Houscau* that belonged to him, namely: the right to graze in the *port* of *Houscau* at *cuyala deras Courreyas* for 75 *bacades* of horned livestock and the right to set up a hut there.[25] A new tenant's farming rights for this *formadgère* du *Houscau* was known in 1513 and in 1533 with the same rights.

Also, in 1612 the census involving the mountain summer pastures in Davantaygue details levying of cheeses from *formadgères* (three cheeses per *formadgères* in *Houscau*, or even in *Barran*). On the other hand, in the pastures in Isaby, the term "hut" is also used with, for example, identification of payments in form of three cheeses per hut in *Séasc* and at *Estibère* in Saint-Orens.[26]

According to Bourdette, the documents from 1482 to 1513 in the *Houscau* tend to show that the "cheese maker" is an assortment of rights. It is certain that here it involves the equivalent of the right of *casadure*, which was evoked more broadly in the neighboring valleys, in particular on the pastures belonging to the count of Bigorre. Article 8 of the 1384 document is clear when it mentions *III formadges per cazedure*, but it could have been more than that. Other texts, in fact, offer similar accounts. As mentioned above, we learn that in 1339 the master of the Hôtel de Castelloubon had the right to dine once a year with his companions in a *formadgere* and to take cheese with him. It would seem that we have an indication of a place or even a building in which the cheeses are located and where the men can stay. Article 8 of the 1384 document also mentions the "huts of these cheese dairies." Sometimes, as we saw in a document form 1612, the levying has been done by huts. In all cases, however, several shepherds appear to have been able to use the same *formadgere*.

More than rights, *formadgere* could also involve a collection of installations intended to accommodate men and herds, focused on the production of chesses as well as their temporary storage. Therefore, the term incorporates one or more huts but also all the related structures required for this essential activity. Of course, the texts remain silent on something that was obvious to the users namely the pastures and animal enclosures. Therefore it is difficult, or even impossible, to specify whether storage had taken place in the individual hut with a salting tub built in, or in specific installations, for example, collective salting tubs for all the shepherds in the *formadgere*. The contemporary data, which I shall address later on, are difficult to relate directly to the fourteenth century. Also, in the absence of any excavations, I cannot discuss these aspects in the manner in which C. Rendu was able to do for Enveig.[27] In any case, the manufacture and storage of cheeses could have easily taken place in the basic framework of the traditional hut.[28]

Also the "cheese dairy" is a real fiscal unit because it is at the base of the levying manorial system (*casadure*). In this context, it can also be a term that is interchangeable with that of the *cuyéou* but with a marked specialization (the *cuyéou* where the cheese is manufactured). Likewise, all the "cheese dairies" do not have the same

[25] Bourdette 1898–1899, T. 2, pp. 298.

[26] Bourdette 1898–1899, T. 3, pp. 73–91.

[27] Rendu (2003), pp. 325–334.

[28] Lamazou (1995), pp. 116–120.

status. It is in fact a question of “free” *formadgeres* as opposed to “simple” ones. In 1339, the freeholds were assimilated into those that belonged to convents or monasteries or military corps, but communities could also own them as well as lords, although under certain conditions. There is even a mention, in this specific case, of a “bought-back” *formadgere* (article 3). A 1339 text states that a “single” *formadgere* consists of livestock belonging to a single owner, whereas the others, in particular the freeholdings, consist of foreign livestock mixed with the local herd. Therefore, it involves an essential difference in the freedom of herd management along with the possibility of choosing whether or not to bring in “outside” animals. We can also sometimes wonder if the *formadgere* does not correspond simply to a herd of dairy animals. The term is not, therefore, so easy to pin down.

Remains of Pastoral Architecture

This discussion is limited to the presentation of pastoral structural architectural remains commonly noticeable in high-altitude pastures such as ruined huts and animal enclosures, but also *leytés* and other structures.

Huts (Cabanas)

Certain regularities can be observed in the dimensions and designs of huts. Whether they are square or rectangular, their dimensions are all around 4–5 m (outside measurements), with walls 0.80 m thick on average. The entryway is always in an angle and width varying, generally, from 0.70 to 0.80 m. Their walls are constructed using the dry-stone technique, sometimes carefully prepared by size, sometimes not. As a general rule, the blocks are not carved, but selected according to their shape and size. To improve insulation, the space between rocks may be filled with earth, grass, or a mixture of mud and dung. Internal designs are optimized to fit the small area as much as possible. This involves, in particular, one or more niches in the walls (generally up to three). The hearth is generally located on the ground, against the wall and usually next to the entrance. Smoke leaves the hut through the *tire-hum*, an opening in the upper part of the gable wall. Visually, these huts were short with roofs made of slate, thatch, or turf (clods on slate for example), and recently sheet metal (which was then covered with blocks or vegetation).

Enclosures

Enclosures also consist of dry-stone walls, not very high and of varying sizes and shapes. We can, in general, see several groupings of average size associated with a large dimension. This is certainly due to the need to regularly moving the ewes around the enclosure in order to prevent the soil from deterioration. There is also the

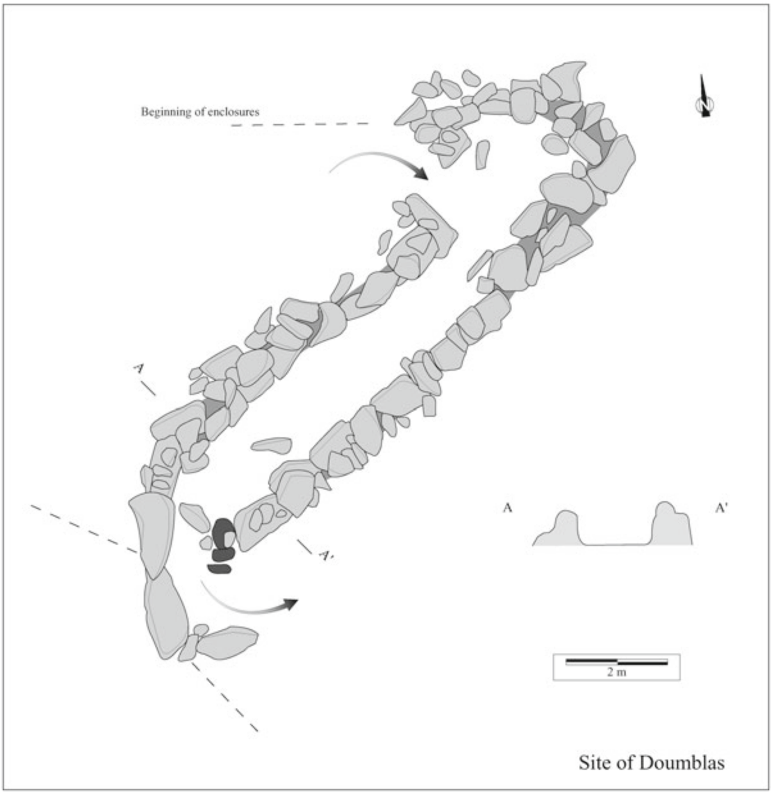

Fig. 5.3 Elongated enclosure, site of Dumblas

question of milking areas. We have not really noticed the equivalent of Catalan *munyidoras*, long and narrow corridors. Nevertheless, some narrow oval enclosures exist across the research area and these enclosures could have been related to the milking of ewes. Their dimensions often remain very modest but several of them can be located in the same size cluster. The few examples from the discussed region are somewhat close to the groups in the neighboring Béarn. In Doumblas, for example (Arrens) this means long enclosures of up to 12 m with the average width around 1.5 m (Fig. 5.3). The heights are considerable, sometimes more than 1 m. These structures may stand separately or, more often, can be integrated into a larger enclosure. In several cases, the ends serve as a sort of baffle.

We should add here that we cannot disregard the case of milking enclosures made of light, "portable" materials, or even of mixed material that leave little or no traces on the ground, but which remain well known in numerous ground. Moreover, light portable structures, like *barguère* and *burguet* exist, but are used rather for spreading dung on the low- and middle-altitude terrains at autumn nights. This way the animals were penned every night in a *barguèro*, a mobile stock made of wood so that they would stay in the same place all night and leave the area well fertilized.

Fig. 5.4 *Leyté*, Liantran-sur-Estaing

The next day, the three sides of the stock would be moved to cover the neighboring area, and so on, until the terrain was entirely spread with dung. When necessary, the *burguet* would be set up in the middle of the flock so that a shepherd could stay to watch over and protect the herd against wild animals. This involves a small portable wooden hut which has the appearance of a one-person covered stretcher. The *burguet* was easy to transport and allowed the shepherd to follow his herd easily.

Shelters for the Young Livestock

These are constructions built generally in a similar fashion as huts, although smaller in size, made with less care, and without interior furnishing. Rarely *cuyéous* do not include them.

Leytés

These are constructions built over a source of water (spring, stream, etc.), or a diverted stream, and used to keep milk fresh. Generally small, but some can reach respectable dimensions (more than 1 m high), and made of dry-stone walls, sometimes with great care, appearing alone or in groups. The Liantran-sur-Estaing site consists of no less than 13 (Fig. 5.4). They are sometimes also "semi-natural," made using small natural stones along streams.[29]

[29] Editor's note: see the chapter by Lozny for descriptions and photos of such structures recoded along the Labas creek.

Fig. 5.5 *Leyté* with wooden door

Traditionally, a *leyté*, whose name comes from the Gascon *lèit* (milk), was covered with slates and earth so that it was better insulated from the sun. In some cases such construction caused this type of structure to retain a marked "tumular" appearance. Originally, a wooden door or a stone slab was used to protect its contents (Fig. 5.5). The cold from the water promoted the rising of the cream to the surface and which subsequently turned to butter. *Leyté* is not necessarily a typical structure of the areas where, like in the upper Adour, butter was the main product. We find them often in Azun and sometimes also in the Cauterets Valley, and they are called *cabanère* or simply *houn* (spring). *Leyté* could also be used as an individual cheese salting tub associated with the raising of mostly ovine, but also mixed livestock. In the valley of the Bouleste (Arrens-Marsous), a shepherd explained the following:

> In the *houn*, I put the milk and also the cheeses that I made on shelves and I salt them inside the houn.

This construction was, therefore, multipurpose and not necessarily characteristic of a certain type of animal husbandry.

I also observed that all pastoral constructions were located on sloped to a greater or lesser degree terrains and at the feet of screes. This way, the raw material was available right on the site. The drawback was that this could cause more than a few problems, for instance the scree could slide and destroy what the shepherds had built. Some eyewitness accounts quoted in the communal monograph of the nineteenth century show that this happened rather frequently.[30] Also, regarding the construction methods, we can see that numerous huts (or lamb shelters) have been constructed

[30] See especially ADHP, monograph n°145.

using a large natural rock on one side. This type of construction represents, of course, economic behavior and does not appear to be characteristic of any chronological phases because huts of visibly recent provenance were also built in this way.

With few exceptions, there are specific architectural structures characteristic of a type of animal husbandry, for instance, related to bovines, ovines, with or without cheese-making facilities, etc. The ideal situation would be to connect each site to a group of components that would allow the understanding of certain details such as migratory route, type of husbandry, etc. We could also try to see whether the complex sites, with enclosures, *leytés*, and other structures, located on the mountain summer pastures have been used during the peak milking period for the ewes, whereas the isolated huts have been involved in rather intermediate grazing periods. Understanding the movements of the herds in the nineteenth and twentieth centuries would not, however, necessarily allow for a better understanding of transhumant patterns at earlier times, including the medieval period. Some of the presently collected data from Davantaygue are corroborated by the fourteenth-century sources, so we know of open pastures for milking and the existence of cheeses-making facilities. Nonetheless, it is still very difficult to generalize herd movement patterns as long as the information remains incomplete.

Archaeological Prospection in Lavedan

In this section I discuss the types of pastoral architecture identified during the several seasons of archaeological prospecting. I began with some methodological remarks followed by brief descriptions of each type.

Methodology of Surface Prospection

The essential point about working in the mountains must be restated here because it presents certain methodological constrains. In the lowlands, where surface prospecting is generally done after plowing, the archaeological data gathered there are literally “reversed.” This way, plowing allows a site to be checked out through the presence of archaeological artifacts that are more or less concentrated (for instance pottery fragments). On the other hand, the existence of more solid structures is often perceptible indirectly. This may involve, for example, rough stones or pebbles coated with mortar, or even stories from the farmer who may have caught the walls with his plow. More precisely, the data are rarely available on the surface, unless other methods have turned positive results, such as aerial prospecting and photography. In the mountains, on the other hand, we have visible structures but not the furniture! This situation forces us to adopt a more “humble” attitude, while remaining extremely prudent with regard to questions of cultural identification and of course the dating of structures. Until now, the absence of data obtained through the use of digging techniques has not allowed us to relay on any other supportive information but those available from historical sources, which has been integrated flawlessly into the needs of this type of research. But even excavations pose a major methodological problem that is difficult to solve. It seems that the nature of mountainous sites would require the use of an excavation technique comparable to the one that we apply in preventive archaeology in lowlands. In fact, only an extensive surface stripping would allow for the correct spatial reading of a complex, multicomponent pastoral structure. Excavating a hut is interesting, of course, but may in the end prove to be rather simplistic as it can only represent one component of a much more complex whole. We must keep in mind, therefore, that when we are at the prospecting stage or even excavating a structure and nothing indicates that a hut is not isolated, this in fact might not be the case. Recording of any enclosures or other associated structures that could surround a shepherd's hut, which are sometimes built of light materials, can only be done after a widespread surface stripping.

The results of surface prospecting in Lavedan allow for the proposition of a typology of the architectural pastoral structures found at high altitude. The key typological designator used here is the exterior shape of structures. Following this approach I can also address "tumular" or "circle-shaped" anomalies whose identification as well as cultural and chronological designation presents a problem. The prospector must always keep in mind the limits of his/her observations. When we consult the many publications on the Béarn valleys and particularly on the Ossau Valley in regard to inventories recorded lately, it seems that this valley is an immense protohistoric necropolis. In fact, all of the "tumulus"-like structures, whether circular in shape or not clearly identifiable, are registered as funerary in nature and dated to the protohistoric era (or even earlier). Here, therefore, we pose a question that appears at the heart of research of the mountainous terrain in the discussed region: Does any hill, rocky or not, necessarily represent a tumulus? The frequency of hills with central depressions is high, but is it necessary to systematically see such depressions as resulting from ancient looting? Indeed, a greater prudence must be used here. This is while prospecting in Val d'Azun and Cauterets we were able to reveal the stages of deterioration of shepherds' huts, the ruins which we are calling, for the lack of a better term, the bottom of a hut.[31] Visibly, a hut in the final stage of its deterioration resembles a rocky hill with a central depression. The collapse of the walls does result in spreading of debris that covers the hut. Sometimes the bottom of the hut does no longer remains of anything but a simple microrelief, but in the absence of subsurface excavations[32] we cannot draw any conclusive statements from it. The excavations of a "cairn" in Larrau, which proved to be a hut dated to the turn of the century,[33] serve as an example of such confusion. In 1976, Massie

[31] Guédon (1995, 1996, 1999).

[32] Guédon (2002). One should always keep in mind that in the mountains there are remains that are very much pared down but could be very recent, whereas other, better preserved may be more ancient.

[33] Nacfer (1995), pp. 85–94.

had convincingly explained that some *tumuli* in Larrau could be "bases of huts."[34] Later, G. Marsan made similar observations in Barétous.

The risk of such confusion could be among the reasons causing the imbalance in recorded sites that exists between Béarn and Lavedan. Of course, the history of research is longer and more extensive in Béarn, but the method used to record and identify archaeological structures is partly responsible for the unusual concentration of *tumuli* in this area and their absence in other regions. In fact, we recommend here the use of a typology based on external shapes of structures, without accounting for their function or even chronology.

Typology of Architectural Structures

"Tumular" Structures

Here I shall approach the most controversial type in which we distinguish three subtypes:

Type 1a: single hill may or may not be rocky. These are well-marked hills without central depression. This type is very often identified as tumulus, which is generally justified. We have, nevertheless, expressed some reservations about certain structures identified as type 1a. In the upper Lavedan this type remains very rare, unlike in the neighboring Béarn. Therefore we cannot establish convincing statistics on the occurrence of this specific type in the discussed here research area. One example of this type might be in the village of Arrens-Marsous. On a berm that dominates the brook in Bernet in the area of the Soulor mountain pass (1,355 m), two rocky structures have been identified (Fig. 5.6). Ar 1/1 is grossly oval in shape (5 × 4 m) and consists of blocks, some of large sizes. Ar 1/2, located 2 m away from the previous one, is smaller and not as smooth. This one could even be a natural landscape feature whereas the Ar 1/1 could very well be a much damaged pastoral hut.

Type 1b: single hill which may or may not be rocky, with central depression. This is the most frequent type and also the one most questionable. As we have already said, the entire problem with this type rests in the distinction between looted tumulus and a collapsed pastoral habitation structure. The stages of deterioration of the dry stone hut walls observed at high altitude make hasty interpretations tricky. However, not every structure that resembles this type is a protohistoric funerary structure.

One example of this type is located on a berm that dominates the Ilhéou mountain at Cauterets (*Pla des artigues*: Ct 1–1,389 m), where we note a rocky hill that is roughly circular, 6.6 m in diameter (Fig. 5.7). The central depression is marked by the presence of a recent bivouac hearth, which happens fairly often as the depression in the center of a "tumulus" protects the fire against wind. The presence of

[34] Massie (1976), p. 90. He also cites E. Dufourcet, who, in 1876, proposed that some tumuli were in fact "tumulus-huts", i.e. "earthen shack ruins" and not sepulchres.

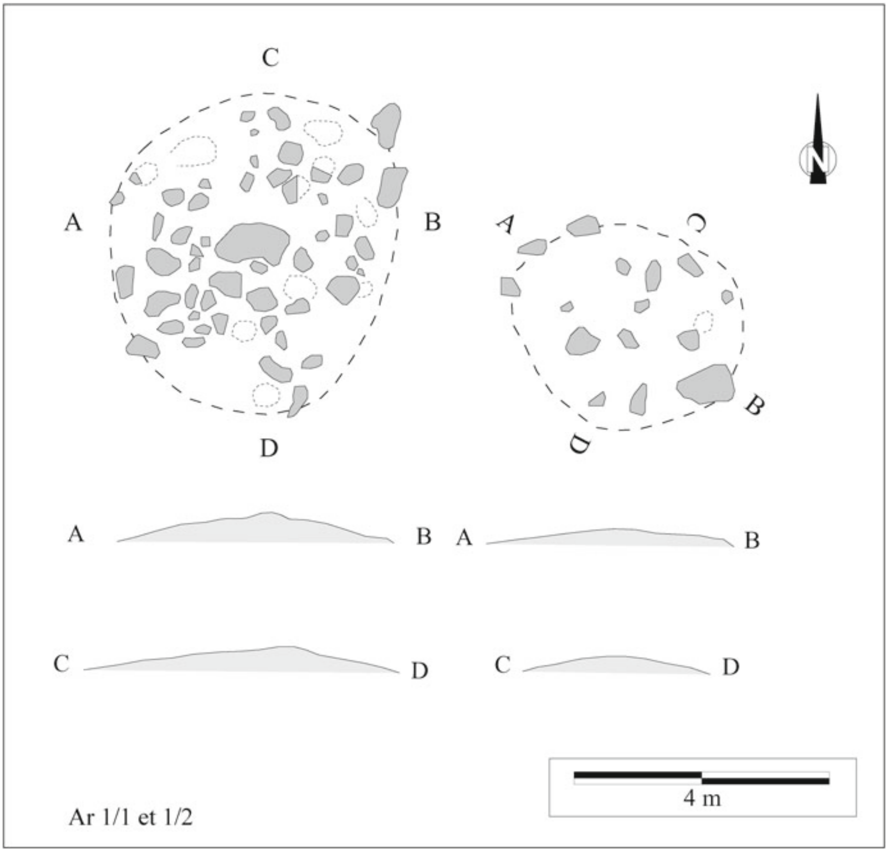

Fig. 5.6 Structure type 1a, Arrens-Marsous, Ar 1/1 and Ar 1/2

these hearths on an archaeological site has negative effects on possible carbon samples and also contributes to further deterioration of the structure. Nevertheless, at a closer look the mass of blocks resembles a quandrangular grouping that could correspond to a collapsed pastoral hut. It seems, therefore, that the possible tumulus might in fact be a hut foundation.

The second example is the Ct 4/2 structure of the *Plateau du Clot* in Cauterets (1,565 m). This example illustrates the ambiguity of this type even better. The central depression of this lovely hill reveals a perfect image of a rectangular structure whose dimensions correspond to that of a pastoral hut (Fig. 5.8).

Of course, we are not contesting here the presence of *tumuli* in mountains in general. Several structures do actually confirm the presence of funerary remains especially in the Marcadau Valley at Cauterets. Such is the case for the site Ct 7/5 on the *Pla de la Gole* (1,863 m). This hill of earth and rocks has in its central depression two large slabs which could indicate the funerary chamber. Unfortunately, it has probably been looted in the past, and recently a bivouac hearth was installed

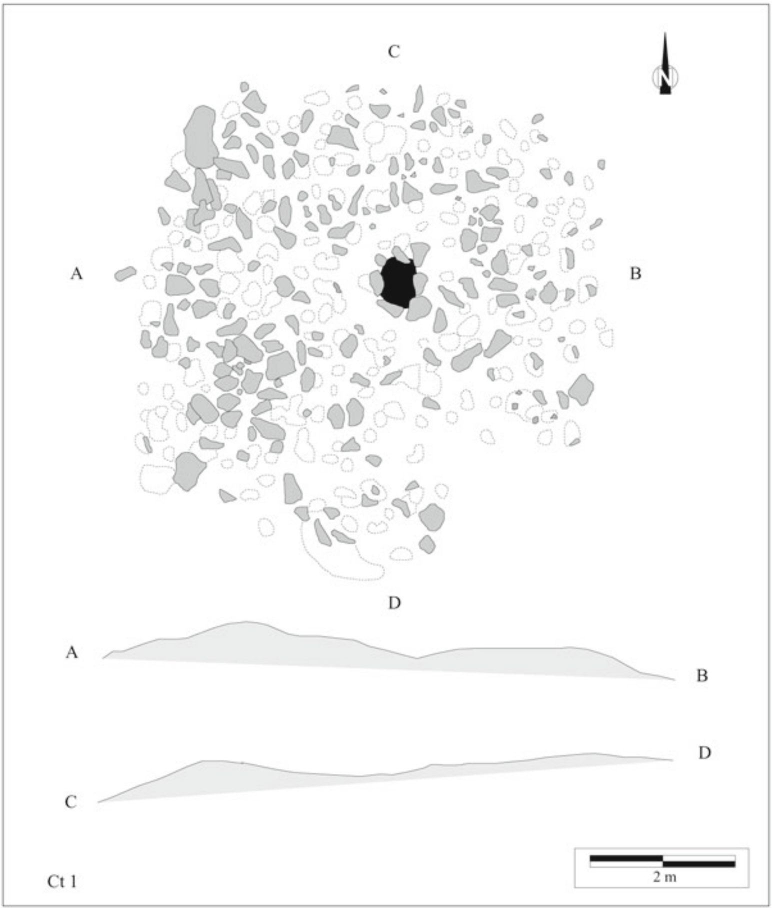

Fig. 5.7 Structure type 1b, *Pla des artigues* – Ct 1

there (Figs. 5.9 and 5.10). This example also reinforces our cautious interpretation of structures that resemble the type 1b. In fact, the dimensions of this structure and its profile are comparable to those of the foundation of a hut. This structure offers a good illustration of the risks of confusion associated with the lack of archaeological excavations. A few other examples of this type exist, such as the Arratille tumulus at Cauterets, at 2,004 m altitude (Fig. 5.11). The Marcadau Valley also offers a few examples, but they remain ambiguous (Figs. 5.12 and 5.13).

In 2006, a research was conducted on one structure in the valley of Labas/Bouleste in the Val d'Azun (village of Arrens-Marsous). This is a rocky structure 5.5 m in diameter and not very high, recorded on the *Artigues* plateau during the 2002 campaign at a little more than 1,500 m altitude.[35] A slightly off-centered

[35] Guédon (2002).

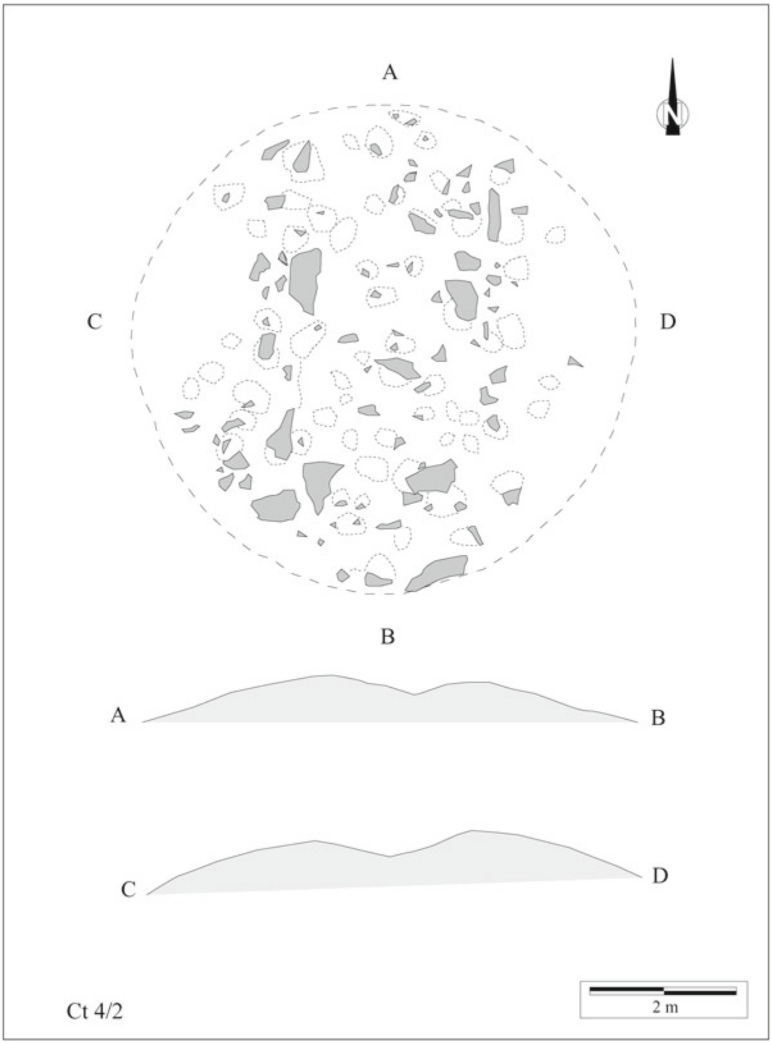

Fig. 5.8 Structure type 1b, *Plateau du Clot* structure Ct 4/2

depression was marked, notably, by a near-total absence of blocks (Figs. 5.14 and 5.15). The research goal was to define what its function was (funerary, very stripped-off hut or even a heap of rocks of natural origin). Not far from there, a circular structure was located with a few sharpening grooves on a natural outcrop suggesting the historical potential of this plateau. The research was designed to test the outline of blocks so that their origin could be determined (Fig. 5.14).

Topsoil covered a level of rather densely located blocks (Fig. 5.15). Thus our entire problem was to demonstrate whether the remaining structure was due to

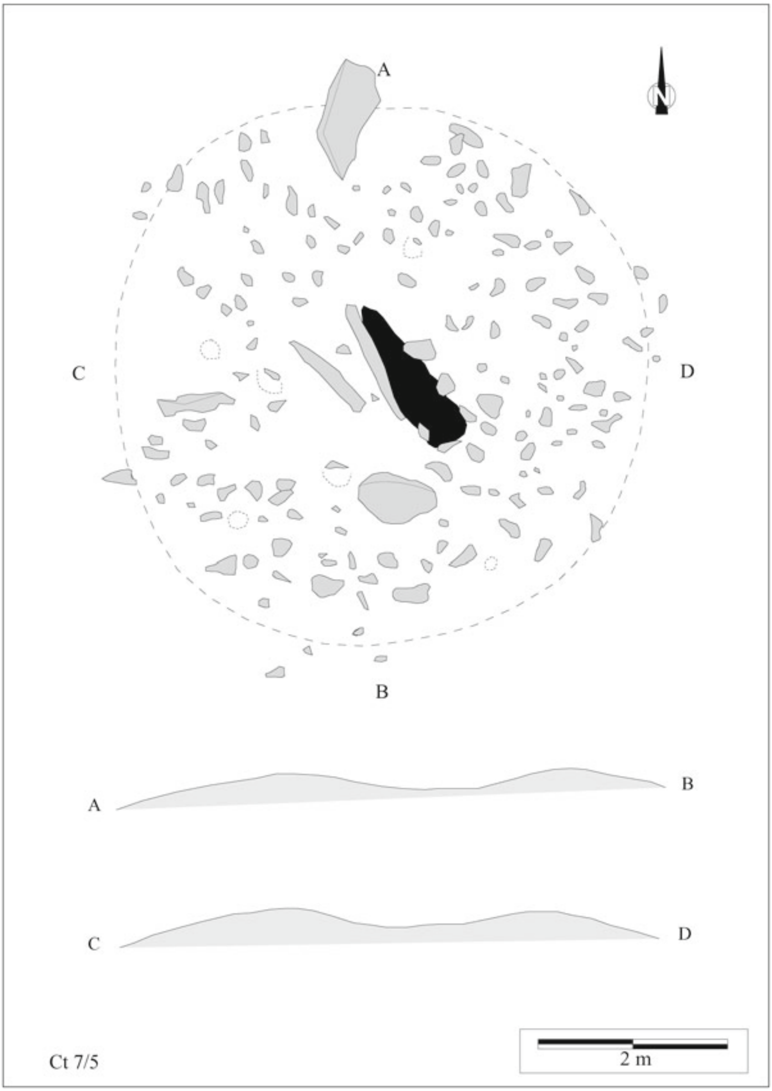

Fig. 5.9 Tumulus, Marcadau Valley, *Pla de la Gole* structure Ct 7/5

demolition or not, in the hope of understanding the mechanisms causing such appearance, without damaging the rest of the structure that could be better preserved. In fact, this is the real difficulty of dry-stone structures as compared to more "standard" remains. It has been shown that the larger blocks appeared to have served as a base for construction with smaller blocks put on top. This is how we were able to identify organization within the scree which does indeed appear to correspond to a wall oriented roughly east–west, which was very much flattened because it was all

Fig. 5.10 Tumulus, Marcadau Valley, *Pla de la Gole* structure Ct 7/5

that was left of two foundations. The demolition process formed a heap of stones around this wall. No suitable dating elements came to light (no hearth or archaeological artifacts). In this particular case, this structure is similar to a dry-stone construction whose dimensions, by extrapolation, recall a shepherd's hut. An extensive excavation of the structure would have provided better evidence.

In general, therefore, we observe that this type raises more questions than it answers. Let me simply point out here that diameters of this type are rather constant and that they are usually around 4–5 m, even if larger dimensions are not rare.

Type 1c: stone structure generally of type 1b or similar, but supported by a rocky block/natural outcropping. Huts or livestock shelters at high elevation constructed against a large rock are numerous. There is a great variation in dimensions but the principle is the same. The structure is supported in part by a block or an outcropping rock but otherwise presents the same characteristics as the previous type.

In few cases the outline of the construction is still easily visible. A good example of type 1c structure is a ruined hut of 6 × 5.5 m (Fig. 5.16) located on the *Estalounqué* plateau at Cauterets (1,710 m), which resembles the "tumulus" structure. On the other hand, when the structure is much damaged, hut foundations may resemble the 1b type with a semicircular appearance (Fig. 5.17).

Type 2a: earthen enclosure and stones with a central depression that is usually deep. Throughout the research area, this type has been shown to be more frequent than anticipated. I located some in each of the three groupings studied. It is generally

Fig. 5.11 Tumulus at Cauterets

found in the form of an enclosure that is generally much less rocky than the type 1 structures, sometimes even essentially earthen. They are circular, or less often, oval, of variable dimensions but the central depression is always clearly marked and even especially deep in some cases.

A good example of this type is the structure Es 6 located in the middle of the Ilhéou mountain pass in Estaing (2,242 m). This structure is almost 5 m in diameter, with a depression 0.7 m deep (Fig. 5.18). The blocks are of considerable size. J. Blot sees an "excavated" tumulus in it, but I have already said that such hasty interpretations might not be justified.

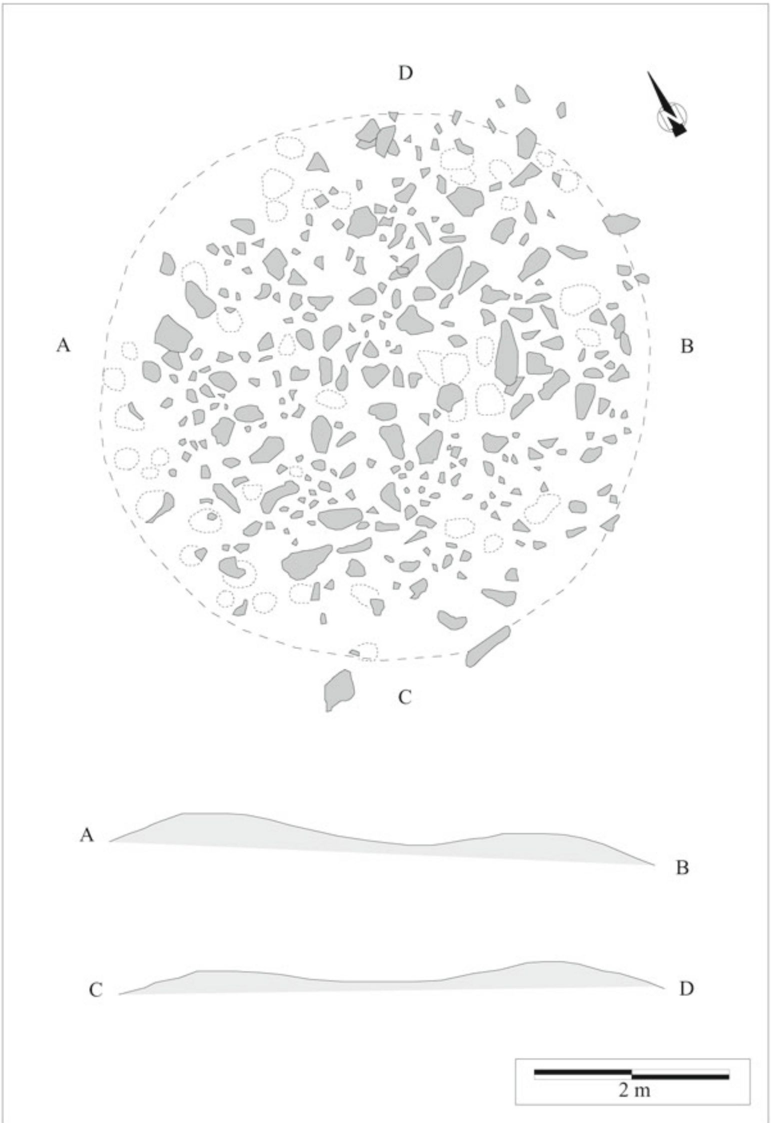

Fig. 5.12 Possible tumulus, Marcadau Valley

Overall, structures of this type exhibit a great variation in dimensions. I noted the existence of some with very small diameters, such as those from the *Pla de la Gole* at Cauterets, whereas others can exceed 8 m.

Type 2b: heap of earth and stones with a central depression, where the enclosure is open. This can very much be a variation of the previous type. The enclosures of this

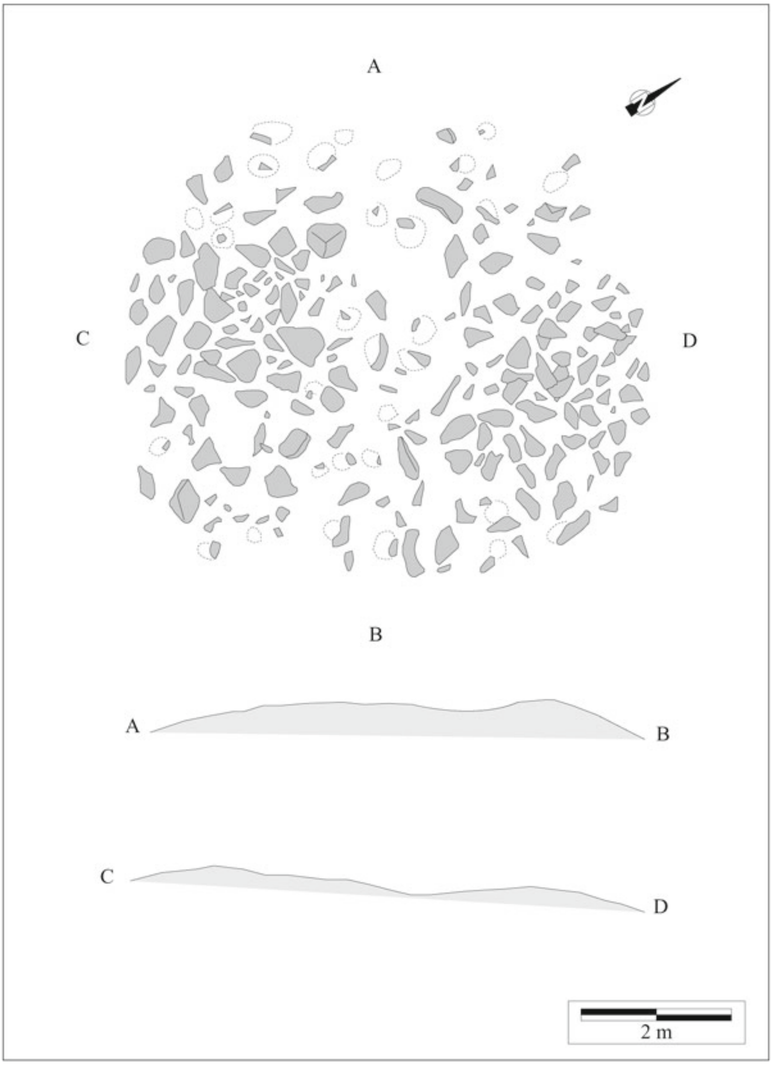

Fig. 5.13 Possible tumulus, Marcadau Valley

type are circular or oval horseshoe shaped. At the present time, we have encountered them essentially in Val d'Azun, isolated or in groups (Fig. 5.19). Problems with their identification remain despite a survey done in 1997.[36] We should, nevertheless, remember that the hut in Larrau, clearly visible as having the shape of the type 2b structure, described above, was excavated because it had been inventoried as a tumulus.

[36] Guédon (1997a, 1997b).

Fig. 5.14 Possible tumulus, Labas/Bouleste, Val d'Azun

Type 3a: this type is represented by simple stone circles. Here we are approaching a problem that is just as complex as with the previous types. The Pyrenean valleys have revealed a few well-known protohistoric necropolises made of stone circles. The upper valley of the Garonne, in the Luchonnais, offers a few groups of the more significant ones. Béarn and the Basque Country also contain those sites. The Lavedan and, more generally, the mountains of the Hautes-Pyrénées have not, up to now, revealed any.

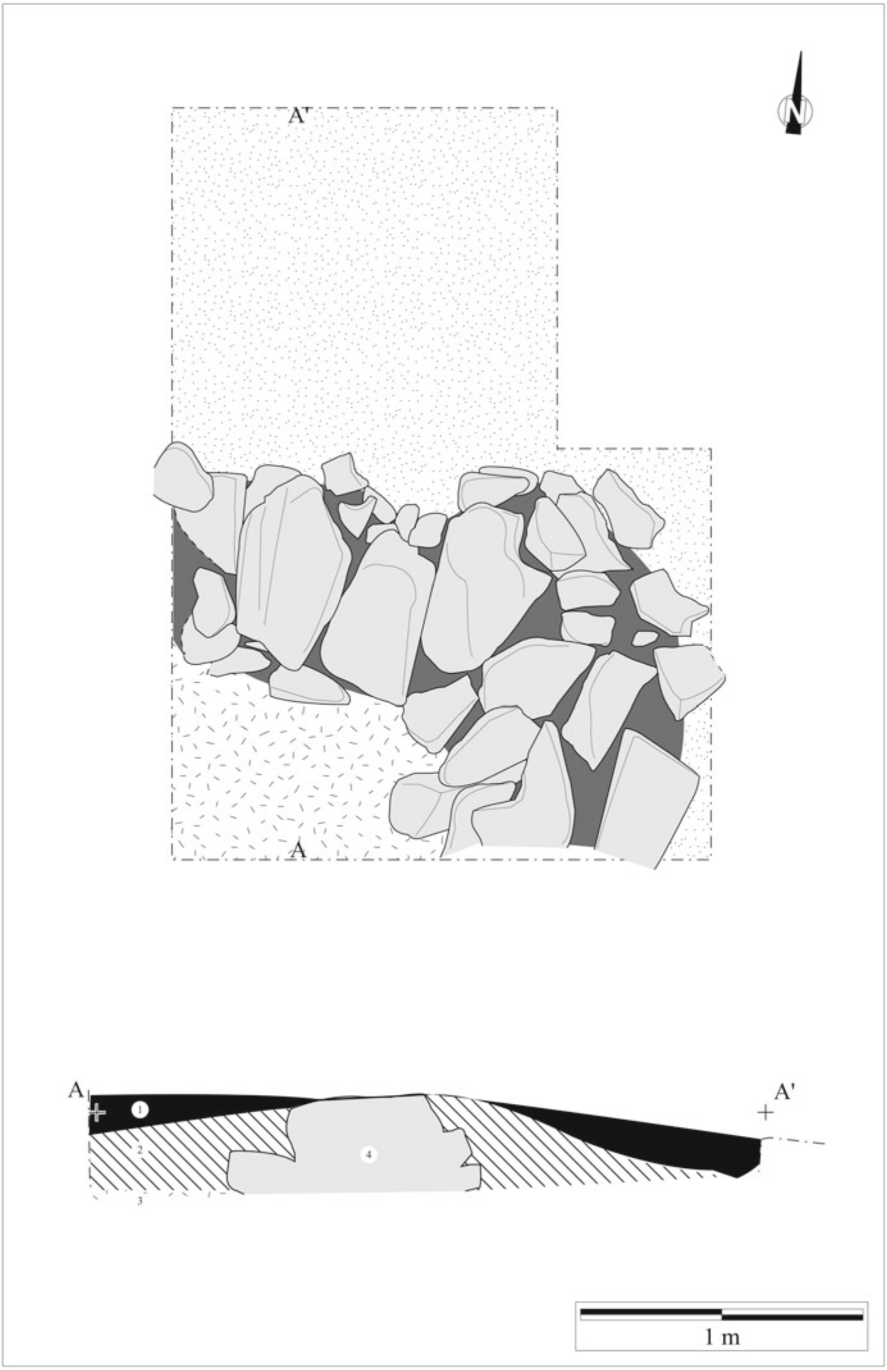

Fig. 5.15 Possible tumulus, Labas/Bouleste, Val d'Azun

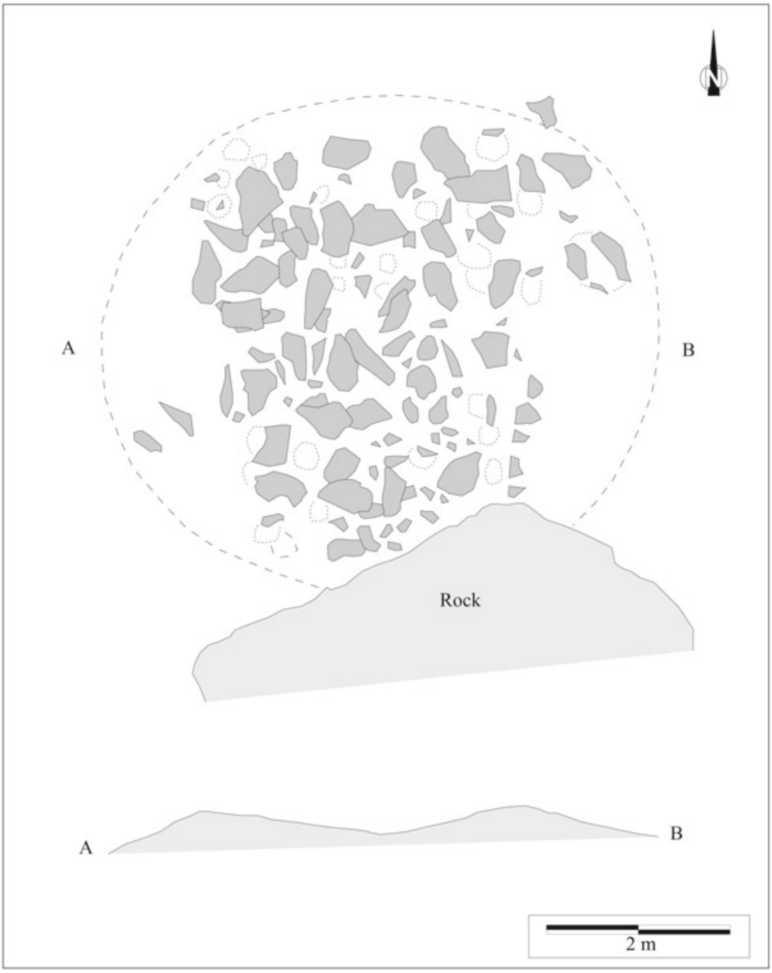

Fig. 5.16 Structure type 1c, *Estalounqué* plateau at Cauterets (ruined hut)

The data presented here remain incomplete due to the small number of this type found. We suggest the term “simple circle” to mean structures comprised of a circle of well-marked blocks of similar size. In these cases, the blocks generally emerge clearly from the ground. The structures are rather constant in diameter, around 4 m. In fact, the circles are most often placed on hills and other dominant formations with, according to our current criteria, very beautiful views onto a valley or a particular mountain. They may be isolated or in small groups, but we know of no group of such structures existing in Béarn. We have found circles at varying altitudes, up to 2,053 m (Cauterets/Estaing). This is where we located one of the best preserved circles in the research area. It is a circle located on a berm that dominates the *Pla de la Gole* at 2,053 m (district of Estaing). Fourteen blocks form a circle 3.5 m in

Fig. 5.17 Foundations of damaged hut resemble structure type 1b

Fig. 5.18 Structure type 2a, structure Es 6 located in the middle of the Ilhéou mountain pass in Estaing

diameter (Fig. 5.20). If a few blocks are visible inside, this circle may still be considered a simple one because it is so well marked. A depression occupies the center of the structure. It is associated with a second one that is much less legible, set up 6 m to the north.

Fig. 5.19 Structure type 2b, heap of earth and stones, Val d'Azun

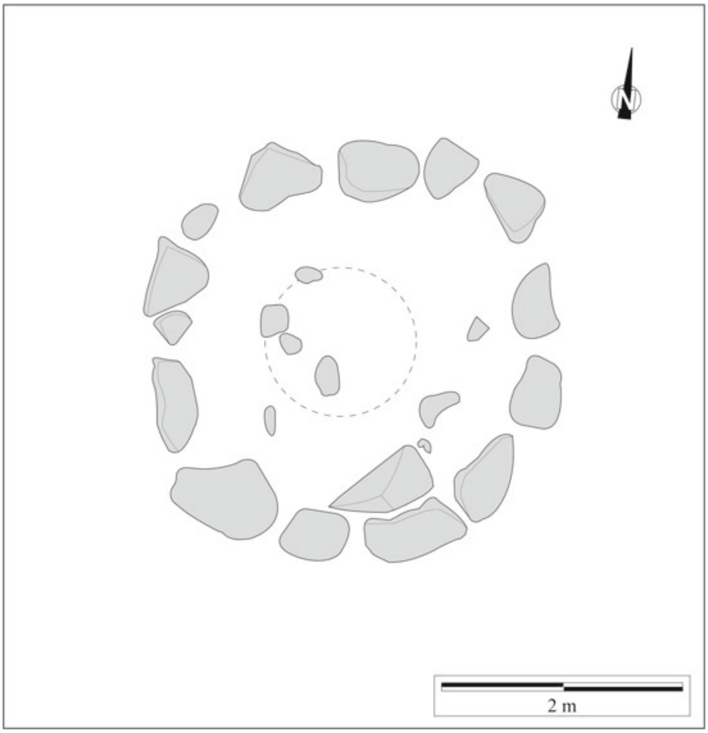

Fig. 5.20 Structure type 3s, *Pla de la Gole*, district of Estaing

Fig. 5.21 Group of structures of type 3a in Ayzac-Ost

Further down, at an altitude of 510 m, the *Bagnestou* site is also of interest. It represents a group of four circles located at the end of a "spur" that dominates the mountain stream at Pau (510 m), north of Argelès-Gazost, in the village of Ayzac-Ost (Fig. 5.21). The site is located in close proximity to the ancient trail that leads to Vieuzac. The circles, of which one is still debatable, have similar diameters, 4 m on average. The most "furnished" structure consists of 19 blocks. It should be noted that the alignment shown to the south (St. 5) could simply represent remains of a much more recent parcel wall. A polishing stone has also been observed in the area, but I have not yet been able to locate it.[37]

J. Boudette mentioned the site of an ancient market called *Aréa* located in the area that is central to other villages of Estrème de Salles in the valley where Ayzac is located.[38] He points out several "circles formed by stones… rather large and projecting so that they can serve as seats." This could likewise be the early meeting place for representatives of the valley. It is rather tempting to compare the circles with this mention by the historian of Lavedan. The geographic position and the presence of circles would appear to agree with historical accounts. This should not be a surprise that the groups of circles are often considered in the oral tradition as a place for meetings that were more or less legendary and highly symbolic.

Type 3b: This type is identified as complex stone circles. This means circles having multiple layers of blocks, or simply circular concentrations without any apparent organization. Their diameters and locations are not different from the previously described type and both can be found on the same site/pasture. The blocks barely emerge from the grassy cover, unlike the simple circles. This type is also observed in Ossau (Atlantic Pyrenees)[39] but some have also been found elsewhere, like the one we noticed above Bagnères-de-Luchon (Haute-Garonne).[40]

The following two examples from Cauterets show clearly the basic features of this type. The first in *Pla de la Gole* is very well marked by a sort of "paving" (Fig. 5.22). It dominates the confluence of the mountain streams at Arratille and Marcadau. The second is located at the edge of the mountain stream in Lutour in a grassland rich in remains of pastoral habitats (Fig. 5.23). Two "slabs" more "standard" that the previous one are planted near the center of the structure, possibly marking a funerary chamber.

Concerning the disparity among valleys in types of cultural remains, we can make a simple observation, namely that whereas numerous sites are known in Béarn and Haute-Garonne, the Hautes-Pyrénées constitute a rather remarkable void. Such disparity could, of course, result from research and may not represent differences in cultural activity in the past. In fact, circle structures do indeed exist in the research area, despite doubts about this voiced not so long ago. The imbalance among the compared valleys tends to even out gradually as archaeological surveys of the region progress. The fact remains, however, that for now we know of no equivalent to the great sites known from Béarn, like the one at *Benou*, to name just one.[41] In our opinion, such disparity poses a big research question for archaeologists and historians as

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[37] Archaeological map record of the SRA.

[38] Bourdette 1898–1899, T. 1, p. 471 et T. 3, pp. 397–408.

[39] Blanc (2000), p. 19.

[40] Guédon (2001a, 2001b), p. 40.

[41] Among others, Blanc (2000), pp. 15–19.

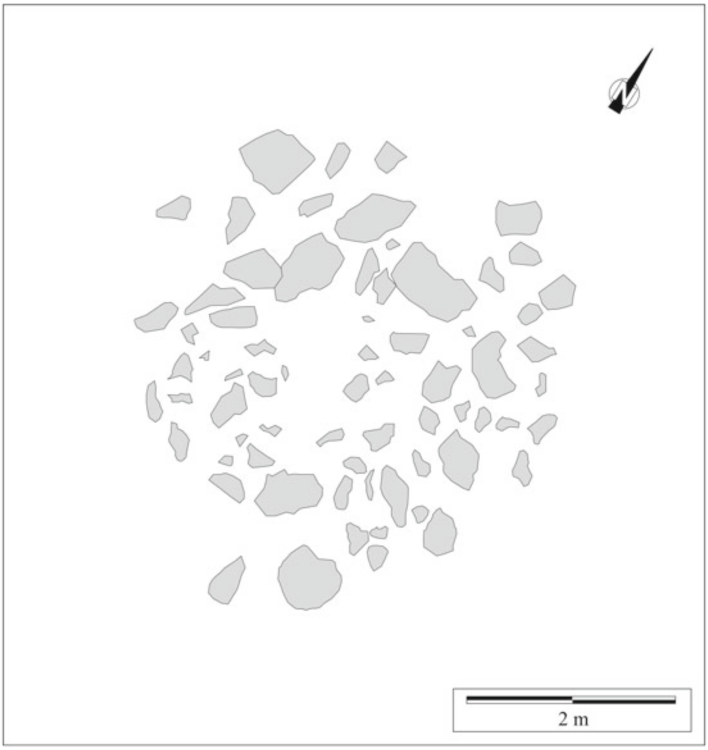

Fig. 5.22 Structure type 3b at *Pla de la Gole*

the difference in density of archaeological remains appears to exceed the suggestion that such imbalance is due to progress in archaeological research. This situation may, indeed, present a real research problem, to which protohistorians should pay special attention in view of its implications on antiquity and the origin of human settlement in the high mountains.

Other Types of Shelters

Other types of structures were also inventoried. These structures represent shelters constructed under rocks. Of course, one should not believe that the granite massifs in the high mountains do not offer any opportunities for shelter; quite the contrary, we have ample examples of shelters under rocks from the research area. Granite blocks are naturally favorable for such type of site. We shall consider two major types, “simple” shelters and *toues*.

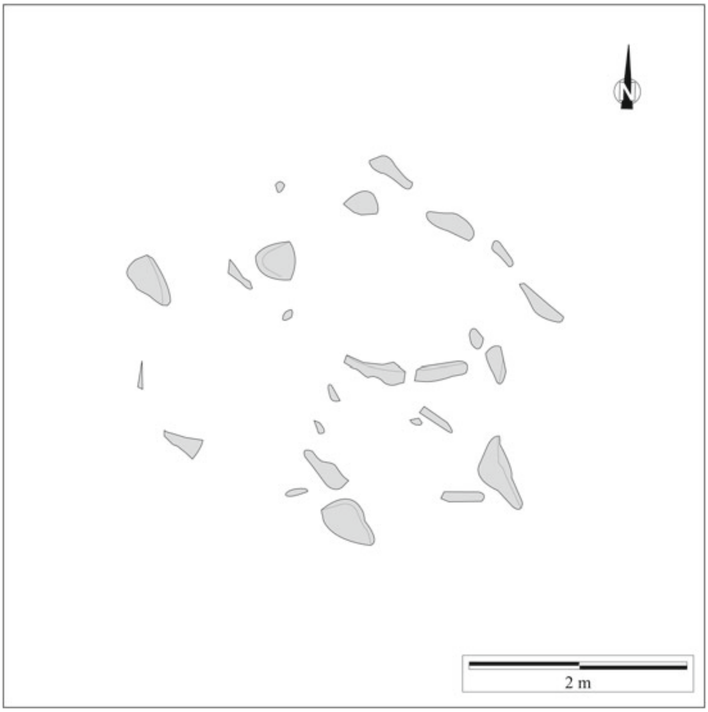

Fig. 5.23 Structure type 3b at *Pla de la Gole*

We understand the term "simple shelter" to mean shelters constructed in such a way to take best advantage of the terrain.[42] They generally involve relatively small spaces, usually between several blocks located at the end of a rockslide. They can be found pretty much anywhere and are very common in areas rich in pastoral habitat, but sometimes appear completely isolated (Fig. 5.24).

Most of the time they are very sparsely equipped with low dry-stone walls to protect the open spaces between the blocks. The most common configuration is a block leaning against another one, or several, forming a space that is longer (up to 4 m) than it is wide, and generally not very high (some are barely more than 1 m). They may have a wide variety of functions but they almost certainly appear in the pastoral context as outbuildings.

Toues constitute a different type, despite similar principles of their construction. In Béarn they are called *quèbes*, and in Spain, *cuevas*. Their dimensions are generally larger than a structure that might be identified as a "hut." Some have a floor area

[42] Some qualify as *toues* insofar as this term etymologically designates a "hollow," a "hole," but not always necessarily one that is man-made. Later on I shall explain the difference between a shelter and a *toue* in the strictest sense of the word. Shelters are also described in *Crecs* or *Cacous*. Berot (1998), pp. 23–29.

Fig. 5.24 Isolated shelter

of almost 40 m^2 (*toues* in *Pacca* or *Migouélou*). Walls may be constructed with great care and interior furnishings may be identical to those in a hut (hearth, wall niches, packed earth or slab floor, etc.). Sometimes, the shelter may be covered with a tarp, as they were in Béarn in the nineteenth century.[43] This proves that lighter structures could have been used at the same time as dry-stone.

It is, therefore, their spectacular appearance that distinguishes them from other sites. In 1461, during the bombing of *Larue*, a mountain in Ossau adjacent to Azun, a *queba* is mentioned *deu miey deu testel (?) de la pena.*[44] The blocks used to support walls and roofs are relatively large; in fact, *toues* commonly mimic their natural environment (Fig. 5.25).[45] Similar constructions also exist in regions other than the Pyrenees. They can be found mostly in locales with granite outcrops. In Lozère, a habitat of the Gallo-Roman period a pile of granite blocks resembling *toues* shelters[46] was recorded. They are represented by real little "houses under rocks" like *la Cétira* in Estaing (Fig. 5.26).[47] The account given by the most celebrated "Pyrenean expert" is an eloquent one. Here is what H. Russel said about the *toue* from *Larribet* in Arrens:

> Imagine this: a huge boulder, at least a hundred cubic m and touching the ground at just one point, so that there are two or three big caves between it and the ground…. We're going to

[43] Dugène (2002), photo 57.

[44] Bourdette—personal communication, 4 n° 192. ADHP, F 127/4.

[45] This is so true that hikers may pass next to some of these without noticing.

[46] Roger (1993)

[47] These were restored a few years ago.

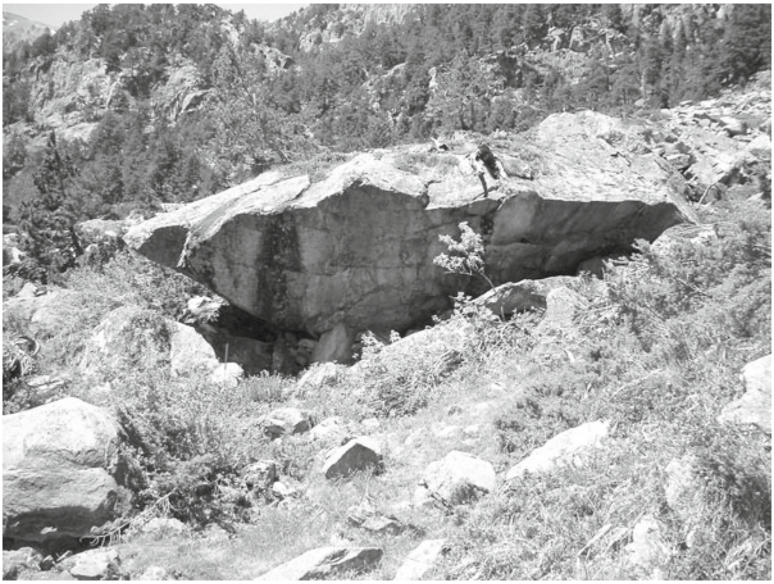

Fig. 5.25 *Toue*

Fig. 5.26 House under rocks, *la Cétira* in Estaing

Fig. 5.27 *Toue* from *Larribet* in Arrens

> sleep under that. This monumental block is called *Tour d'Arribit [Tower]*: it is about 1,800 m above sea level and is certainly one of the best natural deposits I've ever found in the mountains.[48]

Upon inspection of the area, I think that the above description refers not to the restored *toue* but the one located in its immediate proximity (Fig. 5.27). The shelter is over 9 m long and about 3.6 m wide. There is also an external small outfitting present. Two boulders are leaning against the west-side block to form a triangular niche ($1 \times 1.6 \times 1.35$ m) with a large slab for a roof. The floor is a slab and the free spaces are walled. This small structure might represent a small cheese-salting tub. In majority of cases, *toues* are associated with other pastoral structures (enclosures, *leytés*, etc.).

The *toue* in *Castéric* at Arrens (2,095 m) is a good example of a two-roomed shelter (Figs. 5.28 and 5.29). The low walls are constructed with great care. The "high" room appears to have been reserved for habitation, as suggested by the hearth and the paving present at the entryway. Even more comfort was provided by a slab seat outside. The second room may be an outbuilding. Two-roomed shelters are not rare. The *toue* at the *Clot* plateau in Cauterets has an outer area protected by a dry-stone wall and an inner area that is more than 4 m long.

Some structures of this type are even more complex. The *toue* in *Batbielh* at Arrens (2,150 m) consists of three spaces, one with a hearth. The presence of two out-houses, one of which could have been used as a salting tub, makes this a particularly

[48] Russel 1908, p. 40. Other Pyrenean specialists have visited toues, for instance Count Roger de Bouillé.

Fig. 5.28 *Toue* in *Castéric* at Arrens

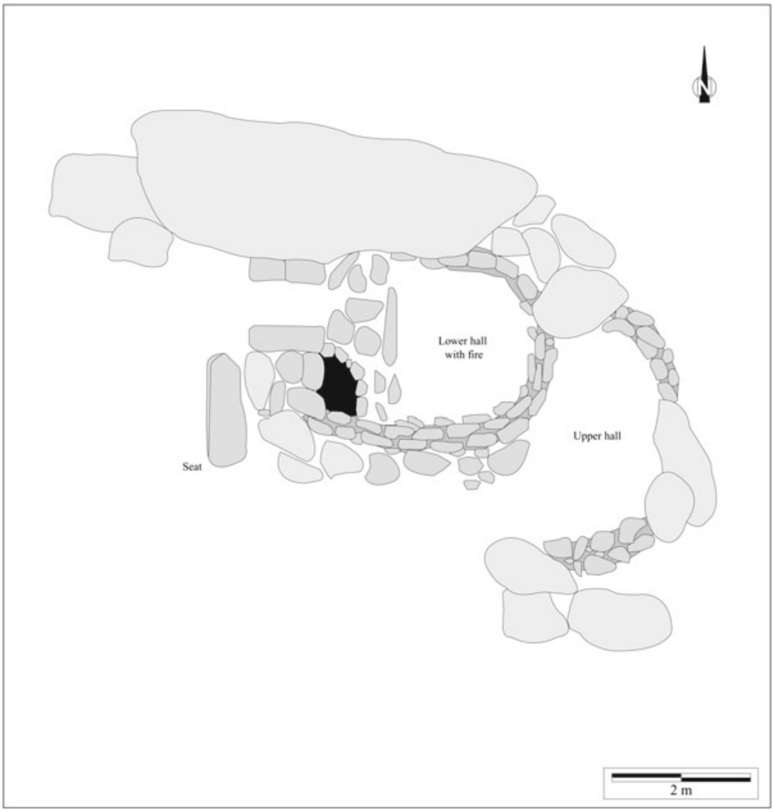

Fig. 5.29 *Toue* in *Castéric* at Arrens

interesting site. The *toue* in *Migouélou*, also at Arrens (2,290 m), is even associated with an outfitted spring and fully integrated into the inhabited space.

The pastoral function of these structures is clear. Some of the sites may, however, have been used as secondary or ridge shelters, especially during bad weather. A shepherd may also need to remain for a few days on a pasture, and outfitting a *toue* is more "cost-effective" than constructing a hut. Nevertheless, it has also been shown that a *toue* was used as a primary shelter. For instance, in 1999 the *toue* in *Castéric* was occupied all summer by a shepherd.

Several accounts contradict the quoted above Russel's romantic vision of sleeping in a *toue*! Here is what Henri Fédacou experienced as a young shepherd in the valley of Gèdre:

> Often, the shepherds came in pairs, with thousands of animals. They had their huts, which were more rustic than ours, and sometimes even settled for a *cacou*, a shelter under a boulder that was simply outfitted for sleeping. I remember sleeping in one of these shelters. It was in July 1915; I had just gone before the draft board. That day I was looking for my ewes at the foot of the *Barrada*, above the circus of *Ets Lits*. The corner was very abrupt; it is a series of rocky bars and small grassy berms, which lead to the Rabiet Lake through the *Passet de Berahècho*. Night surprised me before I had found all my ewes, above the rocky bars; I had to remain up there with a shepherd from Omex and share the *cacou* de *Berahècho* with him. I knew the shepherd, Baptiste, well; he used to come to this mountain every year. At night, there was a terrible storm. There was no door, only two low dry-stone walls per side. I saw the peak of the *Maucapéra* lit up by the lightning; Baptiste was sleeping, he was a tough one!…[49]

Living conditions in such shelters were rather difficult, especially due to humidity. Michel Domec reminds us of it when he presents an account by a shepherd who stayed in *Labassa*. He told him "I can't stay in *Labassa* any more, for I face my death every summer."[50]

Toues exist in large number in Val d'Azun, where I was able to visit 17 of the 20 known sites. I was told about other shelters but did not have the time to go to examine them, particularly those in Cauterets.[51] In the valley of Arrens, *toues* literally punctuate the trail of communication with Spain. This is because they are also used as a refuge for people who make use of the mountain, other than shepherds, notably those who participate in economic and commercial relations with Spain (smugglers). It seems, therefore, that the function as a refuge would be rather obvious in this context of intense frequenting of high-altitude communication trails. This, of course, includes contraband, which was certainly very common even if historians, logically, have trouble quantifying it. As Charles Packe indicated in 1864, the *Port* d'Azun is "often visited by smugglers," and further stated: "… I do believe there are no mountain passes in the Pyrenees where more smuggling occurs, essentially silk

[49] Buisan (2001), p. 36.

[50] Charrier (2000), p. a5.

[51] In Ossau, where archaeological prospecting is more advanced, more than 60 *quèbes* have been recorded thus far, see Dugène (2002), p. 67. It appears, however, that this inventory encompasses all types of outfitted shelters, which might explain the high number.

and tobacco."[52] The accounts of Pyrenean dwellings show that *toues* are also good refuge shelters for hikers and were used by them since the early times of tourism until today.

Some *toues* have also been used to keep ewes, as is evidenced by carpets of their droppings. This could occur naturally or through the actions of shepherds who used such shelters as a "sheepfold."[53] Mr. Cazaux of Arrens explains that in the area of *Larribet*, there are "lots of *toues*," "caverns where you could fit 50 ewes."[54] Such a number is not surprising, however, as the research conducted in the sheepfold grottoes of the pre-Alps, probably used in the Neolithic Period, suggests. The data concerning ancient pastoral practices and herd management have thus been illuminated by a rather innovative aspect.[55] Additionally, these studies show all the benefits of excavating this type of sites.

We are convinced of the great potential that studying of these sites offers and of their contribution of a new knowledge on the elements of pastoral organization. These unusual under-rock shelters should be the subject of archaeological surveys which, I hope, will contribute to better understanding of their function. Besides the undeniable patrimonial interest, *toues* appear to be key elements in the approach to study human settlement in mountainous environments. The mention of a *quèbe* in the partitioning indicated in 1461 can only tempt us to test the archaeological potential of this type of shelter.

Examples of Sites

Some of the sites, aside from the structures presented above, allow us to really appreciate the nature of the remains of pastoral culture encountered at high altitude. Here, we cannot synthesize all the data concerning the questions of spatial distribution or functional problems of the sites, etc. Likewise, it is also not possible to present archaeological sites that are too extensive, like the *Pla de la Gole* in Cauterets for example, within the context of this chapter. I shall therefore provide brief descriptions of several less known sites found in the research area.

Val d'Azun: Arrens Valley

The site at *Banciole,* also known as Ara 1 (1,480 m), is located at the heart of vast pastures belonging to the section of the peak of the *Cabaliros*, in the village of Arras-en-Lavedan (Fig. 5.30). Two huts, 1 refuge hut and a ruined traditional hut,

[52] Charrier (2000), p. 40.

[53] There are also some very nice examples in Béarn and in particular in Ossau.

[54] Charrier (2000), p. a3.

[55] Brochier et al. (1999), pp. 77–114.

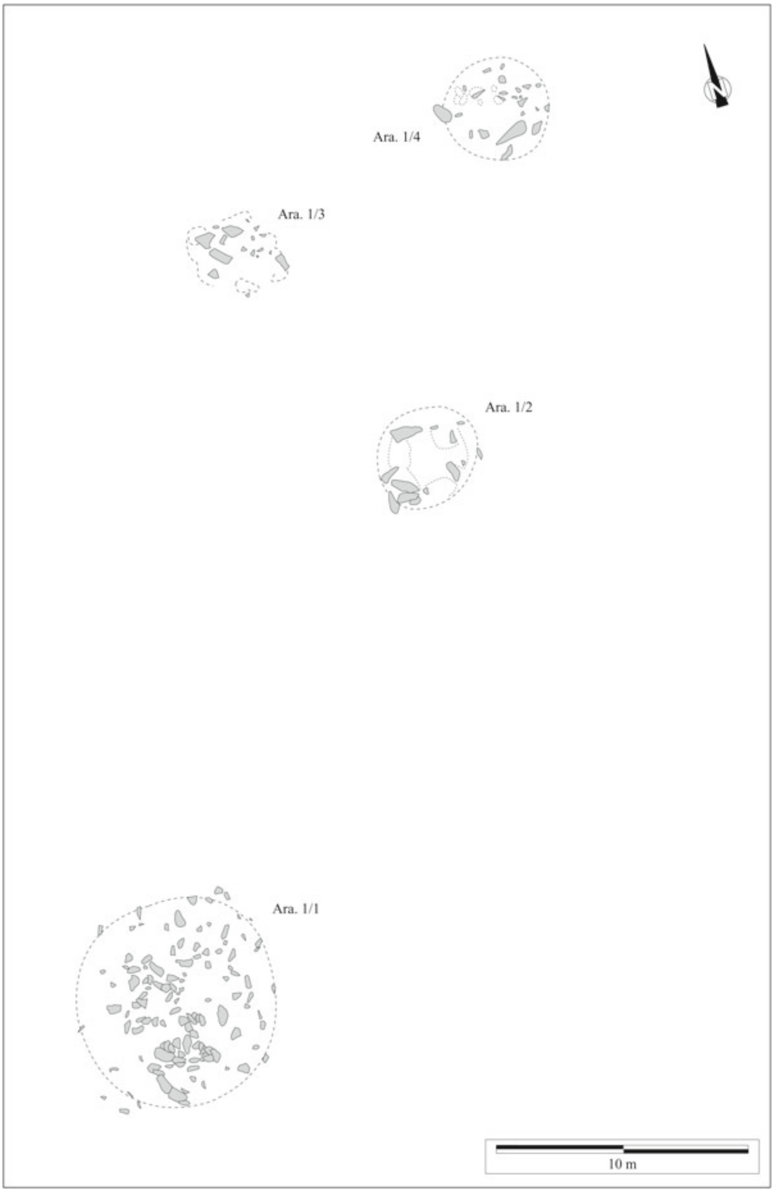

Fig. 5.30 Site at *Banciole*, Ara 1

are located at about 75 m from the four structures at Ara 1.[56] All of them are located on a berm that dominates the brook in *Banciole*. This small group is crossed by an ancient pastoral trail.

All the structures are of type 1b, or similar. Ara 1/1 has a diameter of almost 8 m, which puts it in one of the most common classes. The central depression is well marked but rather shallow. No particular organization can be seen in this rather scraped down rocky structure. About 20 m to the northeast, three other structures can be seen. Ara 1/2 and 1/4 are of diameter between 3.7 and 4 m inclusive. Ara 1/3 is more rectangular.

The Ara 1/1 structure is similar to an ancient hut and could be much older than the one that is located higher up, even if we cannot be specific as to the possible time period. Structures Ara 1/2 to 1/4 are smaller buildings that represent spatial attachments to this hut.

Val d'Azun: Estaing Valley

Site Es. 1: This is the grouping at Oelhestre which was built around the current hut located above the Lake of Estaing at 1,239 m altitude (Fig. 5.31). At about 15 m from the latter, going up from the lake, I noticed what could possibly be the ruins of a hut (?) covered by heavy vegetation. This abundant covering does not allow us to be certain as to its shape and size, however. Next to it is a small rocky heap that could represent an outhouse (perhaps even a ruined *leyté* although I can no longer identify the water supply).

The hut is the center of a cluster, which involves three smaller structures (Es. 1/3–1/5). The first one is less than 10 m away from the hut. We can easily discern the outline of an ancient hut with an opening that should be from the east (Figs. 5.32 and 5.33). The walls can still be clearly seen. Further to the south, there are two other structures (Figs. 5.34 and 5.35). Here, the walls are not as visible, to the point that structure Es. 1/5 could easily be considered as natural. The fact remains that its horseshoe morphology classifies it in what we commonly call hut bases or type 2b structure. Both are of similar dimensions (mean diameter is 5.5 m).

Es. 1/6 is a ruined hut that is beginning to resemble a "tumular" structure but whose outline is still perfectly visible. At about 5 m from this structure a V-shaped

[56] As a reminder, I should note that the ruined hut shows a carved stone dated 1900. I shall also specify that this site, discovered in 1996, may have disappeared by now. In fact, an eyewitness told me about work being done on a pastoral trail in the area (enlargement). This could be the one that crosses the Ara 1 structure, but I did not have the time to verify it. If it is correct, no monitoring or preventive archaeological prospection is necessary here. In any case, this illustrates the fragility of isolated remains in the mountain that, as I believe, should be protected from damage and destruction. It is regrettable that this type of site, which for that matter is recorded in the archaeological map, is not the subject of the same attention as those located in the lowlands.

Fig. 5.31 Grouping at Oelhestre, site Es. 1

Fig. 5.32 Grouping at Oelhestre, site Es. 1

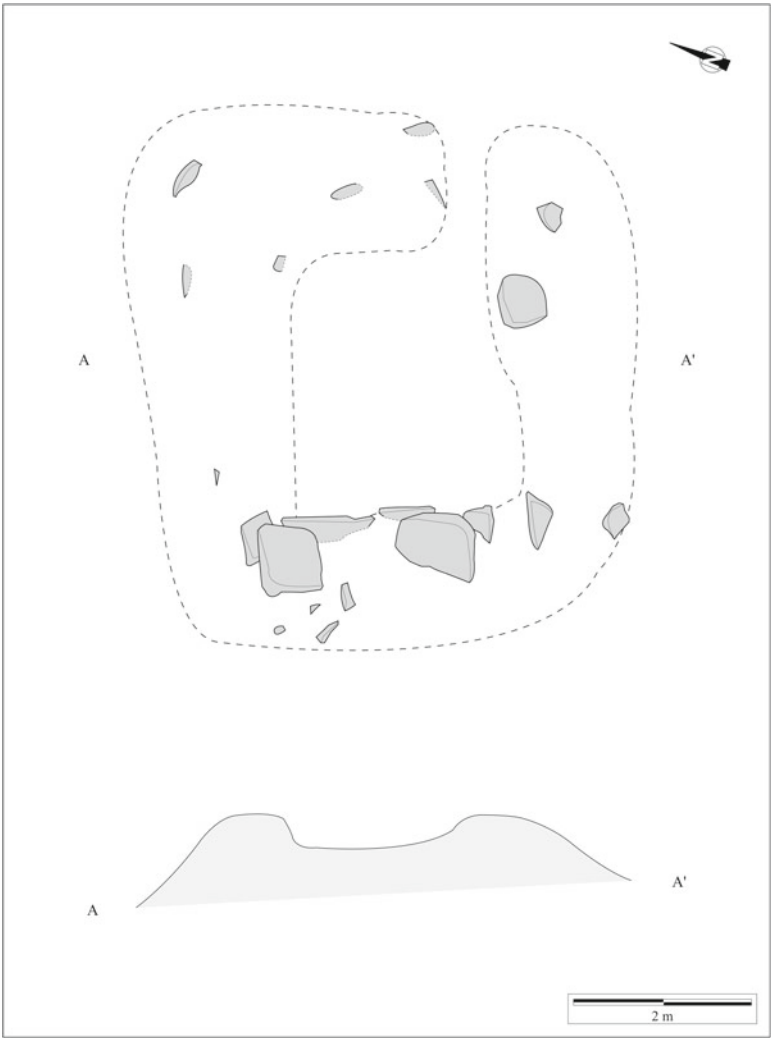

Fig. 5.33 Grouping at Oelhestre, site Es. 1

enclosure appears (Es. 1/7), which ends in a corridor that is 9 m long. This narrow corridor is cut very deeply into the slope and leans against a rocky outcropping.

Above the trail, between Es. 1/6 and the hut, a small rectangular structure measuring 3 × 3 m (Es. 1/9) is located. It could represent a very much scraped down hut. It is associated with a narrow enclosure (Es. 1/8), 6 m long supported partly by a large boulder. In this particular case its 1.2 m inside width suggests that it could have been a milking “corridor.”

Fig. 5.34 Grouping at Oelhestre, site Es. 1

Site Es. 1 is a typical example of a pastoral site which certainly presents several chronological phases but in the absence of archaeological excavations a more precise interpretation is not possible.

Cauterets-Valley de Lutour

Site Ct. 58 consists of two structure, ruined hut 58/1 and a "tumular" in its appearance 58/2 hut foundation, measuring 5×4 m (Fig. 5.36). The central depression

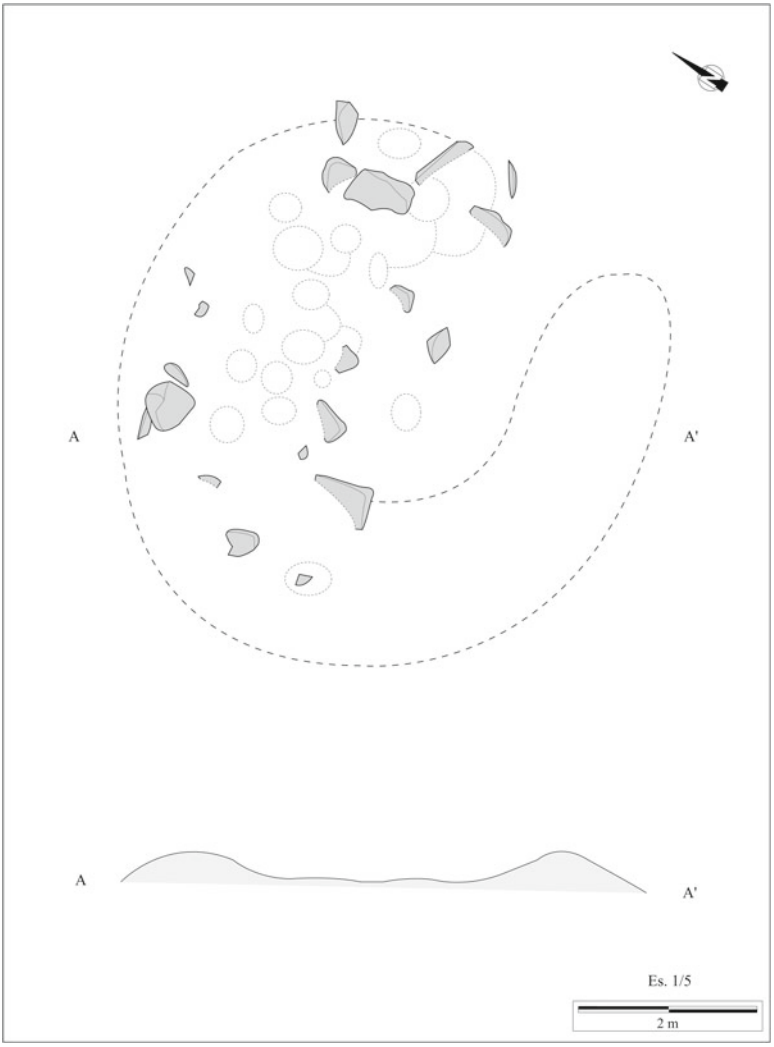

Fig. 5.35 Grouping at Oelhestre, site Es. 1

makes the construction of the walls to be clearly visible; this construction appears older than Ct. 58/1.

Site Ct. 59 is located a little more to the south, at the edge of a small brook; it consists of two structures. Structure Ct. 59/1 leans against a large boulder. Its entire surface, 16 m long, shows traces of outfittings (Fig. 5.37). At least two well-planned construction phases can be identified. The first, to the south, measures 5.5×3.5 m (outside measurements). The blocks are rectangular in shape, with an opening in the northern part. The second construction is also supported by an outcropping rock. It has similar dimensions and is in the same stage of advanced collapse. Structure Ct. 59/2 is a hut foundation

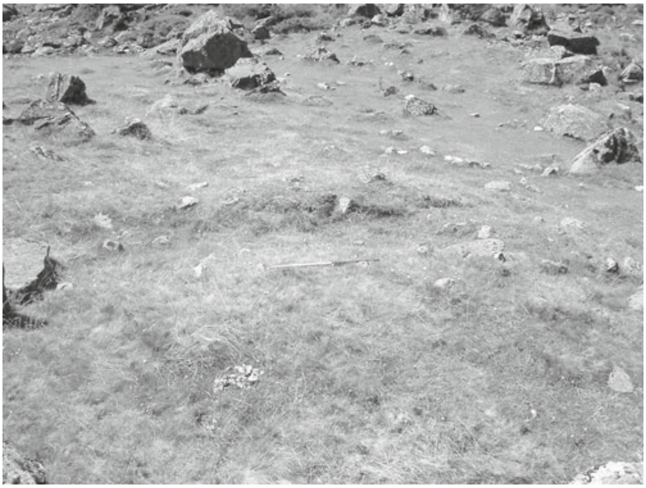

Fig. 5.36 Cauterets, site Ct. 58

located 6 m to the east of Ct. 59/1 (Fig. 5.38). It reaches 6 m in diameter and over 0.6 m in height. The central depression still leaves the walls clearly visible.

Cauterets-Valley de Marcadau: Cayan Plateau

Site Ct. 18 is a group of two structures located near a pond, at the edge of the mountain stream, on a flat terrain. Structure Ct. 18/1 and 18/2 are both connected to the same large boulder and are in a similar state of collapse. Structure Ct. 18/1 is a rectangular space measuring 6×4 m (measured outside) outlined by blocks that barely emerge from the ground but which clearly show where the walls once were (Fig. 5.39). Similarly, structure 18/2 is well outlined by the remains of a rectangular shape measuring 5.5×3.5 m at most. These are two ancient huts.

Structure Ct. 18/3 is located 25 m to the south/southwest from the previous structures. This is a hut measuring about 3.5×2.5 m (measured inside) with some walls preserved. The entryway is located on the southeast side (Fig. 5.40). Structure Ct. 18/5 is located next to Ct. 18/3. This is a pile of stones measuring 4×3 m which leans against a boulder.

A few m away is hut Ct. 18/4 and Ct. 18/6. This latter structure is much damaged and its dimensions are modest (2.5×2.5 m). Ct. 18/4, on the other hand, is a ruined hut.

This small group shows that one site may contain structures representing several chronological phases.[57] In fact, the different states of collapse of these huts suggest that they are not from the same time period. Archaeological excavations would certainly shed more light on the history of this cluster.

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[57] Guédon (1996) et 2003.

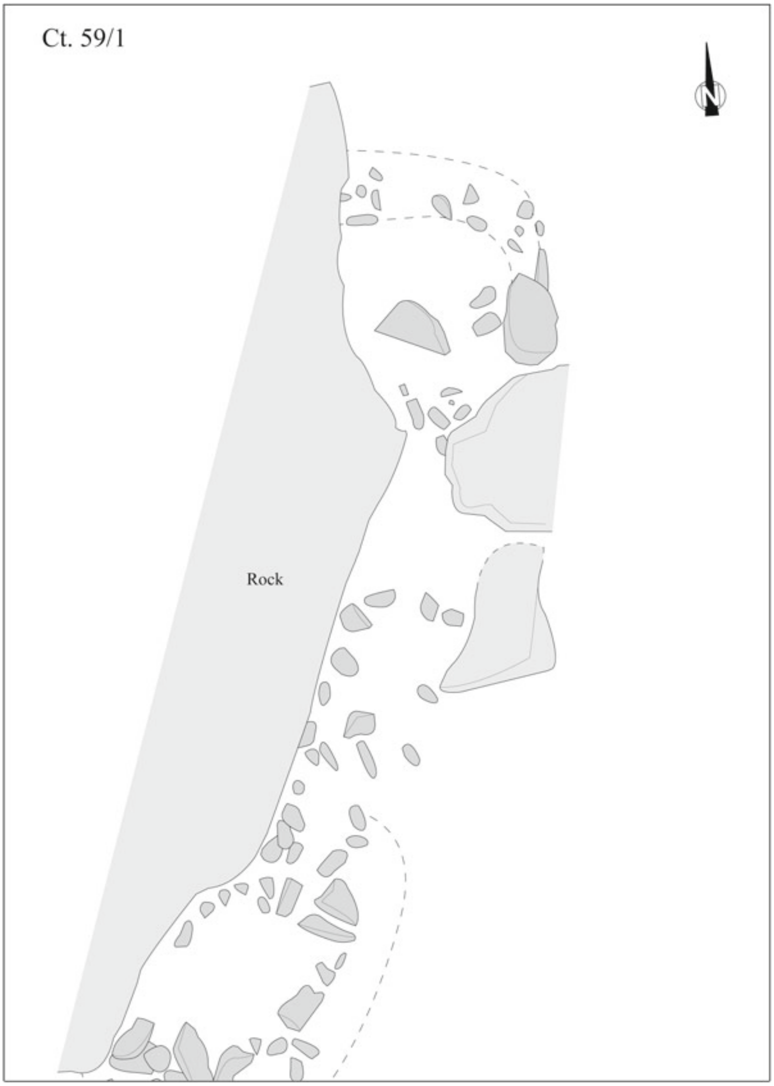

Fig. 5.37 Cauterets, site Ct. 59

Conclusions

In sum, the results of our surveys are very positive. The valleys of the upper Lavedan are particularly rich in remains of pastoral lifestyle and traces of human activities are also found in very high altitudes. They are perfectly integrated into the historical processes that have been brought to light in other parts of the Pyrenees. Studying

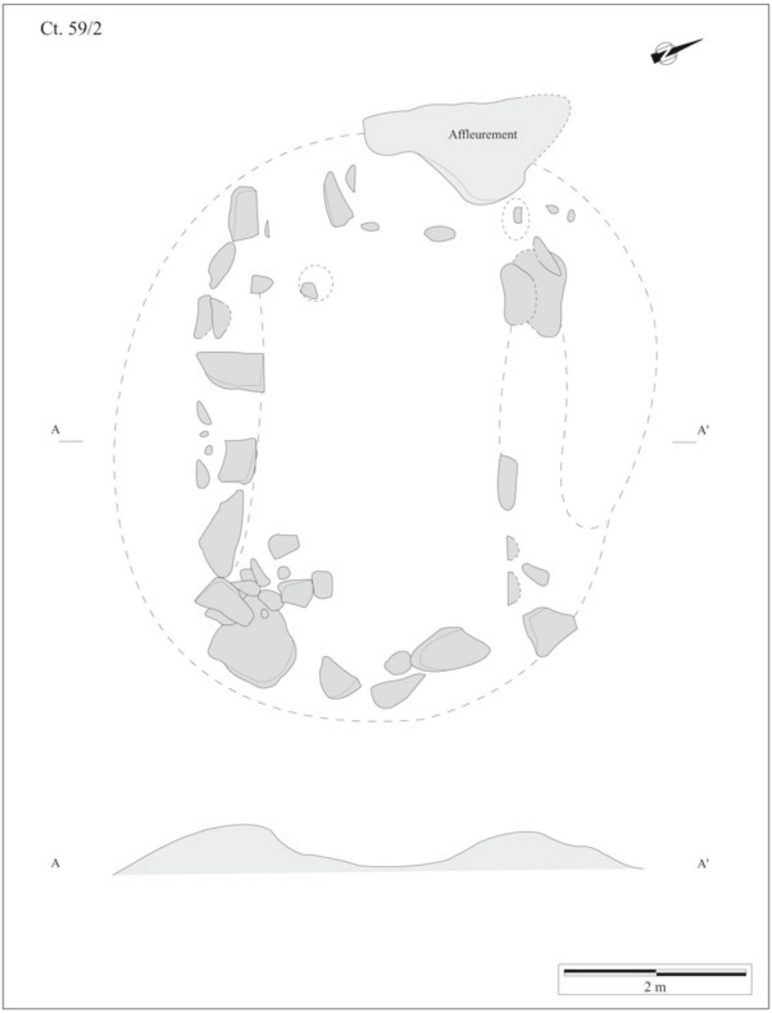

Fig. 5.38 Cauterets, site Ct. 59

those remains has nevertheless allowed us to shed additional light on the traditional pastoral life as the researched valleys exhibit a cultural profile that appears to be somewhat different from the neighboring regions, the Béarnaise in particular, with regard to the most ancient phases of human habitation. Especially the number of protohistoric sites is very inferior when compared to the neighboring regions. Such imbalance, however, might have resulted from wrong identification of sites especially in Ossau and, therefore, their verification seems necessary. On the other hand, however, it might seem probable that the pattern of occupation in these high-altitude

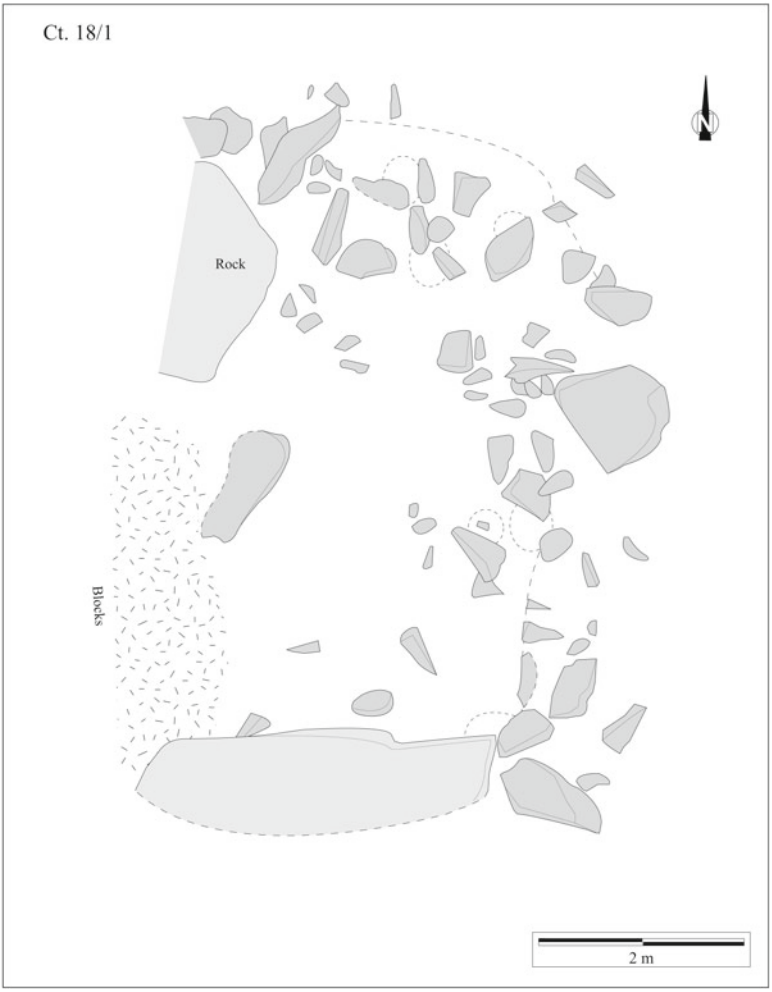

Fig. 5.39 Cauterets, site Ct. 18

valleys in the past could have been different. Such imbalance also exists, for instance, between the Cauterets Valley and Val d'Azun. The absence or at least the extreme rarity of proven protohistoric structures of the tumulus or circle type in the upper valleys of Arrens and Estaing is puzzling. But perhaps it is only a matter of intensification of archaeological surveys including subsurface testing as we are convinced that the increase of archaeological research in the region should refine all these data and contribute to better understanding of the historical processes that took place in the high mountains.

Fig. 5.40 Cauterets, site Ct. 18

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Chapter 6
Mountain Summer Shelters in the Haut Adour Region of the Central French Pyrenees: Examples from the Campan and Lesponne Valleys (Hautes-Pyrénées)

Stéphane Lévêque†

Introduction

In the French Pyrenees, it is common to use the term *mountain summer shelters* for dwellings constructed by herders in order to have a secure place to stay in high altitudes and to ensure care for their herds. These mountain summer shelters have been one of the dominant features of the Pyrenean pastoralism. Located at high altitudes (between 1,200 and 2,400 m), they reflect a specific social organization, patterns of animal husbandry, and also exhibit original forms of architecture. This last point will be the one we shall develop here, paying special attention to the period that is best documented in history, i.e., the time from the nineteenth to early twentieth century, since these shelters were abandoned after that.

The geographic region discussed here composed of the Campan and Lesponne Valleys, represents two geographic and cultural entities. It would be misleading, however, to use the discussed example as a model of pastoral lifestyle elsewhere in Pyrenean valleys, because there are too many dissimilarities, some of which are clear regional differences and others just simple hints that exist in the use of high-altitude pastoral areas from one end of the mountain chain to the other.

In the south-west of France bordering Spain stands a chain of mountains which stretches east–west, from the Mediterranean Sea to the Atlantic Ocean for almost 450 km, and whose width from north to south varies from 50 to 150 km: these are the Pyrenees. This mountain range is the result of the collision of the European and Iberian plates that originated in the Upper Cretaceous and persists until the present time. The highest point, the Aneto (3,404 m) in the Maladeta massif, is located in

†Editor's note: It is with great sadness to inform the contributors and readers that Stéphane Lévêque passed away unexpectedly in December 2012. We lost a devoted scholar of the Pyrenees.

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the central part of the mountains within the upper primary chain, where the highest summits are concentrated.[1]

The Pyrenees are located in the southern fringe of the temperate climatic zone. The northern, French part of the mountain range is characterized by generally two types of climate: the western half is influenced by the Atlantic Ocean, while the eastern half—by the Mediterranean Sea. Relatively significant precipitation in both the Mediterranean and Atlantic sides promotes abundance of vegetation and gives the mountains an image of a green land. The vegetation cover varies according to climatic seasonality, as well as geology and morphology of terrains and also altitude. However, Pyrenean landscapes exhibit a common social and faunal organization that is directly associated with the practice of pastoralism. At the base of the valley there are permanent villages surrounded by fields and grasslands, higher up on the first slopes, especially the sunny slopes, there are mountain hay meadows associated with permanent barns. A little higher up, there is a domain of grassland terrains and forests that comprises the intermediate pastures that are mainly used in springs and autumns. Finally, above this zone, is the area of mountain summer pastures, high-altitude grasslands used in summers and where the mountain summer shelters, which we shall discuss below, are located. The foundations of such organization were established during the medieval period.

Approximately 40 valleys divide the northern side of the Pyrenees. They are, for the most part, perpendicular to the axis of the mountain chain and exhibit an orientation that is approximately north–south. These are narrow valleys embraced at the top by a relief that gets steeper with elevation. The narrowness of valleys causes the valley economic system, which is greatly influenced by the low availability of arable land due to the configuration of the relief. These lands are subject to the rigors of the winter climate.

In the Pyrenees, the interference between human adaptations and natural constraints have produced forms of culture in which high-altitude pastoralism constitutes an essential, if not determining, component. Pastoralism, in its broadest understanding, other than the notion of caretaking of livestock, involves a nomadic or semi-nomadic lifestyle associated with the search for grazing lands. This movement of herds is known as transhumance.[2] Transhumance in the Pyrenees may take several forms depending on the valley and local ecological conditions. There is low-altitude transhumance, when only the herds from the valley at the foot of the mountain, or the nearest lowland, climb the mountain in the summer to reach summer pastures. The second form, high-altitude transhumance, involves herds that come from the lowland as far as 100–200 km away in order to reach the mountain summer pastures. Conversely, animals from a local valley sometimes spend the winter in the lowland and sometimes far away from their point of origin.[3]

In this context, mountain summer pastures represent a territorial resource that is indispensable to the survival of human groups who, out of necessity, practice animal

[1] For the geology of the Pyrenees, refer to the recent work by Carnerot (2008).

[2] Some authors make a distinction between keeping the animals on summer pastures, i.e., valley pastures, and moving the animals in the summer from the lowland to high-altitude pastures.

[3] For descriptions of the traditional transhumance see the work by Cavailles (1931).

husbandry, which appears to be the best adaptational choice. Its products (meat, wool, leather, milk, butter, and cheese) comprise the exchange currency that allows for compensation of the deficit in cereal grains. Animal husbandry, through another of its products, animal droppings, also plays a significant role, because it is essential to the improvement of high altitude soils through manuring.

The livestock, the majority of which are cows and sheep, but also goats and pigs, and, rarely, horses, can be easily nourished during the summer on the vast mountain summer pastures. However, the size of herds is not extendible; it is determined directly by the possibility of feeding them in winter, i.e., by the production capacity of the mountain hay meadows, which, once dried, would be stored and used to feed livestock during the off-season. This possibility of having access to vast pastures in the mountain hay meadows, so necessary for obtaining winter forage, temporarily eases the feeding pressure. Access to pastures appears, therefore, in the history of the Pyrenean populations as a determining element in their survival and the existing archives constantly refer to endless conflicts and disputes that result from the use of the high-altitude grasslands. In fact, the story of the Pyrenean valleys is inseparable from the many disputes associated with the ownership and access to mountain summer pastures[4]. These conflicts, which sometimes appear as legal battles and sometimes take a form that could, without exaggeration, qualify as warfare, and occasionally become both, seem to have been continuous and are documented as far back as the oldest archives go, i.e., around the twelfth century. The permanence, multiplicity, and intensity of these conflicts confirm that the mountain summer pastures represent a vital economic domain. It is essential, therefore, to allow livestock to feed there, and in practice it does not matter much whether the access is controlled by full ownership of the pasture or simply by possessing the right to use it; the latter appears to be a means that allows the owner to limit free availability of his assets.[5] The main cause of these conflicts concerning the use of mountain summer pastures, should certainly find its origin in demographic pressures, which consequently induced an increase of livestock in relation to pasture areas, which are not extensible despite, in some cases, deforestations for the creation of high-altitude clearings, which were turned to pastures. There was, of course, a time when such demographic pressure did not exist. However, a few valley communities had more mountain summer pasture space than they needed. In these favorable situations, some of the high-altitude grazing lands have been rented to villages at the foot of the mountain, or in the lowland, or to Spanish communities.[6] These "rentals"

[4] Desplat (1993).

[5] This point is clearly demonstrated for the Campan Valley by a succession of processes carried out by the community against the Gramont family, the heirs of the viscounts of Asté. The final point in favor of the valley community was put to these lawsuits in 1950 by a ruling of the first chamber of Pau which referred, among other things, to an arbitration award of 1328. Cf. Lefevre (1990).

[6] Reports on the use of mountain summer pastures by the French and Spanish communities suggest the type of relationship relationships that existed among French villages, characterized by a latent conflict. In attempts to appease these tensions, the communities have created transborder agreements called "lies" and "passeries". Cf. *Lies et passeries dans les pyrénées.* Actes de la 3[e] journée de recherches de la Société d'Etude des Sept Vallées. 233p. Tarbes 1986.

allowed the beneficiary community to take advantage of additional resources, but also caused conflict. These strong and constant tensions regarding the use of territories that are*,* à priori, hostile to human occupation, indisputably indicate the vital importance that they represent for the local populations.

A quick look at maps and land registries[7] representing the division of land into communities in mountainous areas very frequently reveals that the administrative organization of lands does not follow the "natural" features of the terrain. This may suggest that conflicts over mountain summer pastures have been, in a way, "fossilized" and are represented in the local cartography. On the IGN maps at 1/25,000, former areas of tension are clearly visible in the form of sometimes astonishing boundaries of towns, and such tensions are also confirmed in medieval texts. Studying of the mountain summer shelters and their patterns seems, therefore, a mandatory step required in order to comprehend the methods of social organization used by valley communities, both from territorial and social point of view.

The problem of time for which the data on Pyrenean pastoralism are available still persists. "Traditional" pastoralism, whether it is exhibited in the many small "ethnology" museums which are, in fact, often only showcases of "old" objects, or whether it is presented in various recollections of the "life of yester year," is limited to a period of about a century, i.e., the second half of the nineteenth century and the first half of the twentieth century. This period corresponds to the apogee of peasant culture, one that is rich in a variety of records (travelers stories, engravings, photographs, etc.) and, therefore, relatively easy to understand within its outlines. The oldest periods are based on the celebrated "the dawn of time," which contemporary historical terminology identifies as the "long term." We should, therefore, shed here some light on "the dawn of time." This ambiguous term rejected due to the lack of sufficient chronological information regarding mountain pastoralism is, nevertheless, materialized in the region by concrete evidence which manifest themselves in different forms: traces of more ancient construction under the presently existing structures, remains whose apparent condition leaves us to assume that they are chronologically older than those more legible, existing variations in construction types, etc. People and their animals have existed in the mountains and used summer pastures from the Neolithic era, as attested to in the eastern Pyrenees by a hut dated (hearth) to the end of the fourth millennium BCE[8]. The pollen analysis from samples taken from high-altitude peat bogs indicates that starting at the end of the second millennium BCE … *an intensification of pressure from humans at all altitudes. This expansion was distinguished by an increase in agro-pastoral development and by more and more obvious deforestation*[9]. For several millennia people constructed variety of shelters to keep and care for animals and their existence suggests that they were the simplest means of protecting oneself, and the most effective among them was certainly the dry-stone wall hut.

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[7] The oldest land registries go back to the first decades of the nineteenth century and are known as Napoleonic cadastral system.

[8] Rendu (2003).

[9] Galop (1998).

The Campan and Lesponne Valleys

The Lesponne and Campan Valleys are located in the Hautes-Pyrénées district. This district, of which about one third of its area in the south is occupied by mountains, is on the border with Spain separated by a high crest line, which never prevented frequent passage by people, farm animals, and merchandise, even in wintertime. The two valleys are in the Haut-Adour area of the Bigorre region, and have no direct link with Spain. These two valleys are considered to be "small" valleys, especially the Lesponne Valley. The latter is oriented north-east/south-west, which is not inconsequential from a climatic point of view. It is about 13 km long and opens up onto the Campan Valley near the village of Beaudéan. The route leading up the valley gives way to a footpath which, after it crosses the Hourquette d'Ouscouaou, leads down to the Argelès Valley by Isaby Lake.

The Lesponne Valley is bordered from the south by high crests, which include some significant peaks such as the Pic de Bizourtère (2,311 m), Pic de l'Embarète (2,213 m), Pène Blanque (2,637 m), Pic de Ballonque (2,285 m), Pène Lounque (2,275 m), and the Pic du Midi, which features the observatory of the same name, and which culminates at 2,872 m. To the north, the crests and mountaintops, except for the Pic de Montaigu (2,339 m) are of lower altitude: Pic de l'Oussouet (1,873 m) and La Peyre (1,821 m).

The Campan Valley incorporates a territory that is approximately 18 km long and about 12 km wide and consists of two branches, the La Séoube Valley and the Gripp Valley, which merge downstream at the height of Sainte-Marie-de-Campan. The Gripp Valley, which is crossed by the Adour de Gripp, is oriented south-west/north-east and opens upstream onto the Barèges Valley by the Tourmalet mountain pass (2,115 m). It is limited to the west by the heights of the Pic du Midi and to the south and east by the Néouvielle and Arbizon massifs, the latter reaching 2,831 m. The La Séoube Valley, which is crossed by the Adour de Payolle, is oriented south-east/north-west and gives access to the Aure Valley through the Aspin mountain pass (1,489 m) or the Hourquette d'Ancizan. It is bordered to the south-east by the Arbizon massif and to the east by the crests of the Bassia with a summit of 1,921 m.[10]

Geology of the Research Area

The Lesponne Valley is a glacial valley formed by basins that are separated by moraine deposits. The bottom of the valley consists of a glacial deposit which, in particular at the hamlet of Lesponne located on top of it, overhangs a plate consisting of igneous rocks (granite, gneiss). The glacial phenomena of the Quaternary Period gave birth to the mountain lakes sometimes very large, like Lac Bleu (47 ha

[10] IGN maps.

and 120 m maximum depth). Peyrelade Lake is not as large but also has a respectable surface area. Others, not as large, are on the north-east flank of the Pic du Midi: L'Oeuf Lake and upper and lower Binaros Lakes.

Several types of rocks appear in the Lesponne Valley namely: limestone, schist, granite, gneiss, and dolomite. Schists, including shale schist, are common in most of the valley, primarily in the upper areas on either side. This material is used in hut constructions, particularly as roofing material. The valley of the Campan and its two divergent branches Gripp and La Seoube are channel valleys. The valley bottoms representing the arable parts are located on glacial alluvial deposits and moraine muds. As in the Lesponne Valley, the slopes of the Pic du Midi consist of metamorphic schist and gneiss, with the presence of some granite. To the south, the Néouvielle and the Arbizon are granite massifs. The crests of the Bassia and the lowest one of the Bouche, to the east, form a limestone mountain range belonging to the axial zone, the sharp slopes that separate the valley of the Baronnies depression. The main mountain lakes here are the ones at Gréziolles and Caderolles, as well as the lakes at Montarrouye, Aygue-Rouye, and Arrou.

Hydrology of the Research Area

In the Lesponne Valley springs are seasonal and permanent. Along with the lakes, they give rise to numerous torrents that pour down and feed the Adour de Lesponne, which pours into the Adour de Payolle and the Adour du Tourmalet. The many springs and lakes of the Campan Valley feed the Adour de Payolle and the Adour de Gripp, which joint at Sainte-Marie to form the Adour. Significant irrigation projects in the form of canals have been carried out, primarily in the Campan Valley.[11] These canals, which are shallow and about 0.60 m wide, are sometimes more than 16 km long. They start in a torrent that is sometimes at more than 1,500 m elevation; their function is to bring water to the base of the valley for irrigation in arable areas that have no aquatic resources.

The management of these canals has given rise to an original system with communal stewards who were responsible for controlling that everyone respects their irrigation time as the users frequently violated the scheduling.[12] The same canals, sometimes supported by specific constructions, were used to bring manure mixed with water down from the hut in the mountain summer pastures to the valley

[11] At the end of the seventeenth century, Louis de Froidour, the Grand Master of Waters and Forests, described the canals of Campan: *(…) since these mountains are full of springs and brooks to their very ends, they make a thousand small canals, along the hillsides that water them and always keep them moist, they make them so fertile and so abundant with grass, that they surpass the best meadows I have seen till now.* Froidour (1892).

[12] This subject is brought up in the article by Adisson (1991).

grasslands to fertilize the fields. A text from 1910 describes this activity a few years before this system was permanently abandoned:

> Near the high grasslands, from 1,400 to 2,000 m high, groups of rustic huts, as many as possible, were installed near a trickle of water, where the shepherds and their herds, either indigenous or immigrant, came to mountain summer pasture; the herds consisted mostly of sheep. Each group forms a "curtail". For six months out of the year, everyone is busy in the upper grasslands or in the forests. (…).
>
> After a quick lunch at the edge of a murmuring channel brook, where we amply quenched our thirsts, we climbed back up this channel, when all of a sudden I saw its waters change before our eyes; they became yellowish, foamy and horribly nauseating. My companion appeared to be surprised at my astonishment, which for that matter did not last long. We reached the cortail de Hount (fountain) Blanque (…) and immediately saw the answer to my question. Downstream from a shallow embankment that created a small lake there, a "lackey", the shepherds of the cortail had accumulated all the manure, the "baboule", which the herd had produced during the summering on mountain pastures. An opening had just been made in the levee, through which the waters of the lackey were escaping, bringing the "baboule" with them. The shepherds, in their wooden shoes, stomped down the semi-solid "baboule", to make it easier to move along. It seems that this was the usual manner of spreading used at the end of each autumn, before the herds descend, to economically fertilize the marvelous grasslands in the lower Campan Valley[13].

Climate of the Research Area

The climate of the central Pyrenees, although influenced by the ocean, is characteristic of a mountainous piedmont. The temperatures vary with altitude and are distinguished by alternations of rounds of heat and cold in all seasons. Similarly alternating pattern can be found in rainfall, which is at its maximum in springtime. Precipitation is ample and waters grazing areas are well watered. In fact, mountain zones promote micro-climates and climatic effects may be very different depending on valleys orientation. The Campan and Lesponne Valleys are known for greater annual rainfall than the adjacent Aure Valley. The rainfall, obviously, contributes to heavier cloud cover and frequent fog. Exposure of the slopes clearly alters climatic conditions because of the sun penetration and persistence of snow or frost in winters. What slope one owns makes an impact on both the production of mountain hay meadows and on the person's social status. In the Lesponne Valley, the shelters are located mainly on the south-facing slope, but there are some houses and barns located on the north-facing slope, and the inhabitants of the latter are considered socially disadvantaged. It is obvious that the "selection" of a poorly exposed area results more from socioeconomic constraints than volition. Mountain summer pastures are rarely totally free of snow before the end of May, while October brings in the first snowy precipitation, which is sometimes abundant. The propitious period for the use of summer mountain pastures is, therefore, limited and generally does not last longer than four months.

[13] Fabre (1910).

Vegetation of the Research Area

As in other mountainous regions, also the Pyrenean vegetation is organized in layers. The very schematic floral organization includes the forest floor and the forest, divided into three subzones: first there is the beech grove, up to about 1,200 m, then there is the beech grove mixed with fir up to about 1,400 m, then the fir, whose upper limit is at about 1,800/1,900 m. In the forest floor zone, there are numerous, vast artificial clearings that have been created for summer pasturage. The forest canopy, to the very top, is the domain of grassland and rocky areas. There are a few isolated pockets of pines and within the beech grove, there are birches and maples. Towards the bottom of the valley, chestnut trees, hazelnut trees, oaks and ash trees coexist. Today the forest is clearly expanding due to the progressive abandonment of mountain hay meadows and certain mountain summer pasture areas. Reforestation is very clearly perceptible due to the presence of rhododendrons, heathers, huckleberry, then shrub-like holly and juniper, gradually joined by fir or beech saplings. This reversion of the forest directly threatens the disappearance of numerous remains of pastoral lifestyle located between 1,200 and 1,800 m high.

Organization of Valley Shelters

The valley shelters are represented by three types that vary depending on the altitude. This involves a real tri-functionality that is directly imposed by the management of grazing resources depending on the season.

The bottom of the valley is permanently settled. In the Campan Valley, it is materialized by a village (Campan) with hamlets and isolated settlements scattered in the valley. One- or two-story houses are mostly oriented towards the south. The upper level often includes a balcony, whose primary function is to dry corn. A barn used as a cow-shed and hayloft is either attached to the house or is located in its close proximity, as is the cow-shed. The same settlement structure is also present in the Lesponne Valley.

Farther up, in the beech grove zone, preferably on well-exposed slopes, barns are constructed that are either single or in groups and which are distributed according to the location of mountain hay meadows. Sometimes, these barns, which then qualify as house-barns, have become permanent residences. This partial change in function is due to the significant demographic expansion of the nineteenth century. The living area, which is recognizable by the presence of a real chimney, has been arranged either over the cow-shed which is on the ground floor, or in the hayloft.[14]

[14] On this subject, consult the interesting study by Buisan (1989).

Above the beech grove zone, there are mountain summer shelters that are locally called *courteous*,[15] sometimes gallicized to *curtail*, and which constitute the subject of this study. They are located in clearings or on high-altitude grasslands used as pastures during the summer. These are primitive lodgings that supposed to be temporary, but were reused year after year. They were never intended as family shelters but only for one of its members. These mountain summer shelters can be summarized according to the level of their constructional complexity, which changes with altitude. There are two constructional groups: those from the lower levels are larger and more complex and correspond to bovine husbandry, while those from higher elevations are generally above the beech grove zone, correspond to ovine husbandry. The limit between these two types is of course not perfectly clear and a mixed area is present at around 1,700 m. It is, however, rare for both types of settlements to coexist in the same place.

Historical and Ethnographic Data

In reference to the Campan Valley, the archives mention the presence of shelters in the mountain summer pasture in the early fourteenth century (Arbitration award of 30 May, 1328 between the village community and the viscount of Asté).[16] However, these constructions certainly existed before they were first mentioned in writing. Archives concerning Lesponne do not go back that far. The medieval texts reveal that the valley communities can be distinguished from each other, but so can the communities occupying the lowlands. These are entities that are more or less politically independent (or try very hard to be) with methods of organization that are very particular and sometimes original with regard to areas of mountain summer pastures.[17]

The name *courtaous*, used in the Haut-Adour (i.e., in Campan and Lesponne) for pastoral shelters in mountain summer pastures, implies the idea of an enclosure, a primordial component of mountain pastoralism, but also suggest the social and

[15] Local terms used to describe mountain summer pasture shelters vary depending on the Pyrenean region. From east to west we find terms like *jasse, orry, courtaou, cujala, and cayolar*. Depending on the valley, these terms may have slightly different meanings.

[16] *Op. Cit.*—Lefevre (1990).

[17] In fact, management and uses of the mountain summer pastures differed from one valley to another. Sometimes, as in the Haut-Adour, the huts belonged to families in the valley recognized by name. In other cases, the first person to arrive after the snow had melted took the possession of it. Some huts have also been auctioned off, etc. … The huts were also used collectively by several shepherds, but sometimes belonged to just one. Each valley, or almost each valley, has established a set of rules that were built around the production of milk, meat … , but also the legal nature of the mountain summer pastures (whether they were subject to lordly rights or not, whether or not they were shared among multiple villages including those from the Spanish side, etc.), and social organizations that were extremely varied.

economic organization. *Courtaous* are located in high-altitude areas above 1,200/1,300 m, and can be defined as … *groups of pastoral exploitation units of mountain summer pastures*[18].

The functional recognition of these pastoral units of mountain summer pastures exploitation and, if applicable, the components they consist of, requires, besides observing them on the terrain, familiarity with some ethnographic data. The data come essentially from two sources: oral testimonies from former cowherds or shepherds, and the writings by the Pyrenean enthusiasts of the nineteenth century and the early twentieth century, who sometimes casually mention or describe more or less summarily, a hut in which they found refuge. The following description of the hut's interior comes from the work of Emilien Frossard in 1868:

> The Marcadaou hut, like most shepherds' huts in the Hautes-Pyrénées, consists of four walls of about one and a half meters at the highest point. These walls are constructed with rough stones that leave gaps large enough to allow air to circulate rather freely. Just one opening serves as a door, window and chimney all at once; the hearth is near the door. The trunk of a young fir tree is laid on the ground at about 50 cm from the hearth, and crosses the hut through and through, serves as a seat and a bed footboard. The rest of the hut was used for sleeping: heather and fir branches served as both a box spring and mattress, bags and blankets of rough wool were used as pillows and sheets. We slept with our heads to the wall and feet towards the hearth. There is room for a half-dozen men on this camp bed: there were five of us.
>
> All this was no doubt very picturesque; but I confess one has to be extremely tired to be able to sleep well in such a dormitory, because it goes without saying that so restrictive a bedroom as this, which never felt the business end of a broom, and in which men of doubtful cleanliness eat and sleep and who don't remove their clothes very often and who bathe even less often, must be inconvenient in many ways. (….)[19].

One of the particularities of the huts from the Haut-Adour as compared to neighboring valleys lies in the fact that the mountain summer pasture huts constitute a family asset. Each house in the valley is inseparable from its barns and from its high-altitude hut. On the other hand, the areas of mountain summer pasture are, here as in other valleys, collective assets. However, it happens, and not so rarely, that a part of the mountain summer pastures located in the geographic area of one valley belongs to outside communities. Such is the case for Campan and Lesponne where we can see villages and even a city in the lowland or piedmont that are either specific or undivided owners of high-altitude mountain summer pastures. The use of the latter was and remains subject (for herds that were foreign to the valley and whose masters did not have their own high-altitude grasslands) to a fee payable, if not for each livestock head, then at least by *baccade*, that is, a group of ten head of large livestock or twenty head of small livestock. The construction and occupation of the mountain hut by the inhabitants from the valley and others were also subject to taxation.

In the Napoleonic land registry carried out in 1825 in Campan, it appears that all of the *courtaous* that existed at the time were indicated there. Each hut is represented

[18] Lévêque (1992).

[19] Frossard (1868).

by a small red rectangle to which a parcel number is assigned. No associated structures were mentioned, which is confirmed by the matrix accounting for only the surface area of the huts. However, and very curiously, the huts were assigned a surface area that is most often 24 m^2, more rarely 20 or 18 m^2. A few surface areas may be larger or smaller. It would appear that these huts, or more frequently their ruins, on the terrain, have a surface area that is often less than the one indicated. It is probable, but still needs to be verified, that the mapped surface is a fictional surface area that refers to a different method of formation than the actual surface of the hut.

Traditionally, herds go to the mountain summer pastures in May/June and remain in the mountain until September/October. In the Haut-Adour, there have been more ovines than bovines at least since the sixteenth century, and still are today. Ewes, primarily of the Lourdaise variety, are very similar to the Tarasconnaise. These are animals used primarily for meat and not milk and this may explain the near-absence of cheeses-making facilities in the discussed valleys. Cows kept here were of the "traditional" breed of Gasconnes of the Auroise or Lourdaise variety, especially adapted to mountainous terrains. At the present time, animals in the mountain summer pasture are of several varieties, some are less adapted to the mountain ecosystem and more fragile, and these are the usual victims of accidents attracting flocks of vultures. The milk resulting from the milking of cows was primarily transformed into butter. Cheese was produced in small quantities, essentially for family consumption. The exchange of meat and butter with customers from towns and villages in the lowland brought in income and grains, the latter being cultivated in the Campan Valley in a very small scale since the arable land was primarily reserved for mountain hay meadows. Butter from Campan appears for the first time in a text from 1328 entitled: *Arbitration award and agreement between the lord Viscount of Aster and the Neighbors of Campan, 30 May 1328.*[20] This text defines for the Campan people the rules of using certain mountain areas in the valley. It specifies, among other things, that *(…) Besides [they] said and declared that each and every one of the people in Campan grazed in the said mountains held just one time per year lease without contradiction to the Lord of Aster namely cows, use for butter for one full day and ewes and goats use in the morning or at night only by choice of the lord Viscount … (…).* It is clear that, at least at that time, the Campan people preferred producing butter and not cheeses and the reasons for such choice remains to be determined. This orientation towards the production of butter is confirmed by a transaction text of 1449 in which it is specified that *Moreover [it] has been granted that each of the inhabitants of Empiège* (courtaou of Empieye) *shall pay to the said lord each year a ball of butter. (…).*[21] The butter of Campan was especially renowned. At the end of the seventeenth century Froidour[22] found it necessary to point out that *Campan is a place so renowned in these provinces for its good butter and for the great quantity it provides and distributes everywhere* (p. 77). He joins another

[20] *Op. Cit.* Lefevre (1990).

[21] *Op. Cit*. Lefevre (1990).

[22] *Op. Cit*. Froidour (1892).

author[23] who in 1614 indicated that, (…) *the butter there is much better than in any other place in the mountains of Bigorre, which is carefully sought out by the merchants of Cieutat*[24] *who transport it and resell it in Toulouse*. At the end of the nineteenth century this butter was still being sold as far as Bayonne (180 km), Toulouse (150 km), Bordeaux (250 km), and even as far as Languedoc. The production of Campan butter[25] was gradually abandoned starting in the early twentieth century and stopped definitively during the 1960s. This specific production taking place in the mountain summer pastures induced an original vernacular element of architecture: the *leyté*. This sort of niche, under which a trickle of water passes, was used to store milk and get the cream (the raw material of butter) to rise to the surface.

The head count of livestock conducted in 1866 for the community of Campan indicated 11,879 heads of ovines and 3,158 of bovines. To these figures we need to add those provided by the villages that possess lands in the valley, which are not quantifiable. Three villages whose territories go beyond the geographic outline of the valley also shared the Lesponne pastures. Due to this fact, it is not possible to determine the exact number of animals that were in the mountain summer pastures.

Mountain Summer Pastures of the Haut-Adour: The Conflict Zone

The concept of "territory" is apparently perfectly applicable to mountain summer pasture areas. Territories are well organized. Since the establishment of the land registry in the early nineteenth century, parcels of land, in fact, reflect defined earlier division of land not by its relief but by "custom," i.e., "usage." But here we find a great ambivalence between ownership and usage. Despite the appearance of a terrain without limits, the customary limits are, however, quite real, proven, among other things, by the murder of a Campan shepherd by the people from Bagnères in 1490 as a result of a dispute over a mountain summer pasture. These high-altitude territories are more defined on a psychological plane than they are materialized in the mountain summer pastures, a fact which does not make them any less real.

In 850, the first count of Bigorre created the baronetcy of Tourmalet[26] (high mountain zone) at the upstream end of the Campan Valley and gave it to the city of Tarbes, thus inducing, for centuries to come, a long series of lawsuits for the possession and/or usage of forests and grazing lands. In 1328, a conflict arose between the Campan people and the Lord of Asté[27] concerning primarily the access to mountain

[23] Guillaume (1887).

[24] Located on hillsides about 10 km from the opening of the valley.

[25] On the manufacture of Campan butter see Serge ABADIE, typescript, Department Archives of the Hautes-Pyrénées.

[26] (Agostini 1993).

[27] Campan municipal archives. Published by Lefevre *Op. Cit*. Asté is a small village at the entrance to the Campan Valley.

summer pasture areas. This dispute did not really come to an end until 1950.[28] In 1524 the monks of the Escaladieu donated some of their land in Cabadur[29] (in the upper valley) to the communities of Campan and Cieutat. This donation instituted an interweaving of terrains that became a source of conflict. In 1602, some people from Campan demolished huts of the shepherds from Ancizan and slit the throats of their ewes.[30] In 1610 a conflict concerning the passage of herds was mediated by the Lord of Beaudéan.[31] In 1615 the consuls of Campan imprisoned a resident for 9 days for constructing a hut without authorization.[32] In 1628 Campan and Asté sealed an agreement stipulating the rights of herd passage.[33] In 1737, about 100 armed people from Campan stopped the passage of livestock from Bagnères towards the mountain summer pastures in Arizes, which, however, belonged to the people of Bagnèrais.[34] In 1739, more problems regarding hospitality, threats, and improper treatment of people from Campan against foreign shepherds[35] erupted. In 1761, after a violent brawl between shepherds from Cieutat and Campan, two people from Campan were condemned to death.[36] In the nineteenth and twentieth centuries, these conflicts continued, although in a more legal context. In the early 2000s, yet another dispute occurred on the public forum with regard to a pasture of which Campan claimed full and complete ownership, whereas three nearby villages claimed joint ownership shared by them and Campan. Each side hones historic texts in an attempt to prove its rights and the dispute has not been resolved yet.

These few events, which are not exhaustive, show the scale of tensions that existed with regard to mountain summer pasture. These tensions are strong because many mountain summer pastures, which constitute enclaves the Lesponne and Campan Valleys, are owned in full by villages located at the foot of the mountain and even in the lowland, not to mention terrains that have been "conquered" by the Aurois, the Barègeois, and certain communities in the Argelès Valley.[37]

Mountain summer pasture areas do indeed correspond to a concept of "high-altitude territory," which sometimes overlapped each other and required rights of passage and a strict monitoring of the animals' paths. The ease of access from the valley, quality of grasslands, slopes with northern exposure, the presence of springs

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[28] Lefevre, *Op. Cit*.

[29] Agostini, *Op. Cit*.

[30] Agostini, *Op. Cit*. Ancizan is a village in the bordering valley of Aure in Campan and its pasturess overlap with the Campan pastures in the Campan northern slope.

[31] Agostini *Op. Cit*. Beaudéan is a village located at the confluence of the Campan and Lesponne Valleys, but most of its pastures are located in Lesponne.

[32] Agostini *Op. Cit*.

[33] Campan municipal archives.

[34] Agostini *Op. Cit*.

[35] Agostini *Op. Cit.*

[36] Agostini *Op. Cit*

[37] The Aure and Barèges Valleys are adjacent from the south to the Campan Valley. The Argelès Valley is located west of the Lesponne Valley and has significant terrain upstream from this valley.

or brooks, all these components, which are eminently variable, constituted, and still constitute the stakes considered to be vital.

Mountain Summer Shelters in the Haut Adour

Until now, no excavations have been done on the huts of the mountain summer pastures of the Haut-Adour.[38] The strategy here consists of conducting preliminary inventories, as complete as possible, of remains associated with pastoralism in the mountain summer pasture areas. An inventory that was extremely pressed and detailed was therefore carried out, starting with the systematic research of the terrain, over the entire territory concerned. This was done to create a body of data from a well-defined geographic and cultural area to produce raw material for coherent analysis.

The results of this inventory immediately show significant occupation of the high-altitude grasslands materialized in the area by a high density of architectural remains. In fact, there are about 250 sites totaling with more than 1,000 structures inventoried within the discussed region.[39].

These figures, however, have to be weighted. In fact, quite obviously, the sites are not all contemporary and, in the absence of excavation data, no objective information is available with regard to the chronology of sites and structures. A typological approach may, however, attempt to fill in, very crudely, this temporary gap.

As for the Haut-Adour, the classical base structure consists of a hut, a cow-shed, a shed, and an enclosure. This functional grouping is, however, assured only for the recent periods, starting with the eighteenth century. A cluster of several basic structures on the same site forms a *courtaou*. These are now unused. The majority of these *courtaous* are presently in a state of advanced destruction and certain structures cannot be distinguished except for their micro-reliefs.

With regard to structures associated with pastoralism, in the Haut-Adour the operating units (no specific term exists[40]) starting in the eighteenth century or the end of the seventeenth century consisted of the hut itself (*cabano*), a small cow-shed for the calves (*bederat* or *tiarat*), a shed (*sès*) used as a shelter for milking cows and which are in general directly connected to the cow-shed, an enclosure (*barguerot*), and (*leyté*) intended for the storage of milk until it has been brought down into the valley.[41] Although many structures are composed of these elements, they do not

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38 The first archaeological excavations of a mountain summer pasture hut in the French Pyrenees took place in the eastern part of the chain in the late 1980s (Rendu 2003, Op. Cit). Since then, a very few quick excavations took place, primarily in the western part (Basque country and Ossau Valley).

39 (Lévêque 1993, 2002, 2003, 2004, 2005, 2007).

40 In the geographic zone discussed here the term "hut" appears to encompass the residential hut and also its associated structures.

41 For local terms referring to different exploitation units, see Buisan (1991). *Op. Cit*. Likewise, for the pastoral terminology in the Campan Valley, refer to the old but still excellent work by Schmitt (1934).

necessarily show a systematic organization. Also, spatial organization of these components is subject to a wide typological variety. This variety is sometimes due to the configuration of the terrain, to the construction capacities of the herder, and also appears due to chronological differentiations.

As for structures associated with herders, they are much simpler and consist, at best, of a hut and one or two enclosures. These constructions are, in general, more complex than the structures for animals.

Topographical Location

The location of sites does not appear to correspond with any precise criteria except the availability of grazing lands, in no matter what capacity. In fact, other than on relatively flat terrains, they may be located on very narrow berms with sharp slopes, or areas of rocky screes, or even areas susceptible to avalanches. These manifestations of mountain inconveniences should certainly necessitate, repeatedly, some work before the summer occupation. Likewise, maximum sunshine and the presence of a source of water in the immediate proximity of a shelter do not appear to be determining criteria. In fact, some settlements have no water within a nearby radius. This latter point appears to be associated with pastures used to graze sheep as with ovines the availability of fresh water for storing milk is not necessary. Such situation has been observed by Emilien Frossard in 1868[42] in the vicinity of Cauterets:

> Finally we reached a place called Peyraoule. (…). Here, a little hut sheltered by rocks in the middle of a field of wild spinach, offers refuge to a solitary herder. (…). The herder is absent and we found it necessary to violate his home in order to drink a little of his water provision, the only one available on this small high plateau. The spring where he must go to draw it is at a much lower elevation.

As for bovines, water appears to be an essential element of their grazing pattern.

If some sites can be considered to be relatively easy accessible from the bottom of the valley, i.e., from the permanent shelters, others require very long walks to sometimes high elevations to reach them. In the Lesponne Valley, the dispersion of pastoral remains by elevation, shows that, among the 115 sites, 2 are positioned within 1,000 m, 4 within 1,100 m, 7 within 1,200 m, 12 within 1,300 m, 7 within 1,400 m, 13 within 1,500 m, 9 within 1,600 m, 26 within 1,700 m, 9 within 1,800 m, 17 within 1,900 m, 4 within 2,000 m, and 4 within 2,100 m. More than half of the sites in the valley are located above 1,700 m.

The data reveal an important peak at 1,700 m and another, less important one, at 1,900 m. The first constitutes the contact zone between the settlements associated with bovines and those associated with ovines. The second peak corresponds essentially with constructions associated with shepherds.

[42] Frossard (1868).

The effects of the demographic pressures that occurred during the sixteenth and nineteenth centuries may have also contributed to the positioning of the shelters in higher altitudes. However, these pressures are difficult to quantify in the absence of any correlation between the few available archives and the chronological data from excavations.

In the Campan Valley, the location of pastoral remains in relation to altitude cannot be assessed before the completion of their inventory, but the data that has been collected up to now indicate that they are similar to that in the Lesponne Valley.

Types of Structures

There are two main types of shelters: isolated structures and *courtaous*.

Isolated Structures

These structures are often poorly preserved and limited to the upper parts of the mountain summer pasture areas above the *courtaous* (above 1,700 m). A few are found in low altitudes. They are believed to be used essentially by shepherds.

There are two types of these isolated structures: huts or crude shelters for people, and enclosures for animals. All are associated with the animal husbandry of ovines. Here the huts may have only a small footprint, sometimes just 3–4 m^2. Often these are simple shelters consisting of low walls that were put up quickly by piling up a few rocks and sometimes supported by naturally occurring boulders. These isolated huts/shelters are of various designs: quadrangular, triangular, and trapezoidal. Sometimes a crack in a boulder served as shelter as it was sufficient for a man to slide into it and close it up simply with a crude low wall.

These structures do not represent a great typological variety as the possibilities for their spatial organization are fewer; the hut is either inside the enclosure, or it is outside of it, the latter being by far the most common. But frequently, there are no enclosures at all, only the remains of huts are visible. In such case, the animals apparently remained free in pasture. On the other hand, the opposite situation may occur: i.e., there is an enclosure but only a trace of a hut or simple shelter remains. Isolated enclosures generally have a footprint of a few dozen square meters, but some rarely may reach a few hundred square meters. Unlike enclosures used for cows, which are mainly quadrangular, enclosures for sheeps vary in shape, often adapted to the morphology of the terrain and attached to existing boulders. These enclosures most often are more or less circular in shape or, inversely, are polygonal, with a high propensity for rounded angles.

These isolated enclosures are sometimes constructed of narrow walls which are so low that they could not in any case dissuade the animals that they are supposed to corral. Here the limits appear to be symbolic rather than real, perhaps simply because the illusion of low walls outlining the enclosure are not intended to block the sheep, but rather to indicate to the dogs that they must make sure that the animals do not go past this limit. This is a very good example of economic behavior in high-altitude grazing lands, as it is not necessary to invest in infrastructures that require a lot of energy to put up and maintain regularly. These particularities in the way in which mountain summer pastures were inhabited, certainly refer to an itinerant pastoralism where, in fact, the herd leads the herder rather than the other way around.

One form of "nomadism" on the mountain summer pastures was noted in 1900 in the lake region of the Caderolles (Campan Valley) by Dr. Lafforgue[43]:

> We understand that pastoral life in these high-altitude regions differs essentially from life in the sub-alpine regions where the shepherds have comfortable huts and basic necessities. Here, none of that is of great importance. Either by laziness, or heedlessness, huts that have long since been destroyed are not reconstructed, and the shepherds, all trussed up in their enormous burnooses of thick caddis, sleep in boulder crevices that are hastily outfitted for a temporary stay. In fact, every eight days, they move and lead their herds to another area to browse on virgin grazing lands.

This text, accusing the shepherds of laziness and heedlessness, shows an ignorance on the part of the author concerning the realities of the mountain agro-pastoral life and the methods used for summering on mountain pastures. It is, however, an eyewitness account.

Almost a century before, in the early nineteenth century, Chausenque gave a similar account[44]:

> Everywhere where there is grass and water, the shepherd sets up with his livestock, and he must not stay there longer than two weeks. During these short stays, he does not take the trouble to construct a "couïla", but takes advantage of some hollow rock or even an isolated block, settles for a half-shelter of a crude wall made of dry-stones; this is what he calls a "cacou". These sorts of dens give the full extent of his needs and of his rustic life .

Courtaous

The *courtaous* themselves consist of at least two basic structures and may be as many as ten in number. These basic structures in the Campan and Lesponne Valleys generally consist of one hut, a cow-shed, [and] a shed arranged over 1 or 2 sides of a quadrangular enclosure. These are primarily intended for cows. There are, however, some structures that do not have all of these components.

Some of the *courtaous*, which were abandoned in the middle of the twentieth century the latest, exhibit constructions that are still quite well preserved. The descriptions below, therefore, refer to the latest conditions of these structures.

[43] Dr. Lafforgue (1900).

[44] Chausenque (1995)

Huts

The roughly constructed hut, and its accompanying out-buildings, is the herder's shelter in the mountain summer pastures where he spends the entire season, from June to September. The dimensions of huts are fairly consistent. Their internal dimensions vary, in the majority of cases, between 2.80 and 3.20 m in length and between 2.10 and 2.60 m in width. The walls are constructed in dry-stone technique using the found nearby materials and are of a width, in most cases, between 0.60 and 0.90 m inclusive, with a clear preference for about 0.60 m.

Two documents from the sixteenth century,[45] one from Bagnères (execution report from 26 September 1534) and the other for Campan (lease for the construction of a hut) refer to measurement units as follows: *canne* corresponding to 1.85 m, *empan* equivalent to 0.23 m, *arraze* which is 0.46 m (or 2 *empans*) and the foot which is 0.33 m. Except for specific cases that are well defined in documents, as above, we cannot find any precise reports on the measurements used in the construction of huts.

Building methods used vary greatly. Some walls are made with great care; the stones are selected by their shape and dimensions and arranged in such manner as to obtain regular sides. This type of preoccupation with construction is found essentially in huts corresponding to grazing cows and in particular to those associated with complex structures.

The material used, which is stone, (schist, gneiss, limestone, granite, depending on local geological availability) is taken from the construction site itself. In rare cases, however, we can observe that some materials were brought in from outside. This situation can be noted in particular in the Campan Valley and more precisely in the sites at the bottom of the Hourquette d'Ancizan. There, on the vast grazing lands, which have little stone available, some of the materials were brought in from the Espiadet marble quarry in Payolle; these are blocks which, for one reason or another, are unsuitable for polishing. They are used in addition to the few stones found on the site. This import of stones was possible because the two sites mentioned above are located near the old, wide trail, which is accessible to carts and allows for travel and transportation of heavy materials from the Campan Valley to the Aure Valley through the Hourquette d'Ancizan.

Dry-stone construction requires the width of the walls to retract slightly as the wall gets higher in order to achieve good stability. Angles are, obviously, formed by crossing foundations, thus ensuring better coherence and solidity of the construction. Among the more recent huts, there are some that use a specific technique for building the walls that consists of squeezing rubble between two facings. Finally, in the first part of the twentieth century, lime was sometimes used in joints.

The huts, with rare exceptions, are low, with gables rarely exceeding 2.20 m, but are not less than 1.80 m in height. The roof consists of flagstones, which are sometimes trimmed and which rest on a wooden structure, whose components consist of

[45] See Buisan (1991).

logs of different cross-sections; their cross-section determines whether they are used as ridge tiles, purlins, rafters, or wall plates.

Observations of the few roofs that are still preserved show that the largest flagstones are placed at the edge of the roof and lifted slightly in order to prevent everything from sliding. Clods of turf were sometimes placed on the flagstone in order to improve insulation from wind and leakproofness, sometimes they even made them impervious just by placing them on a wooden frame. Likewise, earth or clods of sod could be used to provide the walls with better insulation from wind, while taking care to leave a few spaces free between the stones to allow the passing of smoke from the hearth.

A description by Maurice Gourdon made in 1880 in the Haut-Comminges illustrates this concept[46]:

> (…) a moment afterwards we reached the hut in Graouès. Have you ever seen this type of shelter? It is not luxurious, I assure you, and no architect was ever involved in its construction. Walls of dry stones, roughly assembled, support a roof of pine stems still bearing their bark and taken from the neighboring forest; a few slabs and clods of sod cover this primitive woodwork and keep it all cool.
>
> A narrow opening, placed in front, gives access to the inside, or in the back, [and] on a bed of branches and moss spread out on the ground; everyone is free to rest his tired limbs. There is no question of a chimney: in the corner nearest the door is the hearth, and smoke escapes as best it can through the walls.

A low opening (generally around 1.60 m) almost always located at the end of gabled wall, offers entrance into the huts. The width of this opening, which is traditionally closed by a wooden door, is almost always between 0.70 and 0.80 m. Inside the hut, hollows in the walls constitute niches that are used to store the occupant's belongings. Some of these niches, which are located at ground level and partially dug in, corresponded to *leytés* and were supplied with a stream of water. The herder used these *leytés* to keep milk fresh until he went back down into the valley. The only opening was the door, otherwise there was a small hole in the top of the façade gable to allow the passing of the smoke coming from the hearth. This hole was systematically located on the inner side of the façade gable and placed at the floor level. It may have also been in a small pit, as it was noticed in the Montcalm region of Ariège, Marcailhou-d'Aymeric in 1900[47]:

> In one corner, dug into the ground and full of hot ashes was the hearth. The fire was maintained with juniper and rhododendron roots, products of the mountain, because wood is lacking at this altitude.

As with all constructions in mountain summer pastures, the huts are almost never installed on land that is perfectly flat, but due to geomorphological constraints, on slightly sloped grounds. In order to get a flat living surface required leveling out of the terrain. This is why these huts, depending on how deep it was necessary to dig, are sometimes half-buried on one side.

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46 Maurice (1885).

47 Marcailhoud (1900)

Although these do not occur frequently, it is not however unusual to find huts with one side formed by a boulder. In such case the construction required less work and probably offered better solidity to the whole structure.

Cow-Sheds

Cow-sheds have inside dimensions that are usually less than those of huts, and their walls are often built with less care. Where necessary, the terrain has been smoothed out by partial digging and the method of covering is similar to the one used for the huts. These cow-sheds were used to shelter calves that were too young to be released onto the pastures. They connected to the shed or enclosure through an opening that barely exceeded 1.40–1.50 m in height. One cow-shed is typically associated with a shepherd's hut, however there are a few cases where a hut is provided with two cow-sheds.

Sheds

Sheds are rectangular constructions whose length is generally from two to five times its width. They almost always have one side adjoining the cow-shed. They might have been leveled by partial digging out of the terrain and they have roof cover similar to that used in huts and cow-sheds. Their architectural particularity is, on the one hand in their clearly rectangular, elongated shape and, on the other hand due to the fact that one of the longer sides is completely open to the enclosure. Wooden posts or sometimes stone pillars held up the roof on this side. This latter had 1 or 2 panels. The sheds looked a little like a yard used for milking. Some of them, a very few, look like a corridor, i.e., the open side adjoins one of the small sides.

Shed-Cow-Sheds

These are located in the continuity of a shed; they differ functionally due to the fact that the side facing the enclosure is closed. On the other hand, they are completely open to the shed. This architectural peculiarity, while not rare, is nevertheless not very frequent and is encountered primarily in the Campan Valley.

Enclosures

Enclosures, which appear as the symbol of summering on mountain pastures, consist of a stone wall that is in most cases built quickly. The height of the tallest walls barely exceeds 0.80 m, which is perfectly sufficient to block a cow. Most often, they enclose the shed and the cow-shed, and the hut may sometimes be outside. They are of various shapes, mostly rectangular, more rarely trapezoidal or polygonal. One structure may have one or two enclosures, rarely more. They may also be completely disassociated from the other components. Their areas vary greatly.

In the Lesponne and Campan Valleys, they are generally of much smaller size; however rarely less than 50 m^2, locally they may be considered to be large enclosures if they exceed 100 m^2 of area.

Leytés

These are a sort of niche, built using large blocks. These niches are built on top of springs, on top of areas where springs flow out, or on artificial diversions of torrent, so that their bottom is permanently irrigated. Herders placed cans of milk in them to keep them cool and cause the cream to rise to the surface so that it could be removed more easily. *Leytés* may be isolated or in groups. They are sometimes, while the hut is being constructed, placed directly at the inside base of a wall, under which a channel has been dug to allow water to circulate. For reasons associated with the configuration of the terrain, they may sometimes be built a few dozen meters away from the hut.

In 1903 Lucien Briet described the *leyté* from a Campbieil Valley[48]:

> Finally, the products of the milking are put away in a hiding area that is the dairy; this hiding area is no more than a rivulet arranged under the slabs which are themselves covered with clods of turf; the ground looks levelled; you must know of it in order to be able to determine that it exists. A flow of water that is easily diverted from the torrent or from a spring circulates there and keeps things like cream and milk cool, in cauldrons that are half-immersed and covered with round plates of slate, which preserve it marvelously well.

Layouts Inside the Structures

No specific organization of the base structures can be noted in the *courtaous*. Construction is done according to the topography of the terrain and, it would seem, as each herder wishes. The base structures may be a few meters from each other or more clearly separated.

On the other hand, there are several types of layout organization of these basic structures.

One of the types more frequently encountered in the Lesponne and Campan Valleys can be qualified as the "succession type." In this configuration, hut, cow-shed, and shed are constructed in a line and thus form one of the sides of the enclosure, with the enclosure's free surface forming a homogeneous lodging space and/or moving space for the animals.

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[48] Lucien (1903).

In other situations, which are also rather frequent, hut, cow-shed, and shed are spread out on different sides of the enclosure. Sometimes, although less frequently, the hut is outside the enclosure, which surrounds the cow-shed and shed. Rarely, the hut, cow-shed, and shed may be outside the enclosure.

These different types of structural organization may coexist in the same *courtaou*, which is not a rare occurrence. A chronological distinction of the organization of structures does not appear to be an issue. There are, therefore, typical layouts in the distribution of constructions, consisting of a base structure, just as there are typical layouts in the permanent valley shelter. Beyond the need to arrange architectural components that are required for the practice of high-altitude pastoralism, these typical layouts are also the expression of a cultural identity, supported by the ways in which high-altitude pasture lands are used. In fact, the manner in which the mountain summer pastures are used is, of course, dependent upon the way they are inhabited. The same architectural forms are not required for a visit by a family's herd as they are for the presence of a communal, and therefore larger herd, one that requires several herders. Likewise, the owner of a mountain summer shelter will behave differently than one that is granted different places from one year to the next. In the Campan and Lesponne Valleys, the use of the mountain is very much individualized and a specific hut on the mountain is associated with a specific house in the valley. This form of assignment, not to say "privatization" of mountain summer pasture areas is a phenomenon that, from one Pyrenean valley to another, is far from being recurrent. The basic structures that comprise the *courtaous* are not, of course, fixed constructions. Reconstruction, enlargements, and reorganizations have taken place over the years.

The Chronological Approach

Concerning the chronology of structures, whether they are isolated or associated with other structures, it is premature to propose any interpretation whatsoever. In fact, the only distinguishing criteria available relate to the state of preservation of the pastoral remains.

Three states of preservation can be identified:

- Presence of remains to certain height
- Completely collapsed walls
- Presence of micro-reliefs that may or may not contain stones

These three states involve both isolated and groups of structures and may also be encountered in the same *courtaou*. Such a case is a good indicator of the age of the structures and the fact that inside an active *courtaou*, there may eventually coexist structures that have been abandoned and others that are active.

Some traces of pastoral remains may appear as a simple flattening of the terrain, and generally over a much greater surface area than the one used for the installation of a hut. Two explanations may account for this phenomenon. On the one hand, the structures may have been made entirely of wood and such constructions did not left any traces even in the form of micro-reliefs, and which could correspond to architectural forms for which stone is not used. On the other hand, it may also be a matter of a simple preparation of the terrain for the construction of structures which, for one reason or another, have never been finished.

Structures exhibiting the remains of walls are clearly the ones that were abandoned most recently. Their build date, however, remains indeterminable. More study of some of them has shown that they were built on more ancient bases or that they were subjects of rebuilding or structural modifications.

In conclusion, a structure or a *courtaou* that was abandoned around the middle of the twentieth century may very well be of an origin that goes back several centuries, or may represent a place that had already been occupied in the past and was reused after a period of discontinuity.

Completely collapsed structures were quite certainly abandoned earlier. It is very seldom that their typology corresponds to the more complete organization of the settlements, which leads one to consider the existence of a relative chronology. But here again, the date when they were built remains unknown.

Structures identified through micro-reliefs are considered to have been abandoned earlier than previously discussed. They are found most frequently among isolated structures, but also inside *courtaous*. In the latter case, they may be considered to be proof of the age of these groups of mountain summer shelters. However they may, and without excavations it is impossible to tell, be the result of the removal of stones to strengthen another structure or to construct a new one.

The chronological approach is of course inseparable from surveys and excavations that should enable us to reconstruct the various phases of occupation of the mountain summer pastures and their architectural transcriptions into the construction of huts and their associated buildings. Examination of land registries (drawings and ledgers) from the Napoleonic era and the present enables us to anticipate developments in terms of construction or, more significantly, abandonment between the early nineteenth century and the end of the twentieth century. This is the first component of absolute chronology that can be used here. Available archives (public, legal, and those which are in the hands of some aristocratic families that owned the terrains prior to 1789, etc.) can quickly offer some clues regarding possible dates. These latter, according to the research already done, are very limited and for the most part involve lawsuits, arbitration or the establishment of duties and allotments. But in any case, the written documents scarcely allow us to go back earlier than the fourteenth century. Moreover, the great majority of these documents do not go beyond the eighteenth century. In result, the archives can offer information that is extremely sporadic and that remains fragmentary and impossible to use in reference to the medieval period.

Consequently, archaeological excavations appear to be the primary means for acquiring, among other things, chronological data. Although the age of the Pyrenean mountain summer shelters is generally known, the chronological data are, in fact, obtained from random projects. Except for the most recent and most structured typological forms, it is impossible to assess dates using structure layouts as simple shapes crossed over time because they constitute technological constants. Considering the immense quantity of pastoral remains at high-altitudes in each valley or part of a valley, it appears that it is becoming impossible to determine the chronology of their occupations. This might, perhaps, be attainable with a great deal of effort and means, in a very well-defined sector of limited area, but in such case the resulting model would not be applicable to other valleys.

This methodological barrier concerning the chronology of mountain summer shelters must be approached very carefully. An approach that may be more effective is the one that consists not only of chronological issues but also of researching territorial distinctions, i.e., supporting time research by space research. Prospecting on foot is a quick but effective method, which contributes to learning about the structures and their spatial distribution. Such approach allows us to continue making progress in an attempt of gaining knowledge of pastoral civilizations in the Pyrenees.

Conclusions

Mountain summer shelters are examples of vernacular architecture that, by its very definition, is not very exciting. These small structures, which are discreet and often difficult to access and sometimes difficult to notice in the terrain, still remain very poorly understood, not to say unknown, to archaeologists and historians and of course the public. However, they constitute the only material evidence that allow us to take a glimpse into the history of high-altitude pastoralism in the Pyrenees. In large part, these remains are located at an altitude of at least 1,700 m, and are presently threatened by forest encroachment, which happens quickly due to the net decrease in the number of pasture animals. In some areas we estimate that half of the previously existing sites disappeared 20–30 years ago, which irremediably distorts the available information so much that it makes their loss significant. Therefore, it is urgent that we become aware of these pastoral remains, whose "minor" appearance is just that, an appearance. But, it is also urgent that we work hard to inventory them, at least in the areas that have already been sampled.

These temporary high-altitude shelters are not indicative only of agro-pastoral practices, but they also indirectly reflect on a specific way of adaptation of human groups to an environment that is, apparently, not very favorable to them. Thus they allow us to examine a range of social practices, through the community management of high elevation grazing lands and through the various ways in which huts have been used. Through the very variable dimensions of the base units of the *courtaous*, they show the social differentiations, which are sometimes very clear, within communities that are often thought to be egalitarian. Through the established architectural selections, through the organization of structures associated with specific production, and through inventiveness of which the *leytés* are a proof, they testify of multiple adaptational skills, translating to us the energy of a civilization that abruptly collapsed not long after it reached its technological apogee.

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Chapter 7
Landscape Archaeology of the Commons of the Bouleste/Labas Valley, Hautes-Pyrénées

Ludomir R. Lozny

Introduction

The Pyrenees offer abundant high-altitude grasslands exploited by transhumant communities in history and at present. Access and use of these resources was and still is conditioned by a set of rules which includes collective or cooperative arrangements. This chapter presents a preliminary report on human-made, high-altitude landscape features associated with the practice of transhumance and the organization of the commons in the Labas/Bouleste Valley, Hautes-Pyrénées (Fig.7.1 and 7.1a). I discuss a combination of social and natural factors intersecting and contributing to the creation of an idiosyncratic cultural landscape, which due to constant modifications is a dynamic entity composed of many places, which incorporate local, national, and recently global meanings.

Human use of high-altitude pastures over time adversely altered mountain ecosystems. Pyrenees, as all European landscapes, offer ample evidence on anthropization[1] of what otherwise might be viewed as "pristine" landscape. Presently, the Labas Valley is not in danger of further human-caused, direct and quick alterations. It is not going to be converted to a peripheral urban zone with secondary residential homes,

The Labas Valley consists of two main plateaus: Les Artigues in the eastern part and Bouleste in the western part, which is also referred to as *vallée de Bouleste*. I shall use the term "Labas Valley" throughout the text.

[1] Transhumance is seen here as a subsistence pattern, but also as deliberate human intervention in the local biodiversity exemplified by the introduction of animals not native to the environment and elimination of other animals, such as bears and wolfs, from their natural habitats (the recent campaign to reject reintroduction of brown bears to the mountains in order to keep the population of sheep and cows safe serves as a good example).

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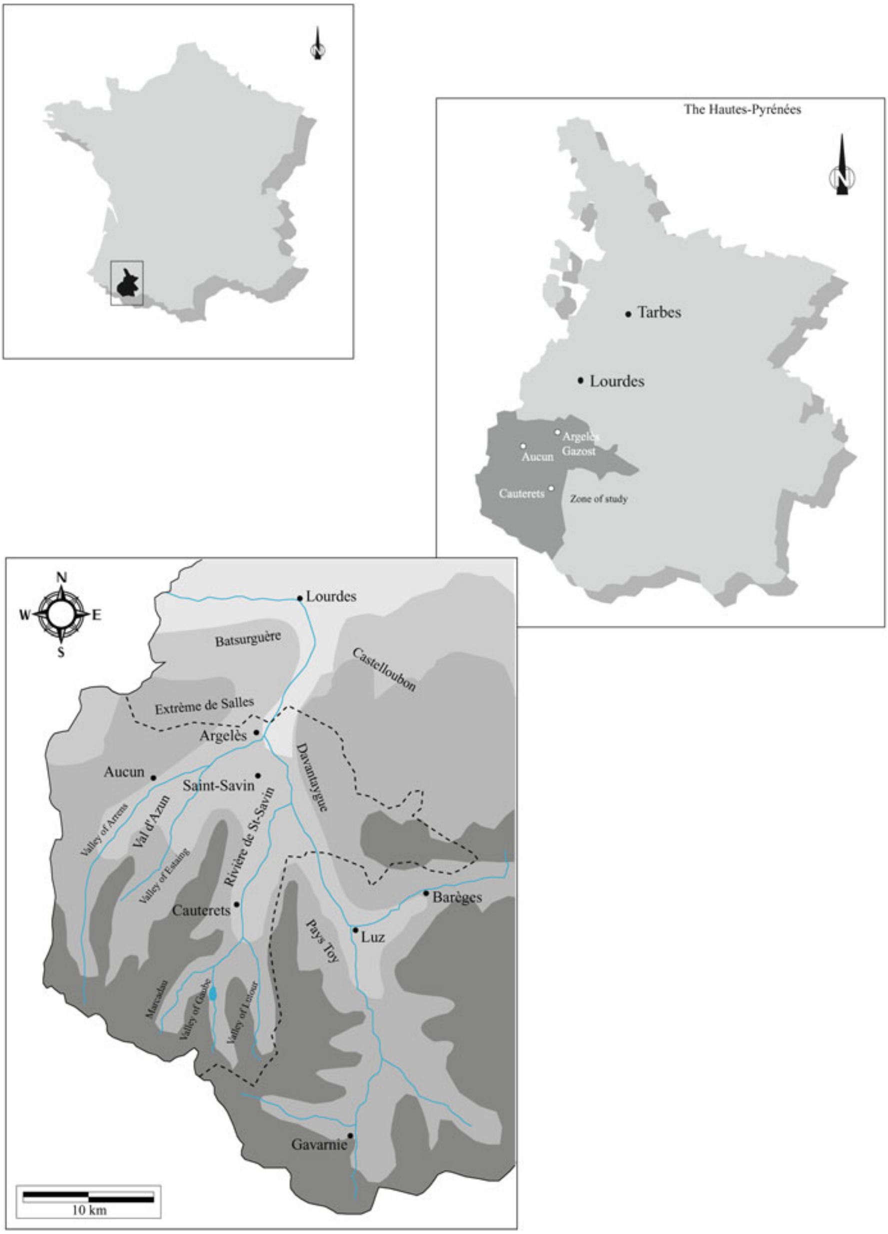

Fig. 7.1 Map of the project area. After F. Guédon

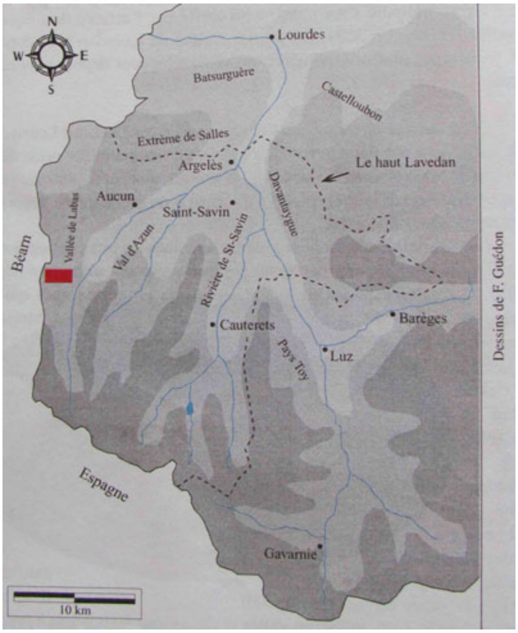

Fig. 7.1a (continued) Red rectangle indicates the location of the Labas Valley

as many other regions in the Pyrenees,[2] because it is located in the Pyrenees National Park (*Parc National des Pyrénées*), created in 1967, and therefore offers access to a fairly preserved cultural landscape.[3] By contrast, regions neighboring the project area face the consequences of enduring and fast-moving socioeconomic processes, including industrialization and depopulation (due to outmigration), all posing serious threats to local sustainable development and wellbeing of the residents. Recently, the region is also a scene of conflict between traditionalists and progressivists epitomized in the decline of the traditional transhumance-based culture and the emergence of a new, service-oriented postindustrial economy with tourism being its most significant local component.

Early scholarly interests in the Pyrenees date to the eighteenth and early nineteenth centuries and were focused on the peoples and their cultures described in the context of the mountains. Recently scholars engaged primarily in ethnographic and folkloristic studies (Cavaillès 1931 [2003]; Sole and Sabaris 2004; Iriarte 2002; Le Roy Ladurie 1979), but also archaeological evaluations (Bahn 1981; Omnès 1987; Sacchi and Vaquer 1996; Barbaza 1999; Rendu 2003). Anthropological studies of

[2] For the most current evaluation of adverse effect due to modernization, economic and political changes, and new policies imposed by the EU, see Vaccaro and Beltran 2010.

[3] Transhumance is still practiced within the park area. Earlier archaeological surveys of the project area were conducted by Dr. Guédon (2003, 2005).

various cultural patterns focused on social organization, such as family and kinship, have been presented by British and American scholars (Campbell 1964; Freeman 1979; Pitt-Rivers 1954; Wylie 1957). Different applications of Broudel's *longue-durée* have been applied to study long-term cultural processes (Le Roy Ladurie 1979; Sahlins 1989). A wide range of works concerning transhumance in Spain and France has been offered by geographers, historians, and ethnologists (Cavaillès 1931 [2003]; Daumas 1976; Pallaruelo 1993; Roige et al. 1995; Ros 2004; Castán 2002; Dugène 2002; Buisan 2002, 2004; Pérez Romero 2006).

The cycle of transhumance was critical in the economic wellbeing of the past communities of the region and still contributes to the livelihoods of local people. Here my key objective is to identify and record cultural remains of transhumance evidenced by a variety of human-made or modified features as they currently articulate in the landscape of the Labas Valley and which I present in the second part of this chapter. I also make references, but am not discussing in detail, to specific ethnographic and historic data on communal organization and the rules regulating access to common-pool resources around villages and in high altitudes. These are the objectives of another project.

Human agency is critical in creating landscapes and modifying ecosystems. The landscape archaeology [archaeological ethnography] approach employed here offers specific nondestructive methods to identify the remains of human activity, while the historical ecology approach is the analytical tool used to explain a history and present conditions of the cultural landscape as it is currently preserved in the Labas Valley. This is a complex landscape composed of many places separated through time but united in space.

Topography, Climate, and Vegetation of the Project Area

The Pyrenees are ca. 400 km long with average height around 2,000 m. The topography of the Hautes-Pyrénées consists primarily of high summits and deep glacial valleys. This part of the Pyrenees consists of tallest peaks in the whole chain. Long and deep valleys are usually oriented north–south and open to lowlands on both the French and Spanish sides; many smaller but also deep valleys, such as the Labas Valley, are oriented east–west, and this direction allows for longer and wider sun penetration which impacts the quality of grasses in summers (Fig. 7.2). These valleys are commonly used by local pastoralists as livestock grazing commons and thus turned into cultural landscapes modestly modified by enduring human activities.

The climate of the region is moderate and Mediterranean with hot and relatively dry summers and snowy and wet winters (northwest winds bring moisture from the Atlantic region through the year). Rainfall is ample and permanent snow line is around 2,800 m above sea level (masl). The climatic conditions of the Hautes-Pyrénées suggest that above the 2,000 masl line the climate is Alpine and below it is sub-Alpine. Average annual precipitation for the region is between 1,000 and 1,300 mm (including snow). Average annual temperatures range from 15 to 5°C in

Fig. 7.2 Summer in Labas Valley

winter (November-January), 9 to 17 °C in spring (February-April), 20 to 25 °C in summer (May-July), and 26 to 20°C in summer/autumn (August-October). Temperatures in high altitudes are different; annual average temperature is 5 °C in high altitudes to about 9 °C in lower altitudes (average winter temperature is −2°C and average summer temperature is 20.2 °C). The vegetation zones are generally divided into sub-Alpine (1,400–2,000 m) and Alpine (above 2,000 m). Most of the slopes are wooded (beech, spruce, mountain pine) to the elevation of about 1,500–1,800 m. At altitudes above 1,600 masl, the vegetation is boreo-Alpine with fir and mountain pine woods and Alpine meadows which become natural pastures. Below 1,600 masl, the vegetation is Euro-Siberian with fields used for fodder, hay meadows, and oak woods and some boxwood. Lower elevation areas contain oaks, pines, poplars, maples hazels as well as the Mediterranean type of vegetation.

Pyrenean Transhumance

Farming in the region is limited to the bottoms of big valleys, especially to their openings to lowlands. Because of thresholds in lower valleys land holdings, highland pastures provide significant supplementary economic assets. Pastoral lifestyle prevailed in the region since the prehistoric times and some authors argue that the Pyrenean transhumance may have originated in the Neolithic Period (cf Bahn 1981; Vegas Aramburu 1991; Brochier et al. 1999; Blanc 2000; Galop 2000; Rendu

2003; Miralles 2005:83).[4] Historically, each big valley was a separate political and economic unit, but all were linked through an exchange network with big towns located at the opening of large valleys to lowlands, where regional-level market places are located (for instance, Aucun, Argelès-Gazost, and Lourdes, the biggest towns of Val d'Azun, the project area). Traditional Pyrenean pastoral subsistence involved sheep (more than 700,000 in the 1950s), but also cattle, which is presently the preferred animal in the Labas Valley due to its rather easy access from the bottom of Val d'Azun and also elevation of pastures mostly below 1,700 m.[5]

Transhumance is still of critical importance to some Pyrenean herders (Cavaillès 1931 [2003]) as taking the animals to higher elevations for 4–5 months allows for preparation of hay and other forage for the winter. Meredith Welch-Devine (2010:45) reports that around 50% of farms in Xiberoa, a province located west to the project area, still practice transhumance. It is also practiced in the eastern Pyrenees, where in 2006 local herders had moved 18,000 sheep between the summer and winter pastures (Estrada et al. 2010). The agro-pastoral system of the Pyrenees still accounts for a sizable job market (25–30%; for comparative data on jobs in the western Pyrenees see Welch-Devine 2010). Throughout the region herders on the French and Spanish side practice vertical (altitudinal) and in some areas, for instance in the eastern Pyrenees and the lowlands of the Ebro Valley in Catalonia (Estrada et al. 2010:114–115), horizontal (lateral) transhumance. Rules regulating access to high-altitude pastures vary, but in most cases the grazing lands are owned [used] collectively either publically (open access) or by group of owners (cooperatives), and the users [participants] pay a fee per head for the livestock they graze. The winter pastures at the bottom of valleys are privately owned and could be leased for a fixed fee. Besides its obvious economic significance, transhumance also serves as a form of displaying prestige and reputation (cf Chandivert 2010:130).

It is a common practice in the western Pyrenees that larger animals such as cattle and horses roam freely. In the Labas Valley, cattle are moved from pasture to pasture which are separated by either seasonal or permanent creeks (Fig. 7.3c, d), whereas horses and donkeys roam at liberty throughout the valley (Fig. 7.3a). Presently, no sheep are grazed in the Labas. Because shepherds are not present daily, the animals aggregate at certain areas and therefore do not use the valley evenly and do not fertilize it evenly. Due to changes in grazing patterns, the quality of grasses in high altitude pastures declined. The present transhumant pattern is of shorter duration (mid-May/early June—late August/early September) and does not include the traditional cheese- or butter-making in the mountain cabins.[6]

[4] Pollen data suggest an increase in human activity in the Pyrenees during the Neolithic Period; see the chapter by Galop et al. in this volume.

[5] Elevation between 1,600 and 1,700 masl separates *ovine* and *bovine* transhumance in the Pyrenees due to change from sub-Alpine to Alpine vegetation zone.

[6] Making cheese and butter in the mountains requires significant time investment and, due to new EU sanitary regulations, also substantial financial investment.

Fig. 7.3 (**a**) Free roaming animals, (**b**) Bouleste Plateau, (**c**) Eastern les Artigues Plateau, (**d**) Western les Artigues Plateau

The Commons of the Pyrenees

The idea of the commons includes common-pool resources managed in a cooperative or collective manner and the common property regimes that comprise the political or institutional level of governance (Ostrom 1990). Communal ownership of pastures in the Pyrenees has been a subject of studies for more than 100 years (Costa 1898) and recently gained new popularity due to the works by Robert McC. Netting (1974, 1980, 1981, 1982) and Elinor Ostrom's (1990) studies on the communal ownership of pastures in the Swiss Alps. Collective or cooperative pattern is characteristic among societies utilizing scarce resources, where the livelihood of individuals depends on decisions made by others. Pyrenean pastures have traditionally been used and managed in a collective/cooperative manner, which is the subject of recent studies by Murray (2010:25) and Welch-Devine (2010:43) regarding the Basque herders. The Basques created cooperative neighborhood work parties (*auzolan*),[7] and resilience of such management pattern suggests its significant contribution to sustainable existence and wellbeing. Meredith Welch-Devine (2010:44) described the ownership structure for the Basque in Xiberoa and pointed out that the common-pool grazing lands are collectively owned and open to all the residence and animal risers in the province. In the Hautes-Pyrénées, the idea of the commons is represented in vernacular terms such as *cuyéou cuyéla*, *courtau*, *courteous*, etc. identifiable, for instance, in local toponymy. Some of the Pyrenean common property regimes date to the Middle Ages (such as Basque *Coutume de Soule*). The French law of 1837 authorized the creation of syndicates to facilitate inter-communal cooperation and to manage the common-pool resources owned by multiple communes.

The commons of the Pyrenees contributed to the emergence of special norms to regulate inter- and intra-group interactions and especially to diffuse conflicts. Recent changes in herd management and the use of common-pool resources are mostly caused by local factors (family disputes) and both national and supranational policies, such as Natura 2000. Disputes and local conflicts regarding grazing land have been traditionally mitigated by, for instance, cross boundary treaties (*facerías*), and trans-border agreements called *lies* and *passerines* in Hautes-Pyrénées,[8] arbitration by the pasture police (institution in decline) and mediation, as evidence in the Aragon Pyrenees (Carbonell 2010:76–78). The Labas Valley is a good example of enduring common property regimes which date to the Middle Ages and are well-structured through the established rules. The rules are based on social norms and traditions which regulate access to resources and also sanction abusers. Common property regimes thus provide a framework for social organization and interactions and their governing bodies, such as the *Cour Générale* of the Basque region of the Kingdom of Navarre, which seemed an incipient democratic institution (Murray 2010:31), gain power to organize larger groups. Management of common-pool resources might be organized in a complex structure with cooperating villages, clans, families, or other groups requesting access to summer pastures in high altitudes. Rules of cooperation also involve payments or various reciprocal arrangements.

Pyrenean transhumance did alter local biodiversity but remains significant to the livelihood of people and their cultural identity. Its significance declined recently due to policies imposed through centralized decision-making by the French government and the EU. The point exemplified by the modern history of

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[7] Societies whose subsistence depends on access to limited resources, like mountain pastures, devise rigorous common property regimes; see the chapter by Pablo Dominguez in this volume on the Moroccan Berbers custom called *agdal*.

[8] See the chapter by Stéphane Lévêque in this volume.

the Pyrenean transhumance is that the increase of centralization in decision-making weakens communal cooperative organizations by imposing new rules and enforcing these rules through governmental agencies. This might in effect contribute to social and local economic crisis, but not necessarily to governmental crisis. While a number of scholars have examined how polycentric and nested institutions contribute to common-pool resources management (cf. McGinnis 1999; Ostrom 1999), few have examined how the success of sustainable common-pool resources institutions is affected by disturbances in nested governance institutions. Undoubtedly, certain regulations are necessary, but central government ruling limits individual access to common resources. Participatory polycentric governance seems a feasible alternative. "Polycentricity" is a normative approach to governance, which stresses the degree to which higher levels of government should not crowd out self-organization at lower levels. It points out that local people know the local environment better than outsiders. The conventional wisdom that common property is poorly managed and should be either regulated by central authorities or privatized is challenged.

Historical Ecology of the Commons

Winterhalder (1994:19) pointed out that analysis of the commons should include explanation of causal events that produced them, including human agency. Thus, ecologists who study interactions between humans and their environment usually examine a variety of sometimes overlapping areas, such as food procurement, competition vs. cooperation, risk minimization, population dynamics, as well as decision-making processes and their consequences for cultural and biological diversity. Human ecology focuses on the complex interactions between people and their environments and the diachronic use of human ecology has been used to develop theories of historical ecology (Crumley 1994a, b; 1998), also referred to as landscape history approach (Tilley 1994; Ashmore and Knapp 1999). Historical ecology is the study of past relationships between groups of people and their environments. Its multidimensional orientation combines the knowledge of various aspects of human activity with the theory and methodology of ecology. It offers diverse methodologies, which allow for a very comprehensive insight into the human condition in the past. Its multidimensional, multiscalar approach (Crumley 1994b) links various disciplines including: anthropology, biology, geography, demography, economics, etc., and combines the knowledge of all aspects of human social behavior with the theory and methodology of ecology. As Carole Crumley indicated (1994a, b), historical ecology encompasses "evidence of the human past with evidence about the environment by studying the evolution of landscapes." Archaeologists who use ecological models accept an interdisciplinary approach, which draws heavily on the physical and natural sciences together with the humanities. The practice of historical ecology concerns diverse evidence of all human activities, physical or intellectual, which might be manifested in the landscape. The application of the historical ecology approach requires a rigorous methodological design, however. Regardless the fact that a landscape might testify about various levels of past interactions (who, what, when, and how), the real challenge rests in the ability to read and decipher the landscape, and furthermore in the ability to manipulate and use landscape histories to fit local, regional, and/or global agendas.

Thus, historical ecology delineates an integrative approach deeply rooted in ecological models. Through the application of historical ecology to examine specific human populations, we can address the following two major questions: (1) What is the population's place in its particular ecological system/cultural landscape? and (2) How do particular behaviors characteristic of this population relate to its place in the ecosystem/cultural landscape? My attempt to answer either of these questions coherently in reference to the Pyrenean cultural context includes the idea of place rather than a culture-specific signifier as the concept of place rather than culture will, in my view, allow for better understanding of the assortment of human-ecosystem relationships over time in the Pyrenees, where valleys often were independent political [cultural?] units and left their idiosyncratic cultural signatures in the high-altitude commons.

Theoretical Assumptions and Working Definitions

The two themes I discuss here are historical ecology (landscape history) as a guiding scheme for studying histories of cultural landscapes, and the concept of place as a time-space identification of human activities examined through the methods of landscape archaeology. The historical ecology approach explains human decisions in terms of deterministically understood relationships among adaptational constraints imposed by a variety of environmental stresses through time. Archaeologists should recognize the evidence of various decisions made by people in the past as their consequences will be preserved in the form of archaeological data such as artifacts, ecofacts, architectural features, landscape modifications, etc. Naturally, as environmental stress increases, human responses diversify and intensify and as the complexity of responses raises, a greater diversity and density of archaeological facts is expected.

Definition of Cultural Landscape

Studying landscapes encompasses several perspectives, theories, and epistemologies. In considering the meaning of the expression *cultural landscape* itself, a multitude of definitions emerge:

- "Meaning imputed by local people to their cultural and physical surroundings" (Hirsch and O'Hanlon 1995:1).

- “Created out of people’s understanding and engagement with the world around them” (Bender 1998:5) and “[p]eople’s engagement with the material world” (Bender 2002:S103).
- “Interdependent relationships that people maintain with the physical, social, and cultural dimensions of their environments across space and over time” (Anschuetz et al. 2001:159).
- “An entity by virtue of its being perceived, experienced, and contextualized by people” (Ashmore and Knapp 1999:1).
- “A set of real-world features, natural or cultural, which give character and diversity to the earth’s surface” (Zvelebil, Green, and Macklin 1992:194).
- “A dynamic component of the physical, natural environment,” “a record of that environment and of environmental changes,” and “an important influence on site formation process” (Holliday 2004:234).

Here I do not follow any specific definition mentioned above entirely but borrow from them. I therefore view cultural landscapes as outcomes of human actions and imaginations, dynamic territorial units filled with specific meanings which change over time. All these meanings are symbolic, but some are cognitive whereas others manifest themselves physically. Archaeologists identify such physical manifestations as archaeological sites; I prefer to call them places to emphasize their dual physical (tangible) and cognitive (nontangible) nature. Places and their meanings change over time and the same physical [natural] landscape might be composed of different places each representing different meaning(s) to different group(s), but not all might leave their imprint in the landscape. Such dynamic nature of cultural landscapes makes them very complex and obscures their cultural identification.

Approaches to Landscape

Two general models emerge from a brief analysis of the variety of approaches to understand cultural landscape: the binary model and the multivocal model. The binary model followed by the industrial, state-level societies is the traditional Cartesian model of landscapes which relates to physical and culturally well-defined territories imposed on a presumed “empty space” and divided through binary representations such as: private/public, cultural/natural, closed/open, inside/outside, ours/theirs. This approach identifies the polarizing boundaries in landscapes such as nature–culture, individual–social, etc., whereas the multivocal model characteristic of nonindustrial, small-scale populations aims at exposing the artificial boundaries and unnecessary dichotomies between nature and culture, individual and social, time and space, past and present, and to bridge the gaps between them. Figure 7.4a, b represent schematic perceptions of landscapes seen as polar or multivocal.

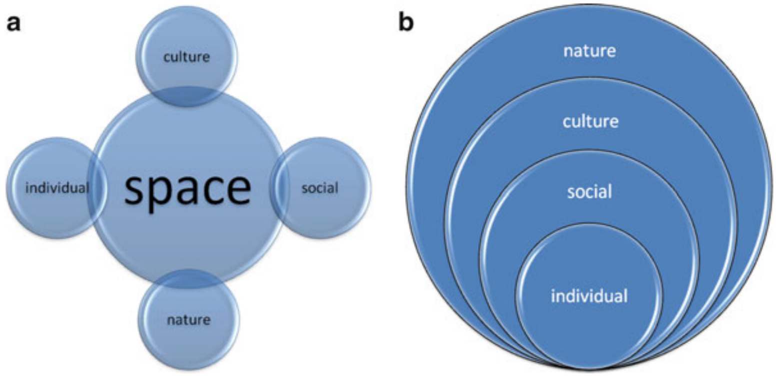

Fig. 7.4 (**a**) Landscape polarity. (**b**) Landscape multivocality

Perception of Landscape

From the above I conclude that industrial people construct cultural landscapes, whereas nonindustrial people contemplate cultural landscape as tangible link to the past (it does not represent the past; it is a part of the past). Collaborative ethnohistoric research with native cultural consultants explores multiple native histories drawing on concepts of cultural landscapes as memory. A model of cultural landscapes encompassing variables of absolute, relative, and representational time and space enables us to better understand the interpretations of the past revealed by tribal research participants. For instance, for Euro-Americans, the past is inscribed on the land and the historical landscape becomes a product of cultural memories. For American Indians, ancestral sites that persist in the present are historical monuments that remind and recall what passed. Cultural landscapes thus do not *represent memory*, *they are memories providing a means to unite the past and the present in a personal* [*social*] *experience*.

My Approach to Landscape

Cultural landscape is like a language. It contains codes and meanings which convey powerful messages about people and their relationships with natural landscapes. Due to symbolic diversity that changes over time, and which might also be present at synchronic scale, cultural landscape presents vernacular distinctions. Generally, cultural landscapes offer foundations to lean on regarding identity, placing ourselves within a network of societies, and they also regulate the relationship we have with those societies. Specific elements of a cultural landscape become strong factors of cultural identity and the Basques of the Pyrenees, the Nuer of eastern Africa, or the

Hopi of the American Southwest are good examples. The Basques without Pyrenees are not Basques, the Nuer without their cattle are not Nuer, and the Hopi without their corn are not Hopi.

But I also see cultural landscapes as antagonistic and paradoxical mixing of places. Today, narratives of place once presented under such headings as "national integration" and "cultural evolution" are being framed in much harsher terms related to economic development caused by state invasion and occupation, or the extraction of transnational wealth at escalating cost in human suffering, cultural denigration, and environmental degradation (Bodley 1988; Burger 1990; Cultural Survival 1993). Place is a site of power struggles and ethnographies of place are stories about contestations.

Cultural Landscape: Place and Space

Cultural landscapes are filled with places. In order to better understand how place is perceived by people, I make a distinction between *place* and *space* as two units of a cultural landscape (Fig. 7.5). From a phenomenological point of view, such distinction makes a lot of sense. Understandably, as Casey (1996) pointed out, for anthropologists/archaeologists *space* comes first, because they are interested in how human behavior articulates in nature. For the local people, however, *place* becomes most significant, because they symbolically fill it with specific meanings often unrecognizable to the researchers of *space*, especially after certain cultural elements of the space have been removed. Thus, anthropologists/archaeologists are primarily interested in how *being-in-place* articulates and this is why we use the concept of culture and relate this idea to a concept of space rather than a concept of place. From a philosophical point of view, it is place that is most significant to people. There is no knowing or sensing place except by being in that place and being able to perceive it. Therefore, knowledge of place is a consequence of experience (practice), constituted by cultural and social structure. Philosophers could retrieve a sense of place (see for instance Casey 1996), but can anthropologists do the same? The anthropological approach to place is to identify and map it out within a space. This is similar to approaches of geographers, historians, sociologists, and political scientists. Recognizing the crucial interactions between people, place, and motion can identify a place. In light of the above, we may say that people are never placeless; places belong to us. We always create our own place in form of a matrix of symbols we identify with at the time.

Place as an Analytical Tool

Let us now turn to a brief discussion of place. The concept of place rather than culture should, in my view, become the key analytical unit to fully understand the cultural potential of a place; it should be the focus for theoretical advancement within the archaeological practice.

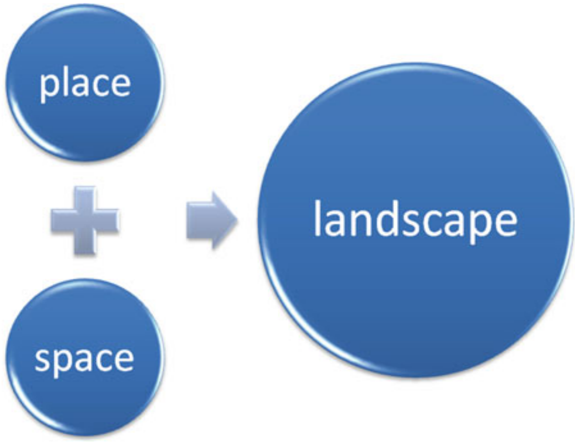

Fig. 7.5 Elements of landscape

The meaning of place is composed of two distinct realms: cultural (recognized/meaningful) and natural, both of which can be experienced simultaneously (Fig. 7.6). Therefore, the full potential of place is in its multiple symbolic meanings but its significance in a specific cultural designation.

Two key assumptions about place (regardless its location) play a significant role in understanding of my approach to cultural landscapes: (1) humans occupy a remarkable diversity of places (ecosystems), and (2) we are the dominant species of our place (ecosystem) and therefore, we may turn any place into "our place," even for a while (Fig. 7.7). Through their unique way of adaptation which is distinctively flexible, for adaptation is at once the solution to a particular problem and the source of unanticipated changes and new problems, we change our places constantly and such changes articulate physically. Archaeologists might recognize them as variations, or variants, of a culture and sometimes as a different culture.

Place and Ecosystem

First, let's consider the relationship between place and ecosystem understood as a very dynamic and constantly changing cycle of matter and energy and their links. The concept of ecosystem is applied to any environment, but more importantly, it describes humans in a very dynamic interplay with other elements of the ecosystem (including other humans). Thus, the concept of ecosystem gives us a way of describing how human populations influence and are influenced by their surroundings

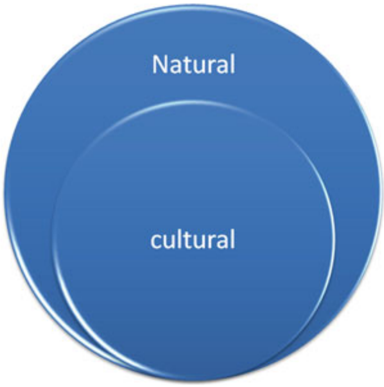

Fig. 7.6 Realms of place

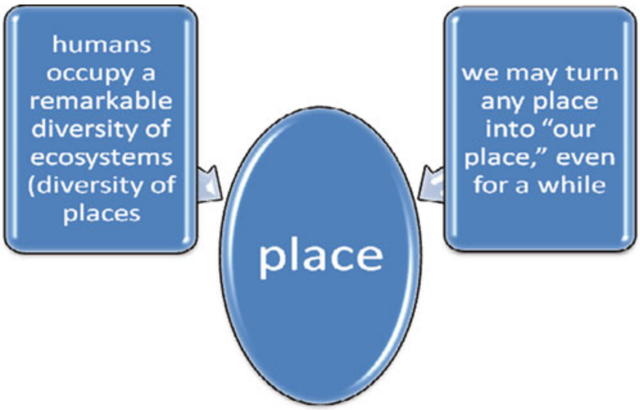

Fig. 7.7 Two key assumptions about place

(Moran 1990). Yet, each ecosystem, although kept in equilibrium or near equilibrium, can be described as constantly changing (Holling 1973).[9] Ecosystems are thus filled with constantly changing places which, as elements of cultural landscapes, contribute to ecosystem change. The speed of change may differ for each place, however.

[9] Two concepts describe continuity and change within ecosystems: resilience, a measure of change a system can sustain while maintaining its basic elements or relationships, and stability, a measure of the speed with which a system returns to equilibrium after absorbing disturbances.

Place and Social Memory

Casey (1996) says that "places gather." Among these "gathered" elements are specific histories, memories, thoughts, cultural traits, symbolic meanings, linguistic features, etc. There are also specific experiences that we have every time we go back to places we know, which are full of memories, individual and social. Place becomes a powerful form of identification. Being in place also means being in a configuration of complex things (material, symbolic objects that define the form of a place). Thus, memories of place are attached to personal experience as well as social experience. We can return to "our" place which we keep in our memory; it is always the same place. "Our" place does not change, only the people who occupy it change. Place is not something simply physical. Place is something for which we continually have to discover or invent new forms of understanding, new ideas (see Casey 1996 for phenomenological analysis of place).

Of course, as well as memories and thoughts, place is composed of physical attributes including artifacts and features of the habitat. In this sense place is inseparable from its surroundings and contains a variety of meanings: historical, physical, and also emotional (assumed). Places constitute a region's environmental and social history. The essence of place is to be regional, and the essence of a region is to be composed of places. Archaeologists do not recover one place but diverse and dynamic time and space relations. Artifacts we find at any particular site change the qualifications we use to assign these places to specific cultures. In effect, we create a very elusive image of the past composed of, most of the time, artificially assigned cultures.

Multivocality of Place and the Politics of Landscape Multivocality

I argue here that place, as space, is also multivocal for it bears the meanings that researchers and preservationists favor in addition to whatever meanings other people might have attached to it. Place contains multiple senses, and even if we can read all of them through the application of diverse methodologies, not all of these meanings will be preserved (because not all of them matter to people at the same time).

Following my observations in the Pyrenees I conclude that people create multiple meanings of place and that people with power force others to accept their meaning and understanding of place. Current cultural heritage preservation practices are presently all about the politics of cultural landscape. The practice of heritage preservation is driven by policies designed to preserve selected evidence of past human activities. This approach contributes limited new knowledge and provokes serious questions such as: What should be preserved, and why? Who decides what will be preserved, and why? Both questions present an obvious dilemma which I discussed elsewhere (Lozny 2006).

Landscape Archaeology of the Commons in the Labas Valley

Two key points underline my approach to researching the cultural landscape of the Labas Valley:

- Time perspective is essential in assessing the full potential of a landscape, as people fill the landscape with different meanings at different times.
- A comprehensive archaeological research of a cultural landscape involves recognition of its multivocality, hence the centrality of the idea of place as a time-space identification of human activities I argue for here.

The project area is in the Bigorre region of the department Hautes-Pyrénées of the Midi-Pyrénées region in southern France. The Labas Valley is located west of Val d'Azun (part of the Lavedan region) and configured east–west (Fig.7.1 on page 125). It is a deep glacial valley (Fig. 7.2) surrounded by mountain ranges with most summits over 2,000 masl, such as Pic de Taillades ou Grand Gabizos [2692], Pic de Bassia [2099], Pic de Louesque [2554], Sanctus [2482], Pique d'Arazur [2142], Grand Arroubert [2398], Petit Arroubert [2183], and L'Arrouye [1873]. The brook Labas runs through the valley and is the only permanent source of fresh water in the valley; several unnamed seasonal brooks are also visible and they fill with snow-melting water and after heavy rainstorms. The land available as pastures in the Labas Valley is generally in the shape of elongated ellipse approximately 3,000 m long and 200–300 m wide [approximately 60–90 ha of which around 45–50 ha are used as pastures]. The pastures are on two plateaus, les Artigues (Fig. 7.3c, d) in the eastern part of the valley at 1,400–1,700 masl, and Bouleste (Fig. 7.3b) in the western part, at 1,800–2,000 masl. Animals, mostly cattle, but also horses and donkeys, graze in the valley from May until September (Fig. 7.3a).

This section presents the results of archaeological survey of the Hautes-Pyrénées conducted in August 2005 (Guédon et al. 2005) and continued in 2006–2007[10] seasons. The goal of the project was to record the material evidence of transhumance in its natural settings. In result, 44 structures were identified and recorded as related to transhumance (Table 7.1). They represent a variety of human-made structures ($N=43$, human shelters, pastoral amenities, and animal enclosures) and one small cave possibly used as human shelter and therefore identified as a structure (structure 15). Two other structures were identified as possible tumuli, but without archaeological inspection they remain unassigned (Figs. 7.65 and 7.66) and therefore are not discussed in this report. If one of these structures might simply be a pile of rocks collected by herders in the preparation effort to construct a *cabana* (Fig. 7.65), the other shown in Fig. 7.66 deserves closer inspection.

[10] I would like to acknowledge the participation of the following individuals in different phases of the project: Lauren McKenna, Alexis Rothfeder, Heather de Waal Kinney, Justin Poplawski, Greg Mount, Mathew P. Dames, Andrzej Boguszewski, and Frédéric Guédon.

Table 7.1 Summary of structures

Structure no. Fig. no.	Elevation	Size	Area in m²	Shape	Construction	Function
1 Figs. 7.8 and 7.9	1,812	2×4	8	Oval+boulder	Multicomponent; boulder+rocks	Animal enclose (ovine)
2 Figs. 7.10 and 7.11	1,801	20×10	200	Boulder+rectangular	Multicomponent; boulder+medium and small rocks	Four animal enclosures of different size
3 Figs. 7.12 and 7.13	1,800	4×3	12	Rectangular	Single-component, well-constructed with small and medium size rocks	*Cabana*
4 Figs. 7.14 and 7.15	1,799	5×3	15	Oval	Single-component, horseshoe, oval-shaped structure, similar in construction to structure 14	Possibly ewes milking facility; similar to structure 14
5 Figs. 7.16, 7.17, and 7.18	1,736	11×7	77	Oval+boulder	Multicomponent; boulder+rocks	Human shelter+animals enclosures attached to boulder
6 Fig. 7.19	1,733	3.5×2.7	9.45	Rectangular	Single component	Uncertain; probably human shelter
7 Fig. 7.20	1,730	3×2.5	7.5	Oval	Single component	Uncertain; probably human shelter
8 Figs. 7.21 and 7.22	1,724	1.5×1	1.5	Rectangular+boulder	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility
9 Fig. 7.23	1,723	1.6×1	1.6	Rectangular+boulder	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility.
10 Fig. 7.24	1,718	30×20	600	Rectangular+oval	Multicomponent	Human shelter+animal enclosure

11 Fig. 7.25	1,706	6.2×3.4	21.08	Rectangular+boulder	Multicomponent; boulder+rocks	A *toue* with two animal enclosures
12 Fig. 7.26	1,699	3×2.5	7.5	Oval+boulder	Multicomponent; boulder+rocks	Animal enclosure
13 Figs. 7.27 and 7.28	1,697	2×1.5	3	Rectangular	Single-component	*Leyté*, milk storing facility
14 Fig. 7.29	1,697	3×2.5	7.5	Oval	Single-component; horseshoe-shaped	Possibly ewes milking facility; similar to structure 4
15 Fig. 7.30	1,583	3.4×2.5	8.5	Small cave	Single-component	Human shelter
16 Fig. 7.31	1,571	3.5×3	10.5	Rectangular	Single-component, well-made, rocks by size	*Cabana*
17 Fig. 7.32	1,563	4×3.5	14	Oval	Single-component	Animal enclosure
18 Fig. 7.33	1,558	1.6×1	1.6	Irregular	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*
19 Figs. 7.34 and 7.35	1,558	5×4; 30×20	20+600	Oval+rectangular	Multicomponent; a complex of human shelter and three animal enclosures	*Cabana*+3 enclosures; similar to structure 10
20 Figs. 7.36 and 7.37	1,557	1.5×1	1.5	Rectangular	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility
21 Fig. 7.38	1,557	5×3	15	Oval	Single-component	Animal enclosure
22 Fig. 7.39	1,556	5×4	20	Rectangular	Single-component; well-built, rocks carefully collected and put by size	*Cabana*

(continued)

Table 7.1 (continued)

Structure no. / Fig. no.	Elevation	Size	Area in m²	Shape	Construction	Function
23 Fig. 7.40	1,556	2.6×1.8	4.68	Rectangular	Multicomponent; boulder+rocks	*Toue*
24 Fig. 7.41	1,556	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
25 Fig. 7.42	1,555	1.7×1	1.7	Rectangular+boulder	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*
26 Figs. 7.43 and 7.44	1,555	5×4; 25×18	20×540	Rectangular+oval	Multicomponent	*Cabana*+3 oval enclosures; similar to structure 10 and 19
27 Fig. 7.45	1,554	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
28 Fig. 7.46	1,554	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
29 Figs. 7.47 and 7.48	1,553	3.6×2.5	9	Oval	Single-component	Prehistoric? (cromlech?)
30 Figs. 7.49 and 7.50	1,553	5×4.5 25×18	22.5 450	Rectangular+oval	Multicomponent; boulder+rocks	Cabana+2 oval animal enclosures
31 Fig. 7.51	1,551	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
32 Fig. 7.52	1,550	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
33 Fig. 7.53	1,550	17×13	221	Oval/irregular	Single-component	Animal enclosures
34 Fig. 7.54	1,548	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
35 Fig. 7.55	1,547	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility

36 Fig. 7.56	1,547	1 × 1	1	Rectangular	Single-component	*Leyté*, milk storing facility
37 Fig. 7.57	1,545	1 × 1	1	Rectangular	Single-component	*Leyté*, milk storing facility
38 Fig. 7.58	1,544	4.2 × 2.3	9.66	Irregular + boulder	Multicomponent; boulder + rocks	Simple construction suggests animal enclosure attached to boulder
39 Fig. 7.59	1,544	3.7 × 2.5	9.25	Oval/irregular	Single-component	Simple construction suggests animal enclosure
40 Fig. 7.60	1,544	1 × 1	1	Rectangular	Single-component	*Leyté*, milk storing facility
41 Fig. 7.61	1,544	1 × 1	1	Rectangular	Single-component	*Leyté*, milk storing facility
42 Fig. 7.62	1,543	3.8 × 3.6	13.68	Irregular	Single-component	Simple construction suggests animal enclosure
43 Fig. 7.63	1,537	5 × 4.5	22.5	Irregular	Single-component	Simple construction suggests animal enclosure
44 Fig. 7.64	1,534	8.7 × 3	26.1	Oval + boulder	Multicomponent; boulder + rocks	Animal enclosure attached to boulder

Filed Methods

Nondestructive methods of landscape archaeology [archaeological ethnography] have been used to make a photographic documentation of structures supported by schematic drawings and basic measurements. The survey was organized according to the scientific standards for archeological surveys in environmentally difficult regions. Because of the mountainous character of the region, the pedestrian survey was limited to systematic observation of selected areas of the valley and slopes steeper than 40° were not penetrated. The survey was conducted from the westernmost part of the valley used as pasture eastward. Seven archaeologists penetrated the valley in two groups. Each group was responsible for locating, drawing, photographing, and describing each structure. Structures were numbered from structure 1 to structure 44. The archaeologists used a hand-held GPS devise to locate site's positioning, including elevation. The goal was to record all recognized historic structures regardless of their possible chronology or preservation. During the analytical phase of the project, the possible prehistoric structures were separated from historic.

Fieldwork Results

In result, 44 historic structures were identified, including 1 small cave (structure 15). All the recorded structures probably represent different time periods, but they were not identified chronologically as no subsurface archaeological investigations were conducted. The structures are in different state of preservation, from well visible outlines, including partially standing walls, to fragmentary outlines. All recorded structures are summarized in Table 7.1. Their brief descriptions and photographs are provided in the following section.

Structures Recorded in the Labas Valley

This section contains descriptions of all structures recorded during the survey. Descriptions of each structure are limited to size, area, shape, function, and constructional details, where available. Descriptions also include GPS location (North and West coordinates and elevation). The structures were recorded using their elevation as an organizing principle, from the most elevated to the lowest within the valley section used as pastures. The sequence starts with structure no. 1 at 1,812 and ends with structure 44 at 1,534 masl.

Structure 1
GPS position: N4254.893W00018.087
Elevation 1,812 m
Size: 4 × 2 m
Figures 7.8 and 7.9

Fig. 7.8 Structure 1

Fig. 7.9 Structure 1

Animal (ovine) enclosure arranged around an erratic boulder used as wall/roof of the structure. A semi-oval ring of medium-sized rocks outlines the extent of the shelter in front of the boulder. This is the highest located structure in the valley (elev. 1,812 m).

Structure 2
GPS position: N4254.845W00018.042
Elevation 1,801 m
Size: 10×6–7 m; 10×2 m; 10×10 m; 4×2 m
Area: 70 m^2 + 20 m^2 + 100 m^2 + 8 m^2 = 198 m^2
Figures 7.10 and 7.11

This is a large complex, multicomponent structure constructed of rocks of different size. It is located approximately 10 m south from structure 3 and approximately 70–80 m south from the Labas creek. The structure is composed of four sections identified as 2a, 2b, 2c, 2d.

Structure 2a is rectangular in shape 10×6–7 m; its walls are approximatly 1.5 m high. The structure is constructed of small and medium size rocks. It western wall is made up of a natural boulder approximately 8 m high. It is adjacent to structure 2b.

Structure 2b is a small 10×2 m rectangle. Its walls are low, made up of a single layer of rocks. It contains natural boulders in its structure. There is an opening in the northern wall of the structure, possible a gateway.

Structure 2c is the largest structure of the complex. It is circular in shape approximately 10×10 m across. It is adjacent to structure 2b and 2d. All walls are single

Fig. 7.10 Structure 2

Fig. 7.11 Structure 2

layer of rocks, except the southern wall which is composed of two layers, small size rocks on top of larger, medium size rocks.

Structure 2d is the smallest structure of the complex. It is rectangular in shape 4 × 2. There is a small opening in the western wall to structure 2c.

This multicomponent complex represents animal enclosures.

Structure 3
GPS position: N4254.846W00018.040
Elevation 1,800 m
Size: 4 × 3 m
Area: 12 m^2
Figures 7.12 and 7.13

This is rectangular in shape structure of medium size located on a small plateau overlooking the Labas creek. It was well constructed with small and medium size rocks. It is located 50 m south from the creek. Its eastern wall is built into a small hill. A possible fire pit is located ca. 1 m from the structure, on its western side (Fig. 7.13). The pit is filled with small rocks. The structure is located in close proximity (ca. 7 m) to structure no. 2. It was used as human shelter (*cabana*).

Structure 4
GPS position: N4254.849W00018.039
Elevation 1,799 m
Size: 5 × 3 m
Area: 15 m^2
Figures 7.14 and 7.15

Fig. 7.12 Structure 3

Fig. 7.13 Structure 3

Fig. 7.14 Structure 4

Fig. 7.15 Structure 4

This is an oval, horseshoe-shaped structure, well-made of similar in size, small rocks. There is a small opening from the east. It was a well-made structure composed of small and medium size rocks. It is located approximately 60 m south of the Labas creek on a small plateau.

Structure 5
GPS position: N4254.887W00017.637
Elevation 1,736 m
Size: 11 × 7 m (all sections)
Figures 7.16, 7.17, and 7.18

This is a large rectangular erratic boulder in the northern part of the Bouleste section of the valley with three stone structures attached to three sides of the rock. It is multicomponent structure composed of three rings of medium and small size rocks. The northern side ring is labeled 5a, the eastern side ring is 5b, and the southern side ring is 5c.

Structure 5a is oval-shaped and composed of medium-sized rocks with the natural rock used as one side (wall) of the structure.

Structure 5b is oval-shaped and composed of small and medium size rocks with the natural big rock used as a wall. It has small rocks piled in the middle.

Structure 5c is the smallest of the all three structures. It is an oval composed of small and medium size rocks.

This structure represents a set of animal enclosures constructed with the use of large erratic boulders as a part of the structure. It is related to ovine husbandry.

Fig. 7.16 Structure 5

Fig. 7.17 Structure 5

Fig. 7.18 Structure 5

Fig. 7.19 Structure 6

Structure 6
GPS position: N5254.889W00017.619
Elevation 1,733 m
Size: 3.5 × 2.7 m
Area: 9.45 m^2
Figure 7.19

The structure was a square/rectangular in its original shape; well-made construction. Presently the walls collapsed and the roof caved in. The doorway is still partially visible.

Structure 7
GPS position: N4254.881W00017.623
Elevation 1,730 m
Size: 3 × 2.5
Area: 7.5 m^2
Figure 7.20

This structure is located in the eastern part of the valley in the section named Bouleste. It is oval-shaped and composed of small and medium-sized rocks. This structure is located south of structure no. 9.

Structure 8
GPS position: N4254.812W00017.587
Elevation 1,724 m

Fig. 7.20 Structure 7

Size: 1 × 1.5 m
Area: 1.5 m^2
Figures 7.21 and 7.22

This structure is a man-made rockshelter, located in the eastern part of the valley (Bouleste). It is situated around a natural boulder with three larger flat rocks forming the walls and the roof of the shelter. Small rocks around the structure might be remains of the wall construction. The structure is located about 30 m from the Labas Creek north. This is a human shelter and can fit one person—a simple shelter (small *toue*). It could have also served as cheese-salting facility.

Structure 9
GPS position: N4254.819W00017.580
Elevation 1,723 m
Size: 1 × 1.6 m
Area: 1.6 m^2
Figure 7.23

This structure is a man-made rock shelter. The construction is arranged around a large rock *in situ* surrounded by small walls made of pilled small rocks. The structure is located in the southern part of the Bouleste plateau, in close proximity to the Labas creek. Like structure 8, this is a human shelter and can fit one person—a simple shelter (small *toue*). It could have also served as cheese-salting facility.

Fig. 7.21 Structure 8

Fig. 7.22 Structure 8

Fig. 7.23 Structure 9

Structure 10
GPS position: N4254.823W00017.539
Elevation 1,718 m
Size: over 30×20 m
Area: 600 m^2
Figure 7.24

This structure is a complex set of several enclosures of different size. It is the largest complex of enclosures recorded in the Labas valley and located in the section called Bouleste.

Structure 11
GPS position: N 4254.847W00017.518
Elevation: 1,706 m
Size: 6.2×3.4 m
Area: 21.08 m^2
Figure 7.25

This multicomponent structure consists of a rock shelter formed by two big boulders and two enclosures on the eastern side of the shelter. One enclosure is rectangular with walls made up of similar size small and flat rocks. The second enclosure is also rectangular in shape and smaller. The structure is situated against a steep hill. A *toue* with two enclosures.

Fig. 7.24 Structure 10

Fig. 7.25 Structure 11

Structure 12
GPS position: N4254.844W00017.489
Elevation 1,699 m
Size: 3 × 2.5 m
Area: 7.5 m^2
Figure 7.26

This is an oval-shaped structure made of small and medium size rocks. A part of the structure connects to a natural rock. It probably represents animal shelter as it is not as well made as the *cabana*-type human shelter.

Structure 13
GPS position: N4254.830W00017.500
Elevation 1,697 m
Size: 2 × 1.5 m
Area: 3 m^2
Figures 7.27 and 7.28

This is rectangular in shape structure with metal sheets used as roofing material. It is located on the northern branch of a small creek, a tributary of the Labas creek, approximately 50 m south of structure 12 and 70 m south from structure 30. The walls are well made of same size flat rocks to the height of 1.5 m. A small doorway appears on the western part of the structure. Inside the structure are piles of small rocks. It may have served as a large *leyté* or *houn*.

Fig. 7.26 Structure 12

Fig. 7.27 Structure 13

Fig. 7.28 Structure 13

Structure 14
GPS position: N4254.841W00017.487
Elevation 1,697 m
Size: 3×2.5
Area: 7.5 m^2
Figure 7.29

This is an oval-shaped structure composed of several layers of medium size and small rocks. The walls are well made and rocks fit well to each other. Possibly ewes milking facility; similar to structure 4

Structure 15
GPS position: N4254.936W00016.908
Elevation 1,583 m
Size: 3.4×2.5
Area: 8.5 m^2
Figure 7.30

This is a small cave located in a hill overseeing the eastern part of the valley (plateau Les Artigues). The cave is easily accessible but not well visible from the bottom of the valley. Could have been used as human shelter.

Structure 16
GPS position: N4254.8894W00016.959
Elevation 1,571 m

Fig. 7.29 Structure 14

Fig. 7.30 Structure 15. Small cave

Size: 3 × 3.5 m
Area: 10.5 m^2
Figure 7.31

Rectangular shelter consisting of limestone rocks of similar size and shape. It is situated on the western slope overlooking valley pastures. The Labas creek is to the south of the structure. The structure is of medium size with a large enclosure located approximately 20 m to the north.

Structure 17
GPS position: N4254.791W00016.868
Elevation 1,563 m
Size: 4 × 3.5
Area: 14 m^2
Figure 7.32

This is a medium size oval enclosure composed of 1 and in some places 2 layers of rocks of different size.

Structure 18
GPS position: N 4254.772W 00016.756
Elevation 1,558 m
Size: 1.6 × 1 m
Area: 1.6 m^2
Figure 7.33

Fig. 7.31 Structure 16

Fig. 7.32 Structure 17

Fig. 7.33 Structure 18

Structure 18 is a small human-made rock shelter constructed along two big boulders. A single line of a small and medium size rocks was aligned in front of two big boulders. The shelter probably accommodated a single person. Simple shelter or small *toue*.

Structure 19
GPS position: N4254.804W00016.826
Elevation 1,558 m
Size: 4 × 5 (*cabana*) 30 × 20 m (enclosures)
Area: 20 and 600 m^2
Figures 7.34 and 7.35

Structure 19 is a rectangular *cabana* constructed of small and medium size flat and rectangular rocks. The *cabana* is well constructed with rocks fitting close to each other (resemble brick layers). The three enclosures are constructed of 1 and in some places 2 layers of medium and small size rocks. The complex represents a human shelter and animal enclosures to keep animals separated by age and/or species.

Structure 20
GPS position: N4254.084W00016.858
Elevation 1,557 m
Size: 1.5 × 1 m
Area: 1.5 m^2
Figures 7.36 and 7.37

Fig. 7.34 Structure 19

Fig. 7.35 Structure 19

Fig. 7.36 Structure 20

Fig. 7.37 Structure 20

Structure 20 is a small, one-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility. It is made of medium and small size rocks attached to natural boulder.

Structure 21
GPS position: N4254.813W00016.846
Elevation 1,557 m
Size: 5 × 3 m
Area: 15 m^2
Figure 7.38

Structure 21 is a medium size ring-shaped enclosure constructed of 1/2 layers of small and medium size rocks. Possibly animal enclosure.

Structure 22
GPS position: N4254.814W00016.841
Elevation 1,556 m
Size: 5 × 4 m
Area: 20 m^2
Figure 7.39

Structure 22 is a ruined *cabana*. It was made of small and medium size rocks, some prepared. The walls are still standing up to 1 m. The doorway is still visible.

Fig. 7.38 Structure 21

Fig. 7.39 Structure 22

Structure 23
GPS position: N4254.810W00016.779
Elevation 1,556 m
Size: 2.6 × 1.8 m
Area: 4.68 m^2
Figure 7.40

Structure 23 is a medium size, rectangular *toue* constructed of medium size well-fit rocks. A big boulder is part of the construction (wall and partial roof). Its construction resembles structure 1 but is better constructed.

Structure 24
GPS position: N4254.823W00016.868
Elevation: 1,556 m
Size: ca. 1 m
Area: 1 m^2
Figure 7.41

Structure 24 is the first of a series of 11 stone constructions situated along the Labas creek. The structures are simple, rectangular stone constructions, located on both banks of the creek. They are built of small and medium size rocks with opening on top which makes access to water possible. They functioned as *leytés*.

Fig. 7.40 Structure 23

Fig. 7.41 Structure 24

Fig. 7.42 Structure 25

Structure 25
GPS position: N4254.807W00016.786
Elevation: 1,555 m
Size: 1.7 × 1 m
Area: 1.7 m^2
Figure 7.42

Structure 25 is a small one-person shelter (?), simple shelter or small *toue* constructed on the opposite side of the big boulder which is a constructional segment of structure 20.

Structure 26
GPS position: N4254.814W00016.820
Elevation 1,555 m
Size: 5 × 4 m (*cabana*); 25 × 18 m (enclosures)
Area: 20 + 450 m^2
Figures 7.43 and 7.44

Structure 26 is a multicomponent complex of medium size *cabana* and three big oval enclosures. The *cabana* is of rectangular shape, constructed of medium and small rocks. The rocks are irregular and do not fit well. The enclosures are big in size, oval and constructed of medium size, one-two layers of rocks. The complex consists of a human shelter and three enclosures to accommodate animals, probably separated by age and/or species.

Fig. 7.43 Structure 26 *cabana*

Fig. 7.44 Structure 26. *Cabana* and three enclosures

Fig. 7.45 Structure 27

Structure 27
GPS position: N4254.828W00016.862
Elevation: 1,554 m
Size: ca. 1 m
Area: 1 m^2
Figure 7.45
Lyeté

Structure 28
GPS position: N4254.826W00016.873
Elevation: 1,554 m
Size: ca. 1×1 m
Area: 1 m^2
Figure 7.46
Lyeté

Structure 29
GPS position: N 4254.792W 00016.746
Elevation: 1,553 m
Size: 3.6×2.5 m
Area: 9 m^2
Figures 7.47 and 7.48

Structure 29 is an oval shape, one layer of medium size rocks with a small opening from the southern side. It is well constructed with medium and big rocks fitting

Fig. 7.46 Structure 28

Fig. 7.47 Structure 29

Fig. 7.48 Structure 29

closely to each other. It might be a prehistoric structure (cromlech?). Oval-shaped animal enclosures are not as well made.

Structure 30
GPS position: N 4254.900W00016.773
Elevation: 1,553 m
Size: 5 × 4.5 and 25 × 18 m
Area: 22.5 + 450 m^2
Figures 7.49 and 7.50

This multicomponent structure consists of one medium size, rectangular *cabana* and associated with it big, oval in shape two enclosures. The *cabana* is rectangular in shape and constructed of small and medium size rocks, all of similar size and mostly flat (prepared?). The wall construction makes an impression of a “brick” wall. The walls are still standing about 1 m tall. There is a small opening, doorway, in the eastern wall of the *cabana*. A big boulder located in the western side of the *cabana* is an integral part of its construction. The oval enclosures are located on the western side of the structure.

Structure 31
GPS position: N4254.830W00016.849
Elevation: 1,551 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.51
Lyeté

Fig. 7.49 Structure 30

Fig. 7.50 Structure 30

Fig. 7.51 Structure 31

Structure 32
GPS position: N4254.836W00016.818
Elevation: 1,550 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.52
Lyeté

Structure 33
GPS position: N4254.906W00016.748
Elevation: 1,550 m
Size: 17 × 13 m
Area: 221 m^2
Figure 7.53

Structure 33 is a big irregular enclosure composed of medium and big rocks. The structure seems to be incomplete. It served as animal enclosure.

Structure 34
GPS position: N4254.830W00016.787
Elevation: 1,548 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.54
Lyeté

Fig. 7.52 Structure 32

Fig. 7.53 Structure 33

Fig. 7.54 Structure 34

Structure 35
GPS position: N4254.833W00016.726
Elevation: 1,547 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.55
Lyeté

Structure 36
GPS position: N4254.833W00016.726
Elevation: 1,547 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.56
Lyeté

Structure 37
GPS position: N4254.830W00016.777
Elevation: 1,545 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.57
Lyeté

Fig. 7.55 Structure 35

Fig. 7.56 Structure 36

Fig. 7.57 Structure 37

Structure 38
GPS position: N4254.842W00016.657
Elevation: 1,544 m
Size: 4.2 × 2.3 m
Area: 9.66 m^2
Figure 7.58

Structure 38 is an irregular in shape outline of medium size rocks next to an erratic boulder. Damaged small animal enclosure.

Structure 39
GPS position: N4254.842W00016.641
Elevation 1,544 m
Size: 3.7 × 2.5 m
Area: 9.25 m^2
Figure 7.59

Structure 39 is a medium size enclosure constructed of one layer of medium size rocks.

Structure 40
GPS position: N4254.829W00016.770
Elevation: 1,544 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.60
Lyeté

Fig. 7.58 Structure 38

Fig. 7.59 Structure 39

Fig. 7.60 Structure 40

Structure 41
GPS position: N4254.833W00016.748
Elevation: 1,544 m
Size: ca. 1 × 1 m
Area: 1 m^2
Figure 7.61
Lyeté

Structure 42
GPS position: N4254.833W00016.644
Elevation: 1,543 m
Size: 3.8 × 3.6 m
Area: 13.68 m^2
Figure 7.62

Structure 42 is a medium size animal enclosure constructed of a one layer of medium size rocks.

Structure 43
GPS position: N42 54.857W00016.613
Elevation 1,537 m
Size: 5 × 4.5 m
Area: 22.5 m^2
Figure 7.63

Medium size animal enclosure partly destroyed.

Fig. 7.61 Structure 41

Fig. 7.62 Structure 42

Fig. 7.63 Structure 43

Structure 44
GPS position: N42 54.869W00016.635
Elevation 1,534 m
Size: 8.7 × 3 m
Area: 26.1 m^2
Figure 7.64

Structure 44 is a medium size enclosure attached to a big erratic boulder, constructed of one layer of medium and small size rocks.

Two other structures, a pile of collected rocks and possible tumulus, were not assigned structure number because their interpretation as historic features was impossible without archaeological inspection. Both are in Figs. 7.65 and 7.66 and are not used in the data analysis and discussion.

Data Analysis and Discussion

Analysis of Structures

This section contains descriptive and statistical analysis of all structures recoded during the survey. The preliminary statistical elaborations concern the data arranged in interval, nominal, and ordinal scales.

Fig. 7.64 Structure 44

Fig. 7.65 Pile of collected rocks

Fig. 7.66 Possible tumulus

Several types of structures were recorded in the valley. Generally, the structures are of three functions:

- Human shelters related to transhumance
- Animal enclosures (sheep and cattle)
- Pastoral amenities, *lyetés*

Human shelters are of three different types[11]:

- Small, single-person shelters
- *Cabanas*
- Human shelters constructed around erratic boulders *toues*

The structures are also of different level of structural and constructional complexity. Some are well made with well visible outlines and preserved foundations (*cabanas*, other human shelters), while others are single-layered ovals (animal enclosures). In terms of their constructional and structural complexity, all structures can be classified as:

- Single-component
- Multicomponent

[11] Structure 15, small cave, is not used in this classification.

And in terms of shape:

- Rectangular (R)
- Oval (O)
- Irregular (I)

The single-component structures are classified as:

- Single-layered ovals
- Small human shelters
- Single *cabanas*
- Single animal enclosures

The multicomponent structures are:

- Structures around erratic boulders, animal enclosures, and *toues*
- Rectangular *cabanas* attached to one or more animal enclosures

All structures are classified in three groups regarding their size:

- Small 1–3 m^2 (human single-person shelters including small *toues* and milk storage facilities *lyetés*)
- Medium 4–23 m^2 (human shelters [*cabanas* and *toues*] and animal enclosures)
- Large 77–620 m^2 (multicomponent structures consisting of human shelters and animal enclosures)

All recorded structures represent different time periods, mostly historic times. Because no archaeological subsurface inspections were conducted, the temporal association of the structures is not provided. In general these structures come from:

- Prehistoric times (possibly structure 28, cromlech?)
- Historic times (43 structures; structure 15 is counted here as historic, for it possibly functioned as herder's shelter)

Spatial analysis of all structures (N=44) reveals grouping in three clusters:

- Cluster 1, elevation 1,812–1,799 masl, ~2.5 ha, Upper Bouleste, consists of four structures (1–4) (Table 7.2)
- Cluster 2, Bouleste, elevation 1,736–1,697, ~10 ha, consists of ten structures (5–14) (Table 7.3)
- Cluster 3, les Artigues, elevation 1,583–1,534, ~28 ha, consists of 30 structures (15–44) (Table 7.4)

Figure 7.67 presents the distribution of structures against schematic relief of the Labas Valley. Three clusters of structures are located on three plateaus: cluster 1, the Upper Bouleste plateau, cluster 2, the Bouleste plateau, and cluster 3, les Artigues plateau. The distribution pattern follows the relief of the valley with the largest concentration of structures in the pasture area of a relatively flat zone within

Table 7.2 Cluster 1, Upper Bouleste, elevation 1,812–1,799 masl, ~2.5 ha area

Structure no. Fig. no.	Elevation	Size	Area in m^2	Shape	Construction	Function
1 Figs. 7.8 and 7.9	1,812	2×4	8	Oval + boulder	Multicomponent; boulder + rocks	Animal enclose
2 Figs. 7.10 and 7.11	1,801	20×10	200	Boulder + rectangular	Multicomponent; Boulder + medium and small rocks	Four animal enclosures of different size
3 Figs. 7.12 and 7.13	1,800	4×3	12	Rectangular	Single-component, well-constructed with small and medium size rocks	*Cabana*
4 Figs. 7.14 and 7.15	1,799	5×3	15	Oval	Single-component, Horseshoe, oval-shaped structure, similar in construction to structure 14	Possibly ewes milking facility; similar to structure 14

Table 7.3 Cluster 2, Bouleste, elevation 1,736–1,697, ~10.0 ha area

Structure no. / Fig. no.	Elevation	Size	Area in m^2	Shape	Construction	Function
5 Figs. 7.16, 7.17, and 7.18	1,736	11×7	77	Oval + boulder	Multicomponent; boulder +rocks	Three animals enclosures attached to boulder
6 Fig. 7.19	1,733	3.5×2.7	9.45	Rectangular	Single component	Uncertain; probably human shelter
7 Fig. 7.20	1,730	3×2.5	7.5	Oval	Single component	Uncertain; probably human shelter
8 Figs. 7.21 and 7.22	1,724	1.5×1	1.5	Rectangular + boulder	Multicomponent; boulder + rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility
9 Fig. 7.23	1,723	1.6×1	1.6	Rectangular + boulder	Multicomponent; boulder + rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility
10 Fig. 7.24	1,718	30×20	600	Rectangular + oval	Multicomponent	*Cabana* + animal enclosure
11 Fig. 7.25	1,706	6.2×3.4	21.08	Rectangular + boulder	Multicomponent; boulder + rocks	A *toue* with two animal enclosures
12 Fig. 7.26	1,699	3×2.5	7.5	Oval + boulder	Multicomponent; boulder + rocks	Animal enclosure
13 Figs. 7.27 and 7.28	1,697	2×1.5	3	Rectangular	Single-component	*Leyté*, milk storing facility
14 Fig. 7.29	1,697	3×2.5	7.5	Oval	Single-component; horseshoe-shaped	Possibly ewes milking amenity; similar to structure 4

Table 7.4 Cluster 3, les Artigues, elevation 1,583–1,534 masl, ~28.0 ha area

Structure no. Fig. no.	Elevation	Size	Area in m^2	Shape	Construction	Function
15 Fig. 7.30	1,583	3.4×2.5	8.5	Small cave	Single-component	Human shelter
16 Fig. 7.31	1,571	3.5×3	10.5	Rectangular	Single-component, well-made, rocks by size	*Cabana*
17 Fig. 7.32	1,563	4×3.5	14	Oval	Single-component	Animal enclosure
18 Fig. 7.33	1,558	1.6×1	1.6	Irregular	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*
19 Figs. 7.34 and 7.35	1,558	5×4; 30×20	20+600	Oval+rectangular	Multicomponent; a complex of human shelter and three animal enclosures	*Cabana*+3 enclosures; similar to structure 10
20 Figs. 7.36 and 7.37	1,557	1.5×1	1.5	Rectangular+boulder	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*; could have served as cheese-salting facility
21 Fig. 7.38	1,557	5×3	15	Oval	Single-component	Animal enclosure
22 Fig. 7.39	1,556	5×4	20	Rectangular	Single-component; well-built, rocks carefully collected and put by size	*Cabana*

23 Fig. 7.40	1,556	2.6×1.8	4.68	Rectangular+boulder	Multicomponent; boulder+rocks	*Toue*
24 Fig. 7.41	1,556	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
25 Fig. 7.42	1,555	1.7×1	1.7	Rectangular+boulder	Multicomponent; boulder+rocks	One-person shelter? Simple shelter or small *toue*
26 Figs. 7.43 and 7.44	1,555	5×4; 25×18	20×540	Rectangular+oval	Multicomponent	*Cabana*+3 oval enclosures; similar to structure 10 and 19
27 Fig. 7.45	1,554	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
28 Fig. 7.46	1,554	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
29 Figs. 7.47 and 7.48	1,553	3.6×2.5	9	Oval	Single-component	Prehistoric? (cromlech?)
30 Figs. 7.49 and 7.50	1,553	5×4.5 25×18	22.5 450	Rectangular+oval+boulder	Multicomponent; boulder+rocks	*Cabana*+2 oval animal enclosures
31 Fig. 7.51	1,551	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
32 Fig. 7.52	1,550	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
33 Fig. 7.53	1,550	17×13	221	Oval/irregular	Single-component	Animal enclosures
34 Fig. 7.54	1,548	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility

(continued)

Table 7.4 (continued)

Structure no. Fig. no.	Elevation	Size	Area in m^2	Shape	Construction	Function
35 Fig. 7.55	1,547	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
36 Fig. 7.56	1,547	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
37 Fig. 7.57	1,545	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
38 Fig. 7.58	1,544	4.2×2.3	9.66	Irregular+boulder	Multicomponent; boulder+rocks	Simple construction suggests animal enclosure attached to boulder
39 Fig. 7.59	1,544	3.7×2.5	9.25	Oval/irregular	Single-component	Simple construction suggests animal enclosure
40 Fig. 7.60	1,544	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
41 Fig. 7.61	1,544	1×1	1	Rectangular	Single-component	*Leyté*, milk storing facility
42 Fig. 7.62	1,543	3.8×3.6	13.68	Irregular	Single-component	Simple construction suggests animal enclosure
43 Fig. 7.63	1,537	5×4.5	22.5	Irregular	Single-component	Function unknown; simple construction suggests animal enclosure
44 Fig. 7.64	1,534	8.7×3	26.1	Oval+boulder	Multicomponent; boulder+rocks	Animal enclosure attached to boulder

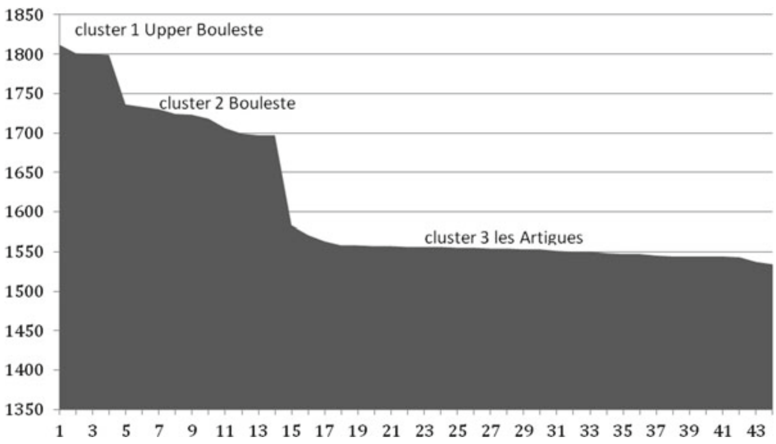

Fig. 7.67 Distribution of structures against schematic relief of the Labas Valley

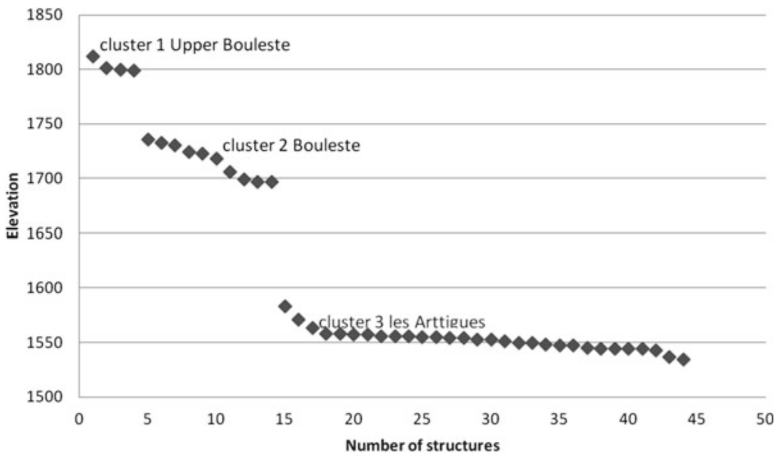

Fig. 7.68 Number of structures by cluster (elevation)

elevations between 1,543 and 1,583 masl (~28 ha), the second, smaller cluster of structures on the Bouleste plateau is limited to the area with elevations between 1,697 and 1,736 masl (~10 ha), and the third, smallest cluster of structures, Upper Bouleste, is located in the most elevated plateau from 1,799 to 1,812 masl (~2.5 ha).

The number of structures in each cluster (by elevation) is presented in Fig. 7.68.

Tables 7.2, 7.3, and 7.4 summarize the structures of all clusters by such factors as elevation, size, area, shape, construction, and function.

Cluster 1, the Upper Bouleste is located in the westernmost part of the valley, above the Bouleste plateau. It consists of four structures (Fig. 7.68; Table 7.2), three medium size and one large-area structure. Structures 2 and 3 seem spatially related and form a complex, large-area structure composed of a human shelter (*cabana*) and four animal enclosures of different size to accommodate animals of different age and also better control certain activities, such as milking. Constructions of two structures are multicomponent, boulder + arranged rocks, and two are single-component. Functionally, the structures represent one human shelter (*cabana*) and three animal enclosures, all related to *ovine* husbandry. Density of structures is ~1.6 per ha.

Cluster 2 is located in the Bouleste plateau in the western part of the valley. It consists of ten structures (Fig. 7.68; Table 7.3) representing greater diversity of size, construction, and function than cluster 1. Three structures (8, 9, and 13) are of small area, four (6, 7, 11, and 12) of medium area, and two (5 and 10) are large-area structures. Six structures are multicomponent, including four representing constructional complexity (combination of natural boulder and human-arranged rocks) and two of structural complexity (human shelters attached to animal enclosures). Four structures (6, 7, 13, and 29) are single-component. Functionally the structures represent rectangular and oval human shelters, rectangular *cabana*, ewes milking amenity, and oval animal enclusures. Four structures present two types unrecorded in cluster 1, three of them (8, 9, and 11) are small human shelters *toue*, and one is a *leyté*, a type of structure related to storing milk; it suggest *bovine* husbandry. The cluster represents evidence of mixed use as the area of ovine and bovine husbandry. Density of structures is ~1.0 per ha.

Cluster 3 is located on les Artigues plateau in the eastern part of the valley and is the largest in the valley. It consists of 30 structures (Fig. 7.68; Table 7.4) mostly concentrated at the southern part of the plateau (29 human-made and one small cave [structure 15]). Fourteen structures (18, 20, 24, 25, 27, 28, 31, 32, 34, 35, 36, 37, 40, and 41) are small in area, 12 structures (15, 16, 17, 21, 22, 23, 29, 38, 39, 42, 43, and 44) are of medium area, and 4 (19, 26, 30, and 33) are large-area structures. This cluster offers the greatest diversity of structures in size, construction, and function. Among the 14 small area structures, 11 are *lyetés* and 4 *toues*. Nine structures are multicomponent, including six representing constructional complexity (combination of natural boulder and arranged rocks) and two of structural complexity (human shelters attached to animal enclosures); one multicomponent structure (30) presents both constructional and structural features. Twenty structures are single-component, 11 of them are *lyetés*, 4 *toues*, 2 cabans, and 3 animal enclosures. Structure 15, small cave is classified as single-component. The number of *leytés* (11) suggest strong emphasis on *bovine* husbandry. Density of structures is ~1.07 per ha.

Size and Area of Structures

Generally, structures of all sizes are present in all clusters, except cluster 1, where only medium and large-area structures were recorded. The largest cluster, les Artigues, at elevation around 1,550 m consists of 30 structures including three large-area structures. The second cluster, Bueleste on a small plateau between 1,700 and 1,750 m, is composed of 10 structures including two large-area structures, and the smallest cluster, Upper Bouleste at and above 1,800 m, consists of one large-area

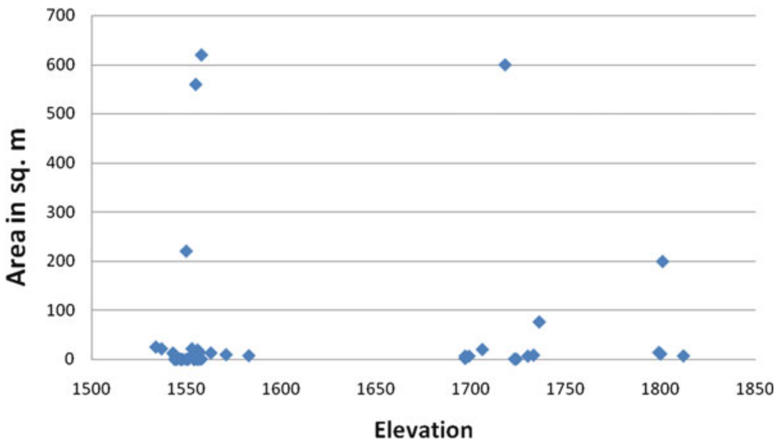

Fig. 7.69 Clustering of structures by size (area)

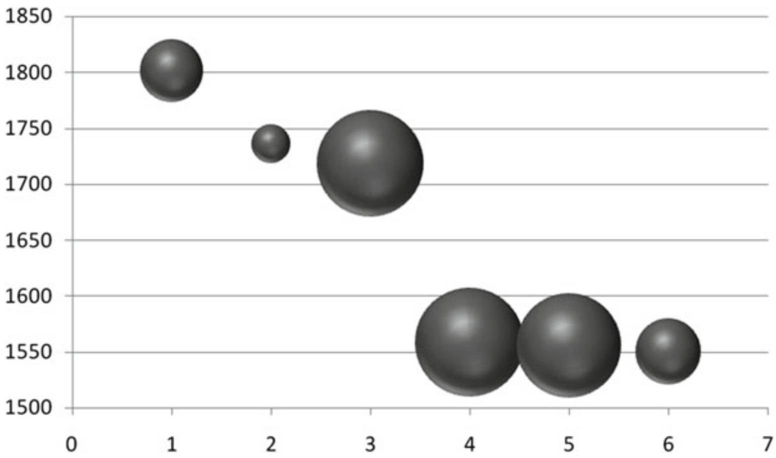

Fig. 7.70 Large-area structures by cluster (elevation)

structure. Distribution of structures by size (area) and elevation is presented in Figs. 7.69 and 7.70. It does not show any specific correlation between size of structures and elevation. Large-area structures are in all clusters and their number in the cluster seems to depend on the area of available pastures. Small structures are in cluster 2 and 3 and their presence suggest mixed *ovine* and *bovine* husbandry, whereas cluster 1, Upper Bouleste, was probably limited to only *ovine* husbandry.

Six structures represent large-area structures, ranging from 77 to 620 m^2. One, 200 m^2 is at 1,801 m (Upper Bouleste), two 77 and 600 m^2 are between 1,700 and 1,750 m (Bouleste), and three, 620, 560, and 221 m^2 are at or above 1,550 m (Les Artigues). It is not clear whether they represent different chronological phases or whether they represent different communities. They might, however, evidence local communal (cooperative) arrangements to use the high-altitude commons.

Shape

The structures are basicaly of two shapes: rectangular or oval (circular), and some are irregular (multicomponent). Structures of these shapes are in all three clusters and do not show any specific correlations with elevation but with function. Rectangular structures are predominantly human shelters (*cabans*), while oval structures represent animal enclosures.

Density

Density of structures by cluster shows relatively even distribution of structures by the estimated area of available pastures (Table 7.5). The presently recorded number of structures per cluster does not represent the number of structures existing at certain time and therefore cannot be used to estimate the minimal economically sustainable territorial unit per structure. Such estimation will be attempted with the spatial and chronological distribution of structures completed. The number of structures per cluster seems to be determined by the area of available pastures, but could also be the result of human decision-making (a hypothesis for the second phase of the project) (Table 7.6).

Table 7.5 Density of structures per cluster

Cluster	Area in ha	No. of structures	Density
Cluster 1 Upper Bouleste	2.5	4	1.6
Cluster 2 Bouleste	10	10	1.0
Cluster 3 les Artigues	28	30	1.07

Table 7.6 Distribution of multicomponent structures, *cabanas* + animal enclosures, by cluster

Structure no.	Cluster	Elevation masl	Area in m^2	Construction/shape
10	2 Bouleste	1,718	600	Rectangular *cabana* + oval animal enclosure
19	3 les Artigues	1,558	620	Rectangular *cabana* + 3 oval animal enclosures
26	3 les Artigues	1,555	560	Rectangular *cabana* + 3 oval animal enclosures
30	3 les Artigues	1,553	472.5	Rectangular *cabana* + 2 oval animal enclosures

Structural Complexity of Structures

Multicomponent structures representing structural complexity are present in cluster 2—Bouleste (one structure), and cluster 3—les Artigues (three structures). They all represent rectangular in shape and well-made *cabanas* attached to oval animal enclosures.

Constructional Complexity of Structures

Thirteen structures (29.6% of all structures) represent constructional complexity which includes erratic boulders as parts of the construction. Multicomponent structures around erratic boulders are in all clusters: cluster 1—two structures (15.4%), cluster 2—five structures (38.5%), and cluster 3—six structures (46.1%). Their sizes range from small 1.5 m^2 human shelters to large-area animal enclosures (200 m^2). Functionally, they represent animal enclosures and small human shelters (*toues*).

In sum, 17 out of 44 structures (38.6%; 27 structures are single-component—61.4%) represent constructional and/or structural complexity. Constructions of structures differ significantly. Some are quick-made showing evidence of opportunistic behavior evidenced in the use of natural features to construct human shelters such as *toues* and animal enclosures, whereas others show a great deal of time and effort investment in the preparation of material (collection of rocks of similar size) and construction of huts. It is not clear whether such constructional differences also suggest chronological differences, but they certainly suggest behavioral difference in the investment efforts. The effort put to the construction of these structures, in comparison with other structures where opportunistic economic behavior is clearly represented (multicomponent structures with erratic boulders or *toues*, Table 7.7), suggests that they might represent group effort in both construction and maintenance and therefore represent evidence of communal organization of animal husbandry in high-altitude pastures. This hypothesis will be further tested in the second phase of the project.

Out of 44 structures, 27 are single-component and 17 are multicomponent representing either constructional or structural complexity (Table 7.8). In cluster 1 the distribution of structures by constructional and/or structural complexity is even, multicomponent structures are more common in cluster 2, while single-component structures significantly dominate cluster 3. Interestingly, multicomponent structures show the evidence of two opposite economic behaviors: constructional complexity, when structures are built with the use of topographic features, mostly erratic boulders, suggests opportunistic economic behavior where human action is minimized to achieve the desired effect (result), whereas structural complexity, when structures consist of well-made *cabanas* accompanied by one or more oval animal enclosures, testifies of increased investment [group investment] of time and effort to construct specific structures to probably serve a larger community.

Table 7.7 Distribution of structures constructed around erratic boulders by cluster

Structure no.	Cluster	Elevation masl	Area in m²	Shape	Function
1	1 Upper Bouleste	1,812	8	O + boulder	Animal enclosure
2	1 Upper Bouleste	1,801	200	R + boulder	Four animal enclosures
5	2 Bouleste	1,736	77	O + boulder	Animals enclosures attached to boulder
8	2 Bouleste	1,724	1.5	R + boulder	Simple shelter or small *toue*; cheese-salting facility?
9	2 Bouleste	1,723	1.6	R + boulder	Simple shelter or small *toue*; cheese-salting facility?
11	2 Bouleste	1,706	21.8	R + boulder	A *toue* with two animal enclosures
12	2 Bouleste	1,699	7.5	O + boulder	Animal enclosure
18	3 les Artigues	1,558	1.6	I + boulder	Simple shelter or small *toue*
20	3 les Artigues	1,557	1.5	R + boulder	Simple shelter or small *toue*; cheese-salting facility?
23	3 les Artigues	1,556	4.68	R + boulder	*Toue*
25	3 les Artigues	1,555	1.7	R + boulder	Simple shelter or small *toue*
38	3 les Artigues	1,544	9.6	R + boulder	Animal enclosure
44	3 les Artigues	1,534	26.1	O + boulder	Animal enclosure

Table 7.8 Single-component and multicomponent structures by cluster, $N = 44$

Cluster	Single-component (%)	Multicomponent (%)	*N* (%)
1 Upper Bouleste	2 (50%)	2 (50%)	4 (100%)
2 Bouleste	4 (40%)	6 (60%)	10 (100%)
3 les Artigues	21 (70%)	9 (30%)	30 (100%)
N	27 (100%)	17 (100%)	44 (100%)

Function

The recoded structures represent seven key functional types summarized in Table 7.9.

The most common functional type is a single animal enclosure (13 structures, 29.6% of all structures), followed by *lyetés* (12; 27.3%), and *toues* (7; 15.9%).

Table 7.9 Functions of structures by cluster

Cluster	*Cabana* + enclosures (%)	Single *cabana* (%)	Single human shelter (%)	Single animal enclosure (%)	Toue (%)	Leyté (%)	Milking amenity (%)	*N* (%)
Upper Bouleste	0 (0%)	1 (25%)	0 (0%)	2 (50%)	0 (0%)	0 (0%)	1 (25%)	4 (100%)
Bouleste	1 (10%)	0 (0%)	2 (20%)	2 (20%)	3 (30%)	1 (10%)	1 (10%)	10 (100%)
Les Artigues	3 (10%)	2 (6.7%)	1[a] (3.3%)	9[b] (30%)	4 (13.3%)	11 (36.7%)	0 (0%)	30 (100%)
N (%)	4 (9.1%)	3 (6.8%)	3 (6.8%)	13 (29.6%)	7 (15.9%)	12 (27.3%)	2 (4.5%)	44 (100%)

[a]Structure 15 is a small cave probably used by herders
[b]Structure 29 might be prehistoric cromlech

Table 7.10 Distribution of single-person shelters and/or *toues* by cluster

Structure no.	Cluster	Elevation masl	Area in m^2	Shape
8	Bouleste	1,724	1.5	R + boulder
9	Bouleste	1,723	1.6	R + boulder
11	Bouleste	1,706	21.08	R + boulder + animal enclosures
18	Les Artigues	1,558	1.6	R + boulder
20	Les Artigues	1,557	1.5	R + boulder
23	Les Artigues	1,556	4.68	R + boulder
25	Les Artigues	1,555	1.7	R + boulder

Table 7.11 Distribution of *lyetés* by cluster

Structure no.	Cluster	Elevation masl	Area in m^2
13	Bouleste	1,697	3
24	Les Artigues	1,556	1
27	Les Artigues	1,554	1
28	Les Artigues	1,554	1
31	Les Artigues	1,551	1
32	Les Artigues	1,550	1
34	Les Artigues	1,548	1
35	Les Artigues	1,547	1
36	Les Artigues	1,547	1
37	Les Artigues	1,545	1
40	Les Artigues	1,544	1
41	Les Artigues	1,544	1

Functional distribution of structures does not show any specific preferences for certain cluster; their number in a cluster correlates with the cluster area rather than specialized production, except for the number of *lyetés* in cluster 3 strongly suggesting a preference for *bovine* husbandry (Table 7.10).

Single-person shelters, some may classify as *toues*, are only present in Bouleste and les Artigues and correlate with the appearance of sigle animal enclosures in both clusters. Some of these structures might not be related to transhumance, however (Table 7.11).

Distribution of *leytés* by cluster suggets that the *bovine* husbandry was limited to 2 clusters: Bouleste and les Artigues and concentrated in the latter where 11 *lyetés* were recorded. All 11 *lyetés* from les Artigues are of similar construction and size. The one from Bouleste (Fig. 7.13) is larger and seems more recent (the use of modern roofing material as part of the construction), wheres the 11 from les Artigues might be older and actually represent the same time episode.

Summary of Clusters

Cluster 1, It, elevation 1,812–1,799 masl, ~2.5 ha, consists of four structures (1–4) (Table 7.2). It is the smallest pasture. Functionally, the structures represent one human shelter (*cabana*) and three animal enclosures. Structure 4 represents milking ewes amenity. The type of structures and the elevation of pastures suggest that this cluster was primarily used for *ovine* husbandry. One large-area structure (structure 2) suggests that it may have been used at some time as a communal grazing area. Chronological correlation of structures has not been determined. The cluster might also contain a tumulus (Fig. 7.66). Density of structures is ~1.6 per ha.

Cluster 2, Bouleste, elevation 1,736–1,697, ~10 ha, consists of ten structures (5–14) (Table 7.3). Bouleste is the second largest pasture. Functionally the structers represent rectangular and oval human shelters, rectangular *cabana*, ewes milking amenity, and oval animal enclusures. Four structures present two types unrecorded in cluster 1, three of them (8, 9, and 11) are small human shelters *toue*, and one is a *leyté* a type of structure related to storing milk; it suggest *bovine* husbandry. Chronlogical correlation of structures has not been determined. The cluster presents evidence of mixed use as the area for *ovine* and *bovine* husbandry. Density of structures is ~1.0 per ha.

Cluster 3, les Artigues, elevation 1,583–1,534, ~28 ha, consists of 30 structures (15–44) (Table 7.4). Les Artigues is the largest pasture area in the valley. This cluster offers the greatest diversity of structures in size, construction, and function. Among the 14 small area structures, 11 are *lyetés* and 3 *toues*. Nine structures are multicomponent, including six representing constructional complexity (combination of natural boulder and arranged rocks) and two of structural complexity (human shelters attached to animal enclosures); one multicomponent structure (30) presents both constructional and structural features. Twenty structures are single-component, 11 of them are *lyetés*, 4 *toues*, 2 cabans, and 3 animal enclosures. Structure 15, small cave is classified as single-component. The number of *leytés* (11) suggests strong emphasis on *bovine* husbandry. Chronological correlation of structures has not been determined. The cluster contains evidence of mixed *ovine* and *bovine* husbandry with preference for *bovine*. Evidence of presumably earlier *ovine* husbandry has been obliterated by the change to presently dominating *bovine* husbandry. Density of structures is ~1.07 per ha.

Conclusions

The case presented here contributes to better understanding of the interconnection between human decisions and their environment in historical perspective. The project's goal is to research the history of transhumance in the Pyrenees and the first part of the project was a survey of the Labas Valley and the results are presented in this chapter. People penetrated the valley at different times and left traces of their use of the high-altitude pastures. The project revealed evidence of collective action and patterns of land-use applied to the commons of the Labas Valley.

One of the results is the identification of the use of the commons in high altitudes. Multicomponent structures representing structural complexity are present in cluster 2—Bouleste (one structure), and in cluster 3—les Artigues (three structures). They all represent rectangular in shape and well-made *cabanas* attached to oval animal enclosures. One *cabana* may have been occupied by five to six men. The effort put in the construction of these structures in comparison with other structures, where opportunistic economic behavior is clearly represented (multicomponent structures with erratic boulders or *toues*), suggests that these large-area structures might represent group effort in both construction and maintenance and therefore correspond to the communal organization of animal husbandry and the use of high-altitude pastures. This hypothesis will be further tested in the second phase of the project. Interestingly, however, multicomponent structures show the evidence of two opposite economic behaviors: constructional complexity where structures are built with the use of topographic features, mostly erratic boulders, suggests opportunistic economic behavior when human investment is minimized to achieve the desired effect [result], whereas structural complexity, when structures consist of well-made *cabanas* accompanied by one or more oval animal enclosures, testifies of increased investment of time and effort to construct specific structures probably serving a larger community. The argument about the communal (collective) use of high-altitude pastures in Hautes-Pyrénées is supported by archaeological, linguistic, and historic data. The collective use of high-altitude pastures has been confirmed by the medieval sources for the Alps and researched recently by Robert McC. Netting, Elinor Ostrom, and others.

Another result is the suggestion that the Labas Valley presents evidence of the line separating the use of pastures associated with *ovine* husbandry (cluster 1, Upper Bouleste and cluster 2 Bouleste), and *bovine* husbandry limited to clusters 2 and 3. This observation corroborates the claim that an elevation between 1,600 and 1,700 m puts a limit in the use of high-altitude pastures.

Finally, the number of structures per cluster seems to be determined by the size of available pastures, but the relatively even density of structures per ha suggests that it might also be the result of human decision-making, which is a hypothesis for the second phase of the project.

Assigning the presented features to one culture would oversimplify the record. A closer examination of historical and ethnographic records, even if preliminary, suggests a great linguistic diversity in naming areas of high-altitude pastoral activities, differences in the pattern of land-use as well as reveals structural differences in the construction and use of structures. A typical pastoral set in Hautes-Pyrénées includes: *cabana*, sheep/cow shed, and enclosure. Since the eighteenth century clusters of such sets are identified as *courtau* which included: *cabana*, *bederat* or *tiarat* (small cow shed for claves), *sès* (shed for milking cows), *barguerot* (enclosure), and *lyeté* (milk storage amenity).

Certain terms still used by local residents point out to the collective arrangements in the use of high-altitude pastures and to the fact that their cultural [social] designations change. *Cuyéou* or *couéyla* or *cujala* and *cortau* are vernacular designations of not well-defined territorial units, which changed as new arrangements to use high-altitude pastures were made in the village or among villages (which may also included linguistic change as terms for territorial units change from valley to valley). They represent places with new physical provisions and filled with new meanings as people saw fit at the time they used the unit. For instance, *courtau*, which in fact is a territorial district without well-defined boundaries, may change depending on such social arrangements. The district typically incorporates a *cabana* and animal enclosures but also immediate pasture. Several *cabanas* and shepherds might have used the same territorial unit such as *cuyéla*, as recorded in some cadastre, where a *cuyéou*, another term for territorial unit, includes 2–5 *cabanas*.[12]

Medieval texts also mentioned that valley communities can be distinguished from each other through the elements of their material culture. Additionally, valleys were independent political units with their own rules to manage high-altitude pastures. Local differences in architectural forms and other characteristics of pastoral lifestyle exist from valley to valley. Thus, each valley may have had its own cultural signature to identify the "ownership" or right to use pastures. This briefly outlines how people encounter places, perceive them, and endow them with significance within specific cultural landscape and the examined evidence seems to suggest such behavior in regard to the Labas Valley in Haute-Pyrénées. Here, I attempt to move beyond generalizations about place as simply a cultural construct by describing specific ways in which places embody different physical and cultural attributes. The meaning of place is therefore a discursive entity—a floating signifier. Feld and Basso (1996) point out "that as people fashion places, so, too, do they fashion themselves." Filling places with meanings maintains the order of "how things should be." And those meanings help us to answer the question of why we hold on to what we like. This leads me to conclusion that we always identify place within a certain cultural context. It is embedded in culture and expressed through behavior or symbols. Culture is found in place, and it gives place its meaning. At the same time, we constantly carry culture into place, and therefore place is constantly redefined by the people who occupy it at any particular period of time. Thus, culture assigns the way in which place is perceived. No matter how specific or detailed our descriptions of place may be, something of importance inevitably is left out, the unknown or unrecognized ("wild" in Casey's 1996 terminology). No doubt place is a reality, but one composed of two distinct realms: cultural (recognized) and natural which people will experience both simultaneously. To be fully in place means to know both the historic and present aspects of a place, and to experience both its cultural and natural meanings. In this sense, we could assume that the time/space dichotomy will also arise from the experience of place since it provides a common matrix for time and space, filled with events, time-space units. Time and history cannot be separated from place, although place will be known by its most manifested aspect, which is culture. The full potential of place is in its multivocal symbolism and significance of cultural designation.

[12] See the chapters by Guédon and Lévêque in this volume.

The approach presented here is an attempt in searching for a new methodology to study complex cultural landscapes such as high-altitude commons. I have approached the subject from both the interpretive point of view and made several assumptions related to cultural landscape and place as its analytical unit and also used interval, nominal, and ordinal scales to organize and manipulate the collected data statistically. The statistical manipulation is preliminary and aims at the organization of data for more advanced elaboration. I have used here only the archaeological data, which combined with historical accounts and supported through ethnographic research would give us a more complete picture on the organization of the commons in the Pyrenees, and such a project is the next step in my research. This preliminary research revealed evidence of specific interactions between humans and the mountain environments existing in the past. Future research will focus on identifying the chronological phases of human activities in the Pyrenees and identities of people who left their marks behind.

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Chapter 8
The Use of GIS and Weights-of-Evidence in the Reconstruction of a Native American Sacred Landscape in Rocky Mountain National Park, Colorado

David M. Diggs and Robert H. Brunswig

In 1998, initiation of a major archeological inventory project in Rocky Mountain National Park (RMNP), Colorado, funded by the National Park Service's Systemwide Archeological Inventory Program (SAIP), opened the door for recovery of new knowledge on the Park's Native American history and cultural traditions. SAIP, operated by the University of Northern Colorado over a 5-year period (1998–2002), recorded more than 1,000 prehistoric and historic archeological sites within ~30,000 surveyed acres of the park's total 275,000 acres (Brunswig 2005b). By the second project year (1999), evidence emerged that many sites and natural landmarks were associated with probable evidence of past Native American religious, as well as socioeconomic, activities and belief systems (see Fig. 8.1). The Sacred Landscapes Project's primary goal has been to systemically collect data presumed to be associated with past Native American religious practices in RMNP in order to formulate and test models of cultural-religious belief and behavior within the Park's cultural (archeological) and natural landscapes.

Sacred Landscapes Research in Archeology

Research into cultural-natural landscapes which incorporates religious as well as socioeconomic components has been an increasingly common topic of interest in recent years. In the early 1980s, British archeologists were using the term "ritual landscape"

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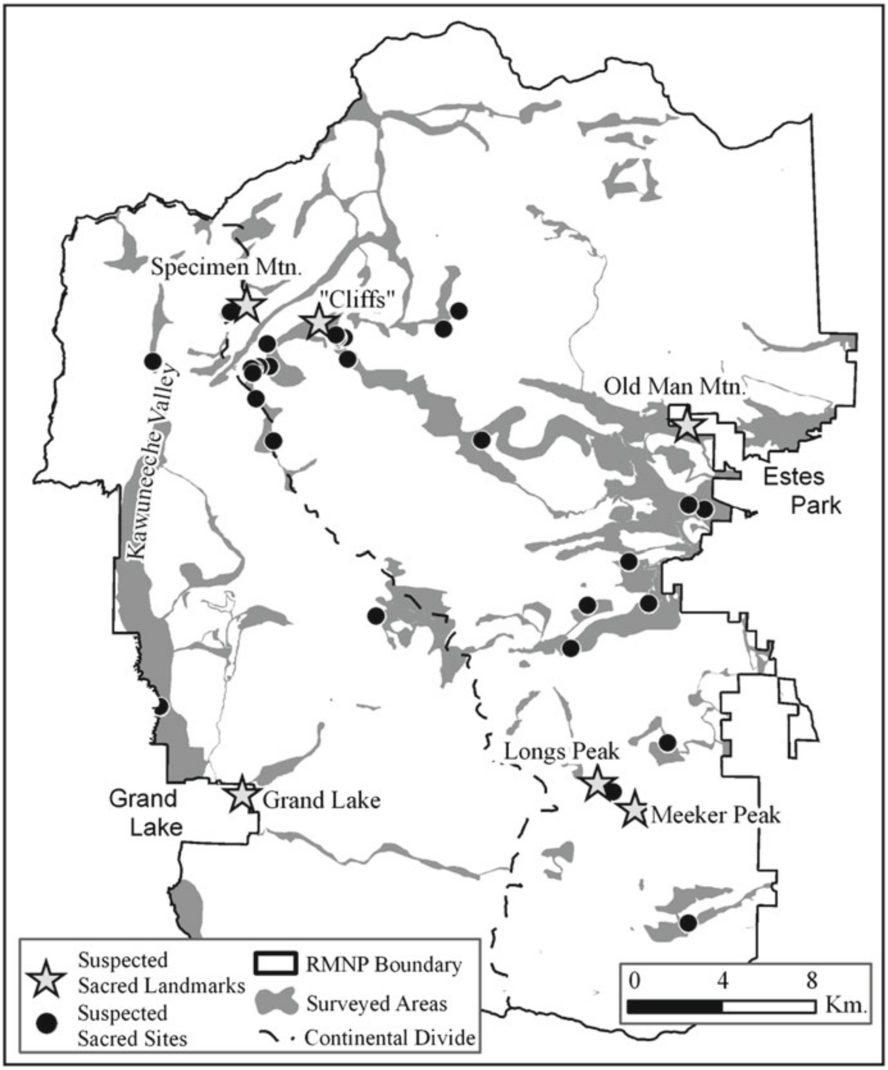

Fig. 8.1 Rocky Mountain National Park and natural/sacred landmarks mentioned in the text

to describe spatial distributions of the Neolithic—Early Bronze Age ceremonial monuments and shrines and attempts to establish their political and religious relationship to regional domestic settlements (cf. Robb 1998). In the Eastern Mediterranean, archeologists have employed computer-mapping software to model spatial distributions of third and second millennium BC Minoan religious sanctuaries in the mountains of Crete (Soetens et al. 2001). On Peru's desert coast, the well-known Nasca geoglyphs (very large-scale cleared areas of desert pavement in geometric patterns) have been Geographic Information System (GIS)-modeled, revealing what researchers described as a "ritually designed" landscape superimposed on the Nasca natural terrain where "lack of visibility" among the geoglyphs created a regional system of ritual features observable in their entirety only from high altitude (Lambers and Sauerbrier 2006; Sauerbrier 2006). The concept of sacred (and mundane) landscapes has been increasingly the subject of contemporary studies of North America's Native American cultures and natural landscapes. Among the best known examples is the Black Hills region, an isolated mountain range in the western Great Plains of South Dakota, Wyoming, and Montana. The Black Hills, considered a sacred landscape by the Lakota Sioux, Cheyenne, Arapaho, Kiowa, and Kiowa-Apache, were viewed by those tribes as an integrated landscape of sacred natural features and sacred sites and features designed to support ritual activities related to associated tribally defined myths and beliefs (Sundstrom 1996). The Lakota Sioux, the last Black Hills historic tribe, viewed many of its geographic landmarks as being identified and mirroring astronomical constellations associated with stories in the Lakota Falling Star myth cycle. Seasonal migrations into and through the Black Hills were scheduled to visit sacred landmarks and, in the process, celebrate cyclical events recounted in those stories (Sundstrom 1996:179, Table 8.2). Although the Lakota were relative late-comers to the Black Hills (ca. AD 1775), they adapted their own religious mythology to the land, blending it with mythological traditions of earlier Black Hills' residents (Cheyenne, Kiowa and Kiowa-Apache) and infused the Lakota belief system into the Black Hills' physical landscape in ways similar to their predecessors (Sundstrom 1996:186). A less expansive reconstruction of a sacred landscape was recently accomplished by National Park Service archeologists, Ralph Hartley and Ann Vawser, for two neighboring mountains (Sheep and Hunt) which encompass a ~23 km^2 area in Wyoming's Bighorn National Forest (Hartley and Vawser 2005). They analyzed data on prehistoric and historic rock-built features, believed, on the basis of archeological and ethnographic evidence, to have religious associations, using that data to model feature spatial distribution patterns using ArcGIS™ and statistical (SPSS™) software. While the scope and depth of the Bighorn National Forest research inquiry were more limited than our own RMNP sacred landscape studies, its general methodologies and results are comparable. One important finding was that rock features interpreted as vision quests on the two mountains appeared to reflect differential field-of-view orientations (facing directions) consistent with features on Hunt Mountain that were oriented to the rising sun (east) while those on Sheep Mountain were primarily oriented to the setting sun (west). For the most part, the dichotomy of feature orientations of the two mountains was dictated by differences in their "natural topography" (Hartley and Vawser 2005:17).

Sacred Landscapes Project Research Design and Methodology

The University of Northern Colorado's Sacred Landscapes Project research design (cf. Brunswig et al. 2009, 2010) emphasizes four lines of inquiry: (1) "mining" of southern Rocky Mountains and north central Colorado ethnographic and historic records related to Native American religious practices, belief systems, and physical manifestations of those practices and beliefs; (2) a long-term consultation program involving, in conjunction with field visits of elders and members of Ute and Arapaho tribes, tribes known to have historically occupied the Park and its region; (3) a multi-year archeological field program designed to identify sites with suspected or historically documented religious elements, including culturally built or modified natural features likely to have been associated with past ritual/ceremonial activities; and (4) utilization of scientific instruments and software, including GIS software, to generate and test landscape patterning and site predictive models using the above sources.

Our Sacred Landscapes Project research design for modeling past Native American religious systems and their physical terrains involves a conceptual framework that works at three levels of analysis. At the base level are individual archeological features defined by a suite of physical traits, geospatial contexts, and archeological, ethnohistoric and Native American consultant-derived interpretations of their ritual-ceremonial functions. It has been established that known or inferred sacred features in RMNP region almost exclusively consist of *rock constructed or culturally modified natural features* associated with a range of ceremonial/ritual practices. Rock art, images and outlines etched, pecked, or painted on exposed geologic surfaces, represents an important venue of portraying religious information and symbols for many pre-literate societies, but is virtually nonexistent in the project area, largely due to lack of suitable geological formations for its creation and preservation (cf. Brunswig 2003, 2005a). However, etched, pecked, or painted historic Ute, Fremont, and other prehistoric-era rock art are well documented in other western US regions which contain appropriate geological formations (sandstone, limestone, etc., Buckles 1971:1058–1138; Cole 1987, 1988).

Information from archeological, ethnohistoric, and Native American consultant sources was used to generate a sacred features classification system associating archeological rock features with known or inferred ceremonial-ritual activities. Features are divided into three provenance-defined (cultural origin source) categories: (1) features known or strongly suspected as having been produced by late historic and modern non-Native American individuals and groups; (2) features known or strongly suspected of having been produced by Native Americans; and (3) "composite" features believed originally constructed by Native Americans but subsequently altered or added to by later non-Native Americans. Native American-associated features are placed within four *classes*: (1) features believed, based on ethnographic analogy and Native American consultation to have been used in shaman conducted spirit offerings and specialized ceremonies, often situated on high and remote mountain tops; (2) features believed associated with individuals' communing (e.g., vision-questing) with the spirit world in general or with locally dwelling spirits; (3) features associated with burial or memorial ceremonies; and (4) individual or groups of cultural features and natural landmarks associated with rituals and ceremonies tied to seasonal changes in the rising, setting, and movements of the sun, moon, and stars.

A second, higher level of analysis and classification is that of *sacred sites and landmarks*, defined as sites with archeological or historical evidence of Native

American religious activities or natural landmarks believed to possess mythic and religious significance (for a complete definition see Brunswig et al. 2009:17–18, 2010:61–62).

The final and most inclusive level of analysis is that of *sacred landscapes*, dealing with the large-scale geographic patterning of ceremonial sites and associated ritual features along with sacred landmarks, e.g., lakes, mountains, valleys, etc. within a defined geographic area such as RMNP. This chapter focuses on the use of GIS and the weights-of-evidence method to model and reconstruct the prehistoric/early historic sacred landscape of the Park.

Sacred Landscapes Data Sets and Modeling Approach

GIS site location predictive models for RMNP have been developed by Christopher Rohe (cf. Rohe 2003a, b, 2004). Rohe's modeling was preceded by an earlier and very preliminary GIS predictive model study of high altitude game drives in the park and nearly mountains by University of Denver student Eileen Ernenwein (2001a, b). As part of the SAIP Project and as the basis of his own MA thesis, Rohe (2003b) created boolean, ordinal additive, and regression type predictive models for 11 categories of purely archeological sites, without reference to possible ritual-ceremonial elements, a subject of inquiry still in its infancy at the time of the original GIS modeling work. Rohe's predictive models made use of 17 GIS layers (2003b:26).

We constructed a preliminary sacred landscape GIS model in 2006, from which we derived promising spatial correlations of sacred sites and sacred landmarks throughout RMNP (Diggs and Brunswig 2006). A more refined model, described in this chapter, was constructed in 2009 (Diggs and Brunswig 2009; Brunswig et al. 2009, 2010:59–60). GIS correlation analysis underpins our efforts to determine site distribution patterns that, integrated with Native American ethnographic and ethnohistoric evidence, may reveal elements of ancient cognitive landscapes created through a past system of Native American beliefs and practices, cognitively and archeologically imbedded in natural landscapes.

Rohe's models provided numerous inferential criteria for modeling archeological sites in RMNP. However, the location of archeological sites with a strong religious component will not *necessarily* be based on the same criteria of sites designed *primarily* for procuring economic resources. A caveat to this premise lies in the knowledge that many sites utilized for game and plant food procurement and processing, such as game drives, would have had ritual activities taking place in conjunction with and in support of domestic activities (see Brunswig 2003:24–27, 2005a:263). According to Ute elders and ethnographic information from other Native American tribes, many vision quest sites are often deliberately situated in highly remote locations where lack of sustaining resources, e.g., food and water, is considered desirable given the goal is physical exposure, abstinence from food and water for protracted periods, and achieving an altered state of consciousness conducive to communication with the spirit world (Deloria 1991; Dormaar 2003:188–189; Dormaar and Reeves 1993; Dugan 1985; Hultkrantz 1987:51–56; Jilek 1982; Nabakov and Loendorf 2004; MacBeth 2007). In such cases, relatively great distance from water could have also been a desirable trait.

Data Sets Examined

Thirty-one archeological sites (out of 400+ such sites in the Park) were identified as having well-established or highly probable Native American religious or ritual components (Fig. 8.1). A total of 183 individual features believed associated with past spiritual activities were found in those sites. The sites often included known or probable vision quest features, older cairns suspected as possible offering sites, burials, crescent walls, cliff-side fissures with rock walls, various types of single to multiple course stone rings, rectangles, and ovals (see Brunswig 2003; Brunswig et al. 2009:12–16 for feature assessment methods). A sampling of four features was subjected to lichenometry-dating and yielded prehistoric dates between AD 1030 and 1150 (Brunswig et al. 2009: Appendix C). Table 8.1 shows variables examined in our attempt to model the RMNP sacred landscape.

GIS data layers were created for the variables listed in Table 8.1 (10×10 m cell resolution). An elevation-based life-zone layer provided representation of montane, sub-alpine, and alpine areas within the Park. Terrain roughness was examined using Rohe's (2003b) methodology of local relief, but within a 1 km radius (Rohe used a 3 km radius). Aspect was analyzed through the use of the following layers: aspect, and cosine aspect (for N–S trending), and sine aspect (for E–W trending). Rohe's shelter layer methodology (see Table 8.1) was replicated to assess whether many sacred sites are found in more exposed areas. Despite the fact that vegetation communities are highly variable over time, we thought it important to see if vegetation or vegetation variety might aid in the modeling of sacred sites. Lux's (2004, 2005) research on ancient trails in RMNP was incorporated into our study. Many sacred sites appear to be close to these trails and we wanted to assess the importance of trail proximity. Finally, Ute elders believed that visibility of several sacred landmarks within the Park might be important to incorporate in our model: the Kawuneeche (Colorado) Valley, Longs Peak, Specimen Mountain, Grand Lake, and the "Cliffs" (as a physical feature in addition to possessing a major sacred site) (cf. Brunswig 2003:66; Brunswig et al. 2009:17–24; Duncan and Goss 2000:13–15). Another site just outside RMNP with Native American spiritual elements, Old Man Mountain, was later included in the analysis (cf. Benedict 1985). Viewsheds from these locations were created and analyzed.

Table 8.1 Conceptual model variables for sacred site locations in RMNP (from Diggs and Brunswig 2009)

Variable(s)	Potential importance
Elevation	High elevation areas represent heightened spiritual significance for many Native American cultures
Local relief (from Rohe 2003a)	Relief is related to terrain roughness. These could include sites that are in "dramatic" settings, with significant down-valley or up-slope views
Aspect and related measures (from Rohe 2003a)	Sites and individual features may have an orientation to view summer sunrise/sunset; or a north/south orientation. Aspect and directional orientation may point to landmarks of spiritual power or landmarks in line with the rising of sun or moon during times of seasonal change such as solstices and equinoxes, phases of the moon, constellation movements, etc.
Shelter (from Rohe 2003a)	Areas exposed or more sheltered to the elements may be desirable for ceremonial or ritual activities
Vegetation and vegetation variety	Native American and prehistoric groups are known to have used certain plants for ritual purposes, many of which could be found or transplanted to, or near, ceremonial locations
Historic Native American trails (from Lux 2005)	Access to known prehistoric and early historic trails in the park may be related to the location of sacred features. The Ute often located ritual/ceremonial sites on or near trails due to the belief the trails were conduits of spirit power, but situated their camps well away from those same trails
Visibility of known sacred landmarks from sacred sites and features in the park	Ute elders have identified certain sacred landmarks in RMNP. Visibility of these features from various sacred sites and individual features may be important in interpreting sacred landscapes
Geology	Availability of basic building materials for construction of simple structures could be important. Iron rich rocks may attract more lightening, and thus have greater spiritual significance
Slope	Steep slopes at some point will limit activities of spiritual significance
Summer light (from Rohe 2003a)	Since most features were located at higher elevation, there may be some association with solar insolation (especially during the summer months)

Statistical Significance of Variables Used in Modeling Sacred Features

We examined and tested a number of variables (see Table 8.1) to see if the sacred sites/features had unique characteristics compared to a random sample of 4,000 points within RMNP. The values for "sites" could vary substantially within a specific site area. Some sites have dozens of features, others only one feature.

Table 8.2 Simplified categorical weights table for elevation

Elevation class (m)	Area (km^2)[a]	No. of features	W+	W−	Contrast
2,221–2,580	81.2	3	−1.41	0.05	−1.47
2,581–2,930	278.2	7	−1.81	0.23	−2.03
2,931–3,280	384.8	0	0.00	0.00	0.00
3,281–3,630	405.9	9	−1.93	0.37	−2.30
3,631–3,990	116.5	163	3.40	−2.18	5.58
3,991–4,343	4.6	1	0.48	0.00	0.48

[a]Areas include a 1 km buffer around RMNP

A polygon feature class was created in ArcGIS that "encompassed" each site. Zonal statistics were then created for each polygon (which represented a site). For example, in the case of aspect all grid cells within the polygon that represented a specific site would be added and a mean determined. This would be the mean aspect for that site.

Ordered variables subjected to a Kolmogorov-Smirnov (K-S) test included: aspect, co aspect, cost distance from historic/ancient trails, elevation, relief, shelter, sin aspect, slope, summer light, vegetation variety, and mean viewshed (Diggs and Brunswig 2009, Table 8.2). The K-S test does not assume that data is normally distributed and can be used to assess if two data sets differ significantly (in our case the sacred sites and the random sites). *P*-values less than 0.1 were considered significant. Two variables: sine aspect (a measure of east–west orientation) and vegetation variety (number of vegetation communities within a specified area) did not pass the K-S test and were eliminated from further study. An important caution regarding the relative location of the sites should be mentioned. It is not surprising that most variables were found to be of statistical significance when compared to a random sample of points within RMNP. Most of the sites and features are located at or above tree-line and it was natural to assume an inherent bias might be reflected in the sacred site/feature data. However, we decided that the method chosen for the current model was adequate for purposes of an exploratory modeling analysis.

Geology, soils, and vegetation were subjected to chi-square tests to assess whether those variables exhibited any statistical correlation with the 31 sites identified as having consultant and historic-source identified or trait-based sacred importance. Both geology and soils were found to be statistically different than the expected site numbers. Ultimately, in our modeling approach, neither of these variables was incorporated in the final model. We were unable to derive a logical and explainable method of reclassifying soils and geology into a smaller number of classes (2–5 of which are needed in the weights-of-evidence modeling technique). Furthermore, when we tested different reclassification schemes for these layers, we were dissatisfied with the modeling results. However, we believe that future sacred site modeling should revisit the importance of soils, and, especially geology, in feature/site locations. Vegetation type did not meet the critical alpha value of 0.1 and was excluded from the predictive model.

Model Selection and Using Weights-of-Evidence to Model Sacred Site Distribution

Archeological GIS modeling clearly generates special challenges for researcher's assumptions on the relative importance of specific environmental elements in the location of historic and, especially, prehistoric features. Attempting to focus solely on archeological sites and features of a presumed sacred or spiritual importance adds an additional element of uncertainty into archeological modeling. We wanted to use a modeling technique that was relatively easy to comprehend, could be used as an exploratory tool, and which had the ability to incorporate expert experience and opinion. The weights-of-evidence technique met these demands better than more traditional approaches (e.g., regression). While, to a degree, all GIS modeling techniques lend themselves to manipulation by those knowledgeable of the data (i.e., archeologists' knowledge of local archeological sites and features), the weights-of-evidence technique provides a simple and comparable measure that can quickly be interpreted.

The weights-of-evidence technique is available in a free ArcGIS add-on called Spatial Data Modeler (SDM), previously called ArcSDM (Sawatzky et al. 2004; Raines 2009a, b). SDM includes weights-of-evidence, logistic regression, fuzzy logic, and neural network modeling capabilities. The extension works best when a specific evidential theme is reduced to a binary layer, although multi-class data can also be used (Raines et al. 2000:46). Some of the earliest uses of the weights-of-evidence technique were in mineral location analysis. The technique has also been applied to archeological site prediction in California and a number of other settings (see Dahal et al. 2007; Hansen 2000; Hansen et al. 2002).

Weights-of-evidence combines data from different evidential themes to predict the occurrence of events (Bonham-Carter 1994; Raines et al. 2000; Romero-Calcerrada and Luque 2006). Each evidential theme is analyzed and output consists of the odds-of-occurrence or logits (Hansen 2000:4). Logits are converted to natural logarithms and used to calculate a positive and negative weight for each variable (Hansen 2000:4). Individual themes are usually (via reclassification and an assessment of weights) reduced to binary layers where one category represents areas where the features tend NOT to occur and the other category represents areas where the features tend to occur. Various binary themes are then combined to create a probability surface indicating the chances that one will find a feature within a stipulated area. Simplified themes do not have to be binary, they can also be ordered (i.e., low, medium, high). Calculation of theme weights for an evidential layer helps the user to set cut-off points for the generalized evidential layers (again, often binary) used to create a final response theme.

The weights-of-evidence method requires a training point data set (samples or control points). We struggled with the issue of whether the data set should be represented by individual sacred features or sacred sites composed of more than one, sometimes up to a hundred or more, feature classified as fitting Native American defined ritual uses. Thirty-one sacred sites, which included 183 sacred features, were identified through archeological surveys and Native American consultations. Most archeological GIS studies make use of site data, rather than individual features. We decided to use both techniques. Site data (as discussed above) were used to assess the statistical significance of individual variables. Feature data (183 features) were used for the weights-of-evidence modeling. A comparison was done with an earlier version of the model (using only 31 site locations) and the resulting map patterns were quite similar (Diggs and Brunswig 2006). Final posterior probabilities numbers did appear to be higher. There is likely an artificial inflation of posterior probabilities with the use of individual feature data. However, since the model's use is one of relative differences, we felt that increased model robustness was worth the price of possibly inflated posterior probabilities.

An example of how weights-of-evidence is used to assess a variable's importance is provided below. A close look at Table 8.2 indicates that most of the sacred sites/features are positioned at higher elevations. Major exceptions are sites on Old Man Mountain and in Glacier Basin, which contain sacred features well below treeline (Benedict 1985; Brunswig 2003). The application of weights-of-evidence usually involves two generalization steps. Calculating the weights for each unique value or "class" within RMNP would create hundreds, if not thousands of categories. Thus, in the case of our elevation data the first step is to simplify the DEM into a much smaller number of classes. Usually in weights-of-evidence, reducing to 15 or fewer categories enhances the interpretation of subsequently calculated weights. The reclassification (using Spatial Analyst) of the elevation theme was logically broken into "life zones" by elevation. Six of these zones existed within RMNP.

ArcSDM was then used to calculate category weights for this reclassified layer. Ordered data (such as elevation) allow creation of three tables: a categorical weights table, a cumulative ascending weights table, and a cumulative descending weights table. The categorical weights table is the easiest to assess. Table 8.2 has been simplified, but it illustrates the general use of the weights-of-evidence technique. Each elevation class shows the number of sacred features found in that zone. The area field tells the user the area covered by each elevation zone within the study area (RMNP). The W+ and W− fields indicate positive and negative weights assigned to each elevation class given its area and the number of features found in each elevation class. The contrast is simply the difference between W+ and W−. Documentation for the method indicates that weights between 0.1 and 0.5 are mildly predictive, 0.5 and 1.0 moderately predictive, 1.0 and 2.0 strongly predictive, and above 2.0 extremely predictive. Table 8.2 signifies that with a W+ of 3.40 the 3,631–3,990 elevation zone, given its aerial extent, is extremely predictive of where one might find sacred features (with a total of 163 features). In other words, many more features were found in this elevation zone than one would expect if the features were allotted equally according to area. Likewise, the 3,281–3,630 elevation zone with a W+ of −1.93 could be considered strongly predictive of NOT finding features in this zone, given its area and number of features (9) associated with the zone. In a similar manner, the contrast between W+ and W− can be useful to assess the predictive value of a variable or class (note the 5.58 contrast for the 3,631–3,990 elevation zone).

Since elevation is ordered data, it is difficult to completely dismiss the 3,281–3,630 zone with its W+ of −1.93 as being non-predictive of sacred features. Prior to doing

Table 8.3 Simplified cumulative descending weights table for elevation

Elevation class (m)	Area (km²)	No. of features	W+	W−	Contrast
3,991–4,343	4.6	1	0.48	−0.00	0.48
3,631–3,990	121.1	164	3.30	−2.23	5.53
3,281–3,630	527.0	173	0.93	−2.44	3.37
2,931–3,280	911.8	173	0.30	−1.70	2.00
2,581–2,930	1190.0	180	0.05	−1.41	1.47
2,221–2,580	1271.2	183	0.00	0.00	0.00

Table 8.4 Simplified cumulative ascending weights table for elevation

Elevation class (m)	Area (km²)	No. of features	W+	W−	Contrast
2,221–2,580	81.2	3	−1.41	0.05	−1.47
2,581–2,930	359.4	10	−1.70	0.30	−2.00
2,931–3,280	744.2	10	−2.43	0.93	−3.37
3,281–3,630	1150.1	19	−2.23	3.30	−5.53
3,631–3,990	1266.6	182	−0.00	0.48	−0.48
3,991–4,343	1271.2	183	0.00	0.00	0.00

so, the question needed to be asked: What about sites that are at the upper limit of this zone? Shouldn't they also be somehow accounted for in the weights table? Weights-of-evidence can calculate two additional tables: cumulative descending and cumulative ascending weights (see Tables 8.3 and 8.4). We used Table 8.3, cumulative descending weights, to determine a cut-off for creation of a binary evidential layer for the final model. Descending in elevation, that variable remains "mildly predictive" when one reaches the 2,931–3,280 elevation zone. Thus, an argument could be made to generalize the elevation layer into a binary layer where elevations between 2,931 and 4,343 m are mildly predictive, and elevations between 2,221 and 2,930 m are NOT predictive of sacred features. In our case, we decided to move the cut-off to the next higher elevation zone so that elevations between 3,281 and 4,343 m were moderately predictive (W+ 0.87) and elevations between 2,221 and 3,280 m were NOT predictive. This ability to generalize layers according to a variety of criteria (including weights and expert opinion) allowed us to experiment with different combinations of generalizations and evidential themes.

Other Model Components

Besides the elevation variable (discussed above), an additional five variables were used in modeling sacred features. Final analysis variables included: (1) elevation (discussed above), (2) cosine of aspect, (3) local relief, (4) slope, (5) cost distance from historic and prehistoric trails, and (6) relative visibility of five sacred landmarks.

Four measures of aspect were initially examined: aspect, sin aspect, summer light, and co aspect. Sacred features/sites might be located according to their ability to gain summer light (south facing). In addition, an east–west orientation might be related to sunset-sunrise and/or summer solstice. However, neither of the two hypotheses appeared to be represented in the data. Surprisingly, the most correlated variable with the strongest weights was cosine of aspect. Cosine of aspect is a measure of north–south orientation. Rohe's (2003b) cosine of aspect was used in our model. This layer was created by converting aspect to cosine aspect = 100*(cos(0.0174533* aspect)). The resulting −1 (south) to +1 (north) scale was then multiplied by 100 to create pixel values from −100 to 100 (Rohe 2003b:39). An examination of a simplified classification and weights table for the data showed a north facing orientation pattern for the features. A partial explanation for this association may be that many sacred sites and features located in remote, exposed places where comfort was minimized, hardship maximized, and altered-states-of-consciousness common to Native American vision-quest experiences could be facilitated (discussed above).

Local relief was determined by first assessing the change in elevation in a 100 pixel radius (1 km) of each 10 × 10 m cell. This creates a layer of maximum values. The same process is used to create a minimum value layer (within the 100 pixel radius). The minimum layer is then subtracted from the maximum layer to obtain local relief (Rohe 2003b). One might look at local relief as a measure of how rugged the area is around each sacred feature (within a 1 km radius). Local relief is not a measure of the steepness or slope at a specific feature or site. In tourist terms one could also consider local relief as a measure of how dramatic the surrounding area. Generally speaking, local relief is high (i.e., rugged or dramatic) throughout RMNP. Exceedingly high local relief may adversely affect visibility of sacred landmarks.

Slope was considered a potentially important factor. At some point slope steepness would impede the ability to construct features or traverse local terrain. A slope map (in degrees) was created from a 10 × 10 m DEM to assess slope steepness. Slope was then reclassified into ten categories roughly based on the Jenks optimization method. Weights were calculated and analyzed. The reclassified slope map was then generalized into a binary theme where slopes from 0 to 29.9° were considered to be associated with sacred features, and slopes of 30° or more were NOT associated with features.

Lux's (2004, 2005) research was used to appraise the importance of historic and prehistoric RMNP trails on sacred feature/site location. In addition, consultation with the Park archeologist resulted in the incorporation of additional trails (inside and along the boundaries of RMNP) that may have had probable prehistoric/historic significance. Nearness to these trails was hypothesized as an important factor in site location. Using simple Euclidean distance from the trails does not, however, take into account differences in terrain steepness, dense vegetation, or other obstacles that could impede or enhance movement. In order to partially adjust for this problem a cost distance surface was created from these trails. Slope was used as the input cost raster surface.

As discussed earlier, several landmarks were identified as having known or likely spiritual associations to either the Ute or Arapaho or both tribes. It was believed that visibility of these landmarks might be important. These landmarks, identified as culturally significant to the Ute and Arapaho (see earlier discussions), include

Specimen Mountain, the "Cliffs" area, Longs Peak, Old Man Mountain, and Grand Lake (see Fig. 8.1). The Kawuneeche Valley and other contiguous headwaters in the Specimen Mountain, La Poudre Pass (Colorado headwaters) and west Trail Ridge, collectively part of a probable Ute creation origin place (Brunswig et al. 2009:21–23; MacBeth 2007:41–43, 46–49), were excluded from this GIS modeling attempt due to its large physical area.

ArcGIS software allows viewshed analysis only from points or lines. The use of a point for each feature presented a problem. For example, if one point was to represent a mountain peak then a viewshed analysis or line of sight from that one point would exclude visibility to many cells. Perhaps the one cell that represents peak is on one side of the mountain, or the single point sits in a small depression. It is quite likely that an observer might see a portion or most of the mountain, but not the specific point. The result is that the software informs us the observer cell is not visible to and from the mountain. Yet, in reality the observer can see the bulk of the mountain (just not the one point). This problem is minimized by creating line features around the mountain peak. The viewshed analysis algorithm then uses the vertices of the line(s) to assess visibility. In other words, we created multiple points (via the vertices of the line) to represent single features. This was done by digitizing five lines around the five cultural landmarks. Each line consisted of 10 vertices, for a total of 50 vertices. An offset of 2 m was used for the line feature vertices. This helps raise the vertices slightly above the surface (in case the line vertices happen to lie in a slight depression). An additional offset of 1.6 m was used for all grid cells (corresponding to the height of a person). Output of the viewshed analysis is a raster grid where each cell reports the number of vertices (of the five landmarks) that can be seen from each grid cell (each processed with a 1.6 m offset). Thus, the output grid provides a coarse measure of the strength of visibility of a combination of the five landmarks. Next, we reclassified this grid into three categories based on Jenks optimization: (1) 0 vertices visible, (2) 1–9 vertices visible (low), and (3) 10–36 vertices visible (high). The "no visibility" category has a −2.49 W+, which is extremely predictive that one will NOT find sacred features in these areas. Low visibility has little predictability, either positive or negative (with a W+ of −0.48). High visibility areas are extremely predictive of sacred features (with a W+ of 3.65). Rather than creating a binary theme for the viewshed we decided to use the three-class categorization of landmark viewsheds in our modeling.

Discussion

Results of RMNP Sacred Sites-Landscapes GIS Modeling

A series of "weights tables" were created for each layer and analyzed. Final analysis variables included: (1) elevation, (2) cosine of aspect, (3) local relief, (4) slope, (5) cost distance from historic and prehistoric trails, and (6) relative visibility of four sacred landmarks. Examinations of the weights shown in Table 8.5 indicate that the

Table 8.5 Final weights for sacred features models

Layer	W+	W+ (Viewshed)	W−	Contrast	Confidence
Cosine aspect	0.68		−0.30	0.98	6.18
Cost distance trails	0.34		−2.90	3.24	5.55
Elevation class	0.93		−2.44	3.37	10.27
Relief class	0.31		−1.50	1.80	6.19
Slope class	0.20		−2.90	2.43	4.77
Viewshed (sacred landmarks)	−0.48[a]	3.64	−2.49	6.13	17.05

[a]Represents low visibility category

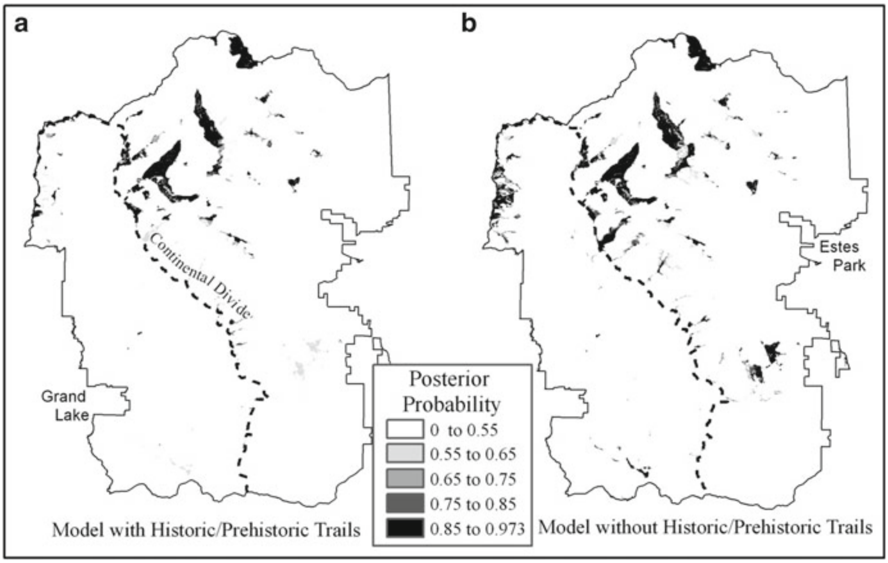

Fig. 8.2 Weights-of-evidence posterior probability model results

cosine of aspect and elevation layers are moderately predictive of sacred features. The relief, cost distance to trails, and slope layers are mildly predictive of sacred features. Rather than binary, the viewshed of sacred landmarks layer was classed into three categories, resulting in the need for the *W*+ (viewshed) column shown in Table 8.5. The viewshed layer is potentially extremely predictive of sacred features, which underscores the probable sacred nature of these features.

Figure 8.2 shows the final models used in our exploration of RMNP sacred site location prediction. Because of the large unit area (0.5 km^2) used in the analysis and the clustering of features into a small number of sites at high elevation, probability numbers are likely inflated. It is appropriate for the reader to view the probability numbers as a poorer-to-better scale. Mihalasky (2001:C3) has suggested that posterior probability maps should be viewed more as "favorability" maps rather than "probabilistic" maps. Research has suggested that weights-of-evidence modeling results will often mirror those accomplished with weighted logistic regression. Comparison of patterns between the two methods will be similar, but probability numbers will tend to be more inflated using the weights-of-evidence technique (Mihalasky 2001).

The relative lack of ethnohistorically or archeologically documented trails in certain parts of the Park (such as the southern portion of RMNP) appreciably affects our resulting cost distance grid. To account for that factor, we elected to create two models: one included the cost distance to documented historic/prehistoric trails and the other did not (Fig. 8.2). Comparison of the models indicates substantial differences in sacred site/feature location predictions for the southern portion of the Park, and to a lesser degree, for the western part of the Park in the Never Summer Range. On one hand, we believe that nearness to historic/prehistoric trails was an important factor, but cannot rule out the possibility that important historic/prehistoric trails once existed in southern areas of RMNP but have not yet been, or cannot be, documented at present due to erosion, soil build-up, and/or plant growth after falling into disuse for more than a century.

Three tests were conducted to assess validity of the final prediction maps. The weights-of-evidence method requires layers be conditionally independent from one another. ArcSDM conducts an Agterber and Cheng Conditional Independence Test which generates a conditional independence ratio by dividing the actual number by the expected number of training points. Values below 1.00 may indicate conditional dependence between two or more variables (Bonham-Carter 1994). Both of the models presented here (Figs. 8.2 and 8.3) had overall conditional independence ratios well above 1.00 (with trails CI = 1.52; without trails CI = 1.24).

Another measure of model reliability advocates a much more cautioned view of the final maps. Mihalasky (2001:C25) shows that an approximate *t*-test can be conducted on posterior probability maps by dividing each cell's posterior probability by its standard deviation. Figure 8.3 shows the results of the approximate *t*-test. Clearly, for large swaths of RMNP we are unable to determine sacred site predictability with a strong degree of certainty. Given this concern, we recommend models developed in this study should be used as only one part of a broader, more holistic approach to predicting sacred feature and site locations.

Finally, a comparison was made between the model with trails and a subset of the sacred feature data set. Ninety-two randomly selected sacred features were selected from the original data set of 183. Using the same six variables (elevation, co aspect, slope, cost distance to trails, relief, and viewed), the weights-of-evidence method was used to model predicted sacred site locations. A comparison between the two alternate models is shown in Fig. 8.4. Patterns between maps of the two models are quite similar. But overall, posterior probabilities were lower, likely a result of the smaller training point sample size. Again, it is necessary to reiterate that posterior probabilities are best thought of as occurring along a poor-to-good scale with the proviso that actual posterior probability numbers may be inflated. Given that assumption, we are satisfied the model accurately predicted the randomly chosen subset of sacred features.

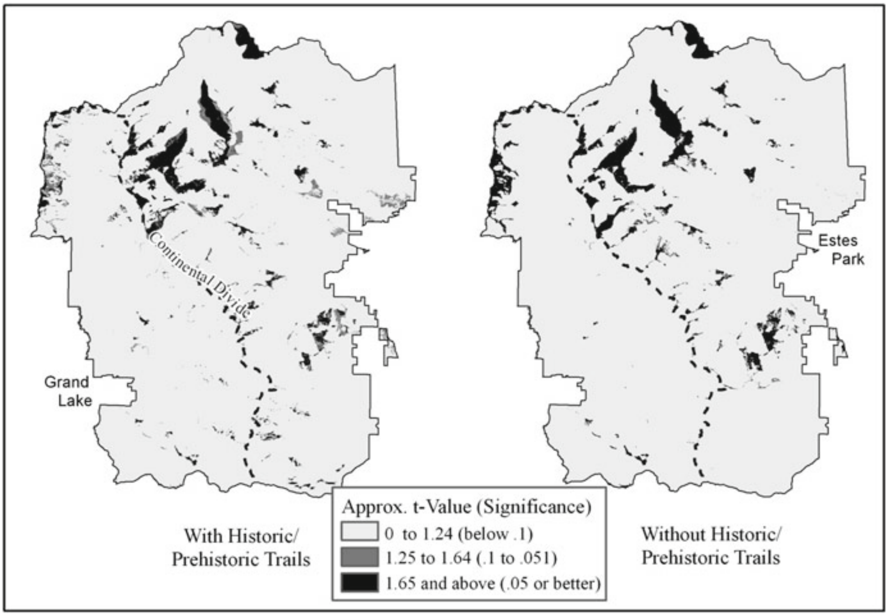

Fig. 8.3 Results reliability. "Approximate" *t*-test model results

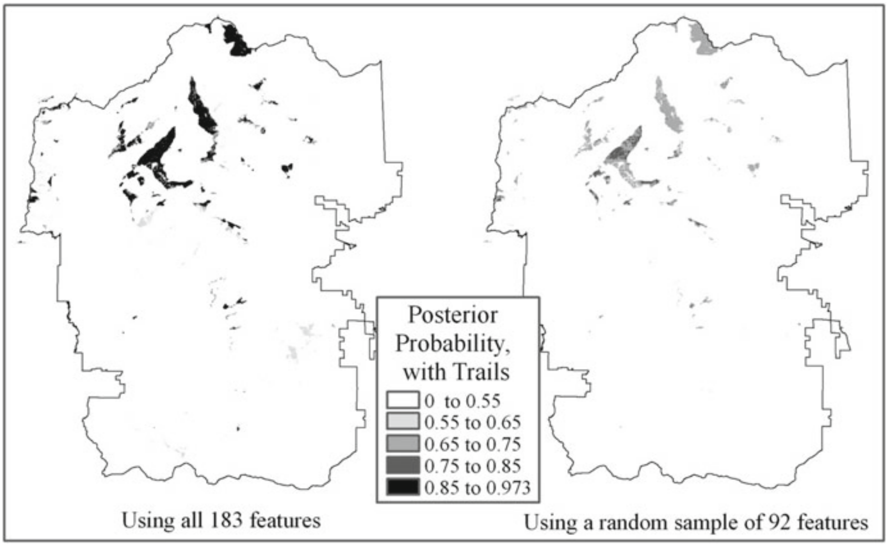

Fig. 8.4 Comparison of model with all features and model with random sample of 92 features from original data set

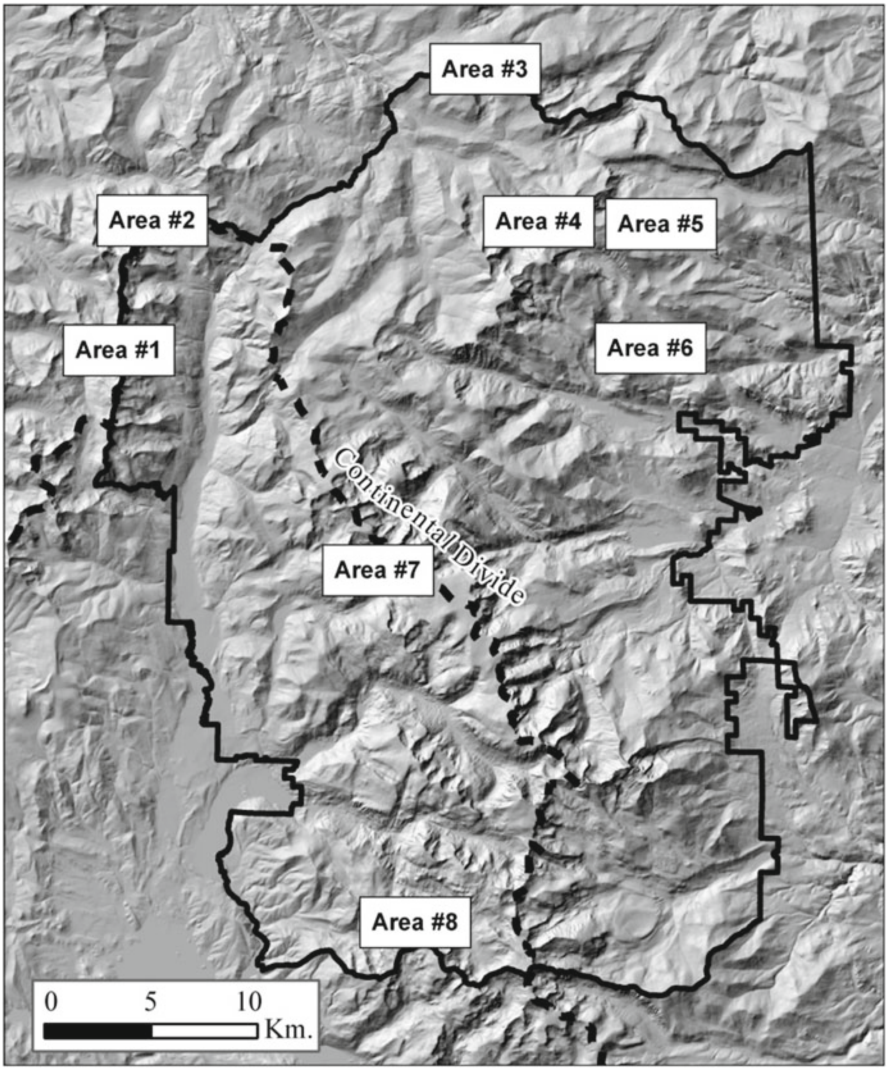

Fig. 8.5 Areas recommended for future archeological survey

Field Investigations Based on RMNP GIS Modeling

Using model results and other sources of information, eight areas of further field survey work are recommended (see Fig. 8.5). Due to concerns about the protection of archeologically sensitive areas, we are unable to provide readers with their precise locations. The GIS models were an important factor in the selection of eight recommended areas for further archeological verification surveys. Equal weight, however, was given to the authors on-the-ground and research familiarity with the Park, discussions with RMNP personnel, and knowledge gained from Native American consultations.

During the August 2010 field season funding was obtained to survey portions of Areas 1 and Two (see Fig. 8.5). A total of approximately 170 acres were surveyed. At Area Two, a major mountain pass was surveyed along with adjacent ridge lines and surrounding areas. A relatively large locale to the south and southwest of the pass was also examined. Survey of Area One consisted of an area around a small but prominent lake, the lake vicinity, and an area of gradual slopes and promising overlooks 800 m north. Two versions of our model had originally been developed. One included known historic and prehistoric trails (Fig. 8.3a) while other did not include the trails variable in the predictive model (Fig. 8.3b). The resulting probability maps represent the probability of finding sacred features within 500 m of a particular cell. Both model versions predicted there was a high likelihood of finding sacred features in Area Two. We should note, however, that the two model versions differed significantly for Area One. Given that Area One is isolated and not near historic and prehistoric trails, the model version B (without trails) assigns relatively high probabilities to this area whereas model version A (with trails) suggested a lower chance of finding sacred features.

The August 2010 survey discovered two sites consisting of five features in Area Two. In Area One, a single site consisting of two features was found. Features in Area Two clearly lie within the high probability prediction areas and are located on the ridge line separating two significant drainages. The site discovered in Area Two is more isolated, but easily within a 500 m radius of nearby high probability areas (the model parameter). In both survey areas, we found that visibility of probable sacred landmarks was a key prediction variable for the overall sacred sites model (see Brunswig et al. 2009 for a full discussion).

Historic and prehistoric trails were also highly predictive, though less so than with sacred landmarks visibility. We had hoped that high posterior probabilities around the lake in Area One in the "without trails" model version would aid us in distinguishing between the relative merits of the two model versions (Fig. 8.3a, b). Three survey crew members made the arduous hike up to the lake which is enclosed in a high mountain cirque. The approach is difficult and, at points, dangerous. Once at the lake, however, the terrain seemed promising for finding sacred features. A large area of rolling terrain was found with a mixture of rock and grass. Views back to a number of sacred landmarks were readily observable. No archeological features, however, were found in the lake's vicinity. This would appear to support our hypothesis that nearness to trails was a key factor in sacred site location. However, 800 m north of the lake two other field crew members discovered a site on a large bench overlooking the drainage to the east. This site also had views of a number of the sacred landmarks. The site must be reached by crossing 600 m of a glacial ground moraine deposits, consisting mostly of large boulders. This site would suggest that relatively easy access was not a key factor in the location of sacred features. Thus, we are left with somewhat of a dilemma in the assessment of the relative importance of one model (with trails) to the other (without trails).

The survey of only two areas and 170 acres is certainly not strong enough evidence to statistically verify or disprove one or both of our sacred site models. From the beginning, we have known (and said) that GIS alone cannot answer the question of where one can find sacred features in RMNP. Nevertheless, initial findings suggest that our sacred site models can be an important heuristic tool to aid in selection of future areas of archeological survey. We did find sites where the model had predicted. The survey of Area One implies that both sacred site models (with and without trails) should probably be consulted when assessing future areas for survey. Our initial feeling is that historic and prehistoric trail are likely an important predictor of sacred feature location. Yet, we can't completely dismiss the notion that this is not always the case. Thus, we believe that both models have value.

Conclusions

The above study describes results of continuing investigations on the nature of past Native American cultural landscapes, specifically related to ritual-ceremonial practices, in RMNP. By combining diverse sources of archeological, ethnographic, and historic knowledge with GIS software and multi-layered data sets and applying the weights-of-evidence technique to our GIS model, we were able to advance efforts in predictive modeling of sacred site spatial distributions. Representations of elevation, viewsheds of known and inferred sacred landmarks, local relief, slope steepness, north facing slopes, and nearness to known prehistoric and early historic trails constituted significant predictor variables for modeling sacred site locations with our current site data.

Our research further shows the weights-of-evidence method is a valuable heuristic device for exploring data associations and testing hypotheses. In the case of sacred features, GIS modeling results can differ significantly from more standard archeological GIS modeling. A rough comparison of our weights-of-evidence modeling with an all-sites archeological predictive regression model by (Rohe 2003a, b) showed only a 24 % area overlap between the two models (both at 0.75 probability of finding sites). This suggests that location variables associated with sacred sites are largely unique from those governing site selection for other functions (e.g., camp sites, game drives, etc.). Testing and reification of our weights-of-evidence model (or future ones), however promising, will require further field surveys and archeological data collection as well as follow-up Native American consultation studies.

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Chapter 9
Adaptation of Andean Herders to Political and Climatic Changes

Julio C. Postigo

Introduction

The concept of adaptation permeated to the social sciences and liberal arts from biology and psychology fostered, among other things, by the developments of research on climate change (Butzer 1980; Folke et al. 2005; Orlove 2005; Young et al. 2006). The revival of this concept allowed for broadening of inquiries about the human condition from human adaptive capacity to high altitudes (Lorna et al. 1998), to the social capacity to respond to current global changes (Adger 2003; Agrawal 2008; Smit and Wandel 2006). It also contributed to revitalization of questions regarding the viability of ecosystems and regions facing climatic changes, and to reexamination of the relations between humans and nature that have jeopardized physical and biological systems (Bernstein et al. 2007; Falkowski and Tchernov 2004; Folke et al. 2005; Rindfuss et al. 2004; Rosenzweig et al. 2007; Turner et al. 2003; Turner and McCandless 2004; Young et al. 2006).

Cultural ecology and cultural-behavioral theoretical frameworks were used in the beginnings of the systematic research on the condition of high-altitude Andean herders (Sendón 2005), seen as agrarian nonfarming group that maintains its livelihood in the landscape above 4,000 m in elevation (Flores Ochoa 1964, 1968). Furthermore, Flores Ochoa (1977b) recognized that the cultural-ecological approach is very useful in analyzing herders' cultural adaptability to the Andean environmental conditions. Thus, environmental phenomena and cultural behavior are understood either as a part of the integrated Andean pastoralist system, or as a partial cause of the origin and development of the sociocultural behavior under study.

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High-altitude Andean pastoralists, in addition to their physiological fitness, adapt culturally to the specific environmental conditions by modifying the physical components of the landscape—e.g., domesticating animals and irrigating pastures—learning the vegetation and animal behavior, and adjusting their own social institutions in order to fulfill the basic needs and survive by coping with economic, political, and ecological changes occurring at the global and local levels (Browman 1987a, 1990; Orlove 1982; Postigo et al. 2008; Young and Lipton 2006).

The chapter is organized in five sections. The first one presents a brief discussion of the commonly used definitions of pastoralism with emphasis on cultural adaptation. The second section presents the key characteristics of Andean cultural adaptation that have been occurring historically. The third examines some of the most powerful social forces such as socioeconomic processes, agrarian reform, national policies, and climate shifts that drive pastoralists' adaptation around the world and particularly in Peru. In the fourth section I present aspects of the Andean herders' adaptation to sociopolitical and climatic processes by discussing the case of the Quelcaya community of southern Peru, and in the final section I offer critical examination of adaptational processes on different scales.

Pastoralism and Adaptation: Basic Definitions

Andean pastoralism is defined as an economic activity that provides the means of subsistence to people either directly through the consumption of its products (meat) or indirectly by bartering for farming foodstuffs (Flores Ochoa 1968). Scholars have argued that pastoralism becomes a mode of production when a household earns more than 50% of its income from livestock using unimproved pastures (Markakis 2004). In most cases, pastoralists do not produce for market and exchange, but for subsistence only. In such instance, small amounts of pastoral products are sold on markets in order to purchase commodities and items otherwise unavailable to pastoralists. Furthermore, pastoralism is also a mode of perception and some pastoralists define themselves as people "who are sedentary but plan to resume herding" (Markakis 2004:14).

Recently, Salzman (2004:1) defined pastoralism as "the raising of livestock on 'natural' pasture unimproved by human intervention." In this definition, the author refers to the relationship between nature and pastoralists as an adaptive process through which people interact with their ecological conditions; this definition does not emphasize the ability to earn subsistence through the productive activity as the key element of pastoral lifestyle.

Pastoralism defined as an economic activity that transforms the landscape in order to provide the means of subsistence emphasizes that mutual transformations of human culture and natural conditions, in which it exists, are at the core of the interactions and adaptations that secure pastoralists livelihood (Browman 1983; Flores Ochoa 1968, 1977a). Following this logic, high-altitude Andean pastoralism is both the crystallization of former mutual transformations of nature and society along the time scale, and the process that leads and metabolizes such transformations. This double aspect of pastoralism encompassed by both continuity and change, preserves useful transformations from the past as well as discards and recreates former strategies to face and adapt to current or foreseen socio-environmental changes. The relationships between high-altitude Andean nature and herder society are based upon energy flows that characterize the interactions between the herders, plants and animals of the *puna*,[1] and the farming populations of the valleys (Thomas et al. 1976a).

Although the definition of pastoralism, understood as an economic activity, a way of life, or a mode of production, always links nature and society, the linkage is established and controlled to some extend by the society. It is a social process involving a set of human–environment interactions that constitutes pastoralism. It is the pastoralist society that decides to use the land and transform the high-altitude Andean landscape to earn its livelihood. Human activities, naturally, must be understood within a wider context of active biophysical and political factors. Through these processes, a society gives a particular meaning and understands nature by filling the ecosystem with specific values. In this chapter, high-altitude Andean landscapes constitute that nature which is transformed by pastoralist society according to a conscious and predefined purpose: continuity of pastoral lifestyle. In pursuit of this goal adaptation is the key process.

Adaptation to High-Altitude Andean Ecosystems

High-altitude Andean ecosystems have been constantly shaped and reshaped by the complex dynamics constituted by the social transformation of nature through cultural adaptation and natural processes occurring beyond the human control (Zimmerer 1999). Adaptation to high-altitude Andean ecosystems is, thus, a complex process that requires both physiological changes and cultural responses to ecological stresses in form of patterns of social organization and institutions in order to create the necessary conditions for sustainable livelihood. In this section I will briefly address the three main components of the socio-natural dynamics in the High Andes: pastoral society, domestication of camelids, and nature-society interactions.

Andean Pastoralists

High Andean pastoralism is a lifestyle that encompasses: (1) social organization of households, extended families, and communities, (2) land tenure systems that combine property and usufruct of pastures, (3) use of pastures based on livestock mobility, and (4) long-standing dependence on processes and forces beyond herders' control.

[1] Grasslands that occur at high elevation, between 3,800 m and the snow-line.

Murra (1965, 1975, 2002) developed an ethno-historical approach to study pastoralists, treating them as an important specialized group that existed before the times of the Inca state. Pastoralists at that time were travelers and merchants who bartered livestock-derived products such as meat and wool for goods such as maize and coca, and supplied wool to weavers in the coast. They constituted the key element within the pattern of verticality (Browman 1974) by controlling and impacting a number of ecological zones (Murra 1975). Currently, Andean herding mobility is mostly horizontal rather than vertical displacement to access and control different ecological zones, and constitutes a limited version of the archipelago model developed by Murra (2002), and adaptation to sociopolitical constrains (Browman 1974, 1987a).

Andean herders live above 4,000 m of elevation in *campesino* communities that do not practice farming. They survive raising mixed herds composed of alpacas (*glama paco*), llamas (*glama llama*), and sheep, bartering of animal products for farming ones (this requires several days of traveling on foot), and selling their labor as seasonal workers. The land tenure system is characterized by the common property of grassland, mainly located on poor soils and dependent on rain (Browman 1983; Orlove 1982). Therefore, livestock and access to pastures are the key elements in the Andean herders' production system (Postigo et al. 2008).

Mobility, grassland use, and involvement in market exchange are relevant variables defining pastoral production system (Browman 1987a). In result, pastoral systems are highly flexible and involve transhumant movements of people and animals, as well as different relationships with the market economy. Andean herders have been involved in market relations since the late eighteenth century, selling alpaca fiber to the English textile industry (Burga and Reátegui 1981; Jacobsen 1993; Thorp and Bertram 1978) under the conditions of natural economy, i.e., based on internal reciprocity and exchange of goods and labor, but also engaging in monetary transactions (Romano 1992). The natural component of such economy where social relations are not mediated through monetary transactions is crucial as it makes the herders resilient to fluctuations of fiber prices and to surplus rate extraction determined by international commodity brokers. Further, the natural component of the Andean economy subsidizes urban economies in at least, two ways: (1) produce is sent by family members in the highlands to their relatives in the cities, and (2) rural immigrants find employment in urban industries run by home-town relatives or friends and diminish the cost of labor (Golte 1987).

High Andean pastoralism is considered as transhumant system because of the importance of livestock mobility patterns (Browman 1974, 1987a; Orlove and Custred 1980; Webster 1973) and other characteristics typical for pastoral nomadism as defined by Khazanov (1984) for Asian pastoralists, and by others for the Andes (Browman 1974; Webster 1973). These characteristics are as follows: (1) pastoralism is the main economic activity, (2) grasslands are used extensively to maintain herds year round using a system of free-range grazing without the use of stables, (3) periodic mobility occurs according to pastoral economic needs within or between specific grazing territories, and (4) production is oriented towards subsistence.

The mobility patterns of livestock and herders, induced by the location of the best pastureland, are important characteristics of an economy based on herding of mix flock (alpaca, llama, and sheep; see Browman 1987a; Flores Ochoa 1968). High-altitude Andean herders and their animals move according to seasonality—rainy and dry season—and accessibility to pastures. Pastures used during the dry season—June through December—are located at higher elevations than those used in the rainy season because dry season pastures are irrigated by springs and runoffs from the melting glaciers. The rainy season pastures are located at lower elevations preventing newborn animals—born at the beginning of the rainy season—from grazing in the higher pastures with harsher weather and more boggy spots where smaller animal could drawn.

In order to move animals among various grazing sites, herders must have at least a main [permanent] house between seasonal pasturelands, and one small temporary hut in each pastureland (Orlove and Custred 1980). Herders' mobility patterns are limited to pastures under household control and by communal borders, as evidenced, for instance, in the case of Huancavelica community (Postigo et al. 2008). Considering the limited area available to animals and the need to return the herd to the starting point, this pattern of movements of animals and humans can be referred to as transhumance (Browman 1974; Orlove 1982; Webster 1973) and such pattern is also present among some pastoralist societies in Africa and Asia (Markakis 2004; Salzman 2004).

During the dry season, herders and flocks of llamas travel to inner Andean valleys—e.g., the surrounding areas of Lake Titicaca and adjacent areas within Puno, as well as to Arequipa, Moquegua, Tacna, and Cusco. The main purpose for these trips is to exchange pastoralist products (fiber, goods, dry meat, and skin) for crops (grains and tubers) and manufactured commodities. Most of the herder communities that I have worked with in Cusco, Arequipa, Huancavelica, and Puno prefer to barter products rather than buy. This preference is understandable because herders obtain more through exchange than buying. For instance, if they exchange alpaca meat for maize, the amount of maize received is greater than if they sell the meat and use the money to buy maize. It is clear that herders' products have unfavorable trade rates. Further, bartering buffers them from the fluctuations of market prices and the dynamics of urban–rural trade rates.

Generally, travel to inner Andean valleys is men's duty and it usually takes more than 7 days of walking about 15–20 km per day while leading 15–30 llamas per herder. This periodic contact between herders and farmers has led to the establishment of new kinship relations allowing herders access to farmers homes, farming products, but also other social networks and ecological zones (Browman 1987a; Golte 1992; Mossbrucker 1990; Sendón 2003, 2005).

Domestication of Camelids

Domestication of camelids is an important feature of the pastoral adaptation to the highlands (Izeta 2008) and is crucial in the understanding of human adaptation to the ecological conditions of the *puna* (Bustamante Becerra 2006; Flores Ochoa

1975; 1977a; Flores Ochoa et al. 1995a, b; Troll 1968). Subsistence at 4,000 m requires pastoralists to adapt to their environment using the natural resources in the most efficient fashion possible (Browman 1983; Flores Ochoa 1968; Moseley 2001). In herders' household's economy llama is a service provider. Llama's main role is beast of burden and the animal provides wool for ropes and meat for *charqui* (dry meat). At times of extreme scarcity, llamas will be slaughtered and consumed. Alpaca is another important element in herders' economy as a product of the domestication process and as a resource managed through social relationships developed by each household:

> The most important animal in this region is the alpaca, since, as this work will demonstrate, human social development is possible at these altitudes in large measure because of these animals. Many important aspects of the culture revolve around or are related to the alpaca, its care, and the products it yields. The alpaca and the llama (*Lama glama*), mammals native to the highlands, were domesticated by pre-Columbian man in the Andes (Flores Ochoa 1979:25).

Camelids have been an important resource for Andean people (Browman 1983; Gade 1969; Moseley 2001). According to archeological evidence, they were domesticated about 2500–1750 BC in the *puna* of the central Andes (Browman 1989; Gade 1969; Pires-Ferreira et al. 1976). Wild ancestors of the alpaca and llama have been part of the High Andean ecosystem for approximately 10,000 years (Browman 1989; Gade 1969; Moseley 2001; Wheeler 1995). Until 7,500 years ago these animals constituted half of the game hunted by the ancient hunters, the other 50% of the prey being the huemul deer *Hippocamelus antisensis*. The importance of the cervid and the camelids for the human existence in the Andean *puna* is remarkable considering that "Domesticated camelids have been the major animal protein source for much of the Peruvian highlands at least for the past 5,000 years" (Shimada 1988:136) and had complemented a diet based on tuberous crops as the primary source of calories (Bonnier and Kaplan 1988; Moore 1988).

Another region of domestication is the Andean altiplano with the evidence of humans exploiting herded animals–i.e., South American camelids—that traces back 9,000 years (Browman 1983). Since 7,500 years ago, according to archaeological evidence from the highlands, camelids were the predominant hunted animals. The archaeological data strongly suggest that early populations living in high altitudes followed the hunting of camelids as their key economic pattern (Browman 1989; Pires-Ferreira et al. 1976, 1984), and such increased dependency on one species had, at some point, turned to herding and domestication (Browman 1989; Pires-Ferreira et al. 1976; Wheeler 1995).

Researchers have carried out multidisciplinary studies of archeological sites concerning human–animal interactions in the Andean regions (Baied and Wheeler 1993; Moseley 2001; Wheeler 1988) and these works are significant contributions to understanding of the domestication of South American camelids (Baied and Wheeler 1993; Browman 1989). Findings from Huánuco Pampa synthesize these contributions well: (1) judging by the abundant remains of camelids, herd animals were crucial to the economy of local population (Wing and Wheeler 1988), (2) based on the evidence, most of the camelids were domesticated, (3) the animal population in Huanuco

Pampa was mature, which indicates the primary use of livestock products, services, and breeding stock (Wing and Wheeler 1988), (4) there was an even distribution of mature population of alpacas and llamas within the herd and such ratio indicates not only that they were approximately slaughter in equal proportions but also that their different uses—i.e., providers of raw material to make fiber and also transportation—were equally acknowledged (Wing and Wheeler 1988), and (5) pastoralists segregated young animals 3 years and younger from the main herd. This separation was due to young animals' high mortality rates because they "are susceptible to bacterial infections in the confines of crowded corrals" (Wheeler 1984 cited in Wing and Wheeler 1988:169). Another important fact is "the dominance of native domestic animal and particularly the herd animal" (Wing and Wheeler 1988:170). Despite all these important findings listed above, only a small portion of archaeological studies has been carried out above 4,000 m in elevation, which is the quintessential location of High Andean pastoralists (with the exception of goat herders).

Despite this ancient use of high Andean grasslands, the major environmental impact on the highlands began when grazing regimes were imposed by the Spaniards in the late sixteenth century (Baied and Wheeler 1993; Butzer 1988; Molinillo et al. 2006). This impact is visible in herding practices carried out—e.g., daily and seasonal mobility—animal's ability to utilize the available grasslands, and preferences in animals' species (Browman 1983; Molinillo et al. 2006). Further, the Spanish largely forced alpaca and llama's displacement to higher lands because grazing areas on the coast as well as Andean slopes, originally occupied by native livestock, were devoted to nonnative species—i.e., goats, cattle, pigs, and sheep.

High Andean regions became the refuge for native Andean stockrearing not only because of the presence of nonindigenous animals in lower lands, but also because the *puna* formed a natural barrier for those animals to penetrate higher altitudes (Baied and Wheeler 1993; Wheeler 1995). In addition, local herds were depleted due to the introduction of new diseases brought in by nonindigenous animals, and additionally by political and economic constrains such as civil wars in Peru's viceroyalty and taxes paid to the Spanish kingdom either in money or domesticated camelids (Baied and Wheeler 1993; Wheeler 1995).

Nature and Society

Pastoralist social and biological adaptations are outcomes of the adaptive process to the limited resources of the highlands and *puna* (Winterhalder and Thomas 1978). Andean herders responded to a range of socioeconomic and climatic pressures at communal and household levels with decisions regarding land use that resulted in further land-cover transformations through feedbacks and interactions such as mobilization of livestock among diverse pasturelands, irrigation of some pastures while letting other remain dry, planting of potatoes, and appropriations of the former *hacienda's* lands. Figure 9.1 presents schematic representation of the complexity of such interactions.

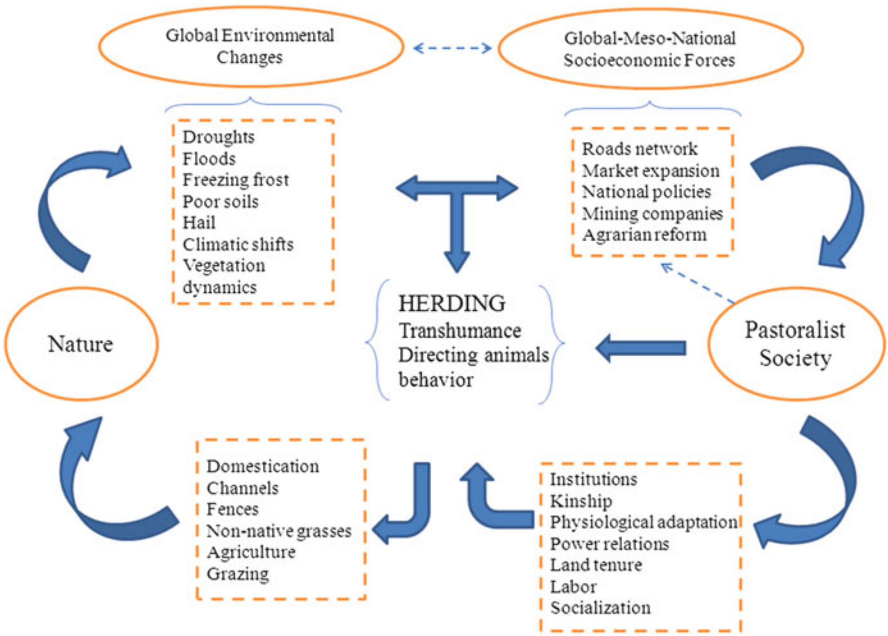

Fig. 9.1 Conceptual framework of Andean herders adaptation

The particular form of responses depends on variety of conditions, such as the institutional arrangements within the community—social relations—socioeconomic status of the household, the existing power relations and exchange networks, and local climatic and environmental conditions (Araujo 2009; Brush 1976; Ensor 2009; Orlove and Custred 1980; Young and Lipton 2006; Zimmerer 1991, 1999).

Andean herders' responses to socioeconomic and environmental processes often rely upon household capacity to access social (e.g., labor force and goods) and natural (e.g., pastureland and water) resources (Golte and de la Cadena 1983; Mayer 2002). This capacity depends on the social relationships that each household maintains (and develop) with other households (Alberti et al. 1974; Bebbington 1997; Bebbington and Perreault 1999; Mayer 2002; Orlove and Custred 1980) and with corporate groups in the community (Brush 1977; Mayer 2002; Mayer and de la Cadena 1989; Orlove and Custred 1980). Thus, in order to understand local adaptational patterns it is important to analyze both the community and household levels of adaptation.

Thus, Andean pastoralism can be modeled as institutionalized behavior mediating between social needs and natural conditions, that is characterized by: (1) adaptation to arid areas, open rangelands, and high altitudes, (2) impossibility of carrying out subsistence farming using a hoe, (3) use of domesticated animals contributing to a more efficient utilization of resources than other subsistence strategies, and (4) the need of adjusting human practices to the demands of animals such as movement to pasturelands, access to salt and water, and protection from predators. Additionally, various strategies to obtain farming products need to be design and carried out (Flores Ochoa 1977b). Andean pastoralism is understood here as a process of adaptation to mountain conditions, in which the intersection of ecological conditions and human needs form the basis for productive activities to secure subsistence. Any modifications of the ecosystem uncontrolled by local populations, such as climate change and national policies, put constrains on human–nature interactions and disturb the pastoralist system. Consequently, within such framework, Andean pastoralism can be considered not just as the only successful adaptive approach to high-altitude landscape, but also the only approach able to permanently sustain human populations under the conditions of limited natural resources. Hence, this dynamic human–nature equilibrium is always in flux and it is crucial to always cope with sudden disturbances that either jeopardize the system's resilience or trigger positive feedbacks that lead to unpredictable consequences (Flores Ochoa 1977b).

Although domestication is primarily a process that involves human-controlled genetic and physiological changes in animals and plans, it is also a social process. Herders must learn the principles of herding and recognize animals' behavior and diet preferences. Simultaneously, they must get to know the landscape's characteristics, environmental conditions, the presence of predators and other potential threats for the flock. Besides the social aspect of the domestication of camelids, pastoral society itself undergoes social adaptation. Pastoralists have to organize themselves to use high-altitude Andean pastures, create institutions to control their landscape and exploit their resources. This requires socialization processes of children (Baker 1976), labor division among household's members, cooperation amongst households, and social networks within and beyond the pastoralist group (Orlove and Custred 1980).

The relationship between herders and their animals has developed from a long process that implied that both—animals and humans—can survive under the ecological and climatic conditions of high Andean altitudes. Thus, Andean domestication also involved animal adaptation to high-altitude climate, environmental conditions, landscape, and pastures (Winterhalder and Thomas 1978). Human populations adapted to these conditions by, among other things, transforming the *puna* which is the source of their livelihood (Baker 1969; Baker and Little 1976; Lorna et al. 1998). Pastoral societies have been transforming the *puna*'s landscape through irrigation of pasture, creation of wetlands, introduction of nonnative species, and domestication of animals (Moseley 2001; Postigo et al. 2008). In result, the key changes regarding Andean pastoralists include: communal land tenure and access to pastures, mobility of households, stock-breeding specializations, and human metabolism.

Adaptation occurs through multiple stages and interlinked levels (Young 2009). At the specie's level, animals, plants, and humans have to adapt to the ecological conditions of *puna*. Biological adjustments of individuals living at high-altitude are necessary and greater lung capacity of high-altitude dwellers than lowlanders is an adaptive response to maintain respiratory functions (Baker 1969; Thomas 1997;

Velásquez 1976). Plants and animals also adapt to *puna* (Thomas 1976b; Winterhalder and Thomas 1978). Domestication of animals over millennia in the Andes illustrates how an interspecies (human–animal) relationship has contributed to making the adaptation at the species level possible. Alpacas and llamas are products of a continued and organized human effort to maintain the crucial resources of the pastoralist survival.

Andean herders have only been able to adapt to *puna* because their biological adaptation occurred while they were transforming the biophysical landscape into their livelihood. Landscape and biota have been modified through domestication, fire, herding, and irrigation carried out by socially organized herders. Interlocked dynamic adaptive processes have taken place. Furthermore, the pastoral group must respond (by leaving, dying, or adapting) to ecological changes that are in part beyond their control, such as wetlands shrinkage, ice caps melting, construction of roads and villages, management of water, and prevention of access to pastureland, and such dynamics shape and reshape the *puna* (Moseley 2001). In this scenario, adaptation to high Andean ecosystems has also been possible because pastoral societies have been able to successfully respond to all kinds of pressures caused either by local or external activities. The following section addresses some of such responses to modernization and climatic changes.

Current Challenges to the Pastoralist Lifestyle in the High Andes

Pastoralists around the world have responded to overwhelming forces external to pastoral society (Dyson-Hudson and Dyson-Hudson 1980; FAO 2001; Khazanov and Wink 2001; Markakis 2004) such as colonial administrations (Bolton 2007), policies imposed by nation-states (Khazanov 1984), pressure from agricultural neighbors (Bassett 1988), and climatic variations (Butzer and Helgren 2005; Gillson and Hoffman 2007). The interactions between pastoralists and external forces are manifested through changes in land tenure systems (Butzer 1988; Trivelli 1992), policies that settle pastoralists in a fixed location (Khazanov 1984), ethnic conflicts over control of pasture and routes (Bassett 1988), urban development, conflicts among water users, increasing frequency of droughts (Bassett and Turner 2007), changes in water availability, and glacier retreat. Since modern times, external forces, particularly climactic and political forces, have greatly shifted the structure of pastoralist societies around the world by altering available natural resources and limiting or restructuring access to land (Bassett and Turner 2007; Bogale and Korf 2009; Browman 1982; Khazanov 1984).

Environmental and political changes have been hampering herders' way of life, including transhumance, by limiting access to key resources, mostly pastures. In the last 40 years, climatic and socioeconomic processes have been acting upon the Peruvian herders of the High Andes. Agrarian reforms and national policies have increasingly forced pastoralists to settle in fixed locations determined by the governmental agencies. In consequence, they now struggle for access to water and land and keep organizing their lives to cope with pollution caused by the mining activities affecting critical resources and also with diminishing governmental services. Climate change and retreat of glaciers have been continuously altering underground water flow that feeds springs and surface runoff crucial as sources of water for animals and humans in the dry season (Barnett et al. 2005; Earls 2009; Mark and Seltzer 2003). In result, the area of available pasturelands diminished and location of pastures shifted. In 2008, droughts and cold climate affected the pastoral production of more than 1 million people in the highlands of 40 provinces in Peru (FAO 2008).

Socioeconomic Forces

The main cause of change affecting the pastoralist society globally is the modernization process carried out through national policies imposed by governments controlled mostly by sedentary populations (Ginat and Khazanov 1998; Homann et al. 2008). Historically, relationships between pastoralists and sedentary societies varied. On the one hand the modernization process and incorporation of pastoralists into sedentary societies threatens the pastoralist way of life; on the other, sedentary farming groups have provided pastoralists with the necessary agricultural and craft products for centuries. Pastoralists' military power and independence have also diminished because of the rising of nation-state. Post-colonial national boundaries split former grassland areas. National policies encourage sedentism either directly or by constraining pastoral land use or grassland cover. Pasturelands are diminishing due to the technological achievements of sedentary groups. Modernization causes increase in urbanization and industrialization and puts pressure on the critical pastoral resources such as water, land, and labor force previously accessed and/or controlled by pastoralists.

The process of modernization in the Peruvian highlands is characterized by road construction, rural development projects, and the agrarian reform (Browman 1982, 1983, 1987a; Trivelli 1992). The development of infrastructure has expanded the domain of market economy and fostered the expansion of capital. The construction of transportation networks has eased shipments of commodities, diminished costs, and improved the circulation of goods and services. These changes, however, benefited others and have not impacted the prices of pastoralist products. One of the most overlooked impacts of new roads is the change in the use of llamas for transportation, which minimized their economic value (Gade 1969). Developmental projects also influence changes in traditional livestock management and access to the natural resources fostering genetically improved livestock breeding, nonnative pasture cultivation, and market-oriented pastoralist economy. Among the consequences of these projects have been the increment of social differentiation within the traditional pastoral communities, enclosure of pastures and water sources causing the exclusion of some community members from access formerly open access resource (Postigo et al. 2008). In such context, Andean pastoralists have to respond to a range of natural and external socioeconomic and political constrains.

Peruvian Agrarian Reform

The Peruvian Agrarian Reform (AR) of 1969 was the most important transformative social and political process in the twentieth century (Caballero 1981; Eguren 2006; Taylor 1987). At the national level, it abolished feudal relations and brought an end to the regime of *haciendas* (large land estates owned by individuals or corporations). It changed the land tenure system distributing 57% of the private pastures. The social relations of production changed because of the end of feudal relations in rural regions. The agrarian structure of rural Peru was altered through the creation of production cooperatives on the coast and Agrarian Society of Social Interest (abbreviated SAIS for its name in Spanish) in the Andes.

The Agrarian Reform of 1969 and the land distribution processes of the 1980s rearranged access to land and constrained pastoralists' mobility within the boundaries of their communal lands. These changes in land tenure systems, though intended for the greater good, often led to practices that degraded pastures and increased tensions within communities as households vie for access to limited communal land (Browman 1983, 1987a; Orlove 1982). *Haciendas* used tenant farm labor to conduct extensive agriculture and livestock husbandry within the estate. Under this feudal system, much of the rural farmland in Peru was controlled by a few powerful landlords. For example, in the Department of Puno in southern Peru, the Agrarian Reform of 1969 expropriated around two million hectares of land from landlords and redistributed them to *hacienda* workers and herders (Browman 1982, 1983; Burke 1970; Mason 1998; Orlove 1982; Trivelli 1992). On the coast, the redistributed land was organized into large cooperatives (generally multiple haciendas were consolidated into one cooperative farm). In the high-altitude Andes *haciendas* became SAIS and the former *hacienda* workers shared *hacienda's* profits and controlled resources (i.e., pasture). These new arrangements led to increased competition for access to better pastures, breeds, and productive infrastructure because peasant communities and small farmers were excluded of the land distribution processes (Eguren 2006; Trivelli 1992). These cooperatives and SAIS were run by managers appointed by the Ministry of Agriculture and were owned by and worked on by ex-*hacienda* workers.

The agrarian problems in Puno and in most part of the southern Peruvian Andes remain unsolved. Despite its idealistic goals, the AR failed to actually improve the lives of most rural inhabitants (Taylor 1987) because it excluded many peasants who were not a part of the *hacienda* system, *hacienda's* financial problems were carried over from previous owners to the new management and therefore *haciendas* were decapitalized before the reform was implemented (Browman 1983). By 1980 livestock, capital, and land were concentrated in the hands of a few (the managers and cooperative members) than before the AR because of the exclusion of peasants and freeholders farming small plots (they received 9.1% of redistributed land, although they comprised 43% of the beneficiaries of the AR (Caballero 1977; Cleaves and Scurrah 1980; Zaldívar 1974), and the surplus extraction mechanisms (Browman 1983).

In response to the persistent inequities not lessened by the AR, further land seizures and invasions occurred in the 1980s in Puno (Taylor 1987; Trivelli 1992). Between 1979 (10 years after Velazco's agrarian reform) and 1987, more than 1 million hectares of poor quality land were distributed to peasants, 42% of land belonging to cooperatives was reorganized and transferred to groups of peasants. The amount of redistributed land was less than the peasants demanded and its poor quality generated anger and frustration with this new land distribution process (Browman 1987a; Taylor 1987; Trivelli 1992). Ultimately, the AR created peasant communities that subsisted on poor quality land and were limited in their mobility. Pastoralists responded to these new conditions by creating institutions such as committees overseeing production, arranging new communities, appointing night watch groups, developing new livestock mobility patterns, relying on goods external to the community, and in some instances migrating (Browman 1987a).

National Policies

Present national policies, e.g., the National Strategy of Rural Development[2] (PCM 2004) and nongovernmental organizations (NGOs) projects create and bolster socio-technological processes as much as the agrarian reform did under the military government, impacting directly herders and farmers activities, and modifying landscapes in the Peruvian highlands (Browman 1983, 1987a). In the past 35 years, national Peruvian agrarian policies have carried out agrarian modernization that favors the agribusiness on the coast and urban food consumers. Such policies impacted the pastoralist system in two ways: the lakes in the highlands are used to irrigate coastal crops, and the herders migrate to work temporarily in the coastal agribusiness. Focused primarily on the coast, these policies are, in fact, undoing the previous agrarian reform because they allow the coastal lands and investment to be managed by few economic groups (Eguren 2006). Coastal agribusinesses fostered their links with international markets and facilitated their food export through trade agreements, which also ease import of subsidized foods. The Andean producers cannot compete with these imported products not only because of subsidies, but also because they have lost the governmental assistance in the form of credit and other inputs. In this context of increased commercial flow, limited opportunities have opened to some neglected Andean products like alpaca's meat, which is increasingly demanded by the urban markets and consumed by household and in select restaurants.

Further, communal land systems have been threatened by attempts to privatize and concentrate lands through modification of laws that used to guarantee communal land tenure. In the High Andes, mining has been negatively impacting natural resources (e.g., through the pollution of soils and water) (Cooke et al. 2009; Dore

[2]Created in 2004 by the Peruvian government. The main goal is to foster human development in rural areas under the criterion of economic-social-environmental sustainability, equity, and democratization of the local decision-making processes.

2000; Fraser 2006; Gammons et al. 2006), while developmental projects carried out by NGOs focused on increase in livestock productivity through the use of new techniques of livestock rearing (such as improved breeds of livestock and grasses) and flocks' management, foster change in pasture distribution, access to water, and the social structure of local communities. These policies are counteracting the agrarian reform of 1969 by creating the conditions for land mergers and by the same time increasing the gap between modernized agriculture in the coastal valleys and the agropastoral system in the Andes.

Climate Change

In the highland tropics, climate change is the most conspicuous current transformation (Francou et al. 2003; Lemke et al. 2007; Liu et al. 2005; Thompson et al. 2006), visible particularly in glacier retreat (Brecher and Thompson 1993; Francou et al. 2000; Hastenrath and Ames 1995; Kaser 1999; Thompson et al. 2006). Glacier retreat uncovers bare substrate where plants existed (Chapin et al. 1994; Easterling et al. 2000; Seimon et al. 2007; Walther et al. 2002; Young 2007) and areas different plant species may again colonize (Grabherr et al. 1994; Pauli et al. 1996, 2007). This process impacts plant dynamics (Barry and Seimon 2000) by encouraging the upward shift of pastures and causing changes in moisture and water runoff which are fundamental for pasture growth and livestock. Wetlands are shrinking in the lower parts and enlarging at higher elevations because of increase in temperatures, shortage of rainy season, and diminished runoff and springs. If water sources are lessened and located at higher elevation, it is likely that channels to irrigated wetlands will be developed where these sources are more abundant and they will drain wetlands impacting local grazing patterns as wetlands are preferred grazing area of alpacas.

The Case Study: Quelcaya's Community

Quelcaya[3] is a community of about 1 hundred families of herders (600 inhabitants) located in the southern part of the Peruvian Andes (Fig. 9.2), in the district of Corani, which is a part of the province of Carabaya in the department of Puno. The region is a plateau between the eastern and western ranges of the Andes. This plateau is known as Collao and is named after the ethnic group that used to populate the area (Markham 1873). The region's rich ecology and magnificent landscape have caught the attention of geographers and explorers since the late 1800s (Markham 1873, 1903), while the region's mineral resources have attracted enduring interest from

[3]Note that the community's name is Quelcaya, which is different than the world-known ice cap Quelccaya, partially located in the area.

Fig. 9.2 Quelcaya herder in a hail storm

miners (Markham 1873; The New York Times 1889). Carabaya is well known for the abundance of uranium and mining companies are actively present in the province; presently three of them explore uranium in Quelcaya's land.

Quelcaya become a rural community in May 30, 1988 due to a resolution R.D 0231-88-UAD-XXI-P. Despite Quelcaya being nominally a new community there are traces of its history that go back to 1863, when the community was acknowledged as a *parcialidad* in the books of taxpayers of Carabaya province (Anonymous 1863). At that time individual herders were paying taxes for using pastures in the zones of Llapha and Huancane. Thus, as a community, Quelcaya is only 24 years old and is, therefore, considered amongst the new communities, which differ from the ones formed at the dawn of the Republic in the nineteenth and early twentieth century (Trivelli 1992). The community's most important governing organization is the board consisting of eight members (president, vice-president, secretary, treasurer, and four vocals) all elected for a 2-year term. There are also several committees to organize other activities in the community, such as night watch guards, vicuña (*vicugna vicugna*) shearing, and agricultural activities.

The community's territory is 31,358.26 ha, and it is divided into three sectors: Central, Llapha, and Huancane. Most of community's infrastructure such as the road, the health center and the primary school funded in 1940, first to sixth grade with only three teachers and 79 students, are located in the Central sector, in which an accelerated process of house building is underway, mostly one-story, one-room, mud-brick houses are clustered there because electrical power will be provided to a village only if there is a minimum number of houses built.

Climate change is a highly relevant phenomenon in the region impacting water supplies and pastures, both crucial to Andean herders' way of life. The elevation of the communal land ranges from 4,200 up to 5,780 m.a.s.l. The Quelcaya's landscape is dominated by the Quelccaya Ice Cap, which is the world's biggest tropical glacier (Thompson 1980; Thompson et al. 1979, 1985). The retreat of the largest Quelccaya outlet has been approximately ten times faster (~60 m/year) between 1995 and 2005 than the 1963 to 1978 period (~6 m/year). In 1991 a proglacial lake of ~6 ha area appeared and by 2005 its area has grown due to melting of the glacier to ~34 ha (Thompson et al. 2006).

Two biotic provinces have been identified in the region: the *altoandina* (high mountains above 4,500 m) and the *puna* (high tableland from 3,300 to 5,000 m) (Boyle et al. 2004; Young et al. 1997). Wetlands and tropical dry alpine are the dominant vegetation types in the *puna*. The flora is generally dominated by two families: *Asteraceae* and *Poaceae* (León et al. 2006). Because of differences in basin drainage, some areas on the eastern parts in the Carabaya mountain range can also be characterized as wet *puna* (Troll 1968) with species of *Cortaderia* (Young et al. 1997).

Transhumant Pastoralism

Pastoralism is the key subsistence activity in Quelcaya. It is based on a land tenure system that combines both communal property and extended family usufructuary rights. The head of the extended family controls the land; most of time it is an elderly man that has some type of document that grants him the right to decide whose land will be used and how. The shift of herds' location and pastures allocation among households are organized and decided at the extended family level. The ways how these decisions are made depend on the amount of power the household head holds, which is inversely related to his age. Another factor to consider in decision-making is whether his sons live in his community or are absent.

Extended families are formed by nuclear families that share not only a common ancestor, but also pastures and, sometimes, livestock. Thus, all nuclear families of an extended family need to coordinate and organize herding activities, labor force allocation to carry out these activities and pasture use to feed the herds. At nights with frost herders move the animals to shelters, if available; during daytime they look for pastures with running water as it prevents ice formation, or will break the ice that is keeping water in the streams from flowing. In response to drought when limited amount of grass to feed the flock is available, herders build a network of channels to irrigate pastures and create wetlands and take the animals to these irrigated wetlands during grass shortages in dry season.

The household is the unit of production and consumption (Orlove and Custred 1980). Livestock husbandry requires mobility patterns that consider the need to feed both the family and the flock. One such pattern is driven by the need to obtain goods from outside of the community (Browman 1987a). Thus, herders travel with a flock of llamas to different areas, depending on what they want to obtain in exchange for their products. For instance, around late July they undertake 8 days round trip to the Marcapata district (Quispicanchi province, Cusco, Peru) to obtain *chuño* (freeze-dried potato), and in mid-August—16 days round trip to the town of Ocongate (Quispicanchi province) to procure corn.

Feeding the flock requires careful scheduling of mobility pattern that must consider the different needs and grass preferences of the mixed flock (llamas, alpacas, and sheep), seasonality (rainy or dry), and the number of pasturelands allocated to households by their extended families (Browman 1987a). When a family controls only one pastureland the herder moves the flock from one grazing area to another within the pastureland. The time the herd spends at each grazing area depends on the distance to water, quality of the grass, and the size of the pasture. Such mobility pattern is known as limited transhumance.

When a household has access to two or more areas, some are used in the rainy season (December to March) and others in the dry season (April to November). In general, the pasture used in the rainy season is located at a lower elevation than the dry season pastureland because there are more wetlands in the lowlands during this season due to rainfall. The higher elevation pastures are also more risky for young animals (usually born in December and January) as the young animals can drown in lakes or channels, get stuck in boggy sites, or freeze. During the dry season the flock is moved to the higher elevation pasture so the animals can use wetlands and pastures irrigated by springs (Browman 1974, 1987b; Flores Ochoa 1968; Orlove 1982) or by melting glacier runoffs.

Although raising livestock is the main activity in the community, bitter potatoes are cultivated in the lowest parts of Llapha. Such farming activity is not common in the region and among the households, however. It is considered within the spectrum of activities as a possibility but each family has to assess the cost and benefits (not only monetary) of undertaking such cultivation in a particular season. Thus, although anybody can cultivate not everybody does it because the arable zone is too far and the time spent on travel—amongst other expenses—is not compensated by the output. Further, the lack of basic farming know-how does not only impose an extra cost in terms of learning process and errors but also that farming is not an appealing activity that herders are prone to undertake. In other region of Peru, I have noticed that herders left cultivated grass uncut because they did not know how to use a scythe and complained that cutting grasses generates blisters.

Climate Change in Quelcaya

Although climate change generally has negative impact on high-altitude Andean agriculture and livestock raising (FAO 2008; Tubiello et al. 2007), as species move upwards (Beniston 2003) and some get extinct (Seimon et al. 2007), there is also some evidence indicating that climate change may be contributing to agricultural development at higher elevations (Araujo 2009). However, more research on the link between climate change and subsistence economy are needed (Morton 2007) to fully evaluate the presently observable impact.

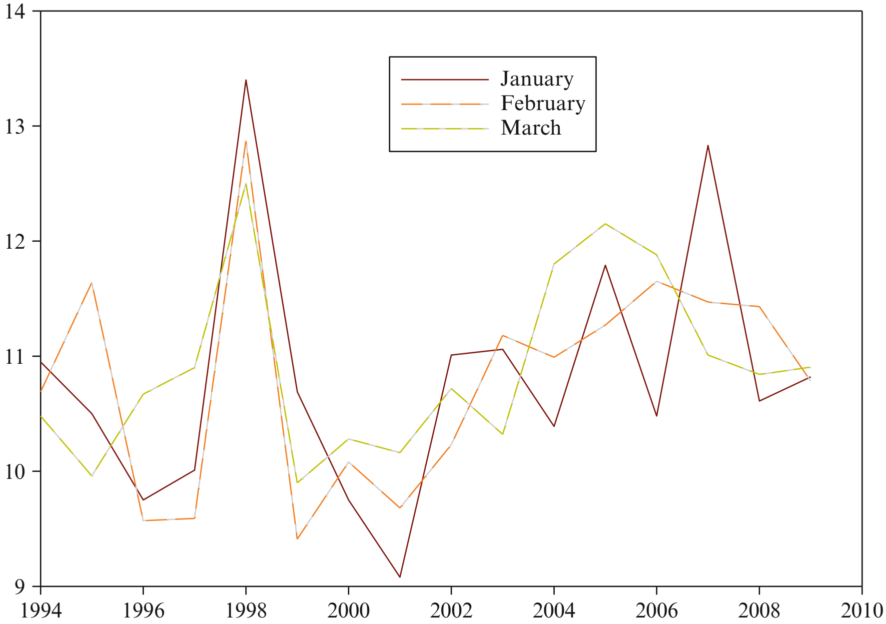

Fig. 9.3 Average annual noon temperature (°C) (Source: SENAMHI. Macusani station)

Climatic changes affect the peoples of Quelcaya mostly through glacier retreat,[4] increase of the extreme temperatures as it gets warmer during the day and colder at night, and shifts in the rainy season characterized by shorter duration and more abrupt changes from intense rain to dry days (FAO 2008). Temperatures have been rising not only in the dry months with cloudless skies and more direct sun radiation, but also during the wet months with more cloud cover, when lower temperatures are expected during the day.

The Quelcaya's population has been responding to climatic variations by instituting a combination of inter-households and/or households-community actions depending on the scale of the climatic change. The rising of temperature during daytime, the shifts of precipitation patterns, and the season with freezing temperatures at night require inter-household and inter-extended family cooperation. These responses are mainly expressed through land-use decisions and modification, land-cover changes, and herds' mobility patterns and are also found among other Andean herders (Browman 1987a; Orlove 1982; Webster 1973). In the case of an extreme climatic event, government action will be needed (Adger 2003) as it was requested in 2008 (FAO 2008).

Data collected by the National Service of Meteorology and Hydrology of Peru (SENAMHI) is consistent with the observations made by people of Quelcaya. Between 1999 and 2008 (last data available) average annual noon temperatures (Fig. 9.3) have been fluctuating within a trend of increasing from 11 to 12°C

[4]The Quelccaya ice cap has lost 22% of its ice (Thompson, personal communication).

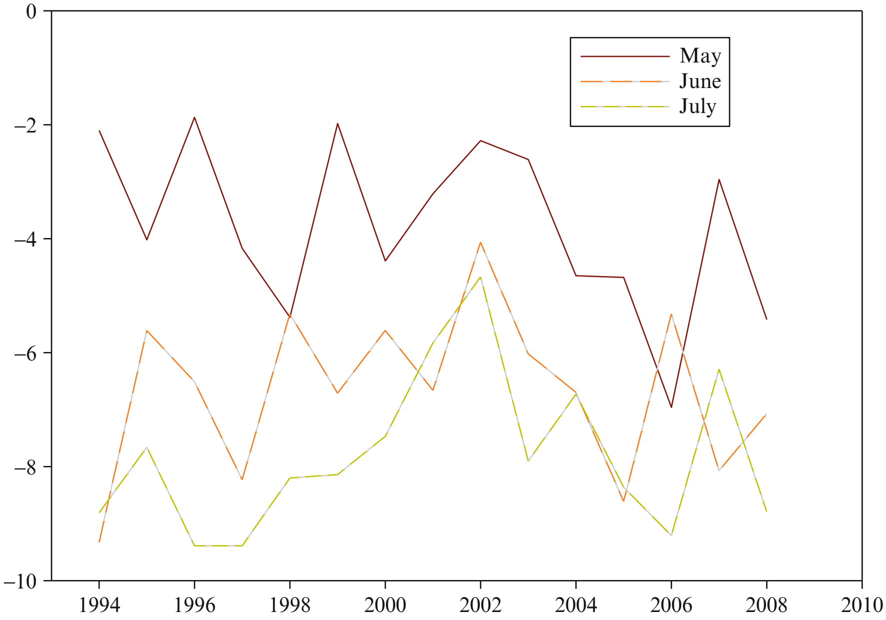

Fig. 9.4 Average annual evening temperature (°C) (Source: SENAMHI. Macusani station)

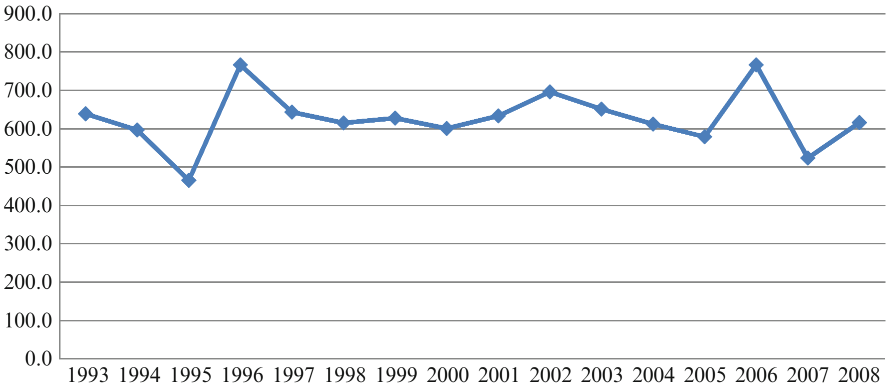

Fig. 9.5 Annual precipitation (mm) (Source: SENAMHI. Macusani Station)

respectively. Whereas evening temperatures (Fig. 9.4) show a decreasing tendency from −0.8°C in 2002 to −2.4°C in 2009. Annual precipitation has been generally on decline (Fig. 9.5) as November—traditional month of rain onset—and April—former month of the end of the rainy season—have become less wet in the last years, thus shortening the wet season in this part of the Andes. Further, Bradley et al. (2009) showed that since 2004 temperatures were frequently above freezing between September and May at the summit of the Quelcaya glacier and averaged daily maximum temperatures were persistently above freezing for most of the year at the glacier's margins (Bradley et al. 2009).

Socioeconomic Forces

The Peruvian Agrarian Reform (AR) ended the ruling of landlords over farmland and in consequence the herders of Quelcaya were able to take possession over the land of the Carmen's hacienda, next to Quelcaya. The AR also provided Quelcaya's herders with the opportunity to better control the pastures as the peasants were empowered and the power of landed aristocracy diminished. Numerous complaints have been filed by the herders to the local and national authorities against landlords and urbanites who invaded parts of the land claiming property rights with fake titles, and others who wanted land granted by the government as compensation for provided services. Before the AR, legal actions were carried out either by families or groups of families of the Quelcaya area; however, once the community has officially formed, legal actions were undertaken by the community acting as a plaintiff as it is the legal owner of the land.

The increasing presence of the 'outside world' is expressed in Quelcaya by the mining companies and infrastructure such as electric power and potable water system. Based on the interviews conducted in 2008, the community sees these investments as an improvement in their living conditions and as an opportunity to obtain some benefits, including monetary compensation as the mining companies, in addition to paying taxes at the national level, also pay fines to the community due to such faults such as frequent unauthorized transit of vehicles and personnel through the community's land. Also, according to the agreement between the mining companies and the community, a group of seven community members, chosen by the community, is hired every month to work as guides or to assist in road maintenance. Further, the mining companies provide certain social services to the community, such as dental care, tests for pregnant women in the public hospital in Juliaca, and transportation of patients in case of emergency.

On the disadvantageous side, the Quelcaya's community is well aware of the threat that mining activities pose local natural resources especially water. This environmental threat has two major issues: pollution of the water from its use in mining activities, and limitation of access to and control over bodies of water by the community. Pollution and demand of water by mining activities have revived intergeneration tensions as well as antagonized families and the community. Families whose land will be directly affected by mining activities see the communal organization of the society as disadvantageous because the money that the mining companies pay for using a family land is addressed to and received by the community. The community, in turn, only gives a small share of the received money to the directly affected families, whereas the rest is spent on other communal expenses. These families do not acknowledge or recognize that relations between mining companies and the community are fair because the community is negotiating with the company rather than each family individually. The families believe that they would be better off by pursuing direct and individual (family–company) negotiations. By insisting on that, they neglect the uneven nature of power relations, especially the discrepancy in education and knowledge between the herders and representatives of the mining companies.

The Quelcaya community has been responding to these climatic and political changes throughout its history at two social levels: extended family–household, and community. These levels operate sometimes in parallel as independent and unrelated units, sometime they alternate, and under certain circumstances they cooperate, while under others they compete (see Brush (1976) for an analytical model). Such complexity of problems derives from the fact that the Quelcaya extended families have been living there for centuries and have paid taxes, and some families still do, to the municipal district because, to them, paying taxes is a signature of ownership. The fact is, however, that they should not pay individual taxes since the late 1980s, the time when they formed the community with a unique collective title of ownership encompassing all the extended families' lands. The community was formed to received land of cooperatives and SAIS that has been distributed by the central government to the peasant communities, as it occurred elsewhere in Peru (Trivelli 1992). Although the Quelcaya community has been created it did not obtain more land because they filed the application to receive lands after the deadline. Nonetheless, as the community came to existence the individual or family rights over the land were turned over to the community which became the only owner and title holder. Furthermore, the only community's assets of land and livestock were those that community's founders donated fulfilling the requisite to form a community.

Quelcaya's origin and subsequent years of functioning as community have shown that it is an institutionalized organization with formal—through the property title—control, but limited if any, access to the land because the extended family households have controlled the land for centuries and still claim its ownership. The community members share a history living in the area where kinship links have been established for years. Quelcaya herders respond (and take advantage when possible) to processes such as agrarian reform and climate change. When legal actions or major infrastructure work are needed it is the community that takes decisions and acts upon them. For instance, agreements with governmental agencies or mining companies are voted on and decided during community assemblies that require a minimum number of attendees to be legitimate.

Conclusions

Local Scale

Quelcaya's landscape is the key element for the pastoralist system that has been changing over the course of history in conjunction with changes introduced to the socioeconomic context of the region and country. South American camelids were domesticated and became conditioned to live in the highland environment over the millennia; more recently sheep were introduced to the Andes along with the Spanish livestock and other farming traditions. From the long-term perspective, these are the most significant culturally induced transformations of the Andean highlands. Pastoralists of the Peruvian highlands survive by carrying out subsistence economy based upon rising livestock arranged through unwaged labor (household) and limited wage labor (herders), by bartering for agrarian products, and by selling alpaca's wool, meat, and skin. Any policy to alleviate rural poverty has to consider herders' socioeconomic and environmental specificity in terms of spatial location, productive activities, environmental conditions, community rationality, and, not to be overlooked, the will of the society (Earls 2009; Ensor 2009; Morton 2007). Policies should be designed and implemented in order to establish a comprehensive and sustainable development of the *campesino* communities in the Peruvian Andes that also include their adaptive strategies to climate change (Earls 2009). Further, the majority of Peruvian population lives on the coast (west of the Andes) and their water supply and hydropower rely on rivers that are fed by the melting glaciers (Barnett et al. 2005; Vergara et al. 2007). Thus the past and the present, modernity and tradition, should be combined and utilized in response to old and new disturbances caused by local, regional, and global socioeconomic and natural forces, such as global climate change.

Although international relations have led to the implementation of the Peruvian National Strategy against climate change, it is still under consideration and is absolutely unknown to the Quelcaya herders. It is likely that this strategy will be introduced through subnational governmental agencies or NGOs. The herders will surely accept this implementation following their practical sense of taking advantage of any opportunity to improve their livelihood. Should this happen, it would be a small step but in the right direction to better lives of powerless and impoverished residents of the high altitudes. Some of the questions that will be raised, however, are: Will the Andean herders long-lasting responses to climate change going to be incorporated into these programs? How will the important local resources be impacted by climate change and how will they be preserved, protected, or improved to mitigate the effects of such change? Is herders outmigration considered an adaptive strategy? Will it be supported? Will the industries contributing to climate change participate financially in combating its adverse impact on human wellbeing in the High Andes? How will policies and cultural adaptation to climate change interlink? Do policy makers understand that, as research demonstrates (Agrawal 2008; Morton 2007), diminishing rural poverty improves resilience and ameliorates vulnerability of peasant communities to climate change and other uncontrolled by them threats?

Global Scale

Andean pastoralism has modified and has been modified by high Andean landscapes over millennia, transforming nature through pastoralism. While doing so, herders' physiology and culture have been adapting in order to carry out this dynamic relationship with its environment. Adaptation is at the core of the relationship between nature and society (Folke et al. 2005). Whether in the benign or the worst future scenarios, or any in between of these extremes, current and future effects of climate change challenge the viability and feasibility of ecosystems and societies with diverse intensity. Such challenges jeopardize not only the social and environmental adaptations but pose a more general question about humankind's adaptive capacity to cope with them. Further, society's reflection on its path of development must not be void, on the contrary, an in-depth analyses is needed on how and why we ended up in such predicament (Young et al. 2006). In other words, the nature of the human–environment relationship has to be under severe scrutiny especially in developed nations, where production activities and CO_2 emissions carry out a vast responsibility for generating the green house effect.

Policy Scale

The term "adaptation" is currently closely related to the Inter-Governmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). The IPCC defines adaptation as "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates, harm, or exploits beneficial opportunities" (Parry et al. 2007:869). This definition points out to the dynamic nature of human cultural adaptation and suggests that the effects of climate change can be socially managed and some might be even beneficial (Adger et al. 2005; Orlove 2009).

The growing presence and acceptance of climate change by politicians have resulted in the frequent use of such terms as "adaptation" and "mitigation" in the policy-related jargon and fostered well-funded programs in developed and developing countries (Adger et al. 2005). The global dimension of climate change resulted in the creation of international agendas steered by the developed nations that have defined the international division of labor to address climate change that can be summarized in the following formula: the first world mitigates, the rest: adapts (Dellink et al. 2009). Further, the global nature of climate change veils the non-global, and spatially and socially specific character of the causes of the global changes (Turner et al. 1990). Downscaling from global to regional and local should aim to identify where are the sources causing global changes, therefore on who bears the moral, ethical, and financial responsibility of lead and undertake radical transformations in the productive logic at the origin of climate change (Dellink et al. 2009).

To investigate the causes of climate change and improved adaptation to it, coordinated work at different levels of social organization is needed. Established linkages between local, national, and international networks may increase the impact of multilevel programs of adaptation (Earls 2009; Ensor 2009; Folke et al. 2005). Integrated programs that combine research, development activities and policy changes, and which include local, national, and international stakeholders, should be implemented (Ensor 2009). Local populations have been coping with climate and social changes for centuries using local knowledge (Earls 2009); this local knowledge should supplement technical knowledge to generate a more comprehensive understanding and solutions to problems resulting from climate change (Araujo 2009; Earls 2009; Ensor 2009).

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Chapter 10
Mapuche Resilience and Adaptation to Arid Uplands in NW Patagonia, Argentina

Ana H. Ladio

Introduction

Human indigenous populations living in arid environments such as deserts, semi-deserts, savannas, steppes, and dry forests have developed unique adaptive strategies related to the utilization of natural resources under ecological pressure associated with water and nutrient limitations (Gragson 1997; Ladio and Lozada 2004a, 2009; Almeida et al. 2005). It is notable that in most of these indigenous societies, the scarcity of physical resources has been combined negatively with detrimental historical-economical-political circumstances, resulting in a state of high social and environmental vulnerability (Montaña et al. 2005). Such is the case of the Mapuche communities living in the Argentinean extra-Andean Patagonia, which have had to overcome extreme living conditions since the arrival of Spanish conquistadores in the region in the sixteenth century, a situation exacerbated by consecutive Argentinean national policies (Bandieri 2005).

Faced with these difficult conditions, a frequently applied subsistence strategy among the Mapuche living in arid lands is the utilization of different ethno-ecological units corresponding with different altitudinal gradients (Ladio and Lozada 2004b, 2009). In addition, due to insufficient rainfall, cattle raising has become Mapuche principal means of survival, supported by small-scale home gardening, gathering of wild plants, and also hunting (Eyssartier et al. 2008a; Ladio 2002, 2006). As early as the seventeenth century, Mapuche incorporated horses (*Equus caballus*), sheep (*Ovis aries*), goats (*Capra hircus*), and cattle (*Bos taurus*), all brought into the area by the Spanish settlers, and they became specialized horse farmers (Torrejón and Cisternas 2002).

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Summer cattle transhumance, known locally as “veranada,” a seasonal movement of people and animals to the pre-Andean forest, serves as an example of Mapuche specialized adaptation to arid conditions, which helps them to cope with this hostile living environment in the lowlands (Ladio and Lozada 2004b, 2009). Transhumant groups utilize two ecologically distinct environments, pre-Andean highlands and extra-Andean lowlands, using altitude differences for seasonal, summer-winter migrations. By following specific routes, shepherds and their families move away from the arid lowlands in summers, along with their cattle and personal belongings, in order to find new pastures (Universidad Nacional del Comahue 1986). It was found in a Mapuche community in the Monte region that such practice not only reduces lowland overgrazing, allowing for the recovery of most palatable plants, but also contributes to an increase in the total richness of wild resources utilized for their subsistence (Ladio and Lozada 2004b).

Since prehistoric times, hunting and wild plant gathering in Patagonia have been associated with the extensive knowledge and use of local environments by human groups who followed seasonal animal migrations and the phenology of useful plants (Bárcena 2001; Musters 1964). Zooarchaeological data confirm hunting of such animals as guanacos (*Lama guanicoe*), rheas (*Pterocnemia pennata pennata*), viscachas (*Lagostemus maximus*), armadillos (*Chaetophractus vellerosus*), southern viscacha (*Lagidium viscasia*), hares, rabbits, partridges, pigeons, parrots, wild ducks, and fishing in lakes and lagoons (Bengoa 1991; Ladio and Lozada 2009). In the past, hunters frequently used fire mainly in the steppe regions (Markgraf and Anderson 1994). As a part of local subsistence, hunting continued until the present day, mainly carried out by the men and without the use of fire, although little study has been conducted on the prevalence or impact of this activity.

In addition to transhumant movements and hunting, the Mapuche groups search for useful and culturally significant wild plants which are important both for their sustenance as well as cultural identity (Ladio and Lozada 2004a). For example, in autumn the Mapuche of the Neuquén Province travel from the lowlands to the pre-Andean forest highlands searching for the monkey-puzzle, *Araucaria araucana*, seeds (“pewen” seeds, called “ngüilliw” in the Mapudumgum language). This gathering tradition was inherited from their ancestors who were ancient dwellers of the Pewen forests (“Pewuenches”) and based their subsistence on Pewen seeds and hunting (Aagesen 1998; Ladio and Lozada 2000). Gathering of “pewen” seeds, which in comparison with other forest resources have high nutritional value, is a social activity called “pinoneo” or “ngumitun” in the Mapudungun language. In general, it is a family-based activity which involves journeys to the sacred forest of great religious significance (Aagesen 1998; Carrasco Henríquez 2004).

The Mapuche people also have a longstanding tradition of horticulture (Mösbach 1992; Pardo and Pizarro 2005; Eyssartier et al. 2008a). They used to cultivate native species such as maize, quinoa, potato, pumpkin, pepper, and green beans even before the Spanish conquerors arrived (Noggler 1972; Parodi 1999; Mösbach 1992; Pardo and Pizarro 2005). As in other rural societies, the women are mainly in charge of the home gardens and are the ones who transmit the knowledge on gardening to their families (Eyssartier et al. 2008b; Noggler 1972). These gardens are mimetic and integrative in character, imitating natural ecosystems (Torrejón and Cisternas 2002). However, the Spanish conquest caused severe transformations of local traditions including significant alterations to local diet and cultivation practices. Most of the traditional crops disappeared, replaced by exotic species which remain the basis of the present horticultural practice (Pardo and Pizarro 2005; Carrasco Henríquez 2004; Eyssartier et al. 2008a).

The maintenance of the above-mentioned cultural practices by the Mapuche is associated with their adaptive capacity and resilience necessary in surviving strategies applied to the Patagonian arid lands (Ladio and Lozada 2009). Resilience refers to a capacity to cope with disturbance and change (Berkes and Folke 2002), behavioral features prevalent in the history of the Mapuche communities inhabiting this region and followed by local communities until present (Ladio and Lozada 2008; 2009). Several researchers have proposed that local practices carried out by men and women in their everyday lives contribute to the accumulation and preservation of knowledge about the environment, thus contributing to their adaptive capacity (Berkes et al. 2000; Ladio 2002; Tengö and Belfrage 2004). This collective body of information, actions, and beliefs generally known as traditional plant knowledge, which evolves through adaptive processes and is handed down for generations through cultural transmission, has a dynamic nature and as such is particularly prone to reorganization and oscillations (Begossi et al. 2002; Berkes and Turner 2006; Walker et al. 2004).

Mapuche traditional practices such as transhumance, wild plant gathering, hunting, and horticulture form unique, distinct cultural domains that are different from each other and reflect different contexts of action and acquisition of knowledge. On the other hand, along with the use of the traditional language, there are also certain activities which give people identity and as such are pivotal in the resilient maintenance of their culture (Carrasco Henríquez 2004; Villagrán 1998). Unfortunately, these traditional practices are significantly diminishing at present, due to acculturation and globalization that affect rural communities around the world (Ladio 2002; Torrejón and Cisternas 2002; Ladio and Lozada 2009; Lozada et al. 2006; Eyssartier et al. 2008a, b).

Quantitative testing of variations in resilience capacity of populations living in arid environments, which have lost part of their traditional practices, is a complex investigation (Ladio and Lozada 2009). However, if we attempt analyzing the variations in traditional plant knowledge in association with the preservation of certain cultural activities, it would be possible, in a transitive way, to describe changes in the capacity for self-sufficiency, and thus, in part, in the capacity for resilience (Ladio and Lozada 2004b, 2008; Eyssartier et al. 2008a, b).

In this work, the complex relationships between the preservation of different Mapuche cultural practices and how they relate to the traditional botanical knowledge related to wild edible plants will be analyzed in several ways. Many studies in the region have shown the heuristic value of quantitative analysis of this kind of wild resource which are culturally relevant for Mapuche and contribute significantly to their subsistence diet (Ladio and Lozada 2000, 2004a, 2009).

In addition, following the ideas presented by Reyes-García et al. (2007), theoretical dimension (the ability to recognize and name edible plants) and practical dimension (the ability to put this knowledge into effective practice) will be compared, in order to understand how they relate to the different activities carried out, so as to predict a greater or lesser capacity for resilience in the traditional plant knowledge among the inhabitants of arid lands.

Objectives of the Study

The key objectives of the presented study are as follows:

- To examine the importance of hunting, home gardening, transhumance, piñoneo, and language in reference to the current Mapuche communities of Neuquén.
- To present the level of variation in traditional knowledge and the use of wild edible plants researched by interviewing two groups of adult men and women: (1) those who maintain these arid environment adaptive cultural practices, and (2) those who do not.
- To present quantitative prediction as to the importance of the different cultural activities and the significance of gender, with regard to knowing more or less about wild edible plants and to using more or fewer plants effectively.
- To determine whether different cultural practices influence the level of knowledge and use of wild plants in the same way.
- To examine the capacity for resilience of traditional plant knowledge in the face of the abandonment of traditional practices in arid regions.

Study Area: Mapuche and Their Communities

The Mapuche are considered the most numerous indigenous group in southern South America (Munilla and Goldztein 2005). They originated through a cultural fusion of different societies which originally lived in the cold temperate forests of the southern Andes of Chile and Argentina (Mösbach 1992). After the sixteenth century, they suffered great social and economic changes and, in result, extended their lands towards the south and east, the driest regions of Argentina, which became part of their territory (Bandieri 2005; Molares and Ladio 2009).

This is the case of the three small Mapuche communities of Paineo (51 families), Rams (25 families) and Cayulef (40 families), distributed in the Catantil Department (Neuquén Province, Argentina, Fig. 10.1). The nearest urban center is Zapala (more than 35,000 inhabitants) located at a distance of about 60–130 km from each population

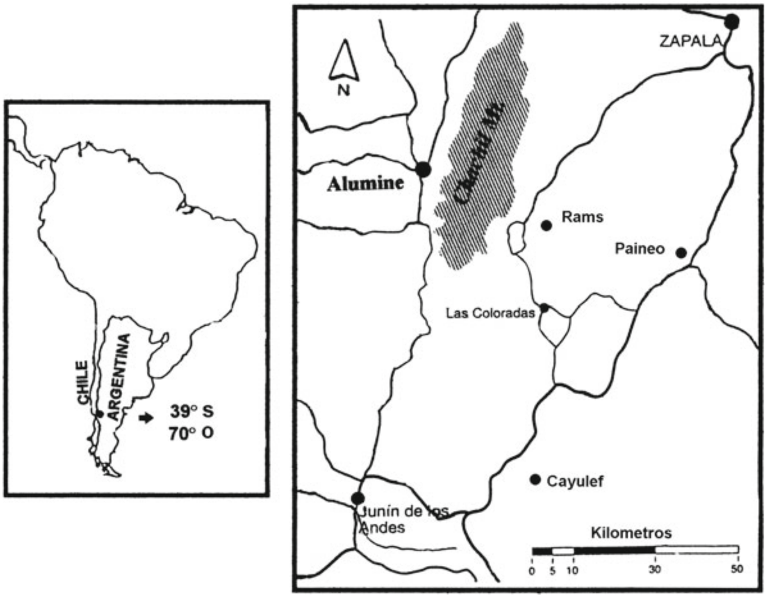

Fig 10.1 Map of the study site. Geographic location of the Rams, Paineo, and Cayulef communities in the Neuquén Province, Argentina

(Fig. 10.1). All three communities limit contacts with this city; the majority of inhabitants live in total isolation and almost never go to any urban center. In addition, accessing the three groups is difficult due to poor condition of the few existing dirt roads and the lack of regular public transport service. The main economic activity is livestock breeding, with sheep and goats kept mainly for the production of wool and meat, supported by the sale of craft items such as hand-made wood and wool products. Some dwellers are illiterate or semi-literate, whereas others have completed the primary level of education. Most children attend government-run schools (with bilingual teaching system) in their communities. Most dwellers inhabit single room houses with almost no furniture and bare-ground floors, no electric power, no running water, and no sewage system. All households use firewood for heating and cooking. These communities are characterized by the strong maintenance of ancestral traditions such as religious ceremonies, the continued use of the Mapuche language "Mapudumgum," and the traditional Mapuche health system. According to the Mapuche cosmology, "Mapu" (the land where they live and from which their basic supplies are obtained) is the main spiritual and material resource for their subsistence and identity. More socio-cultural data on these three Mapuche communities are found in Ladio and Lozada (2000), Ladio (2002), and Ladio and Lozada (2004b).

The study area is a dryland, characterized by the mixed vegetation of the Patagonian and Monte phytogeographical province of Argentina (Cabrera and Willink 1980). The relief is composed of plains and plateaus; soils are sandy and rocky with large extensions of saline ground. In the Patagonian province, the dominant vegetation is shrubby or grassy steppe, with bushes and/or species of cushion-plant, while the Monte vegetation consists of xerophytic, sammophytic, and halophytic scrubs (Cabrera 1971). The mean annual precipitation varies from 100 to 270 mm, concentrated in autumn and winter (March–September) and the mean annual temperature is 8 °C. The combined increase in temperature and decrease in precipitation during spring and summer (October–February) causes moderate hydric stress (Barros et al. 1983). The entire region suffers from moderate to serious levels of overgrazing due to sheep farming (Bisigato and Bertiller 1997; Ladio 2002).

Methodology

A total of 98 adult informants were selected (approximately 80% of all the families): 32 from Cayulef, 41 from Paineo, and 25 from Rams; all were interviewed in Spanish in their homes. Interviewees were 54 women (55%) and 44 men (45%) of different ages ($X = 49 \pm 16.5$, minimum 16, maximum 85 years). There was no significant age difference found between the samples of male and female informants (Wilcoxon test, $p = 0.277$). During 1998 and 2001 project campaigns, houses were selected using random numbers, and 1 member per family was interviewed. All the informants agreed to take part in the interview protocol: free listing, semi-structured, and open interviews were conducted in which we documented the knowledge (lists of all wild edible species known) and use (lists of species with which they used in the previous year) of edible wild plants (Ladio and Lozada 2004a; Alburquerque and Lucena 2004). Informants identified plant species using their traditional names and researchers used specimen vouchers and photographs to identify them using scientific nomenclature. This information was supplemented with field outings accompanied by some key informants. In addition, the researchers registered whether during the previous years the interviewed families had carried out the following activities: domestic home gardening, small-scale animal husbandry with transhumance, "piñoneo" or plant gathering of *A. araucana* in pre-Andean forest, and hunting. We also registered whether the informants spoke the Mapudumgum language or not.

Voucher plant collection and specimen identification was carried out by Ana Ladio and deposited in the Ecotono Laboratory herbarium.

Data Analysis

Firstly, the proportion of cases in which each cultural practice was carried out by the informants was analyzed. Cochran's Q test was used to determine whether the proportions of cases for each cultural activity were equal to each other (Conover 1971). For this study, plant richness cited per person was calculated considering the total number of different species mentioned (plant knowledge) and then effectively used by informants of each gender. Kruskal–Wallis and Wilcoxon tests were performed to analyze significant differences between these two groups of data, between gender and between different cultural practices (Conover 1971; Höft et al. 1999).

Additionally, a binary logistic regression analysis was carried out with the SPSS 10.0® programme, in order to create two models which explain the importance of each of the cultural practices in relation to traditional wild plant knowledge, and the probability of knowing more or less about wild edible plants according to the cultural activities carried out by the inhabitants. The dependent variables used in the two different models were the number of species known and those effectively used by the person. For the first model, the binary categorization was: little plant knowledge = 0–13 species and greater plant knowledge = 13+ species known by a person. In the second model, the categories were: reduced plant use = 0–6 species used by a person, and greater plant use = 6+ species used. These binary categorizations were constructed according to a range of each variable (Table 10.1). As independent variables, binary states such as presence/absence of hunting, home garden, transhumance, piñoneo, and the use of the language were utilized; gender being categorized as female or male. The results are presented in a logistic table with two models. The first (a) shows the probability of knowing more plants and the second (b) the probability of using more plants, in relation to the different cultural practices carried out. In this way the reader can see the calculations of the odds ratios of each state by means of e^{beta} = Exp (beta). The adjustment for the two logistic regression models was tested with the −2 Loglikelihood Pearson test (Agresti 1996).

Results and Discussion

The Current Importance of Traditional Practices

The three examined Mapuche communities in the Catan-lil Department maintain traditional survival practices and multiple use of the environment, but the level of commitment to these varies (Cochran's *Q* test, $p < 0.0001$). The hunting of wild animals is carried out by 53% of the informants, followed by the gathering of *Araucana araucana* seeds (piñoneo) in the Andean pre-cordillera (44%), family horticulture (43%), and finally, to a much lesser extent, transhumance (25.5%) (Table 10.1). It was also found that 52% of informants speak the Mapuche language (Table 10.1).

Hunting for food is carried out with or without firearms, and with the help of dogs. It is currently limited to the hunting of ducks, rheas, hares, and wild rabbits. According to the informants, guanaco hunting is severely restricted due to the enormous population decrease suffered in the Catan-lil Department.

The piñoneo is carried out on horseback, or, less commonly, in a vehicle, and each individual collects between 50 and 100 kg of *A. araucana* seeds in the Chachil Mountain (Fig. 10.2). This mainly involves the gathering of fallen seeds and those on branches that can be removed with a lasso. Pewen forests are managed collectively by these communities. No family may claim exclusive rights to any part of

Table 10.1 Cultural practices, gender, traditional wild plant knowledge and their practical use in three Mapuche communities of the Catan-lil Department of Neuquén, Argentina (N=98 informants)

Cultural practices	Category	Knowledge of wild plants ($X \pm$SD)	Practical use of wild plants ($X \pm$SD)	N (%)
Hunting	Yes	17 ± 7	8 ± 5	52 (53)
	No	12 ± 5	5 ± 3	46 (47)
	p Value	0.000*	0.001*	
Piñoneo	Yes	16 ± 6	9 ± 4	43 (44)
	No	13 ± 6	5 ± 4	55 (56)
	p Value	0.005*	0.000*	
Home gardens	Yes	15 ± 7	8 ± 5	42 (43)
	No	14 ± 7	6 ± 4	56 (57)
	p Value	0.840	0.008*	
Transhumance	Yes	15 ± 7	8 ± 5	25 (25.5)
	No	14 ± 6	7 ± 5	73 (75.5)
	p Value	0.354	0.093	
Mapuche Language	Yes	16 ± 7	8 ± 5	51 (52)
	No	12 ± 5	6 ± 3	47 (48)
	p Value	0.040*	0.038*	
Gender	Women	14 ± 1	7 ± 5	54 (55)
	Men	15 ± 1	8 ± 1	44 (45)
		0.980	0.460	

The comparisons were performed with Kruskal–Wallis test
*Significant difference at p value = 0.05

Fig. 10.2 Landscape of the Patagonian steppe in Rams Mapuche community

this forest. Families often go out for several days to collect Pewen seeds, sleeping at night in makeshift dwellings, or taking refuge in trunks. Detailed descriptions of this tradition can be found in Aagesen (1998, 2004) and Ladio and Lozada (2000).

Home gardens are most commonly rectangular, located near the houses, with a mean area of approximately 30 m^2. There is usually no irrigation system; the inhabitants bring water with buckets, taking best advantage of scarce hydric resources. Water is obtained from springs or streams. Potatoes, onions, broad beans, carrots, peas, and lettuce are the main species grown. Branches of trees and bushes, such as *Populus nigra*, *P. alba,* and *Ribes aureum* (golden currant), are usually found as hedges around these sites.

The results presented above reveal that these practices, so common in the past, are gradually being given up in the region. According to the informants, all the activities have experienced change, but transhumance is the activity that has suffered the greatest loss. The main reasons given are: they now have few livestock to move, the whole family does not participate in the activity, mainly because their young children are being schooled, members of the family now have temporary jobs, the young people have moved out of the area, the advantage gained is small, because of abusive intermediaries, and difficulties in getting permission for transhumance on fiscal lands.

This last aspect is crucial, given that due to the territorial reorganization process carried out by the Argentine government (since the nineteenth century) the transhumance lands lie outside the territory of these Mapuche communities. In no case was it observed that these abandoned cultural practices were replaced by activities that led to any kind of progress among the people. In all cases, the people feel more and more limited in their subsistence economy and more dependent on the state support system.

The Use of Wild Plants and Traditional Practices

On average, irrespective of the cultural activity they maintain for subsistence, inhabitants know more edible wild plants (14 ± 7) than they use effectively (7 ± 5) (Wilcoxon test, $p < 0.0001$). In accordance with Benz et al. (2000); Reyes-García et al. (2005); Ladio et al. (2007), these results can be interpreted as evidence of cultural loss and a gradual process of abandonment of traditional wisdom which is no longer put into practice.

No significant differences between men and women were found for either the number of plants known, (Wilcoxon test, $p = 0.98$) or those used (Wilcoxon test, $p = 0.46$), indicating that the division of everyday tasks between the sexes does not imply any difference in richness. The set of edible species managed by both sexes would seem to be of the same size, although this does not imply that the content consists of the same species. This aspect was not investigated in the present work, because the focus was on identifying differences in cultural activities. However, these results do coincide with those found by Camou-Guerrero et al. (2008), which reveal that the basic activities related to procurement of food are equally relevant to both sexes.

In general, the maintenance of various cultural practices promotes greater knowledge and practical use of edible wild plants (Table 10.1). Those who practice hunting know and use more plants than those who do not hunt and this might be caused by greater and more frequent contacts with the environment. Similarly, those who participate in the piñoneo of *A. araucana* in the Andean pre-cordillera know and use a greater number of wild resources, since this practice promotes greater contact with the plants of these wooded areas (Table 10.1).

In addition, those inhabitants who have home gardens use a higher number of wild plants, although their knowledge of plants is significantly the same (Table 10.1). It was also found that those who preserve and speak the Mapuche language know and use a greater number of wild plants than those who do not. However, no significant differences in plant knowledge and use were found between those who practice transhumance and those who do not.

Binomial Logistic Regression Analysis

The first logistic model (Table 10.2) describes how traditional botanical knowledge, with regard to edible wild plants, varies according to the different cultural activities carried out by inhabitants. These results coincide with those found in the individual comparisons for each variable (Table 10.1), but also add a predictive element of great heuristic value. It was found that the most important variables related to greater knowledge of wild edible plants were the practice of hunting (beta = 1.7 with $p < 0.05$), piñoneo (beta 1.4 with $p < 0.05$), speaking the language (beta = 1.3 con $p < 0.05$) and not having a home garden (beta = −1.2, con $p < 0.05$). Whether or not they practice transhumance was not significant, however, ($p = 0.831$, Table 10.2). By means of the analysis of Exp (β), we find that the probability of knowing more about edible plants increases by a factor of almost 6 if the person practices hunting, increases by 4 if they carry out piñoneo and/or speak the language, and increases by 3 for a woman as opposed to a man (Table 10.2). It was also found in this model that those who have a home garden know 70% less about wild plants than those who do not carry out family horticulture (Table 10.2). There is a discrepancy between this last result and Table 10.1, and also with other study in Patagonia which found that the practice of horticulture was associated with greater knowledge of wild plants (Ladio 2002).

In the case of the model on the effective use of edible wild plants, it was found that only hunting (beta = 1.6, $p < 0.05$) and piñoneo (beta 2.2 $p < 0.05$) have a positive effect. In other words, having home gardens, carrying out transhumance, or speaking the language made no difference to the number of plants used (Table 10.2). It was also found, as in Table 10.1, that being a man or woman made no difference either (Table 10.2, $p = 0.379$). Therefore, analyzing Exp (β), we find that the probability of using more edible wild plants is five times greater if the person hunts, and nine times greater if they participate in piñoneo (Table 10.2).

Table 10.2 Binary logistic regression models including as dependent variable (a) higher or lower level of knowledge about wild edible plants, and (b) higher or lower level of effective wild plant use

Cultural practice and identity	B	SE	Wald	df	Sig.	Exp(B)
(a) Variables in model equation about knowledge of wild edible plants (higher level of wild plant knowledge)						
Hunting	1.725	0.518	11.082	1	0.001*	5.611
Home garden	−1.200	0.546	4.823	1	0.028*	0.301
Mapuche Language	1.3	0.49	7.032	1	0.008*	3.67
Gender (women)	1.172	0.559	4.397	1	0.036*	3.228
Transhumance	0.153	0.715	0.046	1	0.831	1.165
Piñoneo	1.411	0.666	4.495	1	0.034*	4.1
Constant	−2.393	0.687	12.145	1	0.000*	0.091
Hunting	1.604	0.521	9.465	1	0.002*	4.973
(b) Variables in model equation about effective use of wild edible plants (higher level of effective use of wild plants)						
Home garden	0.469	0.511	0.843	1	0.358	1.599
Mapuche Language	0.922	0.501	3.386	1	0.066	2.515
Gender (women)	0.796	0.558	2.036	1	0.154	2.216
Transhumance	−0.716	0.743	0.928	1	0.335	0.489
Piñoneo	2.253	0.703	10.261	1	0.001*	9.514
Constant	−2.988	0.749	15.904	1	0	0.05

Presence or absence of hunting, home-gardens, Mapuche language use, gender, transhumance, and piñoneo were considered as independent variables

*Significant inclusion in the model following Wald statistic ($p<0.05$)

In accordance with Agresti (1996), the greater statistical power of logistic regression models in comparison with non-parametric tests suggests, in this study, that having a home garden has a negative effect on the probability of knowing more about wild plants, although this has no influence on effective use. Similarly, the use of the language is not significant when it comes to using plants. We assume then, that the discrepancies found between Tables 10.1 and 10.2 are due to the highly variable nature of the data (see standard deviations in Table 10.1), which are more faithfully reflected in the logistic analysis.

On the other hand, the two models are found to be very different from each other (Table 10.2). This reflects the very different dynamics between knowing and effectively using and is expressed in a multifactorial way where the different cultural activities have different weights. According to the models, in order to know more about plants in adulthood, it is necessary to hunt, participate in piñoneo, and know the language. These cultural activities support and reaffirm (substantially) the knowledge transmitted by parents in childhood, favoring the preservation and maintenance of the cultural heritage (Lozada et al. 2006; Ohmagari and Berkes 1997). The Mapuche language, and particularly names of plants in this language, includes a complex range of denominations involving ecological, utilitarian, morphological, and organoleptic aspects, as well as references to magic-religious symbols (Villagrán 1998), constituting an essential for the community, unique vehicle which cannot be translated into another culture.

In contrast, the probability of effectively using these plants is not so strongly linked to language, but is related more closely to hunting and piñoneo. These activities, both strongly rooted in local tradition, allow greater and more detailed exploration of the environment, promoting access to environments that are ecologically different to the arid one, as are the *A. araucana* woods and wetlands, rivers, or streams. In addition, these results can be explained by the close link between the gathering of a staple resource (Pewen seeds) and the gathering of other, secondary plant species in that environment.

It is notable that transhumance was not found to be an important variable in the determination of knowledge and use of wild plants. These results go against a previous study carried out in the Paineo community (Ladio and Lozada 2004b). The present analysis includes a higher number of the Mapuche communities and models have been used which distinguish transhumance from piñoneo in each case. This shows that although for many Mapuche communities these activities are associated and complement each other, for example, journeys are shared for both activities at the same time (as in the Paineo and Rams communities), in others, where transhumance is practically impossible to carry out, (as in the Cayulef community), the piñoneo is maintained, albeit with difficulty, and so their plant knowledge is maintained and continues to be applied.

With respect to resilience, the results show that those inhabitants who hunt, participate in piñoneo and/or maintain and speak the Mapuche language have significantly more knowledge about and use more wild plants. They thus have a greater capacity for self-sufficiency in response to the demands of their limiting environment, as they put into practice their ancestral wisdom, which is renewed through the daily experience of direct contact with the environment.

Conclusions

It is widely recognized that the indigenous knowledge of wild plants is decreasing in throughout the world (Byg and Balslev 2001; Benz et al. 2000; Begossi et al. 2002). This fact seems paradoxical, given that elements of self-sustenance and self-sufficiency are being lost. This chapter demonstrates quantitatively how indigenous communities living in arid environments are at lesser risk of losing their capacity for alimentary self-sufficiency if they do not abandon their traditional ways of using the environment. Additionally, in accordance with Adriansen and Nielsen (2002), the importance of mobility (in these communities involving hunting and piñoneo) is shown to be a successful strategy for the optimal use of drylands.

These local practices and knowledge related to the harsh environment are based on a complete understanding of ecosystem processes (seasons, altitudinal gradients, climate irregularities, prey and fruit variability, plant associations, etc.) in an attempt to minimize risk and the adverse impact of these circumstances on their livelihoods. Further analysis in this area should be carried out, taking advantage of the virtues of logistic approximation as in this study, since it can better reflect the nature of data used by ethnobotanists and ethnoecologists. The use of this kind of statistical modeling allows for better "prediction of chance" and provides a more informed context for understanding the conditions for social and ecological sustainability of communities living in arid environments.

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Chapter 11
Medicinal Plant Use as an Adaptive Strategy in the Bolivian Andes: Evidence from the Quechua Community of Apillapampa

Evert Thomas

Introduction

Traditional medicine is an important cultural tradition in the Andes (Bastien 1987a; Vandebroek et al. 2004b, 2008) and continues to occupy a central role in the daily lives of many rural and urban Andean peoples (Sikkink 2000; De Feo 2003; Finerman and Sackett 2003; Macia et al. 2005; Vidaurre de la Riva 2006; Cerón 2006; De-la-Cruz et al. 2007; Vandebroek et al. 2008). Several studies have shown that even though accessibility to Western medicine has increased considerably for rural Andeans, they are still highly dependent on traditional medicine (Bastien 1982; Vandebroek et al. 2004a, 2008). Based on household interviews, Vandebroek et al. (2004a) have demonstrated that despite the presence of a primary health care center (PHC) in the village, people from the rural Bolivian Andean community of Apillapampa still rely heavily on medicinal plants and not pharmaceuticals of industrial origin for their healthcare. Hence, apart from physical distance (Baker and Gesler 2000) some additional barriers limit the use of Western health care products by Andean peoples (Bastien 1987b, 1990; Oths 1998; Kinman 1999; Vandebroek et al. 2004a, 2008). Most importantly, a cultural barrier prevails: local people basically hold more trust in their own healing traditions and beliefs. Western medical practitioners often fail to gain the trust of indigenous people because they do not fully understand, or do not take into consideration, local ethnophysiological beliefs, indigenous etiologies, and/or worldview-related aspects of health conditions (Bastien 1987a; Thomas et al. 2009c). For example, Andeans perceive the etiology of certain illnesses as disrupted internal (body–mind) equilibriums, or upset interrelations between themselves and the biocultural and social setting of their living environment (Bastien 1987a; Carey 1993; Larme 1998; Greenway 1998;

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Espinoza 2002; Vidaurre de la Riva 2006). For Andean people of the Bolivian Altiplano, ruptures in their relationships with animals, plants, and land are attributable as causes of sickness (Bastien 1987a). Second, a psychological barrier prevails because people become suspicious of Western treatment methods such as the administration of intravenous infusions or taking of blood samples. For example, the Bolivian Kallawayas believe that by the age of seven people acquire their amount of blood for life. If during their lifetime they lose some blood, then there is no way of recovering it, except by transfusion. This is one reason why it is difficult to take blood samples from these people (Bastien 1987a). Finally, a considerable economic barrier prevails because many families are unable to purchase the often expensive Western medicines and medical services (Bastien 1987a; Sikkink 2000; Vandebroek et al. 2008). Vandebroek et al. (2008) argued that traditional medicine might precisely owe its continued popularity in the Andes to the fact that it is: (1) traditional, i.e., in agreement with and inclusive of local belief systems; (2) adaptive, for being all-round and dealing with a diverse array of local health conditions; and (3) practical, due to its flexible payment modalities.

According to Bastien (1982), "Andean medicine assumes a synchronistic ideology, natural-based cures and personal skills which function efficiently within a mountainous rural area with structural components of *verticality*, *specialization* and *reciprocity*." The key factors shaping Andean environments are altitude and verticality, which act both as a stressor (basically hypobaric hypoxia and hypothermia) and a resource for biological, behavioral, and cultural adaptations (Leatherman 1998). Verticality is an underlying principle of traditional Andean social, political, and economic organization (Murra 1975). It implies that Andeans specialize in extracting resources from multiple ecological zones along steep mountainsides and exchange their complementary resources for those produced by people inhabiting other ecological zones (social reciprocity, see Murra 1975; Bastien 1987a; Thomas 2009). These conditions are at the base of Andeans' reputation for their extraordinary knowledge and use of microenvironments, an incredible range of technological innovations, and formalized systems of reciprocity (e.g., labor exchange, Alberti and Mayer 1974; Thomas 2009). Andean ethnomedicine follows the principles of verticality and certain communities specialize in specific aspects of traditional medicine, often in accordance with the available resources and diseases that characterize particular ecological zones (Bastien 1982, 1987a; Espinoza 2002).

Reciprocity plays a significant role on many different levels in Andean ethnomedicine. In the biocultural and social context of the Andean individual ties of reciprocity to nature, society, and cosmos are critical to healing rituals, which restore balance to body and soul (Greenway 1998). Reciprocity is also pivotal to the relationships between patients and their healers. Bastien (1982) argued that "reciprocal obligations provide Andean ethnomedicine with a perpetuating structure of prestation and counterprestation between the person cured and the specialist," meaning that when traditional practitioners cure someone, they receive or produce an obligation (*ayni*) on the part of the sick people (or their families) to do something for the curers (or their families) (Bastien 1987a; Vandebroek et al. 2008). Kinship and friendship are clearly needed for accomplishing health projects in the Andes

(Bastien 1987a; Leatherman 1998). In turn, family ties are also important for the assimilation of medicinal plant knowledge by traditional Andean healers (Vandebroek et al. 2004). Another level of reciprocity is evidenced by the interchange of medicinal plants and ethnomedical knowledge between peoples from different ecological environments (zones) and different types of ethnomedical specialization. According to Bastien (1982), medical practitioners travel to other communities providing their services in exchange for services or goods. Bussmann and Sharon (2009) recently confirmed that such practices still exist on the border between Peru and Ecuador where healers from mountainous northern Peru and coastal plains frequently crossover to Ecuador to offer their services to patients who are not satisfied with the more Westernized approach of Ecuadorian healers. Finally, reciprocity binds urban and rural healers into an intricate network whereby urban herbalists provide their peasant counterparts with modern medicine in exchange for medicinal plants (Bastien 1987a).

These structural components of verticality, specialization, and reciprocity stimulated the development of extensive ethnomedicinal knowledge among Andean populations. The Bolivian Kallawayas are one of the Andean societies most famous for their medicinal plant knowledge, and whose pharmacopoeia is composed of approximately 1,000 different medicinal plants (Girault 1984; Bastien 1987a). The Kallawayas follow an Andean pattern of specialization in their medicinal practices at the community level, which according to Bastien (1987a) relates to (1) the availability of specific resources at different ecological levels; (2) skills acquired by practice and passed along through oral traditions; (3) a community's reputation, established by its specialists in traditional medicine; (4) maintenance of this reputation by the elders of the communities through a network of trust with other communities with whom resources are exchanged; and (5) reciprocity, i.e., exchange of medicinal resources between specialized communities.

However, more recent research by biocultural medicinal anthropologists has suggested that approaching Andean health and medicine from a perspective of verticality, specialization, and reciprocity tells only part of the story (Leatherman 1998; Larme 1998; Oths 1998). Health in the Andes is shaped by a complex intertwining of ecological, sociocultural, political, economic, and historical factors (Oths 1998; Leatherman 1998). In this respect, Oths (1998) made a distinction between microrisk and macrorisk factors to differentiate between stresses produced at the local level and those produced in exogenous arenas of power. Microrisk factors are ecological variables such as ecological zone, latitude, altitude, climate, etc., whereas sociocultural variables include demographics, household density, settlement pattern, mode of production, wealth, community cohesion, gender relations, etc. Macrorisk factors include political and economic variables such as market participation, labor relations, political stability, access to biomedicine, as well as historical variables comprising regional Spanish influence and land reform (Oths 1998). Both the micro- and macrorisk factors directly impact what Oths (1998) called "key risk mediators" (i.e., water quality, sanitation, immunization, diet, and treatment use) which in turn precipitate health outcomes, basically morbidity and mortality.

In this chapter I expand upon the ecological perspective of Andean traditional medicinal response to health problems, with a strong focus on verticality and specialization. Where relevant, the link is made to several sociocultural factors that influence medicinal plant use. Hence, I limit myself to a discussion of Oths (1998) microrisk factors. My arguments are based on my research on medicinal plant use in Apillapampa, a community of subsistence farmers in the semiarid Bolivian Andes, and build on a previous paper (Thomas et al. 2008). My ultimate goal is to demonstrate that Andean ethnomedicine is a highly dynamic and adaptive survival strategy.

Methods

Research Area

Apillapampa is located at about 3,250 m above sea level (masl), 17°51′S and 66°15′W, along the road connecting Capinota with Arampampa (Fig. 11.1). No on-site climate data are available, but the nearest village of Capinota (2,400 masl) is characterized by a semiarid climate with a long dry season of 6–8 months and a mean annual temperature of 17.8 °C and precipitation of 447 mm (Navarro 2002). A somewhat lower temperature and higher precipitation can be expected in Apillapampa due to the higher altitude. At the time of research, Apillapampa comprised about 430 households (2,600 inhabitants) of Quechua-speaking subsistence farmers (FEPADE 1998). The study area is situated on the interface between the prepuna (2,300–3,200 masl) and puna (3,100–3,200 to 3,900–4,000 masl) ecological zones (Navarro 2002; Thomas et al. 2010). In the prepuna, two main ecological zones can be distinguished. The first ranges from 2,300–2,400 to 2,700–2,900 masl and is characterized by a combination of *Schinopsis haenkeana* Engl. and *Aspidosperma quebracho-blanco* Schltdl., often being replenished with *Vasconcellea quercifolia* A.St.-Hil. The second zone ranges from 2,600–2,700 to 3,100–3,200 masl and has a potential climax vegetation dominated by *Kageneckia lanceolata* Ruiz and Pav., *Prosopis laevigata* (Humb. and Bonpl. ex Willd.) M.C. Johnst and *Schinus molle* L. Between 3,100–3,200 and 3,900–4,000 masl, the puna part of the study area, the potential climax vegetation is formed by *Polylepis besseri* Hieron and *Berberis commutata* Eichler. More detailed floristic data about associated, companying and substituting species are provided in Navarro (2002) and Thomas et al. (2010).

The study area is highly fragmented as a result of past and present human activity (Pedrotti et al. 1988; Navarro 2002; Thomas et al. 2011a). At present, crop production, animal husbandry, and firewood harvest are among the most important factors causing vegetation fragmentation, since most households own cropping fields in each vertical vegetation zone. Relicts of climax vegetations are mainly situated on soils with limited agricultural potential and/or in areas that are more or

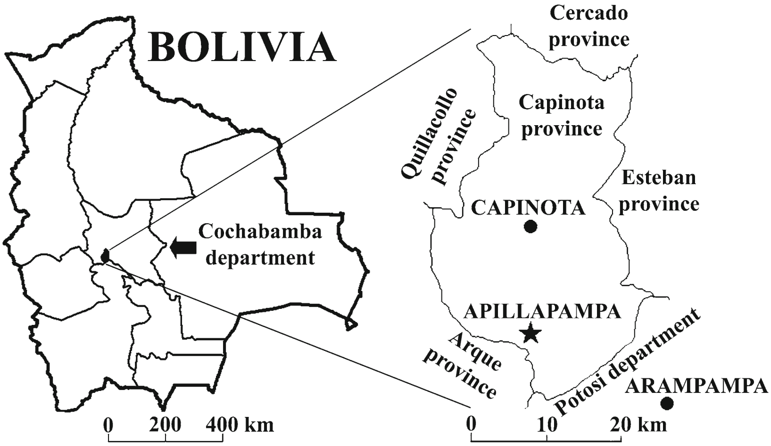

Fig. 11.1 Location of the study area within Bolivian province of Capinota. The city of Cochabamba is situated just north of Capinota province (map elaborated with DIVA-GIS: www.diva-gis.org)

less safeguarded from harvesting of firewood and intensive grazing by livestock (Thomas et al. 2011a).

Data Collection

Informed consent of the Apillapampa community council (*Subcentral*), the local healers' association *Asociación de Jampiris de Apillapampa*, and other participating community members was formalized in written agreements between the researchers, representatives of the indigenous community, and the *Centro de Biodiversidad y Genética* from the *Universidad Mayor de San Simon*, Cochabamba. Copies of this agreement and all details of the project were sent to the Bolivian government (*Ministerio de Desarrollo Sostenible y Planificación*).

A comprehensive quantitative ethnobotanical inventory of all plant species used in traditional medicinal practices in Apillapampa was gathered between December 2002 and November 2003 (Thomas 2009). Plant species were collected in transects, home gardens, and during numerous fieldtrips. Thirty-six transects of 50 m×2 m were installed in order to fully identify the vegetation occurring in the study area and all plants with mature growth (height ≥0.1 m) were sampled (Thomas et al. 2008, 2009b, 2010).

Ethnobotanical data on 387 sampled plant species were gathered ex situ between December 2002 and December 2003 by means of semi-structured interviews with eight males and five females, all local Quechua participants (age range 14–66 years old). Six of these participants were traditional healers from the semiformal healers' association called the *Asociación de Jampiris de Apillapampa*.

Other participants were selected through peer recommendations as described by Davis and Wagner (2003). Interviews were conducted individually and included questions about local plant name(s), use(s), and methods of preparation. Voucher specimens were used as props during interviewing (cf. Thomas et al. 2007). Plant species were shown to at least 1 and maximum 13 participants, with an average of 8.4 (±0.2 (SD)) participants. A *response* or *citation* is defined here as an answer from a participant with regard to a use of a particular plant species. If the use of species A against cough is reported by two participants and the third participant uses it solely for treating rheumatism, then the total number of recorded responses for species A is three. A *medicinal plant use* is defined here as a well-understood use of a particular plant species for one particular goal by 1 or more participants. In the former example, the total number of plant uses for species A is two (cough and rheumatism). Voucher specimens (ET1-600 and TC500-650) were identified and deposited in the Bolivian herbaria of Cochabamba (BOLV) and La Paz (LPB).

To assess the degree of participant consensus regarding the treatment of different health conditions, I calculated the Informant Agreement Ratio (IAR) (Trotter and Logan 1986), according to the following formula:

$$\mathrm{IAR} = \frac{n_{\mathrm{a}} - n_{\mathrm{ra}}}{n_{\mathrm{a}} - 1}$$

Where n_{a} is the number of times a particular ailment was reported by all participants and n_{ra} the total number of reported remedies used to treat this ailment. In the scope of this study I interpreted n_{ra} simply as the number of plant species that was reported for treating each ailment, irrespective of preparation or plant part used. IAR varies between 0 and 1. A value of 0 indicates that every time an ailment was reported, a different plant species for the treatment of this ailment was mentioned. By contrast, a value of 1 is obtained when all participants mentioned only one species for treating an ailment.

Results and Discussion

A total of 307 medicinal plant species was recorded during the present study, covering 79% of all the species shown to participants. Ethnopharmacological data of the most important species mentioned in this chapter are given in Vandebroek et al. (2003) and Thomas et al. (2009a). All inventoried medicinal species are distributed over 77 families. Most represented families are *Asteraceae* (76 species; 25%), followed by *Fabaceae* (26 species; 8%), *Solanaceae* (21 species, 7%), *Lamiaceae* (13 species, 4%), *Convolvulaceae* (8 species; 3%) and *Scrophulariaceae* (8 species; 3%). More than half of all medicinal plants (52%) are herbs, while about one fourth (27%) has a shrub habit. A far lower number of vines, trees, and ferns is used as medicinals with 19 (6%), 14 (5%), and 11 (4%) species, respectively. Most medicinal species grow wild in natural environments (71%), i.e., outside cultivation fields, home gardens, ruderal places, etc. However, the term natural is not really appropriate since nearly all vegetation has undergone significant change, as a consequence of past and present human disturbance regimes, including agriculture, pasturing, burning activities, and firewood harvesting (Thomas et al. 2009b, 2010, 2011a). Among the identified plants, 39 species (11%) were weeds that grow typically, but not exclusively, on agricultural fields. Home gardens are relatively less important sources of medicines with a total of 19 inventoried cultivated plants (6%). This also includes the planted exotics *Eucalyptus globulus* Labill., *Pinus radiata* D. Don, and *Spartium junceum* L. Six medicinal plants (2%) were ruderals, typically growing along roads in or outside the village and 29 species (9%) were introduced, half of which are agricultural weeds.

A total of 1304 different medicinal responses was recorded during ethnobotanical interviews, accounting for 79 medicinal plant uses. Seven of these are related to pain in different body parts (e.g., backache, abdomen, etc.). The plant remedies most frequently mentioned by local participants (Table 11.1) are used to treat rheumatism (130 responses), bad wind or *wayra* (113), cough (109), bruises (104), gall bladder ailments (61), wounds (60), abdomen pain (59), *madre* (52), gastritis (52), and fever (51). The highest diversity of medicinal plants was recorded for the same health conditions, though in a different order: rheumatism (95 species), followed by bad wind or *wayra* (79), bruises (61), gall bladder ailments (48), abdomen pain (46), gastritis (45), cough (41), fever (38), wounds (33), and *madre* (33). Two noteworthy folk illnesses (classified as culture-bound syndromes) are *wayra* and *madre*. *Wayras* are wind- or airborne diseases that can cause symptoms varying from stiff muscles to (facial) paralysis, including Bell's palsy (Bastien 1987a; Larme 1998; Vandebroek et al. 2008). Alba and Tarifa (1993) confirm that *wayra* is equivalent to neuralgia, neuritis, and paralysis. *Madre* is associated by local participants with heavy labor on agricultural fields. Several of its symptoms correspond with the biomedical definition of a hernia, but according to Vandebroek et al. (2008) it is probable that this illness is associated with megacolon and intestinal volvulus (abnormal twisting of the intestine) occurring in Chagas' disease or American trypanosomiasis, a serious human parasitic disease (Brandt de Oliveira et al. 1998).

Health conditions with IAR values higher than 0 are listed in Table 11.1. A high consensus among the responders was documented for hair loss, female sterility, diarrhea, warts, fractures and sprains, and toothache and cough. Only one health condition yielded an IAR value of 1. The exclusive use of *Kentrothamnus weddellianus* for treating hair loss was confirmed by three participants. As indicated in Table 11.1, various health conditions are treated with a remarkably high diversity of medicinal plants. For example, rheumatism alone accounts for almost one third of all inventoried medicinal plants. However, based on a high degree of participant consensus (Thomas et al. 2009a) and available experimental biomedical evidence (Vandebroek et al. 2003) some of these health conditions can probably be treated effectively by only a few plant species. For instance, based on participant consensus *Achyrocline ramosissima*, *Gnaphalium gaudichaudianum*, and *Mutisia ledifolia* (Thomas et al. 2009a) are considered to be the most efficient to alleviate cough. Yet, no less than 41 different plant species were mentioned to cure its symptoms.

Table 11.1 IAR values for reported health conditions in Apillapampa

Health condition	Number of responses	Number of species	IAR
Hair loss	3	1	1.00
Female sterility	7	2	0.83
Diarrhea	8	3	0.71
Wart	8	3	0.71
Fracture/sprains	15	6	0.64
Toothache	23	9	0.64
Cough	109	41	0.63
Malnutrition	15	7	0.57
Pain (breast)	3	2	0.50
Snake bite	12	7	0.45
Bruises	104	61	0.42
Wounds	60	36	0.41
Diabetes	6	4	0.40
Otitis	11	7	0.40
Madre	52	33	0.37
Measles	4	3	0.33
Puerperium	7	5	0.33
Uterus ailments	4	3	0.33
Wayra/bad wind	113	79	0.30
Rheumatism	130	95	0.27
Kidney ailments	20	15	0.26
Fever	51	38	0.26
Constipation	5	4	0.25
Flatulence	9	7	0.25
Skin fungus	5	4	0.25
Pain abdomen	59	46	0.22
Colic	24	19	0.22
Gall bladder ailments	61	48	0.22
Pneumonia	38	30	0.22
Biliary colic	13	11	0.17
Common cold	19	16	0.17
Conjunctivitis	13	11	0.17
Purgative	8	7	0.14
Sore throat	8	7	0.14
Gastritis	52	45	0.14
Pain (back)	18	16	0.12
Pain (head)	32	29	0.10
Scabies	12	11	0.09

Only those health conditions for which the number of responses was higher than 3 and IAR >0 are listed

Two important questions can be drawn from these observations. First, the question arises as to why Apillapampeños use so many different plant species for the treatment of a particular health condition, if they probably have some highly effective at their disposal, and why remarkably few species are used for certain other disorders? The second question relates to the proportion of plants used for medicinal purposes in comparison with the occurrence of these species in the Apillapampan flora in general. One may wonder why this proportion (79%) is so exceptionally high as compared to the estimated world average of medicinal plant use. Farnsworth and Soejarto (1991) have estimated that 35,000–70,000 of the approximately 250,000 angiosperms (i.e., 14–28%) on earth have been used—at one time or another—in some culture for medicinal purposes. In Bolivia, to date at least 3,000 plant species have been identified as being used in traditional medicine (Giménez and Ibisch 2003). This is 13% of the estimated total number of higher plant species in Bolivia (Vidaurre de la Riva 2006). The use of higher proportions than the world mean is scarcely reported in literature. Hensen (1991) found that in Chorojo, a rural Bolivian Andean community, 56% of the 204 species encountered in *Polylepis* forests were used in traditional medicine, whereas Birk (1995) showed that 75% of all 290 species used by the Bolivian Chiquitanos had a locally recognized therapeutic value. Also Bourdy et al. (2004) recorded medicinal plant use within the same order (61% of all 305 species inventoried) among the Izoceño-Guarani. However, more frequently, reported proportions of medicinal plant use fall within the range proposed by Farnsworth and Soejarto (1991). Gimenez et al. (1996) found that the Raqaypampeños, Quechua people living at altitudes between 2,100 and 3,200 masl, used 37% of the 532 species inventoried in traditional medicine. Bye (1993) estimated that 15% of the Mexican flora is used medicinally. Leonti et al. (2001, 2002) reported that 614 of the 2,500–3,000 species (i.e., 20–25%) prevailing in the Mexican Popoluca habitat are used as medicines. Finally, Moerman (1996) calculated that native North Americans use(d) 11.8% of the available flora for medicinal purposes.

I hypothesize that the answer to the questions posted above (*Why are so many different plant species used for treating certain health conditions*? and *Why is the proportion of used plants in Apillapampa so much higher than the world mean*?) relates to the adaptive nature of traditional medicine in Apillapampa and the concomitant human process of plant selection. In the following pages I propose several possible explanations for such medicinal plant selection that can be relevant individually, but also additively or synergistically. These include: (1) availability and accessibility of medicinal plants in time and space; (2) characteristics of specific health conditions; (3) the dynamic and specialized nature of Andean traditional medicine; (4) inability to empirically test the efficacy of plants used in mixtures; (5) sensory perception; and (6) association with other plants that are better known.

Availability, Accessibility, and Ecological Edge

Availability and accessibility of medicinal plants have (at least) two dimensions in Apillapampa: 1 in time and 1 in space. Many herbaceous medicinal plants are only available during the rainy season. If a (dried) stock of these plants has not been built up, during the dry season one necessarily has to count on other (mainly woody) species that remain available during that season. Apart from season, another important factor that influences plant availability and accessibility in Apillapampa is the uneven spatial distribution of vegetation (Thomas et al. 2010). Most Apillapampeños own cropping fields along vertical and horizontal gradients with ecological variation. Accessibility to these fields is rather low due to long travel times, bad or nonexistent roads or steep slopes that require significant climbing effort. To optimize time investment, people tend to build small houses along the edges of these agricultural lands, which allow them to work and stay on-site during various periods of the year. Especially during planting and harvesting seasons, whole families temporarily live in these dwellings. Pasturing of livestock is also one of the motivations for these periodical movements. When humans or animals get afflicted by ailments while temporarily residing on these distant cultivation fields away from the village, people will look for herbal remedies close by before considering returning to the village to fetch remedies that may be more familiar to them. I have been able to observe this on various occasions and it was confirmed by several participants during interview sessions. Participants furthermore explained that local people's medicinal knowledge varies in accordance with the location of the fields they own. When asking a participant about the uses of plants growing in the lowest areas from the Apillapampa living environment (or vice versa), the answer frequently was: "you should ask participant X because (s)he owns land there, and I don't."

High plant densities and short travel distances appear to be decisive factors in plant collection (Grenand 1992; van Andel 2000; Byg et al. 2006; Thomas et al. 2009b, c). Accessibility or availability of plants have been reported to be among the primary considerations of indigenous people when selecting between different treatment options, at least during the early stages of an illness episode (Alexiades 1999; Casagrande 2002). Following her work among the Huastec Maya, Alcorn (1984) argued that people often start with plants that are easier to obtain and resort to less accessible plants if the first treatments do not achieve the expected effects. This observation has recently been confirmed by Lawrence et al. (2005) based on a study among various indigenous and *mestizo* groups in Amazonian Peru. Likewise, Adututu et al. (1979) found that availability of dental treatments was a more important factor than efficacy for choosing plant species to use in Ghana. These publications confirm that medicinal plant selection and use do not seem to be based solely on emic perception of their efficacy for treating illness symptoms (Thomas et al. 2008).

It was demonstrated elsewhere (Thomas et al. 2009a) that plant species with a shrubby life form are significantly overrepresented in the medicinal plant pharmacopoeia in Apillapampa. In analogy with the previous argument, this most probably relates to their higher visibility in addition to being distributed more continuously over the landscape than herbs; woody species occurring in Apillapampa are available year-round, whereas most herbaceous plants disappear during the dry season (There are exceptions on irrigated land and in humid places). Therefore, woody plants are the main medicinal alternative during half of the year (dry season). For that reason, we hypothesized that they are likely to be better known by people, also as sources of herbal medicines (Thomas et al. 2009a). This hypothesis has a relatively long-standing tradition in ethnobotanical investigation and it starts from the assumption that people are more likely to learn, name, and use those plants that are more accessible and/or salient to them (Adu-Tutu et al. 1979; Brown 1985; Turner 1988; Johns et al. 1990; Phillips and Gentry 1993; Alexiades 1999; Frei et al. 2000; Casagrande 2002; Bonet and Valles 2002; Torre-Cuadros and Islebe 2003; Voeks 2004; Van den Eynden 2004; Byg et al. 2006; Thomas and Van Damme 2010). In a recent paper, we found a positive correlation between the accessibility of vegetation and its perceived usefulness in Apillapampa, suggesting that this hypothesis would not only be valid for individual plant species, but also for entire vegetations (Thomas et al. 2009b).

Plants that are abundant at one place in the surroundings of the community might be completely absent at another, and at the same time most herbs that flourish during the rainy season are impossible to obtain during the dry season (Thomas et al. 2010). This uneven distribution of vegetation in terms of time and space over the ecological units where people live and work stimulates a profound knowledge of a diverse medicinal flora (cf. Bastien 1987a). Herbal remedies have to be obtained rapidly whenever and wherever illness strikes. Because individuals cannot consistently track down and collect particular species when needed, knowing alternative ones with comparable therapeutic powers in the different ecological areas where people travel, work, and live is certainly an advantage and can be interpreted as a form of risk management. Similar observations have been made by other authors (e.g., Alcorn 1984; Bastien 1987a; Alexiades 1999; Leonti et al. 2002; Casagrande 2002). For example, the Popoluca people of Mexico consider it essential that certain medicinal species are available in each ecological zone where they go, work, or live in order to treat common ailments. Therefore, encountering substitutes or alternative treatments if certain species are not available is crucial to these people (Leonti et al. 2002).

In addition, Apillapampa is situated on the ecological edge between *prepuna* en *puna* zones, which contain different vegetation (Thomas et al. 2010). It has been suggested that societies that live in environments with high ecological variation, such as on ecological edges, favor the development of extensive (wild plant) knowledge bases through a maximized access to different ecosystems (Bastien 1987a; Milliken and Albert 1997; van Andel 2000; Turner et al. 2003; Thomas et al. 2009b). It would enable societies to respond more flexibly to threats that afflict them (Turner et al. 2003), including diseases. The fact that people from Apillapampa assign an equal usefulness to vegetation from both *prepuna* and *puna* zones (see Thomas et al. 2009b) indeed suggests that they have developed comparable plant knowledge for both zones.

Characteristics of Health Conditions

Apart from availability, characteristics related to specific health conditions might also influence the number of medicinal plants used. I concur with other authors that the number of medicinal plants used to treat health conditions is in many cases related to the prevalence of these conditions (e.g., van Andel 2000; Vandebroek et al. 2008). For example, the high numbers of plant species reported for wounds and bruises in Apillapampa is most likely linked to their high incidence in the area due to the traditional agricultural lifestyle. Wounds and bruises also figured among the most frequently treated ailments in the logbook of the community's PHC which is managed by a local NGO, FEPADE (Vandebroek et al. 2008). PHC data, based on diagnosis of 324 outpatients that were treated during a period of 8 months between July 2000 and April 2001, showed that next to wounds and bruises also respiratory infections (including pneumonia, cough, otitis, and sore throat), diarrhea, biliary colic and cholecystitis, intestinal parasites, and fever were among the most frequently reported ailments or symptoms (i.e., diagnosed in at least 5% of patients; Vandebroek et al. 2008). All these health conditions, except diarrhea and intestinal parasites, also rank high both in terms of the most frequently reported disorders and the number of plants used for their treatment (Table 11.1). This could suggest that over the years, richer ethnomedical knowledge was developed for the treatment of these conditions in Apillapampa, as a response to their higher salience in comparison with other disorders. The high incidence of particularly respiratory, musculoskeletal, and gastrointestinal disorders in Andean communities is confirmed by general literature (Donahue 1981; Bastien 1987a; Carey 1990; Mitchell 1991; Pestalozzi 1998; Oths 1998; Sikkink 2000). To stress the high local incidence of these disorders in the Peruvian Andes community of Chugurpampa, which is situated at the same altitude as Apillapampa, Oths (1998) documented that "in spite of cultural interventions such as immunization, pure water and adequate sanitation and diet these Andeans are hardly ever illness free."

Accordingly, the high number of plant remedies recorded for rheumatism is most likely related to its high local incidence. Rheumatism has been identified as the most prevalent degenerative disease in Apillapampa (FEPADE 1998) and in the Andes, especially among older women who work on the land in skirts while cold wind quickly cools off their legs (Bastien 1987a; Oths 1998). Nevertheless, it is not mentioned as frequently in the PHC logbook since people tend to rely on traditional steam baths for treatment rather than on Western medicine (Vandebroek et al. 2008; Thomas 2009). According to Bastien (1987a, b) rheumatism is typically treated with folk remedies in the Andes because modern medicine has not devised adequate ways of dealing with it.

Also Chagas' disease is among the most prevalent disorders in Apillapampa (FEPADE 1998). The dry Interandean Valleys of the Cochabamba department wherein the community is situated, are considered the center of dispersion of the Chagas' parasite vector (Albarracin-Veizaga et al. 1999). Hence, if the interpretation of Vandebroek et al. (2008) that *madre* corresponds with Chagas' disease is correct, the positive relation between prevalence of health conditions and medicinal plant use, could again explain the high number of responses and medicinal plants recorded for *madre*. The same explanation seems to be valid for *wayra* or bad wind, a well-recognized culture-bound illness in the Andes (Bastien 1987a; Carey 1993; Alba and Tarifa 1993; Larme 1998; Espinoza 2002; Vandebroek et al. 2003, 2008). Larme (1998) identified 16 different types of *wayra* in one community in the Peruvian Andes, whereas Carey (1993) calculated that roughly 2–5% of the population in the southern Peruvian Andes could be expected to suffer from *machu wayra* (i.e., one particular type of *wayra*) during the year. Based on the interviews with local participants, *wayra* is also prevalent in Apillapampa where traditional medicine offers a wide variety of herbal remedies for its treatment.

The fact that relatively few reports or plant species were recorded for diarrhea and intestinal parasites in spite of their prevalence, might point to the fact that people prefer the PHC service to treat these conditions (Vandebroek et al. 2008). The basic health insurance in Bolivia guarantees free treatment for children under age 5. Therefore, mothers may favor biomedical over traditional medicine for their young children, as evidenced by Apillapampa PHC data (Vandebroek et al. 2008). The fact that it is precisely in the age group of 0–5 that morbidity and mortality are highest for diarrhea and intestinal parasites (Remez 1990), might additionally explain why relatively few remedies were reported by local participants.

Another characteristic that may affect the number of medicinal species used are the causal factors that underlie different health conditions. There seems to be a tendency for using more medicinal plants to treat health conditions or symptoms that are provoked by a wide array of causal agents as compared to disorders or symptoms that are caused by one (or a restricted number of) causal factor(s). Here, I refer to health conditions of the first type as "multiple causal agent disorders" (MCAD) and those of the latter type as "single causal agent disorders" (SCAD). I define MCAD as *any kind of disorder or ailment altering a patient's physical or psychological wellbeing that is difficult to diagnose based on mere symptoms because of the wide array of potential causal factors that may provoke its symptoms*. An SCAD is, on the other hand, *any kind of disorder or ailment altering a patient's physical (or psychological) wellbeing that is relatively straightforward to diagnose because of the restricted number of causal factors that provoke its symptoms*.

Fever, as an example of an MCAD, can be the body's response to a viral, bacterial, or parasitological infection, but it can be caused just as well by a poisoning or tumor. Diarrhea is another example: Casagrande (2002) identified at least 23 different pathogens among the Tzetlal Maya communities that may cause diarrhea, including bacteria, protozoans, viruses, and worms. Chronic disorders such as rheumatism are a special case of these MCADs. Rheumatism itself covers a wide range of medical problems and may have many causal factors. On the other hand, trauma is the only causal factor for fractures or sprains which are therefore classified as an SCAD. While the diagnosis and evaluation of the efficacy of a remedy is generally relatively straightforward for SCADs, this is often more complicated for MCADs. According to local participants, the treatment of MCADs (and to a far lesser extent of SCADs) in Apillapampa usually involves a trial-and-error approach whereby different herbal treatments are applied consequently. Such an approach is obviously in analogy with (most) other medical systems (e.g., Ryan 1998; Heinrich et al. 1998; Cocks and Dold 2000; Sikkink 2000; Sumner 2001; Casagrande 2002), including the Western medical tradition. Different herbal remedies are subsequently administered to patients who suffer from MCADs, until the appropriate remedy is found for the specific causal agent, or until the body's defense mechanisms have defeated self-limiting diseases such as common colds (Waller 1993). Therefore, in theory, and in accordance with the number of potential causal factors, MCADs such as fever would require a higher number of different remedies to ensure efficient treatment as compared to disorders with 1 or a restricted number of causal factors (SCAD), such as fractures. It may therefore not be a surprise that in many, if not most, ethnobotanical studies, MCADs consistently figure among the health conditions for which the highest number of remedies or medicinal plants are reported (e.g., Milliken and Albert 1996, 1997; Frei et al. 1998; Heinrich et al. 1998; van Andel 2000; Bourdy et al. 2000, 2004; Leonti et al. 2001; Thomas 2001; Geissler et al. 2002; Etkin 2002).

The fact that SCADs (hair loss, female sterility, wart, fracture/sprain, toothache …) tend to accumulate in Table 11.1 among the health conditions for which participant consensus was highest regarding their treatment, might indicate that for several SCADs highly effective plant remedies exist which are widely known, precisely because of their perceived effectiveness. After all, emic perception of efficacy is one of the variables that most accounts for the distribution of knowledge of medicinal plants (Casagrande 2002; Thomas et al. 2009a, 2011b). Hence, since SCADs are generally more straightforward to diagnose, it is likely that associations between health conditions and their remedies are easier to remember as compared to MCAD. Trial-and-error-driven treatment of disorders (which seems to be the case for most MCADs) not only implies the use of a higher diversity of medicinal plant species, but also complicates the association between health conditions and effective remedies, which is thus less easy to remember by a great number of people and results in lower consensus scores.

The hypothesis that people tend to use more medicinal plant species for MCADs as compared to SCAD clearly does not explain all cases. For example, participant consensus was the lowest recorded for scabies, although no less than 11 species were reported for its treatment. High species numbers for particular SCADs, such as scabies which might indicate that effective, widely known, herbal medicines are not (yet) available in local pharmacopoeia.

Dynamic and Specialized Nature of Traditional Medicine

The cultural tradition of traditional medicine in the Bolivian Andes and in Apillapampa (Vandebroek et al. 2004b, 2008) can be attributed to, *inter alia*: (1) a long history of contact with Western society and its diseases; (2) a long-standing sedentary agricultural lifestyle; and (3) traditional medicine being an adaptation strategy to a hostile and unpredictable environment (Bastien 1982, 1987a; Larme 1998; Vandebroek et al. 2004b). The Quechua in Bolivia have a long contact history with Western society: the Spanish first arrived in the Bolivian highlands in 1532 (Bastien 1987a). Societies with long contact histories generally use more medicinal plants than societies with shorter contact histories. The hypothesis that the contact history of a particular ethnic group with Western society correlates with the number of medicinal plants it uses, as well as with the number of health conditions that are treated with medicinal plants, has a relatively long standing tradition in ethnobotany (Prance 1972; Davis and Yost 1983; Balée 1994; Milliken 1997; van

Andel 2000; Voeks 2004; Vandebroek et al. 2004b; Izquierdo 2005). The underlying mechanism of *less contact parallels less medicinal plants* is linked in the literature with the fact that a lower degree of contact is concomitant with a better nutritional status, as well as a lower number of introduced diseases (Davis and Yost 1983; Alchon 1991; Balée 1994; Milliken 1997; Voeks 2004; Izquierdo 2005; Thomas 2012). According to Balée (1994), the natural state of pre-Columbian societies would have demanded few remedies for treating few diseases. This was confirmed by Alchon (1991) who noted that pre-Colombian America lacked many contagious diseases of the Old World such as measles, smallpox, bubonic plague, cholera, and influenza. Ethnobotanical research among recently contacted groups has indeed shown that their principal health issues were related to basic parasitic-type infections and a narrow range of bacterial diseases (Davis and Yost 1983; Voeks and Sercombe 2000).

It is suggested that the introduction of epidemiological ills, initiated during the Conquest, has led to the development of ample pharmacopoeias among indigenous groups with longer contact histories (Balée 1994). The need to "discover" new remedies for new diseases may have fuelled the assignment of medicinal applications to plant species that were formerly unknown, known only by name, or known for other purposes (Estrella 1995). Milliken (1997) argued that the number of plants and recipes to treat illnesses depends on the length of time a certain indigenous group has been exposed to these diseases, and the seriousness of the health consequences of these epidemics. He found that the Yanomami tribes in Roraima (Brazil), which came into contact with malaria earlier than other indigenous peoples of the region, knew more plant species to combat this infection than groups that became afflicted only recently (Milliken and Albert 1997; Milliken 1997).

As a response to a higher incidence of diseases, societies with a longer contact history have developed larger pharmacopoeias consisting of both native and introduced plants (Bennett and Prance 2000; Voeks 2004; Janni and Bastien 2004; Thomas et al 2011b; Thomas 2012). According to Voeks (2004), intercultural contacts with European settlers and physicians some five centuries ago led to an early but systematically underestimated (intentional and accidental) floristic homogenization of many rural tropical societies' pharmacopoeia. Useful plants from the Old World were actively and passively distributed over the New World tropics and subtropics as a consequence of colonial horticultural endeavors. Most plants were introduced originally as foods or ornamentals and relatively few for their exclusive medicinal value. Through an ongoing process of ethnomedical experimentation, the medicinal power of many ornamentals and food plants were and most likely still are being "discovered" (Bennett and Prance 2000; Thomas and Van Damme 2010). As a result, the pharmacopoeias of societies with long histories of contact contain numerous introduced plant species (Janni and Bastien 2004; Voeks 2004; Thring and Weitz 2006; ; Thomas et al. 2011b). The fact that 9% of the medicinal plants inventoried during the present study are exotics seems to confirm this, at least partly.

Not only contact, but also the (historical) mode of subsistence has important implications for the breadth of indigenous pharmacopoeias (Oths 1998). Agricultural societies, such as the Quechuas, are known to maintain significantly larger pharmacopoeias than their foraging counterparts due the wider range of manifesting illnesses (especially viral crowd diseases, see Brown 1985; Voeks 2004) and because high population densities are favorable for the rapid spread of epidemics (Alchon 1991). After all, farming was, and is, according to Diamond (1997), a "bonanza for our microbes" (Voeks 2004). In the case of the Quechua, the hostile and unpredictable Andean environment also exposes people to hypoxia, hypothermia, and malnutrition. This harsh environment is believed to have fuelled their strong cultural tradition of traditional medicine (Bastien 1987a; Larme 1998; Vandebroek et al. 2004b, 2008).

Even today, traditional medicine is not static and traditional healers in Apillapampa frequently experiment with "new" plant species. One well-respected healer declared that "in fact every plant has medicinal properties"; according to healers the tricky part lies in successfully matching the plants to the disorders they are able to treat. Similar assertions by indigenous healers have also been reported elsewhere (Leonti et al. 2002). Experimentation with medicinal plants seems to be characteristic for societies all over Latin America and beyond (Bastien 1987a; Milliken et al. 1992; Gessler et al. 1995; Milliken and Albert 1997; Milliken 1997; Heinrich et al. 1998; Alexiades 1999; Bennett and Prance 2000; Leonti et al. 2002; Casagrande 2002; Voeks 2004; Thomas et al. 2011b).

Another relevant characteristic of the ethnomedical system in Apillapampa is the humoral (hot/cold) classification system, a legacy of Hippocrates (Foster 1994). In line with indigenous believes throughout Latin America (Foster 1994; Bastien 1987a; Pestalozzi 1998), in Apillapampa most health conditions are classified into the humoral states hot and cold. Traditional healers evaluate the humoral state of patients through interpretation of their pulse. For example, fever is conceived as a hot condition, characterized by a fast pulse, while a common cold is perceived as cold and is said to be accompanied by a slow pulse. A similar dichotomy is applied to medicinal plant species, whereby cold plants are used to treat hot health conditions and vice versa. Alcorn (1984) argued that in actual usages, all available "cold" plants may not be used to cure a "hot" disease, but only (a series of) particular "cold" plant(s) for a particular "hot" disease. Although the present investigation did not focus on studying the humoral system, my interview data strongly suggest that a similar assertion is valid in Apillapampa. Hence, bearing in mind the haphazard availability and accessibility of many plants in Apillapampa, people are "forced" to know plenty of alternative "humoral antagonist" plants for treating humoral health conditions of a particular "hot" or "cold" state. Brett (1994) suggested that among the Yzeltal Maya people, humoral concepts could be a factor guiding medicinal plant selection and experimentation (Casagrande 2002). Casagrande (2002) likewise argued that humoral principles may be particularly important to expert curers who are likely to experiment with new plants and who hold more detailed knowledge about medicinal plants. On the other hand, some authors have hypothesized that the humoral classification may serve as a *post hoc* mnemonic function, providing (lay) people first and foremost with an explanation of plant use and selection for certain illnesses when the type of therapy is already known (Ankli et al. 1999b; Casagrande 2002).

Emic Plant Efficacy and Biomedically Inactive Plants

Efficacy is judged primarily by a participant's perception of a plant's ability to correct deleterious symptoms. These perceptions are mostly based on firsthand experiences and may have a pharmacological basis, but perceptions can also be heavily influenced by social persuasion (Casagrande 2002) or may represent "cultural constructs of efficacy" (Etkin 1988) whereby direct biomedical correlations can be absent. Here I argue how the problematic approach of emically guided testing of the efficacy of plant species in mixtures is expected to contribute to an increase in the number of different medicinal plant species used to treat particular health conditions in Apillapampa.

In most, if not all ethnomedical systems, the efficacy of at least some medicinal plants can be demonstrated relatively unambiguously through empirical testing (Moerman 1991; Bastien 1987a; Heinrich et al. 1998; Leonti et al. 2001; Shepard 2004; Waldstein and Adams 2006). This is also the case for Apillapampa. For example, the efficacy of plants used to expel intestinal parasites can be evaluated directly through examination of feces, and plants with potent antiseptic properties will generally heal infected wounds rapidly. However, it is far less straightforward to assess the therapeutic potential of medicinal plants used in mixtures wherein plants can act individually, additively, or synergistically (Hernández Canoa and Volpato 2004; Gurib-Fakim 2006).

Plant mixtures are sometimes used in Apillapampa in the preparation of herbal teas, plasters, or compresses, but they are particularly common in steam baths that can contain 20 or more different plant species at once (Vandebroek et al. 2003; Thomas 2009). Nearly one third of all recorded medicinal plants is used in steam baths, mostly for the treatment of muscular–skeletal complaints. The composition of the plant mixtures in steam baths varies greatly throughout the year, depending among other factors on seasonal plant availability. In addition, participants declared they frequently experiment with these mixtures by adding "new" plants. Such an approach facilitates the (unconscious and/or unintended) inclusion of inactive plants in the pharmacopoeia. Plant mixtures can undoubtedly be highly effective in alleviating symptoms. However, pinpointing the therapeutic power of an individual plant in the mixture through observation is practically impossible, as empirical testing is focused on the mixture and not on the individual plant. The inability to distinguish between active and nonactive plants could therefore promote the local belief that all plants in mixtures are good medicines and hereby contribute to the high numbers of medicinal species used to treat particular health conditions.

Other factors explaining the inclusion of nonactive plants in ethnopharmacopoeia have been identified in literature and some of these may be valid in Apillapampa as well. Most relevant in this respect is the fact that some ethnomedical preparations are simply placebos and used to treat self-limiting diseases such as minor influenza or a simple cold (Waller 1993; Stepp and Moerman 2001). The placebo effect is a complex cultural phenomenon that exists in all medical systems (Moerman 2003). As such, the placebo effect and emically perceived efficacy of plants that are used in the context of self-limiting diseases might lead to the inclusion of potentially biologically inactive plants in the local pharmacopoeia.

Literature supports the hypothesis that not all medicinal plants in Apillapampa are necessarily biologically active. It has been argued that, although theoretically all plants are potential sources of biologically active molecules (Fellows 1991), far from all plants used in traditional medicine have biomedical effects in humans (e.g., Davis and Yost 1983; Milliken et al. 1992; Waller 1993; Rates 2001; Sumner 2001; Massé 2002). Davis and Yost (1983) stated that: *In no area of ethnobotany is the challenge greater than in the search for new medicines, for in no area is there a greater mixture of fact and fiction*. Likewise, Sumner (2001) argued that: … *ethnobotanists have estimated that perhaps half the folk uses of medicinal plants are valid*. Only 25-30% of the approximately thousand medicinal plants used by the Bolivian Kallawaya are claimed to be effective cures Girault (1984; Bastien 1987a).

All participants from the present study acknowledged that the fact that a plant species is used to treat a particular health condition does not necessarily mean that it is effective in alleviating symptoms or eliminating causal factors. To quantify the proportion of less potent herbal remedies in ethnomedicine in Apillapampa, participants were encouraged to systematically assess the quality of each remedy on an ordinal scale, choosing between (1) good to excellent, (2) fair, or (3) bad (Thomas et al. 2009a). Remedy quality was assessed for a total of 1,119 responses. “Good to excellent” scored highest with 64%, followed by “fair” (35%). Only 1% (10 responses) referred to the rather bad quality of herbal remedies. Of those remedies classified as “fair,” participants often declared that they are sometimes effective in alleviating particular symptoms, but on other occasions do not help at all. Likewise, it was frequently reported (without further specification) that the therapeutic power of a number of such “fair” remedies is patient-dependent: in some people they may be effective, while in others they are not.

Hence, as confirmed by local Quechua participants themselves, it seems unlikely that the proportionally higher medicinal use of the available flora in Apillapampa would be due to a significantly higher bioactivity of the local vegetation as compared to other areas in the world. Therefore, it is more plausible that the pharmacopoeia in Apillapampa contains a number of inactive plants. Future ethnopharmacology studies into the bioactivity of these plants are necessary to corroborate or refute this hypothesis.

Sensory Perception

The importance of sensory cues in the selection of medicinal plants is only recently receiving increased attention (Heinrich et al. 1992; Leonti et al. 2002; Casagrande 2002; Shepard 2002, 2004). Medicinal plants can be selected and classified according to their main sensory and organoleptic characteristics involving taste, detection of irritation, odor, and visual/tactile properties (Milliken and Albert 1997; Ankli et al. 1999b; Chaumeil 2000; Shepard 2002, 2004). Bitter plants are often used to treat diarrhea or to expel intestinal parasites, while plants with pungent odors are frequently inhaled to treat respiratory conditions (Heinrich et al. 1992; Van Damme et al. 1992; Milliken and Albert 1997; Ankli et al. 1999a; van Andel 2000; Shepard 2004). In Apillapampa, most resinous plants are considered to be good remedies for curing muscular–skeletal system pains, including rheumatic complaints, whereas spiny plants are typically used for treating health conditions ascribed to curses (Vandebroek et al. 2003; Thomas 2009).

In most, if not all, societies around the world there are also plants with "medicinal" properties attributed through morphological (and physiological) association, known as the "doctrine of signatures" (e.g., Milliken et al. 1992; Balée 1994; Plotkin 1994; Pestalozzi 1998; Sumner 2001; Dafni and Lev 2002; Grenand et al. 1987, 2004; Leonti et al. 2002; Casagrande 2002; Shepard 2002). This visual perception is also relevant in Apillapampa, as demonstrated by the following examples. *Spathantheum orbignyanum* Schott, locally called *katari sara* ("snakes' maize"), is locally used for treating snake-bites (Vandebroek et al. 2003; Thomas 2009), corresponding with a world-wide phenomenon whereby members of the Araceae family are used for snake-bites, based on their morphological and visual resemblance to snakes (e.g., Grenand et al. 2004). A plant locally called *zapatilla* (*Calceolaria engleriana* Kraenzl., Scrophulariaceae) has shoe-shaped flowers (zapatilla means small shoe) and is typically used for treating twisted ankles or leg fractures. Likewise, several yellow-flowered plant species (e.g., *Alstroemeria pygmaea* Herb., *Sonchus* spp.) are used for treating urinary problems or kidney ailments (Vandebroek et al. 2003). Interesting to note is that sensory cues, including the doctrine of signatures, could serve an important mnemonic function: plants that are both effective (in terms of emic perception) and easy to remember are more likely to be retained in oral traditions (Ankli et al. 1999b; Leonti et al. 2002; Shepard 2002, 2004).

An example whereby sensory cues and humoral characteristics of plants are combined is provided by Villagrán et al. (2003). The latter authors documented that people in the Chilean Andes predict the medicinal quality of plants based on the colors of their flowers whereby yellow-flowered plants are perceived as hot remedies and white or blue-flowered plants as cold remedies.

Plant Association

A minor factor that contributes to an increase in the number of medicinal species is the linking of different taxa (species, genera of families) to similar ethnomedical applications, a common practice in the Andes (Bastien 1987a). For example, although *Plantago tomentosa* Lam. is locally recognized as the best wound healing plant from this genus, all other local *Plantago* species were ascribed an identical use, while being perceived as less useful. The fact that some plants that belong to different genera or families are sometimes also ascribed similar therapeutical value is probably due to association based on morphological and organoleptic similarities with better known or more potent species (cf. Hernández Canoa and Volpato 2004).

Conclusions

In line with studies from other Andean communities, traditional medicine in Apillapampa appears as a highly important cultural tradition. Throughout history, Andeans have developed a specialized ethnomedical system as an adaptation strategy to combat a hostile and unpredictable living environment where illness is always on the brink. The foundations for this adaptive and dynamic ethnomedicinal tradition most probably date back to pre-Columbian times. Over the centuries, people gradually adopted a sedentary lifestyle and became organized in large societies with increased population densities. Such conditions favor the spread of infectious diseases and, in combination with the harsh Andean living conditions (hypothermia, hypoxia, and malnutrition), most probably fueled the buildup of extensive medicinal plant knowledge bases. After the Spanish conquest, new diseases were introduced to which Andeans again responded by developing "new" ethnomedicinal knowledge of both native and introduced plant species. Hence, the development of medicinal plant knowledge in the Andes seems to be largely, but not exclusively, demand-driven, meaning that knowledge is developed—basically through experimentation—when there is a need for it.

As far as curing diseases, at least three levels can be distinguished in the adaptive response related to ethnomedicinal knowledge. The first level entails that exposure to a wider array of diseases will lead to the buildup of a more extensive medicinal knowledge base. Secondly, there are strong indications that the prevalence of disorders correlates with people's medicinal plant response, whereby more plant species are used to treat more salient health conditions as compared to rare ones. In addition to prevalence, there seems to be a tendency for people to develop medicinal plant knowledge to combat particular health conditions in accordance with the number of potential causal factors that provoke their symptoms.

Another characteristic that confirms the adaptive nature of the ethnomedicinal system in Apillapampa relates to the accessibility to and availability of medicinal plants, which are unevenly distributed in the local living environment. To be able to respond to disorders that afflict people whenever and wherever they strike, Apillapampeños have developed knowledge of plants with comparable therapeutic properties in all the different ecological units where they go, live, and work.

Some more culturally determined factors add up to this adaptive behavior and thus contribute to explaining the high number of medicinal plants used. In the case of Apillapampa, people's traditional custom of preparing steam baths, based on varying mixtures of 20 or more different plant species, to which frequently new plants are added, may lead to the inclusion of numerous inactive plants. I have additionally argued that also sensory perception and humoral classification of plants contribute to the buildup of an ample pharmacopoeia.

In my opinion, medicinal plant knowledge is highly dynamic, and in a short study like this one can only provide a snapshot of a society's medicinal plant knowledge. In nonliterate societies, practical knowledge is kept alive, at least in part, through its actual use. If the particular use of plants is no longer required, accompanying knowledge is likely to disappear eventually. Basically, this is what happens through modernization of traditional lifestyles: people tend to substitute traditional knowledge and plant use with modern knowledge and/or practices. For the treatment of some particular health conditions, this trend seems already underway. For example, people's tendency to rely on modern rather than on traditional medicine for the treatment of diarrhea or intestinal parasites in children is likely to be at the base of the decrease in ethnomedicinal knowledge for these disorders (Vandebroek et al. 2008). Hence, unless efforts are made to deliberately retain knowledge of plant uses that are no longer applied by or relevant for a society, whether through written or oral transmission (e.g., potential mnemonic function of sensory perception and humoral classification), it will be lost and/or replaced by "new" knowledge at one time or another.

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Chapter 12
Keeping all the Parts: Adaptation Amidst Dramatic Change in the Pamir Mountains

Karim-Aly Kassam

Introduction

In order to adapt, we must keep all the parts. This is the central tenet of conserving[1] biological as well as cultural diversity. Drawing freely from my recent research in alpine (high altitude) and arctic (high latitude) environments (Kassam 2009a, b, c), I will offer reflections based on empirical cases that examine coupled social and ecological systems (Adger et al. 2005; Berkes et al. 2003; Chapin et al. 2004; Folke 2006; Holling 2001; Liu et al. 2007a, b). While much has been said about coupled systems, the role of cultural values in understanding adaptation to change remains an area not widely explored. The specific aim of this chapter is to illustrate that by keeping all the parts, adaptive capacity is not only enhanced, but the sociocultural and ecological values that inform these adaptive responses by communities under stress are more robustly understood.

Anchors for Adaptation

The Pamir Mountains of Afghanistan are characterized by a global war localized in this region, environmental change spurred on by climatic variation, and an economic and energy crisis resulting from an unequal corporatist economic structure

[1] Here I use "conservation" instead of "preservation" to differentiate between dynamic and sustainable human interactions with their environment (characterized by the idea of conserving) as opposed to isolating a specific environment from humans (characterized by preserving). This nuanced distinction is central to the case for adaptation by keeping all the parts.

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all of which combine to generate conditions of chronic and intense socio-ecological stress. Furthermore, in mountain societies vulnerabilities created by social and ecological stress combine to reinforce and exacerbate each other (Jodha 2005). Offered below are five conceptual anchors to assist in interpreting adaptive behavior by indigenous communities in the Pamir Mountains. Starting with an articulation on the role of diversity, namely, keeping all the parts, a case is made for pluralism as a conceptual lens for viewing the interaction between ecological and cultural diversity. It is the complex connectivity of the ecological and sociocultural, best articulated through the notion of pluralism, which enhances adaptive capacity.

Diversity: Keeping all the Parts

Discussion of adaptation begins with Darwin's contribution to understanding of evolution. Charles Darwin gloried in diversity emphasizing a complex web of interactions and dependence between varieties of life, linking the past with the present and affecting the future.

> It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance, which is almost implied by reproduction; Variability, from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved (Darwin 1996:398).

Francois Jacob, a molecular biologist, also articulates the idea of origin and connects it with the role of biological diversity in contributing to future outcomes. In *The Possible and the Actual*, Jacob (1982) emphasizes that complex and unforeseen possibilities emerge from adaptation and variation. He explains "the actual living world, as we see it today, is just one among many possible ones. … It might well have been very different; and it might even not have existed at all!" (Jacob 1982:15).

Adaptation is at the core of evolutionary thinking and variation is the prime mover of adaptation.

> Diversity is one of the great rules in the biological game. All along generations, the genes that constitute the inheritance of the species unite and dissociate to produce those fleeting and ever different combinations: the individuals. And this endless combinatorial system which generates diversity and makes each of us unique cannot be overestimated. It gives a species all its

> versatility, all its possibilities. … Diversity is a way of coping with the possible. It acts as a kind of insurance for the future. And one of the deepest, one of the most general functions of living organisms is to look ahead, to produce future. … In humans, natural diversity is further strengthened by cultural diversity, which allows mankind to better adapt to variety of life conditions and to better use resources of the world (Jacob 1982:66–7).

The notion of diversity is imbued with the idea of origin and possibilities. It simultaneously bridges the present with the past and opens up to the future. It carries with it a constant sense of becoming.

Jacob explains "Evolution does not produce innovation from scratch. It works on what already exists, either transforming a system to give it a new function or combining several systems to produce a more complex one" (Jacob 1982:34). He refers to this as tinkering. "What characterizes the living world is the basic unity that underlies its tremendous diversity" (Jacob 1982:37). Tinkering creates diversity by endlessly combining bits and pieces. We need to keep all of the parts in order to tinker (Leopold 1949).

Keeping all the parts within the context of coupled systems links the biological with sociocultural know-how. For instance, under Soviet governance, the villages of Basid and Savnob in the Bartang Valley of the Pamir Mountains of Tajikistan switched from self-sustaining agricultural production to mass production under the command (planned) economy. As a consequence, over a period of at least two generations of agro-industrial Soviet rule, the villagers lost the specific variety of watermelon seeds they could grow in the valley. While some of these seeds may be reclaimed from other regions of the Pamir, the villagers also lost the know-how for growing watermelon in their specific montane habitat. Therefore, food security in the Pamir is not confined to specific seed varieties but also the practical knowledge associated with its nurturing to bear fruit. Alternatively, the village of Ghudara, also in the Bartang Valley, but at a higher elevation, strictly conserved the forestland a few kilometers from the village. Therefore, after the collapse of the Soviet Union and the resultant food and fuel shortages, they were able to turn to this forest as a source for fuel wood to meet their energy as well as construction needs. Currently they continue to strictly monitor the use of this forest resource. Keeping all the parts, hence, not only encompasses the physical elements but also the practical knowledge associated with nurturing and conserving plant and animal life.

Pluralism as an Analogue of Keeping all the Parts

In philosophical thought, the notion of *pluralism* acknowledges diversity in the natural environment and human culture. With respect to change, pluralism rejects *monism* and *dualism*. It eschews a conception of reality where nature is reduced to a single irreducible principle. Therefore, it rejects absolutist, monolithic, unitary explanations. Furthermore, it accepts that change is a normal part of sociocultural and ecological processes. By recognition of diversity and change, pluralism as a concept maintains that diverse groups work successfully to realize the common good for society as a whole (Kallen 1915; Engelhardt and Jennings 1989; Mason 2006).

Pluralism, is a sociocultural analogue for the biological notion of “keeping all the parts.” Both view diversity as a means of ensuring future possibilities under conditions of change. Like the idea of keeping all the parts, the concept of pluralism infuses hope because it envisions human societies not as victims but agents. This agency arises from the ability of diverse groups to affect the social fabric of their respective communities in order to adapt to change and achieve the common good. For pluralism to be effective in achieving the common good, diverse groups must agree on a minimal consensus of their shared values and interests and develop rules for conflict resolution (Galston 1989; Langerak 1994; Axelby 2007). Therefore, pluralism facilitates the development of sociocultural institutions that enhance adaptive capacity.

Adaptive Capacity

In evolutionary biology, adaptation “broadly refers to the development of genetic or behavioral characteristics which enable organisms or systems to cope with environmental changes in order to survive and reproduce” (Smit and Wandel 2006:283). With respect to human societies, it “refers to a process, action, or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity” (Smit and Wandel 2006:282). Like vulnerability, adaptive capacity of organisms or groups involves a number of interrelated determinants such as ecological context, cultural system, and social structure.

Adaptation is a response action aimed at well being or safety. It may involve market exchange, social networks, and individual or institutional responses (Adger 2003; Adger et al. 2005; Smit et al. 2000; Smit and Wandel 2006). Whatever form the action takes, it requires an enabling environment provided by cultural frameworks, social structures, and ecological systems. The adaptive response must not be viewed simply as a reaction to a challenge because it may also take advantage of new opportunities presented by change.

While climatic variation in the Pamir Mountains through warming temperatures, erratic precipitation, and glacial melt presents formidable challenges, there are some opportunities related to environmental changes that have solicited adaptive responses from villagers demonstrating their capacity to adjust. For example, three villages at high elevations, namely, Ghudara (in the Bartang Valley, Tajikistan), Pul-i-Zirabon (in Shugnan, Afghanistan), and Sarhad-i-Broghil (in Wakhan, Afghanistan) were villages where wheat was rarely successfully harvested because of frost damage. However, over the past decade, villagers maintain that they can now regularly harvest wheat. They report that plowing and sowing begins 15–20 days earlier than it did a decade ago, and harvesting also takes place 15–20 days earlier. Previously, villagers maintained that their grandfathers used to grow mostly barley because they could not successfully harvest wheat, but now they grow more wheat. In addition to climate change, there seems to be a transformation in preferences from barley to wheat. Using a combined sociocultural and ecological lens is germane to this example of variation in climate combined with alteration in food preferences (from barley to wheat) because both changes doubly reinforce each other.

Life at the Ecological Edge

With respect to the role of both ecological and cultural diversity in facilitating adaptation, Turner et al. (2003) observed that ecological edges, the transition zone from one ecological system to another, are highly important to human communities as they are areas from which two or more unique ecosystems may be accessed. While the idea of edges suggests limits, they are, in fact, a place of interface. These transitional zones are high in biodiversity as they tend to incorporate multiple features of species composition, structure, and function representative of the ecosystems that they join together. Therefore, human communities not only benefit from this richness but they also display a similar analogue in the form of cultural edges. These cultural edges rather than being margins between discrete social entities are, in fact, spaces of social interaction, cross-fertilization, and synergy where not only is there trade of material goods but also sharing of knowledge. In short, "ecological and cultural edges enhance the biological and cultural diversity of a landscape and allow for the exchange of oral histories, technologies, songs, information, genetic materials, and goods that may be necessary to adapt to both expected and unanticipated changes in ecological and social systems (Turner et al. 2003:456).

The high Arctic Iñupiat community of Wainwright, Alaska, for instance, strategically makes extensive use of the land and sea. With access to both the Chukchi Sea as well as the Brooks Mountain range ecosystems, the residents ensure food sovereignty by hunting and gathering from a rich biodiversity of marine and terrestrial mammals, birds, fish, and plants (see Fig. 12.1). In fact, ecological edges defined Iñupiat cultures historically. Up to the mid-1800s, cultural diversity was supported by rich biological diversity of the sea and land in northwest Alaska. In this Arctic region of 40,000 square miles (104,000 km^2), an area slightly larger than South Korea, ten different Iñupiaq "nations" engaged in trade, warfare, and peace. Their societal boundaries and territorial borders were determined on the basis of cultural and ecological resources that defined their relationship to the land and sea (Burch 2005). Factors that contributed to identification these different cultures included ecological edges and hunting of migratory animals along these intersections.

Connectivity of Sociocultural and Ecological

Adaptation to change takes place with multiple systems interacting; thus illustrating the interplay among the cultural, the social, and the ecological. The role of cultural and social processes as being conceptually independent, but mutually interdependent,

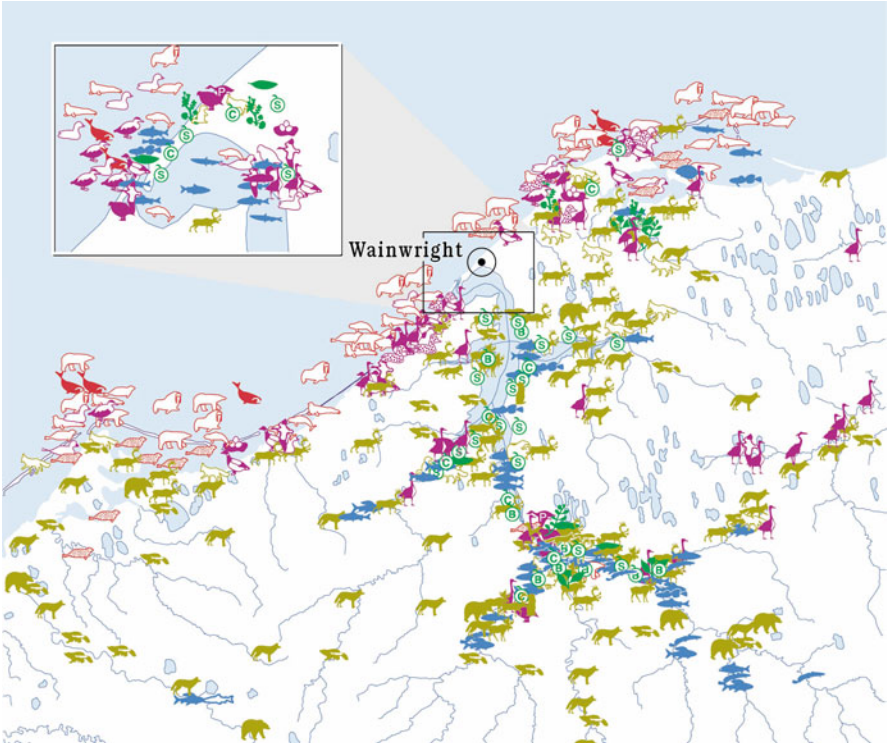

Fig. 12.1 Ecological resources of the Iñupiat community of Wainwright, Alaska

yields interesting insights into the complex connectivity that comprise relations within ecosystems. The impact of the two World Wars and the Russian Revolution compelled Sorokin (1962) to write a four-volume work on social conflict titled *Social and Cultural Dynamics*. At a time in history when the promise of humanitarianism and democracy seemed strong, the seemingly impossible outcome of dictatorship, human suffering, and mass murder occurred. These events drove Sorokin to develop a system to examine social change. A similar sense of hope developed after the collapse of the Soviet Union in the late twentieth century and yet global conflict did not abate in Central Asia. In Afghanistan, a 30-year global war threatens to spread into neighboring regions and Tajikistan faced almost a decade of conflict in the 1990s.

Using Sorokin's ideas as a basis, Geertz (2000) developed two levels of sociocultural analysis. First, culture is an ordered system of meanings and symbols through which social interaction takes place. Second, the social structure is the pattern of interaction itself. At the level of culture, there is a framework of meaningful and communicative symbols, values, and beliefs. In this system, human beings define their world, express their feelings, and make their judgments. The cultural level is where individuals draw meaning, interpret their experience of the world, and guide their actions. On the social level, the continuous process of interactive behavior forms a social structure. It is within this structure that individual or group

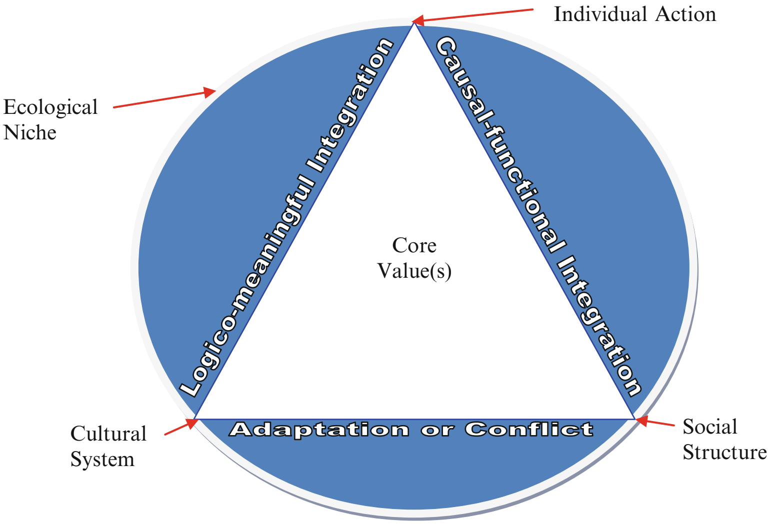

Fig. 12.2 Integration of cultural values with social structure in ecological context

action takes place in the context of a network of social relations. At the level of culture, there is "logico-meaningful integration" (i.e. meaning based on values) of values and at the social level, there is "causal-functional integration" (i.e. application of values) in the form of action (Geertz 2000:142–69; Sorokin 1962). These sociocultural interactions are grounded upon an ecological foundation—a habitat from which a social group can adapt to changes. In the context of change, when there is synthesis between cultural system and social structure of a community or group in a specific ecological context there is adaptation; otherwise, we observe conflict (see Fig. 12.2).

The Sociocultural and Ecological Dynamics of Adaptation: The Case of the Pashtu and Shugni in Afghanistan

Illustrated below is an example of how complex connectivity between the ecological and cultural facilitates the survival of the Arab Pashtu and Shugni in the Pamir mountains of Afghanistan in the context of prolonged war and ever increasing environmental change by sustaining cultural and religious diversity and maximizing the use of different ecological niches. The Arab Pashtu and the Shugni in Afghanistan have a complex and symbiotic relationship. Like the Iñupiat in the Arctic, these two communities utilize the interface of ecological edges along high mountain environments to ensure food security and mutual survival. The Arab Pashtu are pastoralists. They migrate in the spring from lowlands in the provinces of Baghlan, Konduz, and

Fig. 12.3 Research area and ethic groups

Takhar to the highlands near Pul-i-Zirabon, in the province of Badakhshan. Since both humans and livestock depend on salt, villagers from Badakhshan have historically traveled to lowland markets such as Faizabad to purchase it (Barfield 1981). The Arab Pashtu are Sunni Muslims and speak Dari, an Indo-European language related to Persian. The Shugni are highland farmers who live in the region of Pul-i-Zirabon near Lake Shiva, Badakhshan. The Shugni also have animals and, in the summer, Pashtu encampments and pastures border their villages and pasture lands. The Shugni are Ismaili Muslims and speak Shugni, an Indo-European language of the Pamir group (see Fig. 12.3).

The ecological professions of these ethnically and religiously diverse groups are distinct, but seasonally their habitats overlap. The Arab Pashtu arrive in Badakhshan in June and return to the south in September, traveling three weeks to a month in each direction (see Fig. 12.4). The Pashtu travel through several ecological zones and encounter a variety of ethnic groups along their journey. It is noteworthy that the Pashtu consider themselves the wealthier members of the relationship. The measure of their wealth is the number of animals: while the Pashtu nomad is said to have 800–1,000 sheep and goats, a Shugni farmer is considered wealthy if he has 50 animals. The Pashtu openly acknowledge the relative poverty of their Shugni neighbors: "We do not fight with them [the Shugni] because they are so poor. Instead, we consider them our brothers." Equally the Shugni acknowledge the relative wealth of their nomadic trading partners.

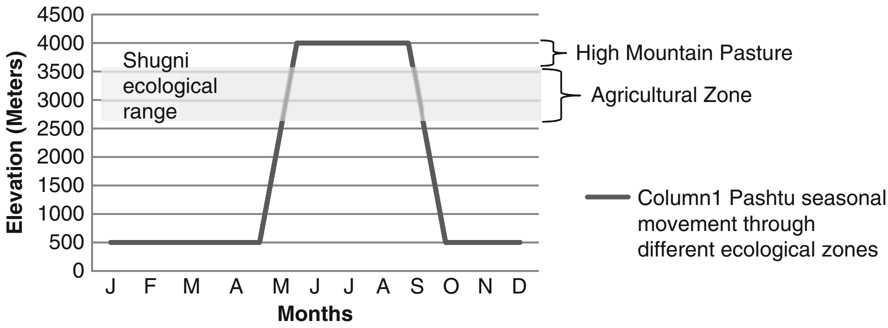

Fig. 12.4 Seasonal overlap of ecological niches of the Pashtu and Shugni

The Shugni grow mainly wheat, barley, and peas and keep livestock such as goats, sheep, and a few cattle, as well as horses and donkeys. When they have surplus crops, the Shugni are unable to move these commodities to the lucrative southern markets. While the Arab Pashtu carry sufficient rice on their animals in their migration highlands of Badakhshan, they buy their wheat from the Shugni, as well as dried yogurt (see Table 12.1). The Arab Pashtu are an important (albeit seasonal) force in Badakhshan as they are the link between the lowlands of the south and the highlands of the north. The difference between these ecological zones works to their advantage in trade and facilitates a symbiotic relationship with the Shugni farmers in Badakhshan. The relationship has been mutually beneficial. The Shugni obtain tea, salt, oil, ironware, cloth, and kitchenware from the Pashtu, and sometimes donkeys, cows, sheep, and goats. Most of the time, items are exchanged and not purchased using cash. The subsistence agriculture of the Shugni does not provide the villagers in Badakhshan with sufficient cash to purchase salt, tea, cloth, and ironware from distant markets, and they must make long journeys to Faizabad and Rustaq to obtain necessary goods. Aware of the cash needs of villagers, the Pashtu bring sufficient cash to the highlands to purchase wheat from the Shugni (Barfield 1981).

These transactions, which take place between individuals (generally men), are based on more general communal relations established between the Shugni and the Arab Pashtu. Both villagers and nomads sustain relations that were first established by their grandfathers more than 40 years ago. As a result of these relations, a villager may ask his nomad friend to bring a list of items from southern markets, such as cloth and kitchenware, on his next trip north. When the Shugni go south, the Pashtu extend similar hospitality. While Shugni women do not visit the homes of the Pashtu in the lowlands, the Pashtu women do visit the homes of the Shugni women when in the highlands. In the villages, the nomad not only has an assured place to sleep, but experiences the stability of long-term hospitable relations.

As noted earlier, the Shugni farmers also keep animals, using mountain pastures in the summer. However, as they lack the resources to retain a large group of animals through the harsh winter, the Shugni trade their goats and sheep to the Arab nomads. The Pashtu nomads can pay cash or exchange the expensive items they

Table 12.1 Comparative summary of Pashtu and Shugni relations

	Arab Pashtu	Shugni	Comparison
Religion	Sunni	Shia Ismaili	Religious distinctiveness
Language	Dari	Shugni	Linguistic and cultural distinctiveness
Profession	Nomadic pastoralists with some agricultural land	Sedentary farmers With livestock for pastures	Pastoralists are Sunni Muslims, while Ismaili Muslims are sedentary farmers who also keep animals
Trade items	Livestock, kitchenware, ironware, salt, and other items from southern markets, cash	Wheat, animals, dried yogurt	The Pashtu bring southern market items to trade for agricultural items
Employment	Employer	Employee	Pastoralists are employers
Habitat (location)	Lowlands to highlands: Valleys and villages in Baghlan, Kunduz, and Takhar with seasonal use of high mountain pastures	Highlands: Valleys and village region of Pul-i-Zirabon with and seasonal use of high mountain pastures	Seasonal overlap in niche occurs between the Pashtu and Shugni
Elevation range	500–4,000 m	2,500–4,000 m	The pastoralists begin at lower elevations and seasonally migrate to very high mountain elevations
Sacred sites	Not shared	Not shared	Both cases demonstrate diversity in religious distinctiveness.

have transported from southern markets for goats and sheep to renew or increase the size of their herds. This trade saves the Shugni farmers a costly trip to the market.

During summer, wealthier Shugni (who have more than 50 animals) will give some of their male goats and sheep to the Pashtu to tend in their pastures. In the autumn on their return to south, the Pashtu return the animals back to the Shugni. Similarly, during their stay in the highlands, the Pashtu will bring their injured animals to the Shugni to tend in the vicinity of their villages. In the winter season, the Shugni give their male horses and bulls to Pashtu to take south and in the spring they bring them back. The Pashtu also store their extra supplies such as tea and salt in the homes of Shugni.

The Shugni maintain that conflict with their Pashtu neighbors is rare but may arise when the Pashtu shepherds are careless and let their animals graze in Shugni pastures, crop land, or land designated for growing fodder. Although the niches overlap, the presence of spatial boundaries speaks to the old adage that "good fences make good neighbors." The Shugni also pointed out that conflicts are usually resolved in favor of the side that possess the most resources to influence decisions made by local government arbiters. Both the Shugni and the Pashtu are at the mercy of regional government commanders who are extorting animals from the two communities. These local commanders are particularly vicious to the Pashtu (who have relatively more wealth to extort). Use of pastures in Badakhshan is highly competitive, and access to new pastures is acquired through purchase, rental, or theft. Pasture rights were established and reorganized in 1921 by Nadir Khan. The Arabs have exclusive rights to pastures in the form of *firmans* (deeds) issued by the government. These rights—which are not tribal or common property, but individual family rights—are guaranteed by the state, and they may be bought, sold, rented, or inherited. While the Arab Pashtu have individual titles to summer pasture use, the Shugni villages have collective title to their traditional summer pastures. The idea of renting pastures reinforces the notion of private ownership (Barfield 1981). In our interviews, the Pashtu reported increasing difficulties with local government because their lands are under threat from local commanders. In the highlands, these commanders buy up from the government the pasture land on which the Pashtu have traditionally grazed their animals. They then rent it back to the herders for 4,000–5,000 Afghani (USD80–100) per season, a significant capital outlay in this region. In many cases, the Pashtu have deeds to prove grazing rights from the time of their grandfathers, but the local commanders insist that they pay to use the land. In the spring, as the Pashtu migrate northward with their animals from lowland provinces, such as Baghlan, Konduz, and Takhar, these local commanders control the trails and demand animals in return for safe passage. When the Pashtu tribesmen refuse, the commanders or their henchmen assault the tribesmen and take their animals by force.

The Pashtu and Shugni do not practice intermarriage, thereby retaining their cultural distinctiveness. However, Shugni women recalled past times when their families were indebted to the wealthier Pashtu tribesmen and women were given to repay the debt. "In earlier days, our ancestors were very dependent on Pashtu because they were prosperous, and our ancestors were always in debt, which they could not repay, but they would give away their daughter in return for the debt. Now there are no such cases, and may God prevent their return." The giving of daughters as repayment of debt is no longer practiced. Barfield (1981) reported that sometimes close ties between wealthy Shugni farmers and Pashtu nomads are secured by a one-way marriage relationship between Shugni women and Arab Pashtu males. He maintained that Arab Pashtu refuse to let their women marry Shugni men. However, our interviews indicate that, in fact, both sides reported no marital connections.

Each group is careful not to enter each other's religious space such as *Mazars* (sacred places) or prayer sites. The Pashtu explain: "We do not say bad things about their [Shugni] *Jamat Khanas* (places of prayer) and we do not visit them, and they do not say bad things about our holy places and they do not visit them. Moses had his religion and Jesus had his religion." The Ismaili Muslims, in their places of worship, pray with both genders present, men on one side and women on the other. There is no physical barrier, and both genders are given equal preference of space as both equally occupy the space of the prayer hall from front to back. During the summer, while the Pashtu were visiting the village of Pul-i-Zirabon, women did not attend the *Jamat Khana* for prayer. The Shugni men explained that they were absent to protect themselves from persecution by followers of the more extreme interpretations of Islam.

The nomads also help their Shugni friends to secure winter employment in the southern lowlands. The less wealthy Shugni seek seasonal employment in the south, and at this time, they live at the homes of their Pashtu friends. Their work tends to involve caring for and feeding livestock, collecting fuel for heating the Pashtu homes, and fetching water. They may also work as agricultural laborers, plowing fields in the lowlands and planting rice. They are paid in cash and payment is mutually decided before they come to south to work. Such seasonal employment lasts for 1 or 2 months.

The Value of Pluralism

Adaptation to change takes place with multiple systems interacting thus illustrating the interplay between and the interdependence of the sociocultural and ecological systems. The case of the Pashtu and Shugni illustrates that pluralism has many facets in terms of human ecological relations. In this sense, the *common good* is achieved by harnessing ethnic, religious, and ecological diversity. Pluralism makes a case for keeping all the parts so as to retain adaptive capacity.

When cultural values of a group or community are retained and practiced, they manifest themselves through individual action in a social context (Sorokin 1962; Geertz 2000). If there is synthesis between the cultural system and social structure, conflict is avoided and adaptive responses are formulated. The case of the Pashtu and Shugni is informative because their milieu is rife with conflict yet their approach is pragmatic as they negotiate human ecological relations with a practical wisdom that helps secure their livelihoods though the practice of pluralism. The interdependence between the Pashtu and Shugni is not limited to economic self-interest. This interdependence is not only an outcome of a materially determined calculus but an organic engagement of diverse cultural systems and social structures in the context of varied yet overlapping ecological zones. Trust and confidence sustain this interdependence. It is noteworthy that the notions of “diversity” and “pluralism” are part of the lexicon among the ethnically varied Muslims in the Pamir Mountains of Central Asia. A geological cross-section of religious history in the Pamir Mountains reveals the presence and ongoing influence of indigenous beliefs, Zoroastrianism, Buddhism, and multiple interpretations of Islam. Instead of weakening the foundation of social life, a lack of homogeneity in the religious sediments of the peoples of the Pamirs contributes to a pluralistic cultural fabric that enables resilience and facilitates survival. For instance, the ethnically diverse Shia Ismaili Muslims, which include the Shugni as well as several other groups in both Afghanistan and Tajikistan, have specific words for cultural diversity and pluralism. Co-emergent with the waning of Soviet power, strengthening of Taliban power, and increased outside contact

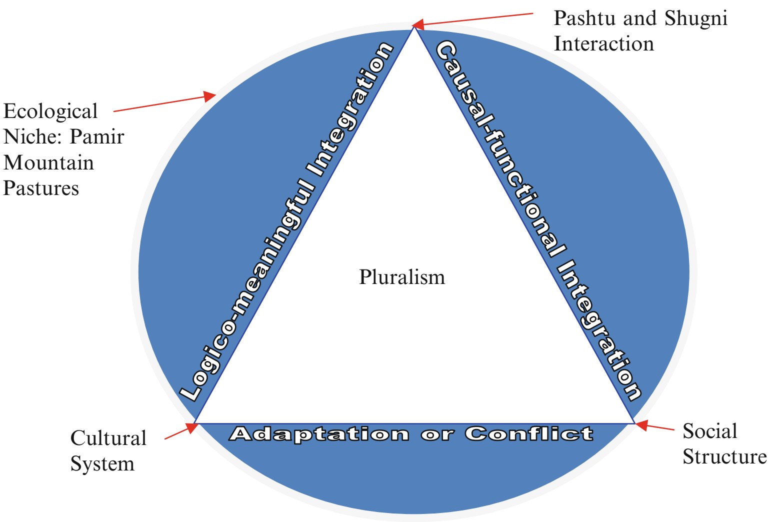

Fig. 12.5 Pluralism as adaptive response within sociocultural and ecological systems

in the 1990s, they use the words *chandandeshi* (meaning "several opinions") to refer to diversity and *gunoguni* (meaning "varieties")[2] to refer to pluralism. In addition, a long and sustained history of the Silk Road in this region speaks to the development of institutions that facilitated difference and negotiated conflicts. Despite the interruption described as the "closed frontier" caused by colonial expansion in the nineteenth century and Cold War in the twentieth century, this history is part of the consciousness of the inhabitants of the Pamirs. The fear of the Shugni to openly practice their faith, which includes women participating in prayers as equal partners, while the Pashtu nomads are within the Shugni's ecological habitat speaks to the fragility of pluralistic relations (see Fig. 12.5). In short, the practice of pluralism in the context of the Pamir refers not only to economic needs but also to sociocultural awareness that extend to ecological niche.

Conclusion

The Pashtu and Shugni operate at the interface of ecological edges drawing from agricultural and mountain pastures. These edges bring together varied and overlapping ecological niches and cultures in the mountain environment of the Pamirs of

[2]I first noticed awareness and the use of these concepts and specific words in interviews with villagers in 2006. I am grateful to Dr. Sharofat Mamadambarova who shed light upon lexical origins of these words.

Badakhshan, Afghanistan. The complex connectivity of cultural and ecological diversity generates creative adaptive responses to the chronic stress of war and environmental change. Survival of the Pashtu and Shugni is directly linked to the practice of pluralism, keeping all the parts, in a sociocultural and ecological sense.

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Chapter 13
From Yaks to Tourists: Sherpa Livelihood Adaptations in Sagarmatha (Mount Everest) National Park and Buffer Zone, Nepal

Jeremy Spoon

Introduction

Mountain ecosystems create opportunities for innovation. Change is a constant. Human biology must cope with hypoxia and cold stress. Shallow soils are unproductive and unstable and grazing land can be limited. Forest resources are slow growing, especially in higher elevations, and there is an increased risk of pulmonary disease (Moran 2008). Ecological, political, and economic factors influence the livelihoods of mountain dwelling people against this backdrop of scarcity and vulnerability. Marginal environmental conditions greatly affect the ability to procure resources for sustenance through farming, herding, trade, or market-based sources. These challenges may in turn cause conflict or stagnate a nascent market economy. Considerable uncertainty thus exists in both the natural and social worlds of these populations, requiring creative solutions for multifaceted problems. Indeed, mountain peoples require various short- and long-term adaptations to survive in these environments.

At any point in time, a population's needs may shift from one configuration to another. In some cases, especially in the increasingly interconnected global economic system, livelihoods change from subsistence to market-based approaches (e.g., Godoy et al. 2005) or from one market to another (e.g., Vaccaro and Beltran 2007). I view these shifts as livelihood adaptations. The term adaptation as used in this chapter is not intended in a Darwinian sense, for instance as an impersonal description of human behavioral strategies vetted solely by the process of natural selection (Driscoll and Stich 2009). Rather, my point is to focus on the human innovation behind adaptations to change (Armitage 2005). These adaptations reflect

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both the individual and collective decisions of a population responding to their internal and external needs at a specific point in time. While human biological constraints and selection pressures do shape outcomes, they are interdependent with the specific social and cultural factors unique to each population. Thus adaptations to the same ecological conditions may result in very different outcomes. Adaptations are complex, heterogeneous, and context specific.

The physical environment is not a passive actor in these human–environment dynamics. Mountain ecosystems function in nonlinear, often stochastic ways. A useful lens for understanding these dynamic processes is a framework of nonequilibrium ecology that includes people in the ecological system. Forsyth (2003:64) defines nonequilibrium ecology as "an approach to ecological explanation that emphasizes the variable, and often chaotic, nature of change within ecological systems, at a series of spatial and temporal scales." Equilibrium ecology, by contrast, emphasizes the role of competition. For example, a nonequilibrium explanation of plant community structure (i.e., species composition and function), would consider the complex interplay of competition as well as forces like predation, parasitism, climatic disturbances, stochastic events, etc. The environment is thus continually in flux in different geographies and points in time, which parallels the anthropological lens that views culture as continually in motion or experiencing consistent change—although the nature of these changes may not be consistent or predictable. By contrast, equilibrium ecology views plant community function as a single complex organism, which returns to its original state following disturbance. This overly simplistic ecology purports notions of balance, harmony, and functional order; when broadened to encompass ecosystems supporting human inhabitants, it corresponds to an essentialized or ahistorical perspective of culture as unchanging. The notion of competition in equilibrium ecology is as a key process regulating system function causing humans to be seen as potential competitors denying resources to other parts of the system (Saberwal et al. 2001; Leach et al. 1999; Lister 1998).

Accordingly, people's actions and practices, influenced by ecological, political, and economic forces, conserve, reproduce, or alter ecological features and processes (Leach et al. 1999). But those influences are not unequivocally *bad* for the ecosystem. Indeed, several studies illustrate that human generated disturbances from small-scale indigenous peoples, such as patch burning, rotational grazing, and select plant harvesting techniques, were environmentally beneficial (Ticktin and Johns 2002; Yibarbuk et al. 2001; Gadgil et al. 1993). However, scale must be taken into account, as certain human-caused disturbances, such as clear-cutting forests, dam construction, and carbon emission from automobiles, certainly impact the environment in destructive ways.

Mountain peoples require creative solutions to cope with mountain geographies. These innovations include utilization of different ecotones (e.g., alpine to subalpine to temperate) to procure resources from the physical environment or other peoples. Some mountain peoples practice seasonal transhumance where livestock migrate from lower to higher pastures at certain times of year and others trade or purchase food products from peoples who live in other nearby ecotones. Turner et al. (2003:442) explain that transitions from one ecotone to another often result in high levels of species richness and biodiversity. Each ecotone may also be inclusive of a cultural group, creating linked cultural and ecological edges. Human communities situated "on the edge" thus benefit from this increased cultural and ecological diversity.

The altitudinal gradient of mountain ecosystems provides many edges and thus opportunities for innovation, especially in knowledge exchange and the procurement of resources from a different zone. For example, trade in agricultural, pastoral, and forest products between zones increases each population's ability to survive at a certain point in time. Predictions of ecological changes as a result of anthropogenic climate change will certainly shift edges, reconfiguring human–environment dynamics. Indeed, high elevation landscapes are among the most susceptible to climate change effects.

Integration into a market economy, particularly a market with a global reach such as tourism, will importantly alter how any population interacts with the physical landscape. A group may rely on the land in one way over a specific time span (e.g., herding, farming, and/or the collection of forest products) and change this relationship entirely at another (e.g., tourism, mining, or timber extraction) or conduct a combination of strategies that continually reconfigure. At one time this relationship may be beneficial to biodiversity conservation and at another environmentally destructive (Spoon 2011a). Environmental sustainability is thus a process and not an end product (Berkes et al. 2003) and may require learning to respond to emergent environmental issues. New problems may arise that did not exist in a previous configuration, such as the consumption of nonlocal goods that create nonbiodegradable litter supplementing or replacing pastoral, agricultural, or forest products.

The ability of mountain peoples to make their own "rules" on how they interact with natural resources is in many circumstances crucial for environmental sustainability, especially in the case of protected areas. Many protected areas were established throughout the world that use an equilibrium ecology model that considers humans as a destructive disturbance to ecosystem function, which resulted in the marginalization of thousands if not millions of peoples in the name of nature conservation (e.g., Ghimire 1999; Colchester 2000; Saberwal et al. 2001). However, in select contexts small-scale populations did retain land titles and are involved in the management of protected areas, such as Joint Forest Management in Rajasthan, India (Ross et al. 2011). In these contexts, environmental conservation may be a priority of the local population, especially if they rely on the natural resources for their livelihood, whether forest products or tourism profits. Indeed, Persha et al. (2011) found a correlation between the ability of a local population to make their own natural resource conservation rules and positive forest outcomes in East African and South Asian protected areas.

In this chapter, I explore Khumbu Sherpa livelihood adaptations, demarcated by the protected area Sagarmatha (Mount Everest) National Park and Buffer Zone. I assess how ecological, political, and economic forces shaped five centuries of human–environment relationships, such as marginal agricultural land, protected area establishment, and an exploding tourism industry. Specifically, I focus on the transition from agropastoralism and trade to tourism and what influences tourism in the protected area had on ecological knowledge and understanding of the Khumbu landscape. I also discuss how local institutions have begun developing litter abatement programs in response to the increase in volume of nonbiodegradable waste created by commercial products purchased outside and imported into the valley.

Khumbu and The Sherpa

The Khumbu region (Fig. 13.1) lies in the lap of the world's highest ecosystems. Completely surrounded by mountain peaks, many over 6,000 m, Khumbu contains some of the highest mountains in the world and embodies a dramatic altitudinal gradient from 2,800–8,850 m. This creates ecological edges from temperate to subalpine to alpine. The Sherpa are relative newcomers to the Khumbu area in comparison to the settlement of other Himalayan peoples. Although sparse, piecing together oral history with some written accounts, the Sherpa migrated to Khumbu from the Kham region of the eastern Tibetan Autonomous Region in the sixteenth century because of war, famine, or drought (Ortner 1989; Oppitz 1973; Sherpa 1999). Ortner (1989) explains that families migrated to the area depending on need. Wealthier families were more prone to settle in the lower elevation temperate valleys called Solu and Pharak, whereas the less affluent families settled the higher elevation subalpine and alpine ecosystems called Khumbu.

As of 2007, there were between 3,000 and 4,000 Khumbu Sherpa, living in their ancestral homeland, as well as Kathmandu and various transnational contexts. My survey research found that approximately 2,800 Sherpa lived in Khumbu for at least 3 months per year and that wealthier families retreated to Kathmandu during winter, and some for the monsoon season as well. Additional ethnic groups, such as Rai, Tamang, and others, served as laborers for the Sherpa, also populated Khumbu. Further, there was an increasing number of Sherpa and non-Sherpa renters who seasonally inhabited the area, typically to work in some tourism business (Spoon 2011a).

Khumbu was considered by some Nyingma Buddhist Sherpa to be a *beyul* or sacred hidden valley. These areas were set aside by the progenitor of Buddhism in Tibet, Padmasambhava or Guru Rimpoche, in the eighth century for his followers in times of need. Padmasambhava was said to have subdued the demons that occupied pre-Buddhist Tibet and facilitated their return as protectors for his followers. These deities or *yul lha* protected the *beyul* and its residents if a certain code of conduct was followed. This code places a taboo on the harming or killing of sentient beings from plants to animals to humans. It also encouraged the socially responsible behaviors of providing food for all residents of the valley and refraining from violence. It was the following of this code of conduct that made the *beyul* powerful (Spoon 2011b).

Beyul and *yul lha* were dual, overlapping conceptions of landscape. It was unclear whether the *beyul* and *yul lha* concepts migrated from India or if *yul lha* existed in pre-Buddhist Tibet as mountain deities that were remade upon the arrival of Buddhism in Kham (Studley 2010). *Beyul* and *yul lha* spiritual perspectives certainly had varied interpretations throughout Sherpa settlement in Khumbu. Over the

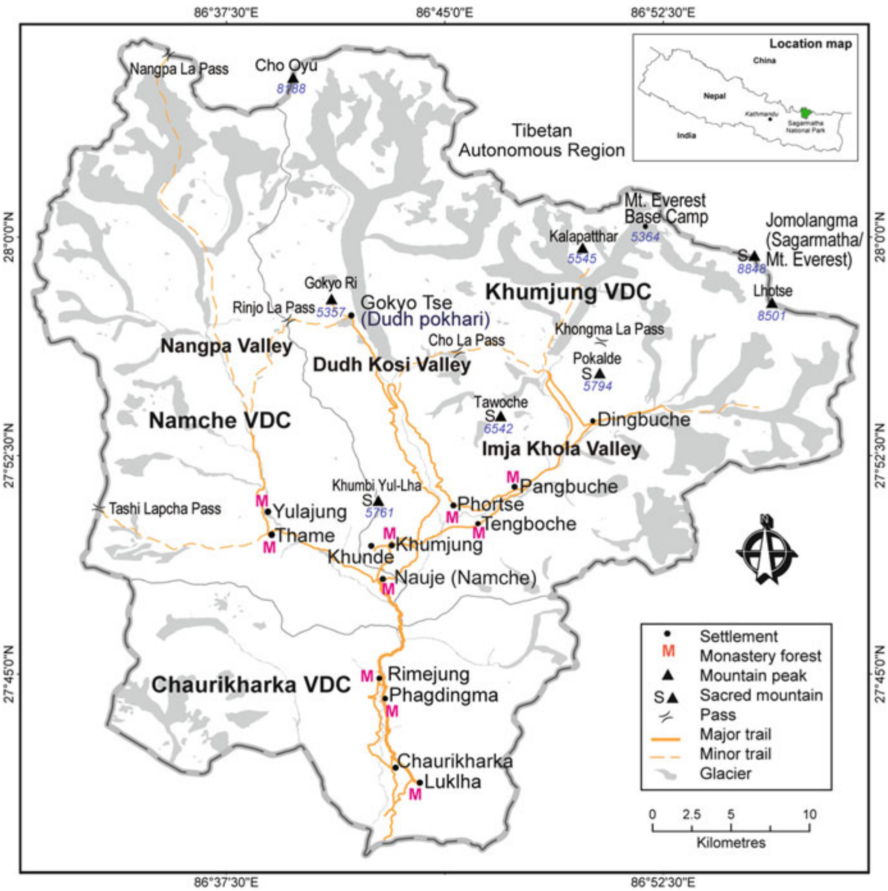

Fig. 13.1 Map of Sagarmatha (Mount Everest) National Park and Buffer Zone (Khumbu and Pharak). Tourist route to Mount Everest Base Camp is in the Imja Khola Valley. (Map courtesy of the International Center for Integrated Mountain Development, first published in Spoon 2011a)

years, the reasons to venerate these deities and their powers shifted depending on the needs of the Sherpa. Farming, herding, trade, and tourism influenced these ways of knowing, which were based on incremental learning from lived experience and responses to crisis and mistakes (Berkes and Turner 2006). Between 2004 and 2008, I found that both *beyul* and *yul lha* spiritual values influenced human–environment dynamics in seemingly environmentally sustainable ways; however, knowledge and practice related to these spiritual values was heterogeneous and influenced by tourism and other forces (see below). I also experienced a resurgence of interest in reviving the *beyul* tradition among some more affluent elders and monks.

These Sherpa spiritual values and others have conservation value even if conservation is not the overt goal, not uncommon to certain sects of Tibetan Buddhism.

To understand Sherpa–environment relationships, physical, social, and cultural factors thus require consideration. Accordingly, H.H. Gyalwang Karmapa (Dorje 2011:1096) shares the importance of a holistic perspective in the following way:

> We cannot simply address the political and scientific aspects of problems such as climate change, intensive extraction of natural resources, deforestation, and wildlife trade. We must also address the social and cultural aspects of these problems by awakening human values and creating a movement of compassion, so that our very motivation in becoming environmentalists is to benefit other living beings.

Making it Work: Farming, Herding, and Trade

Before tourism, the Khumbu landscape was not a place for one survival strategy, but rather a complicated often shifting matrix of farming, herding, and trade. The intensity for a family to participate in each of these efforts depended on a host of factors, which included geography, climate location of settlement, endowments, family networks, and more. This mixed way of life allowed opportunities for individual innovation and entrepreneurialism—adaptation to consistently changing life-ways. At one time, families specialized in a particular aspect, such as hybridizing yaks and cows, and could supplement their efforts with other strategies, such as trade of a specific cultivar from south of Khumbu (e.g., rice) to its Tibetan neighbors to the north, which in turn provided a commodity for trade (e.g., salt). The family may have also had a small potato and buckwheat crop, which was principally consumed in the home. In another time, this matrix may have shifted altogether.

Most of the Khumbu Sherpa were from less affluent households and settled on the least arable land compared to the wealthier Sherpa who settled further south in the Solu area. Settlement in the higher elevations restricted the diversity of possible cultivars, namely buckwheat and barley, and forced a mixed subsistence strategy for survival. Stevens (1993) argues that the Khumbu agricultural landscape shifted significantly with the introduction of the potato in the 1850s. Although never directly colonized, the potato crept into Nepal via British India. For the Khumbu Sherpa, this meant a new, more resilient crop that could be grown at high elevations to supplement the grains. By the early to mid-twentieth century, potatoes replaced buckwheat and barley as the primary agricultural product and local varieties were developed.

As of 2011, potatoes were the primary cultivar in the region with at least six varieties grown. Another common outdoor crop was mustard greens. Some households over the past 20 years also had small greenhouses made primarily of plastics to grow carrots, cauliflower, squash, and more. Sherpa diets adapted with changes in cultivars, especially growing potatoes and trading for rice. Whereas in the past the primary foods were grains; contemporary diets mirror other Nepali ethnic groups, especially the consumption of *dal baht* or rice, dal, and curry. Each Sherpa household continued to own agricultural fields; however, the labor in the fields was by and large conducted in tandem with non-Sherpa or outsourced altogether.

Fig. 13.2 Yak/cow hybrids or *Zopkio/Zhum* transporting goods for tourists along the Dudh Kosi River. (Photo: Jeremy Spoon)

Sherpa herding embodied seasonal transhumance from lower to higher pastures in concert with the growing season. Families typically had lower and higher elevation residences, called *gunsa* and *yersa*, which they inhabited depending on seasonal requirements for herding. Brower (1991) explains that Sherpa herders contained three primary types of livestock, yak-nak, yak-cow hybrids called *zopkio-zhum* (Fig. 13.2) and cows, whose numbers fluctuated depending on ecological and social forces. Over the centuries, the Sherpa specialized in both the herding and the breeding of livestock. Not every Sherpa family had livestock and typically these cattle were used for different reasons. Some families utilized their herd for dairy products and wool, while others used them for the portering of goods in trade. Still others may have combined these needs at various intensities or were strictly breeders. Similar to agriculture, herding afforded opportunities for adaptations over time to deal with shifting needs. Herd sizes fluctuated, as did the role of livestock.

In 2006–2007, I found Sherpa livestock holdings to be on the decline. Several families had sold their entire herds and others were maintaining small herd sizes compared to the past. The breeding of hybrids was also on the decline. The production of dairy products and the spinning of wool also appeared to lessen, especially with the ease of obtaining goods from Tibetans who visit Khumbu seasonally for commerce. Livestock were almost entirely used for the portering of tourism goods, especially the hybrids (see next section); however, human porters far outnumbered the use of livestock.

Sherpa trade by and large was based on the obtaining of agricultural products from elevations below 3,000 m to the south of Khumbu, largely rice and vegetables, to trade to higher elevation areas which cannot produce these commodities. To the north, these products were traded for salt and other products from the Tibetan Plateau. Not all Khumbu families traded, more sedentary households relied on traders to receive the goods they could not produce themselves. Some families achieved affluence through trade, especially in the one center of Khumbu trade, the village of Namche (pronounced Nauje). Men typically traded, leaving the household for expeditions to the south and north for extended periods of time. Some families more involved in trade were typically polyandrous—one brother went trading and the other stayed home with his wife. Intensity of trade year-by-year depending on a host of factors, including resources availability, taxes leveraged by the Nepal nation-state, political dynamics in Tibet, and more (Fürer-Haimendorf 1975; Stevens 1993).

Sherpa trade shifted dramatically over the past 50 years. Trade, once a necessity for sustenance in the mountains, was dramatically interrupted by the Chinese seizure of Tibet in 1959. Trade intensity changed depending on the location of settlement in Khumbu and other factors. Most families ceased participation in the 1960s and 1970s, with some continuing through the 1980s and beyond. In 2008, the Sherpa were more passive recipients of trade than the actors. The Nepal–China border remains open (albeit occasionally closed) for Tibetans to travel south to Khumbu, but closed for the Sherpa to travel north to China. Sherpa purchase commodities from the Tibetans, mostly for use in tourism. Some Tibetans maintain relationships with families they traded within the past; however, the majority of the trade model has been adapted to tourism and the integration of Nepal and the Sherpa into the global market economy.

The Tourism Transition

Khumbu is by and large geographically isolated from the rest of the world. Yet it became the sanctuary—the sole source of sustenance, shelter, and aid—for increasing numbers of tourists attempting to summit or glimpse Mount Everest. Mountaineering notoriety and a global fascination with the east, fueled by fantasies of Shangri La from sources such as James Hilton's *Lost Horizon*, amplified the industry. Tourism was the vehicle integrating the Sherpa into the global market economy, which, over time, profoundly reshaped the Sherpa way of life. The flux of Sherpa agropastoralism and trade intensified with the advent of tourism, a process that began before the first tourist set foot in Khumbu. Ortner (1999) illustrates that

Fig. 13.3 Tourist luggage was typically portered by laborers from various parts of Nepal. The ages of these individuals varies widely. Loads can exceed 40 kg or more per person. This luggage resting along the tourist route belongs to the western trekking group in the upper *left*. (Photo: Jeremy Spoon)

Sherpa individuals (including some Khumbu Sherpa) began working in tourism as guides and porters in Darjeeling at the turn of the twentieth century. Their participation increased exponentially with Sir Edmund Hillary and Tenzing Norgay's (a Khumbu Sherpa) successful ascent of Mount Everest in 1953. Tourists began visiting Khumbu in the 1960s with the help of Sherpa guides and porters (Fig. 13.3). This form of trekking tourism was largely tent-to-tent led by Sherpa and supported by large staffs that helped with everything from portering supplies to cooking. The tourism route led from the former trade center of Namche to Tengboche Monastery to Mount Everest Base Camp, with a stop at the mountain lookout of Kala Pathar.

Tourism was enhanced with the establishment of Sagarmatha (Mount Everest) National Park in 1976 with help from the New Zealand Government and the subsequent UNESCO World Heritage designation in 1979. The Park was expanded in 2002 to accommodate the Pharak region directly to the south of Khumbu between Lhukla airport and Namche. To the advantage of the Sherpa, the protected area did not usurp the local residents from their ancestral lands in the name of nature conservation prevalent in many protected areas (Dowie 2009; Stevens 1997). The Sherpa retained land titles in settlements within the Park itself. This allowed tourism entrepreneurs to engage directly with the tourism economy. The Sherpa were also granted some comanagement opportunities, which increased with the advent of the Buffer Zone in 2002. In this model, the Sherpa received 30–50% of the annual revenue from entrance fees to be used for development, conservation, and culturally focused projects. Examples of Buffer Zone projects I observed between 2004 and 2011 included trail improvement, establishment of a women's handicraft cooperative, and a Sherpa song competition.

Beginning in the 1980s, the tent-based trekking with outdoor cooking shifted to a lodge-based model with indoor kitchens. Households along the trekking route began modifying their lower and higher elevation residences to accommodate tourists. The base tourist route remained the same; however, a minority of tourists did visit other valleys (Spoon 2010). For example, between October 1 and November 30, 2006, there were 672 total visits to the three primary Khumbu valleys: 447 on the tourist route and 225 off, with only 45 groups visiting the least toured Nangpa Valley (Spoon 2008).

The number of Khumbu tourists reached upwards of 30,000 in 2009 (Sherpa, personal communication)—a number that trumped the Sherpa population tenfold. Visitation was highly seasonal. The bulk of tourists visited between September and November and to a lesser extent March to May. During these months, the area transformed to accommodate the increasing numbers. Trails with sparse traffic became trekking highways with countless footprints (and dust) from daily traffic. Thousands of Nepalis flocked to the region for work and to sell goods. Indeed, there were economic opportunities in Khumbu far beyond what was possible in other parts of Nepal. Between August 2006 and August 2007, the Khumbu Sherpa tourism market share was approximately 29.3% or US$1.4 million, which translated to US$2,026 per household, nearly ten times that of a typical household in Nepal, one of the poorest countries in the world (Spoon 2010; Dahal 2004).

Households along the tourist route adapted their livelihoods to accommodate the industry. They also interacted more with the tourists. These individuals economically benefited the most from tourism, exceeding the standard of living of their Khumbu counterparts. The former trading center of Namche became the tourism center rather seamlessly (Stevens 1993) and yak pastures became stops on itineraries. Households off the route participated in the tourism economy, but generally with lesser intensity. Families on the route owned most of the lodges and teashops, and at one time, were the majority of trekking guides. Some settlements off the route specialized in mountaineering, while other communities continued as farmers and herders, which indirectly supported the growing industry with vegetables, dairy products, and portering capabilities (Spoon 2011a).

A growing chasm related to differences in standard of living between on and off the route settlements also emerged. At times, these differences mirrored the structural inequality created by the big and little families upon first settlement in the region. Between 2004 and 2011, I observed shifts in material possessions and the indicators of material wealth. Imported items from Kathmandu and abroad were given high status. For example, during the annual Dumji ceremony dedicated to the mountain protector deity, many households on the route showcased imported alcohol and other outside food goods as markers of their status. This seemed to increase annually and was far less common at the same ceremony for households off the route.

As of 2008, the matrix of the tourism industry reflected the Khumbu Sherpa moving away from the on-the-ground tourism roles to focus on lodge and teashop ownership or specialized positions in mountaineering. Outside actors from throughout Nepal were the service providers. The Sherpa also stigmatized some positions as the work of poorer ethnic groups. Inflation in the area also forced some Sherpa to search for more stable employment in Kathmandu and abroad. Remittances from Sherpa abroad were also increasing as a contributor to the local economy. It was not uncommon for former trekking guides to solicit the help of a tourist to assist with obtaining a visa to the United States, Europe, Australia, or Japan for employment.

In terms of impacts on the physical landscape, increasing tourist numbers and their crowding in certain locations created numerous threats, including nonbiodegradable garbage littering the trekking route, pressure on local forests from firewood, and lodge building material extraction, especially in the alpine areas, and soil erosion along trails (Byers 2005; Nepal 2003; Rogers and Aitchison 1998). In varying degrees, similar effects of tourism were also evident in the Annapurna and Upper Mustang protected areas of Nepal (Nepal 2000, 2003), as well as the trekking corridor of Sikkim Himalaya in northeastern India (Chettri et al. 2002).

Along with tourism came development. By 2011, each lower elevation settlement had electricity from micro-hydropower (externally sponsored projects began in the 1980s) and generally had cellular phone coverage. There were schools in every major settlement, including a locally owned and operated private school, a hospital, and multiple health posts. An additional hospital was also under construction. Both monastic education and local medicine were on the decline as a result of these changes; however, there was 1 *amchi* or Tibetan doctor with an office in Namche.

Western-style education was on the rise throughout the area. Curriculum was taught in nonlocal languages transmitted by non-Sherpa teachers (there were some exceptions) and generally did not contain information about the local landscape (i.e., not place-based). My interviews with parents and students revealed a focus on English and mathematics, subject areas that were connected to success in tourism. I also noted an outmigration of wealthy, high achieving (i.e., on-the-route) students to Kathmandu boarding schools. Before the advent of schools in the 1960s and the tourism boom, Sherpa knowledge was by and large acquired from multi-generational family members in the home and through agro-pastoral and trade activities or in the monastery.

Gender roles also reconfigured. In 2006, only 28.9% (9.4% male/19.5% female) of Sherpa men and women were actively farming and only 18.0% (9.2% male/8.8% female) were herding even though 100.0% owned agricultural fields and 73.0% owned livestock. Rates for fuelwood and leaf litter collection were similar at 18.0% (6.7% male/11.3% female) and 19.7% (6.7% male/13.0% female), respectively. Most of this work was outsourced to Solu Sherpa, Rai, Tamang, and other nearby indigenous peoples. In the same year, 77.0% of households hired external labor for agriculture, 17.0% for livestock, 69.0% for fuelwood, and 68.0% for leaf litter. Some households let their fields go fallow and others combined smaller livestock holdings with larger ones to make it cheaper to outsource. In tourism, males typically acted as trekking guides and females often ran the family's lodge or teashop. Women's lives thus became more sedentary, devoid of contact with the forests where they once harvested leaf litter and food plants. Some male Sherpa trekking and mountaineering guides also traveled to lead groups in other Himalayan regions.

Finally, tourism had a significant role in the articulation of Sherpa identity. Foreigners flock to Khumbu searching for an "authentic" experience with Sherpa culture. Being Sherpa was indeed good business. Ortner (1999) suggests that tourist constructions and Sherpa self-fashioning took place at the same time in complex and unpredictable ways. This dialectic included the Sherpa artfully bending tourist desires for their own gain. Western admiration indeed helped to strengthen and provide tangible reasons to be Sherpa; in this sense Sherpa identity was reinforced through tourism (Fisher 2004). In Adams' (1996) ethnography, the Sherpa came to mirror some of the desires of the tourists, reflecting the Sherpa aspiration to be the kind of people the tourist want and the type of culture that they envision. Whatever the case, it is clear that the land is not the only tourist commodity. These host–guest dynamics in tourism's contact zone (Pratt 1992) no doubt influence livelihood adaptations, especially as the tourism industry continues to grow.

Adapting Ecological Knowledge and Understanding

As discussed above, the Khumbu Sherpa way of life has been continually in flux since their arrival in the sixteenth century. Their complex agro-pastoral-trade strategy allowed them to live on less arable, extremely environmentally challenging circumstances. Each household had its own unique assemblage of these three survival strategies, which shifted over time depending on need. The advent of tourism brought with it a new set of opportunities, shifting the focus away from a tradition of subsistence living. My research conducted on Sherpa household demographics, agro-pastoral participation, and tourism interaction conducted between 2004 and 2008 found that each family continued to farm, albeit often outsourced, and herding was on the decline. In contrast to past eras where most Sherpa gathered their own resources, only poorer Khumbu Sherpa and other ethnic groups were generally carrying out the collection of non-timber forest products (see Spoon 2010, 2011a, b). More market integrated, on-the-route households still required forest resources to operate their tourism business, principally firewood, and were required to deal with large amounts of nonbiodegradable litter and human waste. However, they were often not themselves the firewood harvesters or garbage handlers and instead hired laborers frequently carried out these tasks.

To focus the lens on the nuances of adaptation processes, exploring Sherpa ecological knowledge and understanding helps to illustrate what the Sherpa need to know about the land in the context elucidated above. To define ecological knowledge, I borrow from Berkes' (2008:10–11) definition of traditional ecological knowledge as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through the generations by cultural transmission, about the relationships of living beings (including humans) with one another and with their environments." Ecological understanding underpins ecological knowledge. According to Turner and Berkes (2006:497) ecological understanding is composed of four elements: (1) the incremental learning of individuals and groups; (2) the development of concomitant belief systems; (3) the creation and perpetuation of ways of encoding, communicating, and disseminations information; and (4) the development of institutions. Ecological knowledge and understanding thus reflect thousands of years of incremental learning with shorter-term knowledge learned from crises and mistakes, a process Berkes and Turner (2006:479) call "adaptive co-learning." Adaptive co-learning can be expanded to include multi-actor circumstances, such as dual governance in a National Park with nongovernmental organization (NGO) partners. Adaptive co-learning includes exchanges of knowledge with actors that see and interact with the land differently and links with schools as a form of knowledge transmission, beyond oral communication in the home (see Spoon 2011a).

I conducted research on Sherpa place-based spiritual values (e.g., *beyul* and *yul lha*), species (e.g., plants, mammals, and birds) and landscape knowledge between 2004 and 2007. Mixed quantitative and qualitative methods were implemented with 100 individuals across a stratified random sample, revealing that tourism indeed profoundly influenced Sherpa's ecological knowledge and understanding. A multiple regression analysis found that individuals living on the tourist route and from the younger generations generally had less knowledge of place-based spiritual values, species, and landscapes. Knowledge of mountain protector deities, the taboo against hunting and killing animals, subalpine tree species knowledge and the touristed Imja Khola Valley (containing the trek to Mount Everest Base Camp) remained consistent or were increasing across the population.

Some knowledge was remade, especially in relation to the powers of mountain protector deities. For example, the mountain protector deity Khumbu Yul Lha now extends his protection beyond local environmental hazards to protections from Maoist cadres and plane crashes. Similarly, the goddess of Mount Everest, Jomo Miyo Lang Samba, recently gained the power to bring tourists to Khumbu. Her former role was to provide ample fodder for livestock and a fertile growing season (see Spoon 2011a, b).

Households on-the-route and the younger generations between 18 and 49 appeared to view the land as less spiritually endowed and as more of a tourism commodity. These groups of individuals scored relatively low on the structured questionnaires that I administered to gauge knowledge about spiritual values, species, and locations. Corroborating these findings, qualitative life history/future projections with many of the same individuals showed a waning interest in Sherpa cultural traditions among many youth and an increased knowledge about the needs of the tourism industry and the worlds that the tourists, urban, and transnational Sherpa come from or live in. The results indicated that indeed these demographics were not relying on the natural resource for agro-pastoral subsistence, but were instead reliant on tourism-related income in some fashion.

Besides herding and farming less than their parents and grandparents, younger individuals were also educated in western-style schools in nonlocal languages (principally Nepali and English) and were not learning from their relatives in the home or in the monastery. This is especially true for the growing number of students sent to boarding schools in Kathmandu. This fissure in knowledge transmission is thus further severing ties to the historic spiritual tradition. Lessened spiritual knowledge about *beyul yul-lha* and other spiritual values that connect to more environmentally sustainable decisions probably eased inhibitions or oversight related to the cutting of live wood and timber, as well as the release of garbage and human feces into the local rivers. Increased reliance on tourist money for the procurement of externally produced commodities likewise weakened connection of on-the-route households and the younger generation to the land.

School curriculum was sourced from Kathmandu, which had influences from Indian, British, and American curriculums. As observed between 2004 and 2011, environmental education curriculum did teach about some local species in tandem with others of significance in Nepal, such as the Elephant and Rhino. Most of the teachers were non-Sherpa, with five total Khumbu Sherpa instructing across six schools. Each school had an eco-club that participated in revegetation projects as well as littler abatement campaigns, which became increasingly important as the volume of tourists swelled.

The Sherpa-governed Buffer Zone sponsored some of the curriculum and programs, and additional support had been given by international NGOs such as the World Wildlife Fund. By and large, the curriculum focused on overstory species and endangered animals, and is taught in the paradigm of western natural science. For example, as of 2007, curriculum taught about primary subalpine trees, such as the Himalayan Fir, Blue Pine, and Tree Juniper. These were also the primary species used in revegetation programs sponsored by the Himalayan Trust (an NGO) and supported by the National Park. The curriculum also taught about charismatic megafauna of Nepal, such as the Rhino and Elephant, and that they were important to biodiversity. There was no curriculum related to understory species and most local mammals and birds. The names of discussed taxa were also transmitted in Nepali and English, not Sherpa. Significantly, it was not uncommon for a younger person to know the name of a species in Nepali and not their mother tongue.

Male yak herders, who were the exclusive holders of detailed knowledge concerning subalpine understory plants, demonstrated that understanding falls away when no longer needed. Herding was on the decline, being so much less viable as a livelihood option to support a Sherpa family than serving the tourist industry. Adaptation caused yak herding knowledge to fall away and be replaced by other information relevant to the new configuration of the human–environment dynamic in the tourism era. Elders were not teaching the younger generations the plants that they needed to know to herd; this is evidence that the knowledge was no longer viable and that yak herding was being outsourced and replaced by other livelihood strategies. Livestock did provide value to tourism through the portering of tourist luggage and supplies; however, most of the actual herding was conducted by non-Khumbu Sherpa. In instances where an individual had knowledge of these species it was almost exclusively because the family required the youth to herd instead of attending school. This was typically because an elder male family member had died.

Fig. 13.4 Gokyo Tse (Lake) with stacked *mani* stones in foreground. Some consider the alpine lake to contain a *Lu* or water spirit, which results in a pollution taboo. The alpine lake and nearby Gokyo Ri (5,357 m) are growing in popularity as tourist destinations. (Photo: Jeremy Spoon)

The Khumbu social and ecological world also caused certain knowledge domains to persist or to be remade. Ortner (1995) argues that Sherpa Buddhism was shifting from shamanistic and individual worship to monastic and communal worship. This trend shows a departure from spiritual practice in and around the home to worship in the monastery, which may be a product of shifting relationships with the landscape. For example, most households used to have a *Lu* spirit that provided both positive and negative outcomes to the family, such as long-life, wealth, sickness, and bad luck. These spirits lived in trees, under rocks, in water sources (Fig. 13.4), and at constructed indoor shrines. *Lu* were tended by females and passed down through the generations. Their worship had some environmentally beneficial outcomes such as a taboo against cutting trees or polluting water sources. Knowledge of *Lu* spirits was on the decline for individuals from on-the-route and younger cohorts. By contrast, knowledge of protector deities who were worshipped in and around the monasteries was stable and increasing for some tourism service providers. This is evidence of a shift from individual or family worship outdoors or at home to communal worship dictated by clerics usually in the monastery. Protector deities centralize Sherpa worship to a single location (a mountain) as compared to several trees, forests, and water sources scattered throughout the landscape. This adaptation in Sherpa spirituality is less in conflict with the behaviors necessary to thrive in the tourism economy.

This brief discussion of Sherpa ecological knowledge and understanding in flux illustrates adaptations to their circumstances, driven by ecological, political, and economic forces. What the households on the tourist route and younger generations needed to know changed from strict agro-pastoralism and trade to tourism and much decreased herding and farming. These changes required adaptations that shifted ecological knowledge and understanding. Whether or not the current configuration is more or less environmentally sustainable depends on how long-term incremental learning negotiates (500 years of agro-pastoralism and trade) with shorter-term stressors (tourism). It is clear that reliance on natural resources had changed as had the scale of resource use required to sustain the tourism industry.

Adapting Institutions: Litter Abatement

Sherpa institutions involved in environmental decision-making also reflected adaptations to the thriving tourist economy. As new challenges developed in Khumbu, new solutions emerged to cope with them. Here, I focus on Sherpa adaptations to increases in nonbiodegradable litter mostly from tourism (Fig. 13.5). I draw from 14 semi-structured interviews with leaders from local institutions, both external and Sherpa-governed, conducted in summer 2011. The select institutions in this study can be considered formal with a distinct identity, some form of legal status, a clear set of operational rules, and a defined purpose (Soussan et al. 2001). These included Buffer Zone Management and User Group Committees (in Khumbu two management

Fig. 13.5 Non-biodegradbale litter strewn outside a rubbish bin along the tourist route to Namche Bazaar. Some Sherpa argue that the litter culprits are non-Sherpa laborers who migrate to the area for work during the tourist seasons. (Photo: Jeremy Spoon)

committees representing 18 user groups), youth clubs (males under 35), women's groups (loosely composed of women over 18), school groups, and national and international NGOs. The information shared by these leaders may or may not represent the opinions of the peoples that they work with.

Nonbiodegradable litter had become a huge issue in Khumbu, especially during the tourist seasons. Local estimates of nonbiodegradable litter collected between January 2010 and July 2011 totaled approximately 5,840 kg. Volume of waste increased with popularity of the trekking route, coming from tourists and tourism service staff (i.e., porters and trekking guides) as well as the locally run lodges and teashops. Litter was concentrated at the base camps for popular mountaineering peaks, such as Mount Everest and Island Peak. Litter included plastic bottles and other plastics, tin cans, glass, mountaineering equipment, clothing, and more. Most of the litter was burned in various pits or incinerated in Namche or Khumjung settlements. Larger scale recycling and/or reuse services were in their infancy in Khumbu and require resources to transport out of the area. Without roads, transport must occur via helicopters or human or livestock porters. The problem was such a concern in the 1980s that the Tengboche Abbot assisted in the formation of the Sagarmatha Pollution Control Committee (SPCC) (Stevens 1997).

In 2010–2011, the Sherpa-governed Buffer Zone User Groups, youth clubs, and women's groups enacted the majority of litter programs, both small and large scale. National and international NGOs led by Sherpa and non-Sherpa had programs, as did "eco clubs" at the schools. The National Park, army, and police also assisted with some projects. A survey of 14 institutions that organized litter abatement programs (ten implemented by Sherpa governed institutions and four initiated by schools, national and international NGOs) found that seven consisted of only Sherpa participants and seven had mixed groups of Sherpa, Rai, Tamang, Tibetan, and other ethnic groups. Plastics were burned in open pits and incinerators and there were few to no components to discuss reduced consumption, reuse, or recycling.

Most Buffer Zone User Groups each had a village cleaning campaign, which in principle involved multi-generational members of all households, and sometimes non-Sherpa residents who were typically household laborers. Some youth club, women's group, and school programs received external financial support from national and international NGOs, such as the SPCC and The Mountain Institute, while others did not. Most programs were annual or planned as annual at the time of the interviews. The Namche Youth Club and Namche School Eco Club hold weekly and monthly programs at the market and around the settlement. All programs were youth dominated, and in the case of the youth clubs, planned and implemented by males under 35.

There was a perception that the non-Sherpa laborers who flock to Khumbu for work to assist in a myriad of tourism and related tasks were the major litter culprits. Various Sherpa individuals commented that Rai, Tamang, Solu Sherpa, and others did not care about the area since they were from other parts of Nepal. To them it may be that the landscape is seen as a work setting and not as delicate subalpine and alpine ecosystems requiring stewardship. Across the interviewees and through considerable participant observation there appeared to be a dearth of knowledge regarding how to deal with nonbiodegradable waste. Since many of the migrant laborers came from poorer subsistence-based regions of Nepal, there was a good chance that they lacked awareness about the subject. It remains to be seen how much responsibility the Sherpa will take in managing the litter of their non-Sherpa hired laborers. When asked, most Sherpa commented that the laborers were indeed the culprits; however, it was rare for the Sherpa to consider themselves accountable for the actions of the laborers in their employ.

Leaders justified litter abatement activities giving the following three reasons in order of frequency: preserve the environment, welcoming tourists, and health reasons. No participants gave spiritual reasons to justify this action, which by and large, reflected the perspectives of young adults influenced by some level of western education and a lifetime of exposure to the tourism industry, National Park and NGO programs, and so on. Research on ecological knowledge and understanding with 100 individuals discussed above illustrated that these younger individuals knew less about the Khumbu environment and were less spiritually connected to it than their parents, again demonstrating a cross-generational shift in the ecological knowledge and understanding held by the Sherpa. Nonbiodegradable litter issues were relatively recent phenomena and developed in tandem with the increasing tourism industry as well as western-style education and allopathic healthcare. These individuals also lived their entire lives inside the National Park, which supports a western model for conservation. External governance by the National Park and the commodification of the landscape and culture for tourist consumption no doubt influenced local perspectives about nonbiodegradable litter and other forms of waste. Over the years, there had also been several NGOs in and out of Khumbu offering differing levels of training in tourism management, which no doubt included litter abatement.

Most of the interviewees commented that litter abatement was important for tourism. Several felt that litter was not welcoming for tourists and therefore caused them to go to other settlements with their business. These justifications for litter abatement illustrate adaptive co-learning among the Sherpa and local schools, the National Park, NGOs, tourists, and so on. Indeed, learning occurred through school curriculum, workshops and projects sponsored by the Park and NGOs, and from conversations with tourists. They also reflect how economic incentives (i.e., tourist visitation) influence environmental behavior (i.e., litter abatement). The land thus appears as the tourism commodity and the litter affected the ability to sell it to the consumer. Before tourism, most waste was biodegradable and did not require major interventions, especially with the Sherpa tradition of composting human and food waste with leaf litter from the forest floor. Adaptive co-learning helped the Sherpa to shift their livelihood to engage the new problem, requiring the Sherpa to learn new skills, which continue to develop.

Sherpa adaptations to cope with increases in nonbiodegradable litter express how the population shifted their needs from strict herding, farming, and trade to a tourism-based economy. Litter threatened their livelihood and therefore required learning to respond to the disturbance. With shifted ecological knowledge and understanding from the strict herding-farming-trade era, there was an emergence of younger leaders and a multicultural framework in a once homogenous area. These solutions were far from optimal (e.g., the burning of plastic and limited education on reduced consumption, recycling, or reuse); however, they do show how the Sherpa, other Khumbu residents and various national and international actors co-learned, handling problems in creative ways. Indeed, the full breadth of Sherpa ecological knowledge and understanding now includes a conception of nonbiodegradable waste in additional to flora, fauna, and other natural features.

From Yak to Tourists: Livelihood Adaptations

The Sherpa adapted their livelihoods over time to deal or cope with change and respond to disturbances. They shifted the agro-pastoral-trade configuration depending on ecological, political, and economic forces. The process continued with tourism, which amplified resource use and environmental stressors. Herding and farming reconfigured, and trade eventually ceased. Sherpa ecological knowledge and understanding also shifted during this time. Households living on the tourist route and the younger generations had less spiritual value, species, and location knowledge. It appeared that the land was increasingly seen more as a tourism commodity to sell (the natural landscape) and use (timber and firewood) and less spiritually endowed. Some knowledge persisted and/or was remade. Local institutions adapted to the nonbiodegradable litter issue with abatement programs, some organized and implemented solely by Sherpa settlements, youth clubs and women's groups. Others were enacted with heterogeneous groups, composed of permanent and seasonal residents, typically less than 40 years old.

The Sherpa only lived in the Khumbu area for a little more than five centuries. The incremental learning that ensued connected them to the Khumbu landscape and the landscape to them. This relationship evolved according to need and reflects creativity and entrepreneurialism. Tourism integrated the Sherpa into the global economy and changed how they needed to interact with place. It increased economic capacity and expanded the breath of the Sherpa experience all over the globe. What the Sherpa needed to know in tourism differed from what they needed to know in the days of strict herding, farming, and trade. These livelihood adaptations will no doubt continue into the future, especially with the instability of the global economy. Tourism is an uncertain livelihood strategy to say the least; however, it is certain that Mount Everest will remain an attraction of international significance for years to come.

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Chapter 14
The Sources of Ethnic Pride and Social Stability Among the Nuosu (Yi) of Southwest China

Martin Schoenhals

Introduction

Among mountain-dwelling peoples in China, the Tibetans are no doubt the best known; probably, few scholars know about the Yi, even though, at seven million people,[1] they are larger in population than the Tibetans. "Yi" is the official Chinese government term that covers a diversity of ethnic peoples in southwest China. Many of the Yi peoples, especially those living at lower elevations in Yunnan Province, have been assimilated into Han Chinese culture, but one group, who call themselves the Nuosu (the term I will use), have preserved their own language and culture in their homelands in southwestern Sichuan Province. The Nuosu live in Liangshan, a region designated as an autonomous prefecture by the Chinese government.

There are many fascinating attributes of Nuosu culture. I was intrigued by their caste system, since castes, like race, are usually associated with complex societies. The Nuosu, on the other hand, are subsistence agriculturalists. Related to caste is a Nuosu characteristic especially worthy of understanding for anyone studying mountain dwellers. The Han Chinese, who make up 94% of China's population, view the mountains, and mountain peoples, as a locus of poverty and backwardness—the epitome of the uncivilized peoples so prominent in Chinese ways of thinking about the world—but the Nuosu, themselves, are clearly convinced that they are superior to the Han. In fact the Nuosu believe that they are superior to all other ethnic groups in the world. As one Nuosu friend told me, "Even if Queen Elizabeth came to marry a Nuosu man, she would be rejected by that man's family in favor of any Nuosu woman, even the very poorest."

[1] Statistical data and all other information in this article refer to the time of research, 1994–1995.

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The Nuosu have a pride in their culture which they directly connect to their lives in the mountains. For them there is virtue to life in the mountains, and the Nuosu consider themselves to be the most virtuous, and superior, of all peoples, despite their remoteness and, by almost any metric, their very real poverty. The question I will address in this article is how it is that a poor, subsistence agricultural people, in the midst of a country with over 1 billion people, could maintain their language and culture and, even more surprisingly, maintain their fundamental esteem for their own ethnicity. In addressing this question I will focus on Nuosu social structure, since it is their caste system, as well as their clan system, that underpins Nuosu identity, and gives them such a strong sense of ethnic self-confidence despite their minority status within China and extreme distance, physically and socially, from the sources of national power.

I believe it is important to reveal one's own potential biases and so I need to say that my study of Nuosu caste during fieldwork among them in 1994–1995 was motivated by a desire to better understand racism and caste systems. American racism and South African apartheid are similar to caste systems, such as caste in India, and I have used my understanding of Nuosu caste to theorize, more generally, about caste and race, and their origins (Schoenhals 2003). As a progressive American, I find race and caste odious, a sentiment that I tried hard to hide while among the Nuosu, but which good friends easily sensed. One of these friends, a teacher and an intellectual, had his own ambivalence about Nuosu caste, but he accepted it at another level as something central to his own society and culture. This is an attitude I tried to adopt toward the Nuosu myself, acknowledging dispassionately to myself (and anyone who asked) my disdain for caste, while at the same time trying to understand how it functioned to give the Nuosu such a distinctive sense of ethnic self-confidence and superiority.

Who Are the Chinese Nuosu People?

China itself, as the Chinese are proud of saying, is a multiethnic country, and it is fitting to begin an introduction to the Nuosu by situating them within the diversity of ethnic groups in China.

The People's Republic of China has 55 groups officially designated by the Chinese government as ethnic minorities (*shaoshu minzu*), plus the Han Chinese, who are the vast majority of the Chinese population at 94% of the population (Hook 1991:77). In southwest Sichuan Province is a high-altitude, very mountainous region, the southeastern section of the Tibetan Plateau. This region is home to a group of people called Yi by the Chinese but who call themselves the Nuosu. The Nuosu have their own language, a Tibeto-Burman language, with tones, and it is a completely different language from Mandarin Chinese, even the Sichuan dialects of Mandarin. (In fact many speakers of Nuosu from different parts of the Nuosu region have great difficulty understanding each other.) Unlike many other minority groups in China, which have lost their own languages and become assimilated into Han culture, both young and old Nuosu speak the Nuosu language as their native language, with the rare exception of some Nuosu youth. The small percentage of young Nuosu who attend a few grades of elementary school learn to speak and write basic Mandarin Chinese, but most Nuosu are not educated. However, most of them can speak basic Mandarin Chinese, although often with heavy accents from the Nuosu language. This can make it difficult for non-Nuosu such as the Han to understand what they are saying.

The Nuosu—in contrast to many of China's 55 governmentally defined minority groups—have not only easily preserved their own language, but their own, distinct culture as well. Since the Nuosu live in a notoriously rugged mountainous area, the Han, despite their general history as tenacious colonizers of China, have never succeeded, even to this day, in absorbing the bulk of Nuosu people into Han society, Han culture, and Han language (Mandarin Chinese). This is largely due to geography, but also due to the fact that the Nuosu have never had a unified government or ruler of their own, living instead in hundreds of large clans often at war with each other. As is often the case worldwide, divided, warring people are much harder to colonize and conquer (consider the Amazon peoples versus the Aztecs), than are those with a unified government that can be co-opted by outside colonizers, and/or cleanly removed and supplanted by the colonial rulers themselves. Societies such as the Nuosu, which lack a tradition of central government and possess a long tradition of fighting within their own society over resources and power, cannot be easily organized or conquered by an outside colonizer bent on instituting centralized rule. Although some attempts were made historically by the Han to rule the Nuosu through indirect rule, these eventually failed, and if anything it was the Nuosu who ruled the limited number of Han settlers in the Nuosu region, since the Nuosu would periodically descend from their mountain communities and capture and enslave Han, who were brought back to work as slaves on Nuosu lands. Rather than the Nuosu becoming Hanified, these Han gradually became Nuosu-ified!

Geographic Setting and Subsistence of the Nuosu

The contemporary core homeland of the Nuosu is a sparsely populated (especially sparse when compared to eastern China) heavily mountainous geographical region which is approximately 60,000 km^2 in area, with a total population, Nuosu and non-Nuosu, of 3.7 million people, according to the 1990 census (Liu et al. 1992:1). This region is located in southwest Sichuan Province in southwest China and is known as the Liangshan Yi Nationality Autonomous Prefecture. Liangshan, as I will refer to it from now on, is called an autonomous prefecture because it is a region designated by the central Chinese government to enjoy certain privileges of autonomy due to its status as an area with a large percentage of ethnic minorities, in this case the Nuosu, who make up about half of Liangshan's population. There are numerous other autonomous prefectures in China, such as those for the Tibetans, including the most well-known one, in the far southwest of China. As an autonomous prefecture, Liangshan has at least nominal autonomy, since a majority of its ruling local officials, and governor, are all Nuosu.

Political boundaries do not always coincide neatly with cultural or geographical ones, but in the case of Liangshan, the different types of boundaries match fairly well. Liangshan is located on the southeastern section of the Tibetan Plateau and hence is differentiated from surrounding Han Chinese regions by its many mountain peaks and by its much higher average altitude. In fact the high mountains of the region have historically served, to a significant though not absolute extent, to keep out non-Nuosu peoples. The core area of the Nuosu, east of the Anning River (basically, the eastern half of Liangshan), has an average altitude of 2,000–2,500 m, with mountain peaks of 4,000 m and above (Dowdle 1991:24, 26–27). To the north and east of this region, that is, north and east of Liangshan, is the low-lying Chengdu Plain, an area of dense Han population—hence a region geographically and culturally distinct from Liangshan.

Within Liangshan itself, altitude is also a fairly good divider of ethnic groups since the Han, who now make up roughly half of Liangshan's population, live in the few relatively agriculturally prosperous valleys, such as the one surrounding Xichang, while the Nuosu, who make up 42.3% of Liangshan's population (1.5 million people) (Liu et al. 1992:11), tend to live in the higher altitudes, where the agriculture is much less prosperous. Other ethnic groups include Tibetans, Hui, and a number of other groups.

With its high mountains and high altitude, Liangshan is not well suited for agriculture, with a few exceptions. In the areas of elevation between 2,000 and 3,000 m, where the majority of the Nuosu live, much of the soil is infertile and can only grow buckwheat or potatoes. While Liangshan lies at a low latitude (26–29°N), the temperature in the 2,000–3,000 m areas is variable, both seasonally and diurnally, with long periods of frost and an average temperature in the coldest month of −3 °C (Dowdle 1991:33–34). In some parts of the 2,000–3,000 m region corn and oats are grown. The animals which are raised are goats, sheep, pigs, chickens, and cattle, although the sparse grasses at the high altitude make for poorly fed goats and sheep. As one informant told me with a somewhat bitter laugh, "Marty, there isn't much meat on their bones to eat." In fact this informant's family lives at a high altitude, at about 2,500 m, and several dozen of their mountain goats froze to death during the winter I was in Liangshan, in 1995. At these high altitudes water is also scarce; many Nuosu must descend steep mountain trails to find a stream for water. Nonetheless, it is amazing to take a bus across the mountains, and reach the mountain top, at about 4,000 m, well past the line where trees grow, and yet find Nuosu living up there. The life of these high-altitude Nuosu, and even those at somewhat lower altitudes, is hard. They rarely eat meat, and eat two meals each day, with potatoes and cakes made out of buckwheat as the substance of each meal. Wood is becoming much scarcer due to deforestation by the Han, who take lumber out of Liangshan for other regions, and so it is becoming harder to find fuel to cook and keep one's home warm in the winter. When I asked many older Nuosu what their strongest memory of childhood was, the most common answer was "being cold." Hunger is also a major problem, and Liangshan officials estimated for me in 1995 that approximately 800,000 people, out of Liangshan's 3.7 million people, do not get enough to eat every day. The vast majority of these malnourished people are Nuosu. In fact the poorest counties within Liangshan are all predominantly Nuosu areas.

Liangshan itself has some of the poorest counties in Sichuan Province, which, in turn, is one of China's largest provinces in area, and was the largest in population during my 1994–1995 research. (After that period, provincial lines were redrawn and Sichuan lost a portion of its population and its designation as China's most populous province.)

At lower altitudes, and in some particular areas of Liangshan, the agriculture is better. Liangshan's dry, very sunny winter, with almost no clouds (except in the morning) from November into April, makes for good growing conditions at lower altitudes. For example, in the areas around the city of Xichang, the capital of Liangshan located in central Liangshan, at around 1,500 m, the good soil and moderate daytime temperatures, plus minimal wintertime water from streams, allows for fairly productive agriculture. While nighttime winter temperatures are near or slightly below freezing in Xichang, afternoon temperatures rise into the high teens and low 20s (Celsius), so that hardy vegetables such as peas can be grown in the winter. As the rains and warmer weather come in spring, rice is planted. Xichang is warm enough to have two frost-free seasons. It should be pointed out, however, that the lower the altitude and the better the soil, the more likely the area will be populated by Han, rather than Nuosu. Even in mixed areas, the Han will occupy the valleys and the Nuosu the foothills. Thus, the productivity of Xichang-area agriculture, while worthwhile mentioning, is not representative of the way the majority of Nuosu in Liangshan live. The overwhelming majority of Nuosu are peasants, and they engage primarily in subsistence agriculture, raising food for their own needs. There are some exceptions. For example, Yanyuan County is well known in southern Sichuan for its apples, and some Nuosu have become prosperous growing apples. Sometimes, when an animal is killed to be eaten, a family will have surplus food, but the Nuosu traditionally consider it dishonorable and stingy to sell meat rather than giving it away in a large feast to neighbors and friends. Although the traditional Nuosu aversion to the mercantile life is receding somewhat, one still sees a large majority of Han running the stores or stalls at market days, even in areas where the majority of residents are Nuosu. One young informant told me with total contempt that it is the Han who are driven by a desire for money, and greedily sell meat rather than giving it away.

Nuosu Ethnic Pride

When visiting different Nuosu regions, friends and informants would often point to the low lying areas and the slopes above them and note that Han Chinese occupy the former, while the Nuosu occupy the latter. To the outside observer, it would seem clear that the Han Chinese must have forcibly occupied the best lands, leaving the mountains to the Nuosu. One mythic account of Nuosu mountain-dwelling does allude to this possibility. I was also often told that the Nuosu were living in the Chengdu Plain but were forced out of their prosperous farmland and into retreat in the mountains by Zhuge Liang, a leader and military strategist who lived from 181 to 234 A.D. Another Nuosu myth says that there was a huge flood in the mythic past which washed away Han communities in the plains but saved the Nuosu, who wisely were living in, or retreated to, the high ground of the Liangshan Mountains. The Nuosu who told me this used the myth to explain why the Nuosu continue to live in the mountains to this day: they are used to it and, despite the hardships of mountain living, it confers certain advantages. While I heard this myth from only 1 or 2 informants, I did hear often about how much better adapted to mountain life the Nuosu are and, by implication, the superiority of the Nuosu over the Han.

A frequent question I asked was what the Nuosu thought about the Han. While Liangshan, the Nuosu area, is a large area with several different dialects of the Nuosu language spoken, there was a unified answer to my question. Every Nuosu whom I asked said the Han were sneaky and deceitful, while the Nuosu are frank and honest. The Han tell you what they think you want to hear, but then stab you in the back. The Nuosu do the opposite. I was told that stealing is the most reviled of all immoralities. The man who steals a small animal from another man's farm is the antihero to the Nuosu. On the other hand, the man who walks into another man's lands during broad daylight and takes his cow (the most precious of the animals raised and eaten by the Nuosu) by force is the hero. The thief is petty and sneaky. The daylight hero is open and brave. This is one of the most frequent contrasts the Nuosu make between themselves and others, especially the Han.

This contrast has larger social structural and historical resonances. While the Han subdued and assimilated ethnic groups throughout China over the centuries, the Nuosu to this day, have resisted assimilation. The high mountain residences of the Nuosu, a sign of backwardness and poverty to the Han, were actually advantageous for the Nuosu, since their mountain residence kept out the Han colonizers. In fact even more than this is true. The mountains provided the perch from which the Nuosu could raid lower-lying Han villages, to capture and enslave the Han. In Liangshan there were, as there are today, Han and other ethnic groups living among the Nuosu, and the Nuosu would periodically descend from their mountain villages and capture non-Nuosu, often children, and enslave them. One ex-slave I interviewed from Liangshan's Yanyuan County was, for example, captured by his master when he was 4 years old. His brother and sister were likewise captured and they were all sold off separately to different masters. Slaves could be resold to new masters and my informant was sold three separate times, on three different occasions (also, see Zhan 1987 for discussion on slavery).

One of the reasons that the Nuosu say they so detest the Han Chinese is because the Han were the historical slaves of the Nuosu. The worst insult a Nuosu can make of another Nuosu is to call him *hxie mgat* ("Han," with the implication being that "your ancestors were slaves"), and this equation between Han and slavery is part of the Nuosu belief system to this day.

Caste and Ethnic Pride

As is true in many parts of the world, the enslavement by one group of another group leads to the creation of a system of racism and/or castes. The non-Nuosu who were enslaved by the Nuosu were assimilated into Nuosu society, or their descendants were assimilated. But the Nuosu have a strong emphasis on descent. Therefore, those Nuosu whose ancestors were slaves, were themselves still considered slaves. And those Nuosu whose ancestors might have intermarried with slaves were, likewise, considered of impure heritage. This situation led to a caste system among the Nuosu, a system persisting today. In this system those of impure blood—slaves and those intermarrying with slaves—form the lower caste, the White Yi (I will use "Yi" here rather than "Nuosu," in order to remain consistent with Chinese ethnographical usage). Those who never marry anyone but a pure-blood Nuosu are the higher caste. They are the Black Yi. Whether "Black" actually refers to skin color or not is disputed, although it is true that the Nuosu are considerably darker than the Han Chinese. Therefore, it is probably the case that the terms do refer to skin color, making the Nuosu unusual among race and caste systems in that they place the darker people on top.

Black Yi constitute about 7% of the total Nuosu population while White Yi make up 93% of the population (Zhang 1987:441–442). Below I will discuss the details of Nuosu caste, but for now it is sufficient to note that their system is based upon strict endogamy and strict status ascription; there are no fixed occupations of the castes, nor any religious ideology backing it up, as is the case in India. Black Yi and White Yi intermingle in daily life. It is only in marriage that the caste system comes into sharp focus, since a Black Yi will *never* marry a White Yi, nor will a White Yi marry a Black Yi. If a Black Yi youth ever tried to elope with a White Yi youth, something that has happened, the clans of the respective youths sent out search parties to find the youths. If found, both youths were forced to commit suicide. I often asked my informants, high school students at an academically elite high school, if they would ever consider marrying cross-caste. They said they had few objections to doing so, but their parents, usually their mothers, had all previously told them that if they ever married cross-caste, "I will commit suicide in front of your face." Needless to say, I never met a youth willing to risk parental suicide in order to intermarry with the other caste.

Children belong to the caste of their parents and can never change their caste status, no matter how rich or educated they become. The combination of ascription and endogamy means that there are no Black-White mixed caste children. Everyone is either Black or White, and whatever caste a person is born into, they will stay in that caste for life.

Caste systems and race systems are well known for their dynamics playing out at school. A base for my research was Liangshan Nationalities Middle School (*Liangshan Zhou Minzu Zhongxue*), where I stayed during 9 months of ethnographic research carried out in 1994–1995. Minzhong, as the school is called by the Chinese, is the most prestigious nationalities middle school in Liangshan Yi Autonomous Prefecture. It is located in Xichang, Liangshan's capital city.

When I first went to Liangshan, I assumed that I would find what anthropologists have found in many American and European schools. According to that literature, school becomes a prime site for the conflict between different cultural allegiances that pull ethnic minorities in opposite directions. This is because school is often a primary route to entrance into the society and status of the dominant group. In addition, schools are usually run, for the most part, by members of the dominant group, according to majority group values. Thus success at school can symbolically represent assimilation to the dominant group but also, correspondingly, a forsaking of one's own group. Failure to succeed at school, rebellion against teachers, and the refusal to participate in school at whatever level can come to symbolize separatism, or at least allegiance with the minority person's home community and home culture. Failure and rebellion become a form of resistance by minority students to the wider oppression they face in society from a dominant majority (Fordham 1996; Erickson 1987). The literature on schooling and minorities is filled with examples of how minority students—African-Americans, for example—manipulate their identity in school to "act white" or "act black," sometimes seeing success at school as part of the former process, and rebellion against school and failure to learn as part of the latter one (see Fordham 1996, especially Chap. 7). The tension between cultural allegiances—to the dominant group or to the minority one—and the tension over the conscious affirmation of these allegiances through assimilation or separatism—can be pronounced and sometimes painful, the source of a cultural and personal identity crisis (Fordham 1996).

One of the explanations for discipline problems and the lack of effort among disenfranchised groups in schools in Western contexts is that misbehavior and the withholding of effort is a means by which ethnic minority students symbolize their refutation of their teachers, and the dominant culture they represent, and their allegiance to their peers, and their minority identities more generally (Fordham 1996; Erickson 1987).

In order to see if this occurred among students at Minzhong I interviewed dozens of Nuosu students and asked the following questions:

- Who does better academically in school—Han or Nuosu students—and why?
- What students are popular in your class and why?

Nuosu student informants, the principal, and Han and Nuosu teachers almost unanimously agreed that Han students at Minzhong do better than Nuosu students. One reason often given for why Nuosu don't do as well as Han is that Nuosu, having gone to inadequate rural primary schools, lack a good educational foundation (*jichu*). Many Nuosu also explained that they have difficulty in school because school is conducted in the Han language, which is not their mother tongue. Surprisingly, even students who had been living in Han areas as students and attended years of school claimed that the Han language was a major barrier preventing them from doing well in school.

The most commonly given explanation for a difference in academic achievement between Nuosu and Han was that the Han study harder than the Nuosu, and that the Nuosu like to "play" (*war*).

When I was told that Nuosu don't study as hard as Han, I always pushed for further explanation. 1 Nuosu student explained that the Nuosu don't study that hard because they know they can always rely on their very strong and supportive clans (*jiazhi*) if they encounter financial distress. The Nuosu have a dependent nature (*yikaoxing*), which this student criticized. A Han teacher said that she believed the lower threshold which Nuosu must meet to be accepted to college (part of the

Chinese government's affirmative efforts on behalf of minorities) makes it easier to get into college, and therefore Nuosu students don't study as hard. Often informants could not give any explanation for why the Han study harder than the Nuosu.

But what is especially important is what was conspicuously absent in explanations for why the Nuosu don't study as diligently as the Han. No one—Nuosu or Han—claimed that the Nuosu were intellectually inferior to the Han. In fact quite a number of Nuosu informants (but no Han informants) said they believed that the Nuosu are intellectually superior to the Han. Also absent as an explanation: No one said that the Nuosu withheld effort in order to "act Nuosu." While working hard was clearly identified as Han behavior, no one said that the Nuosu choose not to work hard so that they don't seem like Han. Often when the subject of ethnic minorities in America came up—a subject the Nuosu seemed to be genuinely interested in—I would describe how some African-Americans withhold effort in school in order not to "act white." All informants, even those who were quite honest and open with me, denied that such a dynamic exists among the Nuosu. In fact when I asked students what they had learned, if anything, by going to school with Han students, a common answer was that they had learned to study more diligently. This was seen as a Han virtue, and one which the Nuosu should adopt. Many students told me that the Nuosu should have a sense of pride in their ethnic group (*minzu zizunxin*), and when I asked what this meant, they usually explained that one should strive to earn honor for one's own ethnic group (*wei women minzu zheng guang*) through diligent study. Han students often use a similar phrase, except that they say they want to earn honor for their country, something I never heard the Nuosu say. Perhaps especially indicative of the absence of the ethnic politicization of effort is the fact that Minzhong's principal has specifically tried to increase the percentage of Han students at the school, so that the Nuosu will emulate Han assiduousness. This strategy would not work if Nuosu were prone to do the opposite of what the Han do.

What is especially interesting about the issue of effort is that while whether one works hard or not is not ethnically symbolic for the Nuosu, effort is politicized (in the sense of symbolizing a contest of allegiances) for the Han, at least among urban Han. When interviewing students at Third Affiliated, my former urban Han middle school research site, I was often told that students who are too diligent are disliked. They are viewed as too much of the teacher's pet, and, because of their diligence, not friendly enough to peers. It is the student who is intelligent (*congming*) whom students respect. *Congming* is a broad word with many connotations, but it generally indicates a person who can learn things without really trying too hard. It also connotes someone who is naughty (*tiaopi*) and rebellious—the opposite of the obedient and simple, honest (*laoshi*) person. Third Affiliated students often liked and respected social, smart, somewhat rebellious, and naughty classmates.

I asked Nuosu students who they most liked and who was most popular. In contrast to the Third Affiliated urban Han, Nuosu students looked up to hard-working, obedient (*ting hua*), straightforwardly honest (*laoshi*), and polite classmates.

The point here is simple: Even though the Nuosu may have seen themselves as not always studying very hard, they did look up to the diligent student, rather than displaying the ambivalent and often resentful feelings of urban Han toward such students. Nor did the Nuosu politicize disobedience to the teacher. Whereas urban Han students, caught in a complex social structure which rewards those who can display their morality and competence, thrilled at the prospect of disobedience to an incompetent or immoral teacher and viewed the consistently obedient student as dull in both a social and mental sense, the Nuosu looked up to students who were consistently obedient and polite toward their teachers. Hence I did not see Nuosu students trying to challenge or disobey the teacher in order to score points with their Nuosu (or Han) peers.

In summary those Nuosu who go through school do not feel alienated from their own ethnic heritage. For Nuosu, school and ethnic identity have little relation to each other. Why is this so?

My basic premise is simple: The Nuosu do not see school as a setting for ethnic identity contestation because among the Nuosu identity—ethnic and social—is fixed at birth, and therefore not contestable. The social status most salient among the Nuosu is one's caste status. And as I have discussed above, caste status is determined by the status of one's parents. It is, therefore, fixed at birth and unchangeable: A White Yi will never be able to become a Black Yi, no matter how much money s/he makes, nor how much education s/he receives. Going to school does not change one's fundamental status in Nuosu society.

Ethnicity is likewise defined so as to be unchangeable. While many ethnic groups will define a member of their ethnicity by various features—the ability to speak the native language, adherence to cultural values, and practices held by the ethnic group (the wearing of the group's clothing, celebration of its holidays, etc.)—the Nuosu define ethnicity differently. For the Nuosu, a person is Nuosu if and only if their ancestors were all Nuosu. As informants repeatedly emphasized in conversations with me, a Nuosu person whose ancestors were Han people enslaved by Nuosu masters is not considered to be a true Nuosu person, even though that Nuosu person may have fully assimilated all aspects of Nuosu culture and language. Likewise, if a Nuosu couple were to go to America and have a child there, who knew nothing of Nuosu culture or Nuosu language, this child would, nonetheless be Nuosu. An interesting manifestation of the Nuosu descent-based definition of ethnic identity is, I believe, the quite extensive emphasis on inside versus outside in the Nuosu ethnopsychology. The Nuosu often stress that a person is one way on the outside, but something different, and more authentic, on the inside. The personality word, *lu ap nyi*, for example, means someone who appears attractive, but is really an ugly person in character. There is also a word, *lu nyi*, for its converse—someone appearing ugly but who is really good on the inside.

The descent-based definition of status and ethnicity means that one's identity is fixed at birth, and is not manipulable by changing one's clothing, language, place of residence, etc. This means that the identity conflicts, and tensions over assimilation versus separatism, so characteristic of American and European ethnic groups, do not hold for the Nuosu. Importantly, for the discussion above, a Nuosu youth can attend a Han school, and yet s/he will know that s/he will always be Nuosu, no matter how superficially Han-ified the youth seems on the outside. This explains why there is no ethnic politicization of school attendance, behavior, and achievement.

More on Nuosu Caste and Its Unique Nature

In my book (Schoenhals 2003) I compare Nuosu caste to Indian caste, American race, and South African apartheid. There are, indeed, many similarities. But as the discussion above suggests, there are some fascinating differences as well. Here I consider the nature of Nuosu caste in much greater ethnographic detail and emphasize the characteristics making it unique.

In 1956 Democratic Reform was initiated in Liangshan and by 1958 a rebellion against its purveyors had been suppressed. Initially Black Yi were given positions of leadership, but they soon lost these positions, and in the 1960s systematic discrimination against Black Yi and "slavelord class" (those who had been slaveholders before 1956) White Yi occurred.[2] Formerly slaveholding Nuosu were denied jobs, and denied government positions, and government positions were given to non-slaveholders. During the Cultural Revolution children of bad-class (Black Yi and slaveholding White Yi), Nuosu were often denied the opportunity to go beyond elementary school, thus extending the effects of the discrimination against Black Yi and upper strata White Yi into the next generation.

After Deng Xiaoping came to power in 1979, class labels lost their official importance. Thus the official discrimination against bad-class Nuosu ended. Peasants were given equal parcels of land, and today Black and White Yi are approximately equal in wealth. In addition the end of official class background discrimination has allowed Blacks (and former slaveholding Whites) to attain leading political positions, so that both Black and White Yi have caste members in elite government posts in contemporary Liangshan.

Yet caste persists. Sometimes anthropologists encounter a situation, or are told a story, which is so revealing of a central characteristic of a culture that it is hard not to return over and over to this situation or story in one's mind when trying to understand the culture. For me this happened one relaxed evening when talking with one of my key informants, and best friends, whom I will refer to as Wang. Wang, a teacher at Minzhong (the school where I was based), explained that his current wife, whom I knew, was his second wife. Originally, Wang had refused the two women his mother had arranged for him to marry and he instead married a woman he loved. She was an educated Nuosu woman (quite rare) who was an official. Unfortunately for Wang, however, she was not a pure Black Yi, since her father was Black Yi, but her mother was rumored to have mixed blood. Despite the fact his wife was educated, and was an official, both important status attributes in China and in Liangshan, Wang's powerful clan persuaded him to get a divorce and find a new, pure Black Yi wife. After 2 years of marriage Wang divorced his wife, even though they were on good terms (and have remained on good terms to this day). His clan relatives then found a pure Black Yi woman for him. She was young, attractive, and pure Black, but she also had little

[2] The Chinese Communist Party analyzed the Nuosu using a class-based, rather than caste-based analysis.

education and lived in the countryside as a peasant. Because the Chinese government does not easily allow peasants to move to towns or cities even if they marry a city-dweller such as Wang, Wang had to spend a great deal of time, money, and effort before his new bride could come and live with him in Xichang. Finally, he succeeded. While content with this new wife, Wang seems to maintain a certain nostalgic fondness for his first wife. Wang told me all of this without bitterness, but rather with a sense of the inevitability of what had happened. It seemed especially meaningful to him though, since he picked a very relaxed and happy time to tell me the full story (although he had alluded to it a few times before), and he seemed to enjoy being able to confide in me about his first marriage and about his affection for his first wife.

The point of Wang's poignant story, a point Wang articulated to me on many occasions, is that caste is more important than wealth, education, or anything else when determining whom you marry. For all of Wang's relatives a pure Black Yi woman who was a peasant without much education was a better match for Wang than a well-educated official of suspect blood. It is important to add that education and official status are viewed by the Nuosu as positive attributes in a wife. It is simply that these attributes are less important than the all-important issue of caste purity. Wang said that even if the Queen of England were to try to marry a Black Yi man, he would refuse her in favor of a Black Yi peasant woman. No amount of money could convince a Black Yi, and his family, to allow his marriage to a non-Black Yi or a non-Nuosu, both of whom are in the same category from the perspective of the Black Yi because of their lack of pure Nuosu heritage. This same caste and ethnic endogamy, of course, holds for Black Yi women.

Why is cross-caste marriage so strongly forbidden, and of such concern to the entire clan, I asked? Wang explained that if a Black Yi from clan A, male or female, were to marry out, this would lower the status of the entire clan A. Other clans would gossip about clan A because it allowed one of its members to marry out. More importantly, other clans would be reluctant to allow their children to marry anyone from clan A. One incidence of exogamy affects the entire "family." The White Yi spouse of a clan A person potentially contaminates any and all future offspring from the clan, thus making the clan no longer pure Black Yi. Having such purity is what gives the clan its rank as Black Yi. Losing this purity, or even the potential for loss of purity through production of mixed-blood offspring, seriously threatens the clan's standing as a Black Yi clan. One can, therefore, see why an entire clan, such as Wang's, would take such an interest in making sure he did not marry anyone but a pure Black Yi woman, even if she wasn't educated or wealthy.

Wang's story illustrates central features of all caste systems: the creation of two autonomous spheres of prestige, one based on domination factors such as wealth and power, and the other on the immutability of one's ancestry, with the latter prestige premised on the purity of the ancestry of each and every member of the caste. That Wang, a well-educated urban intellectual, still abides by traditional Nuosu rules of endogamy, as do the majority of his urban Nuosu counterparts, is a further illustration of the continuing potency of Nuosu caste.

As I pursued my research by interviewing other informants, I confirmed the persistence of caste endogamy and ethnic endogamy. As my Minzhong student informants told me, serious societal pressures continue to insure that Nuosu only marry Nuosu, that Blacks only marry Blacks, and that Whites only marry Whites. Killing the offenders is no longer an option because such actions would meet with punishment by the state, but other very serious threats are used by the Nuosu to forbid cross-caste and cross-ethnic (for example, a Nuosu person marrying a Han) marriage.

How is endogamy guaranteed post-1956? To begin, many of my informants, who came from typical Nuosu peasant families, told me that their parents strenuously forbid them to marry non-Nuosu (for example, Han), or a Nuosu who was outside their caste. Informant #80,[3] a Black Yi, said he was willing to marry a White Yi woman but if he did so, his family would commit suicide. Informant #15, upper White Yi, said that if he married a Han woman, his mother would hang herself right in front of him. Informant #44, Black Yi, had a relative who fell in love with a White Yi woman, but #44's relative's mother said, "If you marry her, I'll kill myself." Many informants said that their parents warned them they would disown them (*bu yao*, *bu ren*) if they married non-Nuosu or a person from the other caste. Informant #44, for example, said his mother would have him expelled from his clan if he had a non-Nuosu girlfriend while in school. (Students are actually not allowed to date in high school, but some secretly do so.) Interestingly, it was mothers who were most likely to make this threat because women are more traditional in their beliefs than men (although this does not suggest that fathers were tolerant of cross-caste marriage; they were not). Informant #15 said his clan would expel anyone marrying cross-caste. While many informants expressed a desire to choose a spouse from outside their caste, or from a different ethnic group, virtually all of them said that they would not do so because of the opposition of their parents.

Given the strenuous opposition of parents to cross-caste or cross-ethnic marriage, and the possibility that anyone so marrying would be disowned by his or her family and clan, it is not surprising that in the Liangshan countryside such exogamous marriage is virtually nonexistent. I asked dozens of student informants who were from the countryside if there were such marriages in their home areas, and the nearly unanimous answer was that there were none. In all of my interviewing I only found one informant who seemed to know of a specific example of cross-caste marriage taking place in or near his home, in the countryside. Informant #72, from the Xichang countryside, told me that in his hometown one Black man married a White woman. Both the groom's and bride's respective clans opposed this marriage and the man and woman were expelled from their respective clans, a very serious punishment. The ensuing conflicts were serious enough that local officials had to come in to separate the conflicting parties.

Research by Lin Yaohua and Pan Jiao (Lin 1993), centered in Meigu County, comes to a conclusion similar to mine: Caste endogamy to preserve blood purity is still, among the contemporary Nuosu, very much in force (Lin 1993, see especially pp. 2–3). In one of several examples, the author cites the following incident occurring

[3]For more information on informants' backgrounds, the reader may consult the appendix in Schoenhals (2003).

in Meigu County in 1988: A young woman "G" fell in love with cadre "B." However, G's father found out that B's family's caste rank was not as high as G's, and G was tied and beaten by her father three times [as punishment for her relationship with B]. G broke up with B as a result (Lin 1993:3). In this example both G and B were White Yi, except that G was higher White Yi compared to B (Pan Jiao, personal communication). B then courted another female, whose caste rank was, as in the incident described above, also higher than his. This difference in rank led the woman's father to oppose the couple's relationship. The woman escaped and hid at B's house, but to no avail, as her father found her and forced her to come home. While en route to their home, feeling ashamed and resentful, she killed herself with poison (Lin 1993:3).

Lu Hui's (2001) study of marriages over the last few decades in Butuo County likewise supports the pattern of Nuosu endogamy. Lu takes account of the radical changes in Nuosu society during this time, but finds that endogamy continues. She argues that endogamy, in fact, helps the Black Yi preserve their high, aristocratic status despite the challenges to their status in the political and economic domains.

Statistics on marriage collected by Stevan Harrell (personal communication) and Ma Erzi also show the persistence of caste endogamy, and ethnic endogamy, among the Nuosu. Harrell and Ma found, in a survey of over 226 marriages in Baiwu Township and Yanjing Township, in Yanyuan County, that there was only one marriage between Black Yi and White Yi. The exact data are as follows:

226 total marriages
217 endogamous marriages: 44 Black Yi couples, 158 *qunuo* (upper strata White Yi) couples, 15 *mgapjie* (White Yi, but who rank below *qunuo*) couples
9 exogamous marriages: 1 Black Yi with White Yi (latter was *qunuo*); 5 White Yi with non-Nuosu (for example, with Han); 2 *qunuo* with *mgapjie*; and 1 Black Yi with *Nzymo* (a caste position some Nuosu consider at or above Black Yi status)

Above all, what Harrell and Ma's data show is only 1 Black/White marriage out of 226 marriages, no Black Yi with non-Nuosu, and only 5 White Yi with non-Nuosu. Clearly, endogamy, both of caste and ethnicity, is still the rule.

While I did not supplement my informant interviews with collection of marriage statistics for Black/White marriage, I did conduct several surveys among Minzhong students which asked their father and mother's ethnicity, thus allowing a determination of the extent of ethnic endogamy among the Nuosu. Since the Minzhong students come from all over Liangshan, and the vast majority are from the countryside, this gives a good indication of the Liangshan rural pattern. The data show little exogamy, despite the fact that Liangshan as a whole has roughly half its population represented by the Han, and nearly half by the Nuosu, with the two groups living among each other in many parts of the Prefecture:

129 total marriages
113 marriages of Nuosu with Nuosu, or 87.6%
9 marriages of a Nuosu father and Han mother, or 7.0%
6 marriages of a Nuosu mother and Han father, or 4.7%
1 marriage of a Nuosu father and a Hui mother, or 78%

As for Liangshan urban areas, we might expect that the urban situation would lead to greater exogamy, due to the greater freedom from tradition in general in Chinese and other cities worldwide. We might expect the individual to be able to act in all respects, including marriage, with greater independence in urban areas, free from the social pressures and entanglements of life in small-scale villages. The greater rates of education among Chinese urbanites might also lead us to suspect that caste would be weak in Liangshan cities.

But, as it turns out, our expectations about urban areas are incorrect: endogamy, while slightly less strictly enforced than in the countryside, is nonetheless nearly universal in Liangshan urban areas. There a variety of reasons why urban residence and education have little effect on Nuosu caste. As the story above about Wang's marriage, divorce and remarriage illustrates, the clan has a strong effect on urban people as well as rural people. While urbanites have jobs and incomes, they may often need to rely on their clan for a variety of reasons. Wang, for example, turned to his relatives when he needed to borrow the equivalent of more than 1 year's salary in order to purchase his apartment at Minzhong. Nuosu who have problems with the police or officials in the cities (even in Chengdu, a 15-h train ride north of Xichang) will often turn to their rural clan to come to their support en masse. Urbanites also need support from their clan when one of their parents dies. As Wang explained, carrying out the proper ceremony upon the death of a parent is one of the key responsibilities of a good son. But such a ceremony requires a great deal of help—both in the form of labor and money—from one's clan in order to be carried out properly. The deceased parent must be taken by large numbers of people to a rural spot and cremated. A man needs to kill at least 1 cow for all of the hundreds of visitors present at the cremation. Wang could neither afford this without borrowing from his clan, nor could he (nor would he) simply carry out the ceremony alone, since large numbers of people present at the cremation attests to the respect accorded to the deceased. Wang, an only son, knows he must maintain good relations with his clan even though he lives in the city and has an urban job. This is why he obeyed their wishes regarding his marriage. I heard an interesting story of how far a clan will go to stop an urban member from marrying exogamously. In this case a Black Yi man from Xichang who worked at a paying job (that is, he was not a peasant) decided in 1993 to marry a White woman. His clan steadfastly opposed the marriage, but he went ahead with it anyway. During his wedding banquet in Xichang, the man's clansmen came in from the countryside and trashed the banquet, overturning tables, and getting into fights with the men at the wedding. This man's clan now has ostracized him, and intentionally has broken off all contact with him.

For their part, the reason rural relatives compel their urban counterparts to adhere to caste is not only a desire to see tradition preserved. Rather, any incidence of exogamy threatens the purity, and hence status, of the entire clan. This is true even in the case of the marriages of urban Nuosu. Therefore, the very well-being and status of the entire clan is threatened by exogamy, and this is why they react so strongly, and collectively, to this threat.

Endogamy and Rank

A Han scholar, and very good friend of mine, asked a very revealing question when visiting me in Liangshan one time: "How is it that the Black Yi are considered to be above the White Yi? What does it matter that Black and White Yi don't intermarry. What is it that Black Yi have that White Yi don't have?"

My friend, having grown up during the Cultural Revolution, was of course well schooled in a materialist paradigm, and I tried giving the anthropologist's idealist answer: Black Yi may not be wealthier or more powerful than Whites any more, but they have nonmaterial prestige—a prestige which both they, and White Yi, acknowledge they have.

This is the start of an answer perhaps, yet only a start. It is hard for the abstract idea of superiority to have much meaning unless it becomes played out in some social context. The idea and ideology of Black Yi superiority is further weakened in its actual significance since this ideology is not very well elaborated, nor well articulated by a majority of informants, who usually just said that Black Yi were superior because that was just the way it had always been. In contrast to the volumes of books on American race, and the constant daily discourse about race, the Nuosu don't really talk about Black and White Yi differences in their everyday lives and especially don't elaborate an ideology of differences which could support Black Yi superiority.

So if Black Yi superiority is weakly maintained as an idea, how is it manifest as social fact? In many caste systems caste rankings get played out in everyday interaction. I'm thinking, for example, of the requisite deference behavior of southern blacks to whites, or the separate drinking fountains, toilets, and schools of Jim Crow. Or in South Africa there was the apartheid-era segregation of beaches, hospitals, train stations, etc. In India the rules requiring distance from the lower castes, and the preservation of upper caste's food and water from the polluting contact by the lower classes, mark, on an everyday basis, the social reality of the ideology of upper caste purity.

But the Nuosu are proud of their lack of deference behavior and even during the pre-1956 period notions of food and water pollution were minimal. After all, slaves cooked food for their masters. Only one person mentioned food pollution notions to me as existing in the past. Even so, he said Black and White Yi could eat together (in contrast to Indian tradition forbidding cross-caste eating), although they could not share the same drinking bowl. One other person said that the two castes could be present at a meal, but that they formed separate groups when the food came. This man, a White Yi, did not explain why, only mentioning that this pattern was more comfortable. Unlike India, where food and drink taboos are often seen as the essence of caste, such taboos are of minimal importance among the Nuosu.

Black Yi superiority and purity is not performed on a daily basis, nor through symbolic acts such as the preservation of food cleanliness. Blacks and Whites had always lived among each other and so there is no set pattern of residential segregation between Blacks and Whites. Many villages have Black and White families living among each other, so there is no categorical pattern to segregation, even though there are some cases in which a village will have all Black Yi or all White Yi. Since people live in villages among family members, however, it is not surprising that such segregated patterns could develop from time to time since Black Yi and White Yi have no kinship relations with each other. This latter fact does make for a certain lack of interaction between adult Black Yi with White Yi since the Nuosu spend so much time visiting people in their large clan networks. But this pattern of visiting can also segregate Nuosu within the caste, from those who are from other clans. In all of my many visits to people with Wang, we almost always visited other Wang's, or close relatives from his mother's family. Thus, Wang was not only associating primarily with Black Yi, but with only those Black Yi who were in his clan, or his direct in-laws.

Black Yi superiority and purity, then, is not performed in daily routines. Rather it is performed at a very special time and for the actual, rather than symbolic, preservation of caste: It is in choosing a mate that purity and superiority becomes evident.

Nuosu Caste and Ideology

While American race, Indian caste, South African apartheid, and other systems of caste display rank in everyday encounters, Nuosu caste does not. This makes the Nuosu interesting and unique. Because Nuosu do not instantiate caste in daily encounters, it is not possible for seemingly mundane interactions to confirm or challenge caste. Also, because caste is not challenged or confirmed in daily interactions, in the realm of symbolism and ideas, caste does not become ideologically elaborated. Much to my surprise, when I asked my informants questions about caste, they had little to say. It just is what it is. The long discussions and debates that one can arouse in the USA when discussing issues of race, are largely absent from the Nuosu domain.

All of this has consequences for the stability of Nuosu caste. Where caste and race are symbolically displayed, and ideologically elaborated, the stage is set for eventual changes in the power structures that exist. For example, I have heard African-American southerners describing, interestingly, how they would move the "whites only" sign up a row of seats in buses in the South years before the Montgomery bus boycott created an overt challenge to Jim Crow. And anthropologists, of course, played a key role in challenging the ideology of American race long before the major 1960s civil rights legislation finally passed.

I was curious, then, to know how education might be affecting attitudes to caste and other aspects of traditional Nuosu culture. Did Nuosu youth return home and try to challenge their parents' views about caste? What was the parental reaction?

Many Nuosu students, teachers, and school personnel did try to change Nuosu traditions by advocating new values. Their efforts, however, were simply not well received and not very effective. Here are some examples:

- One informant said that when he goes home on vacation he and other educated people will tell uneducated youth that there are no ghosts and no gods, but the latter persist in their beliefs. "Have you seen a ghost?" my informant asks. "Yes," they answer. Informant: "What does a ghost look like?" They can't answer, but remain unpersuaded.
- Another informant has told people in his hometown that caste should change. He tells them if caste continues, the Nuosu people (that is, Black and White Yi) can't unite. "Only by uniting can we mutually help each other in cases of trouble." [He doesn't say what kind of trouble but there is a good chance that he means trouble from local government officials and/or from local Han.] I ask how his hometown friends and family react to his views on caste. "They say it's the talk of an educated person and they have no interest in it."
- One very thoughtful informant told me how his teachers in junior high school, both Han and Nuosu, influenced his views on caste. One teacher, a Nuosu, told my informant he was forced to marry someone he didn't really want to marry and that if he had married someone else his life might have been better. My informant thought his teacher's views were quite convincing. This informant, a Black Yi, said he's seen people in the city who have married White Yi or Han and they seem to get along happily. In the countryside after marriage sometimes couples won't speak to each other for 1 or 2 years, he notes. Nonetheless, he is still ambivalent about caste, admitting that he sometimes believes in caste when he hears the older generation talk. He also feels he must marry within his caste, fearing that if he doesn't, his parents might commit suicide. His older brother, who is educated and has a paying job, has told my informant that he will try to persuade their parents to allow a cross-caste marriage if the informant so desires. Sensing that such pressures might lead to change in caste, I ask, "Will caste change?" Caste will eventually disappear he says, but he thinks this will take a very long time to happen.
- On one of my first days at Minzhong I heard Li, the principal, address an all-school assembly. One of his important points was to urge students not to be overly clannish, that is, not to bind too tightly with their own fellow clanmates, and not get in fights with other clans, as happens at many Nuosu schools. Yet on my last visit with Li, he lamented to me that the Nuosu clan remains quite strong. Nuosu can always rely on their clans and because of this they lack the entrepreneurial spirit of the Han, Li told me with real sadness.

Why Is Nuosu Culture so Resistant to Change Wrought by Education?

Why does education not lead to reduced status for the elderly, with a concomitant weakening of caste? Why doesn't the system of achieved status inherent in education supplant the system of ascribed status characterized by caste?

The changes in arranged marriage (arranged marriage is declining) within the context of the preservation of caste provide a partial suggestion of the answer: The Nuosu compartmentalize their identities, their status systems, and their cultural changes. While the challenge to arranged marriage in Han society was intimately connected with a wide range of other changes in China, such as changes in the status of the young and in the status of women, the challenge to arranged marriage among the Nuosu does not need to entail alterations in caste; the young desire to choose their mates, but they continue to do so within the confines of caste.

A similar compartmentalization occurs among status systems among the Nuosu. Education is valued among the Nuosu as something useful in its own right, but is not seen as something which should dethrone traditional Nuosu culture or caste, or traditional Nuosu elites. This means that while the Nuosu elders might listen to their educated sons explain how to do a geometry problem, and would value the money-earning jobs their sons get through education, they would never yield their larger authority to them, nor allow their sons' educated views to challenge conventional Nuosu wisdom or social structures. This is quite in contrast to the Han, for whom the notion of being educated is virtually synonymous with culture/civilization itself: To say someone is educated in Han Chinese, one often says s/he "has culture" (*you wenhua*). And as that broad phrase suggests, the educated person is seen as not only knowing how to do geometry, but is also believed to have a better way of going about life, in all its aspects.[4]

I also saw this same lack of conflict between the "modern" and the "traditional" in Nuosu attitudes toward the *bimo*, their traditional healers. While some students looked down on *bimo* as peddlers of superstition, quite a few others told me that, while they didn't particularly believe in superstition, there was something about *bimo* methods that sometimes worked. Many students told me that they believed in Western medicine, as did many of their parents, but that sometimes Western medicine didn't work, but for some reason *bimo* medicine did. There was no feeling that a belief in Western medicine necessitated a renunciation of traditional health techniques, or a decline in the status of traditional healers.

Thus, among the Nuosu, the educated and the "modern" are not seen as socially irreconcilable with that which is non-modern: traditional wise people and traditional wisdom. There is no intellectual conflict, nor an overbearing pressure to choose, between one mode of thought or the other. This situation is really part of the larger phenomenon of a caste society—the incommensurability of different types of status. Wisdom, formal education, and caste are three completely irreconcilable domains of status, and one's status in one of these domains cannot affect one's own status, or that of others, in any of the other domains. Such compartmentalization of identity and status is, in fact, the very essence of caste and it contrasts with the situation in most non-caste societies, where the various status-giving attributes can influence each other. Among the Han, for example, wealth could traditionally be used to acquire education, as is true today, and education could help burnish the reputation of a wealthy merchant.

[4]For an ethnographic account of Han views of education, and the larger meritocratic ideology of the Han, see my book (Schoenhals 1993).

Final Thoughts

As noted above, as an American progressive I am repulsed by racism and by the segregations of any and all caste systems. I do not hide this view, nor think that it should be hidden. However, as an anthropologist it is fascinating to see a culture, such as the mountain-dwelling Nuosu. The Nuosu are among the poorest peoples in China, and among the lowest in status, at least from the majority Han view. And yet the Nuosu themselves do not see things this way. They are fiercely proud of who they are, and they act this pride out any time they marry, since they won't marry anyone who is not of pure Nuosu heritage, no matter how rich that potential non-Nuosu person may be. Thus, class mobility and education, and contact with "modern" urban peoples, are not the forces for change in Nuosu society that they are in so many other parts of the world. The Nuosu have created a social structure that is stable and largely impervious to attempts to change it. It is a structure that gives them pride, too, and inoculates them against the ethnic self-doubt, or even self-hatred, so common among so many other of the world's geographically and culturally marginalized peoples.

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Chapter 15
Globalization, Environmental Change, and Coping Strategies Among the Ifugao of the Philippine Cordillera Mountains

Lynn Kwiatkowski

Introduction

Living in Ifugao Province of the Philippines, Ifugao people are situated within the Central Cordillera Mountain Range of northern central Luzon Island. While their social structure and culture have historically developed in relation to the environmental conditions of the mountainous terrain they live within, these developments have intersected with the historical ongoing social, political and economic shifts that have shaped their society, culture, and environment. Over the last century, as Ifugao people have become more extensively integrated into the global market economy, their ability to adapt to the environment of the Cordillera Mountains has involved an expansion of the scope of the sources of livelihood available to them. They have faced difficult environmental and social conditions in recent decades, including a growing population, deforestation, and rice terrace degradation. From engaging in agriculture, to tourism, transnational labor migration, craft production for local consumption and global exportation, international development programs, and maintaining swiddens to raise particular crops, Ifugao people have coped with these challenges by finding creative ways to diversify their livelihoods and participate in opportunities both within and outside of the Cordillera Mountains. These labor practices have enhanced the ability of their culture, as well as their kin groups, to thrive and change in relation to their shifting social and natural environments. But this process has also been an uneven one among different social groups. Drawing upon political ecology theory, I will assess class and gender differences in approaches to coping with changing social, cultural, and natural environments among Ifugao people of the Cordillera Mountains during the early 1990s (Fig. 15.1).

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Fig. 15.1 Irrigated rice terraces in Ifugao Province

Methodology

This analysis is based on ethnographic research that I conducted in Ifugao Province for 16 months, spaced in 1990, 1992, and 1993 (Kwiatkowski 1998). I also draw upon my experience of Ifugao culture and environment while serving as a community health volunteer in the Peace Corps during the early 1980s. At that time, I lived and worked among Ifugao people for 27 months. These two experiences enabled me to observe changing social, cultural, and environmental conditions occurring over this period of time. It is important to recognize the specific historical time period that I am discussing in this chapter, since communities within Ifugao Province continue to change and respond to new conditions, problems, and opportunities in novel ways as social and environmental conditions shift. Neither local nor global contexts are fixed; instead, they are rapidly changing, necessitating taking these processes into account as we try to understand the practices that Ifugao and other people have undertaken in their attempts to negotiate their changing natural and social environments (Leatherman 2005).

In my research, I focused on hunger and malnutrition, gender, and local and international health and development processes addressing these health issues in Ifugao.

I lived within Ifugao Province, conducting participant observation throughout my research period. I interviewed male and female adults of 62 families residing in three barrios that were located within two municipalities of Ifugao Province. I also interviewed numerous key informants during my research, including government officials, health personnel, religious leaders and healers, local nongovernment organization (NGO) personnel, international development personnel, scholars, and others, both within and outside of Ifugao. I also collected documents, books, and other materials printed in the Philippines that informed my research. Drawing on this research, in this chapter I hope to contribute to the literature that explores diverse coping responses employed by people living in mountainous regions that are changing socially, culturally, and environmentally, and how these can be uneven and relative to one's social position (see also Adams 2006; Leatherman 2005; Turner 2007; Waterson 1993).

Political Ecology and Coping Responses

I draw upon a political ecology perspective to analyze the kinds of coping responses that Ifugao people have made to changing mountain environments that intersect with emergent social, political, and economic forces influencing their culture, everyday livelihoods, social positions, political power, and health. Watts and Peet (2004:3) write that political ecology is a field "that seeks to understand the complex relations between Nature and Society through careful analysis of social forms of access and control over resources—with all of their implications for environmental health and sustainable livelihoods." This approach has long highlighted politics and political economy in the analysis of humans' relationships to the environment, and different forms of and conflicts over control and accumulation of resources (Ibid:6). It can take into account structural inequalities, both between and within nation-states, influencing environmental conditions and changes, and human agents and their motives and actions. Leatherman writes, "like much anthropological political-economy, political-ecological approaches focus on the 'unity of structure and agency' (Roseberry 1988) in studying human–environment interactions within broad global histories" (Leatherman 2005:51). Ifugao people's approaches to their mountainous environment in the late twentieth century were significantly influenced by broader social, political, and economic forces.

I will focus here on sociocultural processes that Ifugao people have drawn upon as they have tried to address and cope with their changing environmental and social conditions within the mountainous region of Ifugao during the early 1990s. The significance of this focus is to investigate the complex relationships involved in the emergence of coping responses to changing conditions, some of which can involve overlapping allegiances and contradictory positions for individuals and families who attempt to access potential resources that could improve their everyday lives. The Ifugao people experience divisions in their communities in a number of arenas, including divisions based on historical and modern conceptions of economic status, religious practice, gender, and political affiliation. In addition, a great deal of diversity can be observed in the natural environment in different areas of Ifugao, in regard to altitude, slope, temperature, and rainfall patterns, influencing the residents' relationships to the environment and their productive activities, particularly for farmers and craftspersons (Brookfield 2001; Conklin 1980). In my chapter, I will particularly focus on mountainous areas at higher elevations, rather than those areas of Ifugao that are at lower elevations and border lowland provinces.

Ifugao of the Cordillera Mountains

Located within the Central Cordillera Mountain Range, since 1987 Ifugao Province has been a part of the Cordillera Administrative Region (CAR) of the Philippine nation-state. Other provinces making up CAR are Abra, Apayao, Benguet, Kalinga, and Mountain Province, as well as Baguio City. During the early 1990s, when I conducted research in Ifugao, the population of the province was approximately 147,000 people (National Statistics Office, Republic of the Philippines 1992a).

Ifugao is particularly renowned for its extensive rice terraces sculpted on mountains within the province. In addition to wet-rice agriculture, Ifugao people have also long engaged in swidden cultivation on the mountainsides, producing root crops, such as sweet potatoes, vegetables, fruit, and other crops and plants. Forest areas are developed and maintained by families, providing important resources as well as ensuring irrigation water for agriculture and seeds for swidden cultivation (Conklin 1980). As I will further discuss, during the early 1990s Ifugao people engaged in these productive activities as well as a range of other forms of labor.

Ifugao society is characterized by diverse environmental and social conditions. During the early 1990s, municipal centers, including the capital city of Lagawe (Fig. 15.2), tended to have modern amenities, such as electricity, piped water within houses and buildings, and other modern infrastructure and services. Ifugao homes located in rural villages outside of municipal centers, on the other hand, commonly had few amenities, with no electricity, gas or electric stoves, piped water, refrigerators, or toilets in many homes. Travel remained difficult, as most travel was done on foot on long, mountain trails. There were few roads within Ifugao, except mainly those linking municipal towns and a highway extending to other provinces and the national capital, Manila. Health conditions were poor, and while local indigenous and Christian religious healers were available to most Ifugao people, most poor people had inadequate access to biomedical health care.

During the early 1990s, while Ifugao people culturally constructed local notions of economic status and ranking, the government officially classified 21% of people living in Ifugao as making up a middle class and 4% an upper class. Most Ifugao people (75%) were classified as living below the government designated poverty line (National Statistics Office, Republic of the Philippines 1990, 1992b).[1]

[1] In 1992, the government designated poverty level for a family of six in Ifugao was set at an annual income of 27,396 Philippine pesos (approximately 1,074 US dollars at that time; National Statistics Office, Republic of the Philippines 1992b).

Fig. 15.2 A commercial street in Lagawe, the capital of Ifugao Province

Local cultural constructions of economic and social status included the concepts of *kadangyan*, *bacnang*, *natumok*, *and nawotwot*. *Kadangyan* are traditionally wealthy and high prestige individuals or families who have developed or inherited extensive areas of irrigated rice fields. They also have adequate rice to eat throughout the year, which was historically a key signifier of wealth. *Kadangyan* typically own numerous domesticated animals, including large animals such as water buffalo and/or cows, and other symbols of wealth, Chinese vases for instance, a large home, and other amenities, as well as "native" style homes. Many *kadangyan* also have access to services such as electricity. *Bacnang* are individuals or families who are newly wealthy, or the *nouveau riche*, within Ifugao, who earned wealth through participation in agriculture, including raising cash crops, the market economy, and/or the government structure. While *bacnang* may own large areas of irrigated rice fields, they may also have considerable savings of money, and symbols of wealth associated with the *kadangyan*. Some *bacnang* and *kadangyan* receive remittances from family members who work temporarily or permanently overseas. During the 1990s, both *kadangyan* and *bacnang* were highly interested in educating their children, some of whom have become professionals and government leaders.

The middle class and status group are identified as the *natumok* (Barton 1919). They are characterized as individuals and families who own irrigated rice fields and cultivate enough rice for their daily food for much of, but not the entire, year. In the early 1990s, the *natumok* generally had stable incomes, though often working in several forms of employment and labor. Many were professionals, such as teachers and health professionals, or small business owners or traders.

Fig. 15.3 Ifugao communities dot the Cordillera mountainsides

Some *natumok* who farmed also raised cash crops, which enhanced their economic status, and some also received remittances from family members working overseas. Many *natumok* built modern homes, which may or may not have had other modern amenities. Education of the *natumok* families' children was also common and valued.

The poor, or lower class, are conceptualized as *nawotwot*. The individuals locally identified as *nawotwot* have few or no irrigated rice fields. They can cultivate rice, root crops, and other crops on mountainsides, which are open to Ifugao families who desire to cultivate an area. This is considered to be difficult labor by most Ifugao people. A symbol of the poverty of *nawotwot* families is consumption of sweet potatoes as their main subsistence food, obtained from swidden farming and other forms of gardening. The poorest Ifugao people during the early 1990s commonly owned no irrigated rice fields, and relied on swidden farming, labor on other people's agricultural land, and/or wage labor. Their access to cash was inconsistent, and engagement in multiple forms of labor common. Most poor families lived in "native" homes, which tended to be smaller than modern homes (Fig. 15.3). Educating their children was desired but not always possible, due to lack of funding for their children's education and their need for their children's labor, in agricultural fields or the home, or as wage labor. Borrowing money and food were common practices of poor families, particularly in periods of crisis, such as illness of a family member, or prior to the harvest of a new crop.

By the 1990s, Ifugao people were integrated into a market economy, and prestige and wealth were attained through new avenues, such as business success, educational achievement, and government political power. Still, their cultural conceptions of wealth and status continued to be related in part to the mountain environment and the transformation of mountain resources, in agricultural production, cultivation of rice and other food, and the management of forest areas, as they attempted to meet their subsistence, livelihood, and social and cultural needs and desires. Ifugao people's cultural and social identities also stemmed in part from their relationship to the land during the 1990s, with access to types and areas of land connoting cultural ideas of status. For many Ifugao people, Ifugao identity and status orientation also intersected with indigenous ritual practices associated with agricultural production and other life events. This was the case even for those who identified strictly as Christians and who had reappropriated traditional Ifugao ritual practices to conform to Christian beliefs and ideologies. New and historically older means of acquiring status often intersected in the 1990s as well, with successful professionals, business persons, and politicians maintaining or increasing their social status through the performance of indigenous Ifugao or Christian rituals. For example, these rituals evoked the status of a family through symbols such as the size of a ritual gathering, and the number and size of animals sacrificed within Ifugao indigenous rituals, or killed for sharing among participants of Christian rituals (see also Waterson 1993). Social, economic, political, and environmental forces intersected to shape Ifugao people's cultural and social identities.

Globalization and Change

Over the past two centuries, Ifugao people have experienced extensive social and cultural change, which they have had to cope with to sustain an emergent Ifugao identity and lifestyle in the mountainous region. Historical changes that were particularly significant were Spanish and the US colonialism, and later the establishment of the Philippine nation-state. Each of these processes involved political, economic, social, and cultural changes that influenced Ifugao people's everyday practices and ability to control natural resources in their communities and their social life. While contact with Spanish colonizers had occurred at least since the 1500s, including through colonial and Catholic missionary activity, the Spanish had the greatest impact on Ifugao society by the mid-1800s, with their control of most areas of Ifugao by that time. This led to Ifugao people's loss of political autonomy, including the beginning of a loss of full control over their land and resources. The Spanish introduced the Regalian Doctrine, which made the King of Spain the owner of all property in the Philippines, including the area making up Ifugao Province (Serrano and Cadaweng 2005:110). This doctrine had an impact on Ifugao people's relationship to their land and to the Philippine government during the late twentieth century as well.

The US colonization of the Philippines began in 1899, following the defeat of the Spanish in the Philippine colony. By 1901, the US colonial presence was felt in Ifugao with the establishment of a colonial military government in the Ifugao region. This significant political change led to the introduction of new forms of government, education, economy, and employment in Ifugao. Christian missionary activity continued during this period as well, both Catholic and Protestant. Ifugao people developed new orientations to the mountainous region during this colonial period, with new forms of livelihood introduced in addition to agriculture and cultivation, including working in government positions, military service, and labor, such as road building for the colonial government (Fry 1983).

With the emergence of a new Philippine nation-state in 1946, the Ifugao region was incorporated into the modern state political system. Included among the changes experienced by Ifugao people have been their marginalization and their designation as a minority group by the Philippine state, Christianization through international and local missionary practices, the development of "Ifugao" and "Cordillera" identities, and their increasing involvement in warfare. For example, the US colonial government had retained the intent of the Regalian Doctrine, and in 1935, in preparation for independence from the US colonization, the Philippine Constitution established the configuration of the Regalian Doctrine that was in place during the early 1990s. The Regalian Doctrine then stated that all of the natural resources, which included lands of the public domain, belonged to the Philippine state, making Ifugao lands and resources the Philippine state's property. This law was resented by Ifugao people since they and their ancestors had claimed and transformed the mountainous land that they lived and thrived on prior to colonization by the Spanish and the US and the establishment of the Philippine state (Serrano and Cadaweng 2005:110). The perpetuation of this doctrine led to land titling, which some Ifugao participated in to establish their claim to their ancestral land; yet even these titles could be overridden by the state. This began the process of privatizing commonly held lands. Only after the period of my research, on which this chapter is based, was the 1997 Indigenous Peoples Rights Act approved by the state, according indigenous cultural communities and indigenous peoples of the Philippines the rights "to their ancestral domains to ensure their economic, social and cultural well being" (Republic of the Philippines, Congress of the Philippines 1997:1).[2]

In relation to these changes, during the early 1990s Ifugao people challenged the government over recognition of their ancestral land rights, manipulation of government land-titling policies, land disputes among Ifugao families, national and local corruption by government leaders, and deforestation of some areas by logging businesses. The Ifugao were also embroiled in the armed conflict being fought between the Philippine government and the communist New People's Army (NPA), which began in the late 1960s, either as participants in each army or as civilians who were inadvertently caught up in the conflict (Kwiatkowski 2008). The mountainous terrain provided a strategically beneficial location for the NPA to engage the Philippine military, also at times making Ifugao people's access to their irrigated rice fields, swidden fields, and forests dangerous or prohibited. Earlier historical conflicts included local warfare, headhunting rituals, revenge murders,

[2] This law has not been problem-free during its implementation in regions of the Philippines where indigenous people live, such as in Ifugao Province, sometimes leading to conflicts over land claims (Asian Development Bank 2002).

and resistance against the Spanish and the US colonizers and Japanese occupiers during World War II.

For some Ifugao people, participation in the NPA may have been, in part, one coping response to the state's usurpation of Ifugao people's rights to their ancestral lands and resources, and the state's marginalization of Ifugao and other indigenous peoples in the Philippines (Finin 2008; Kwiatkowski 1998, 2008). As indigenous people, a crucial issue for many Ifugao during the late twentieth century was control over their resources. This also led to some Ifugao people's participation in social movements or organizations advocating for indigenous rights and autonomy, such as the Cordillera Peoples Alliance. Others, in contrast, have turned to government avenues for access to resources, such as through acquiring political power, acquiring professional employment in government positions, or participating in government sponsored programs. Thus, there was a variety of coping responses to the problem of contested political and economic control over local resources among Ifugao people. This is a historically and politically shaped problem that Ifugao people have faced as they have attempted to gain their livelihoods by drawing on the resources of their ancestral lands in Cordillera Mountains.

These historical, political, and economic forces also led to increasing contact with non-Ifugao people on national and global levels and Ifugao people's incorporation into the modern Philippine nation-state. With the development of the market economy and intensifying globalization processes, the Philippine state facilitated the establishment of tourism and international development processes in Ifugao. These state engagements were a part of the ongoing process of Ifugao people's incorporation into the nation-state, and the state capitalizing on the culture and environment of the Ifugao people through these forms of development. Tourism in Ifugao depended on the mountainous environment that had been shaped by human productive labor (Fig. 15.4). Tourists are enticed to gaze upon the rice terraced mountainsides, proclaimed by many Ifugao people to be the "eighth wonder of the world" and named a UNESCO World Heritage Site in 1995, and to learn about indigenous Ifugao people and their culture.

Changes and Challenges in Ifugao Society

By the early 1990s, many Ifugao people also perceived themselves to face a number of problems in their mountain and social environments, many of which were being addressed by their own residential communities, government agencies, NGOs, Christian churches and institutions, and/or international organizations that had offered aid and operated within Ifugao since at least the 1970s. To understand the problems that Ifugao people perceived themselves to face, I present here problems that Ifugao people living in one *barangay*, or village, identified in 1992 during a meeting sponsored by an international development organization. This international development organization sought to promote sustainable, community-based development in rural areas, through processes such as rural micro-projects and community-based participatory approaches.

Fig. 15.4 Tourism and commerce are important economic sectors of the Ifugao town of Banaue

It also addressed environmental and resource management in Ifugao. The *barangay* in which the meeting took place was located at a distance from the center of its municipality. A road was constructed through it, making travel and transportation of goods easier than in other *barangays* that had no nearby roads. Many of the difficulties that were expressed at this meeting were shared by residents of other *barangays* within Ifugao, although not all (Ticsay 2005). This discussion provides an opportunity to understand what issues Ifugao people responded to as they made decisions in their lives to cope with their changing social and mountainous environment.

One problem that emerged during the meeting's discussion was a lack of adequate water supply due to denuded forests. Ifugao people said this problem led to a lack of adequate water for wet-rice and vegetable agriculture, and a resulting low level of production of these crops. Another result of denuded forests was soil erosion, which also negatively affected rice and vegetable production. These problems may have been due in part to problems such as illegal logging by businesses in Ifugao. Extensive wood carving contributed to deforestation. Wood carving for sale began to emerge in full force in the 1970s with the government construction of a highway connecting Ifugao to other provinces and Manila. This problem was later addressed and alleviated, however, limiting wood carving and making wood carving production more sustainable (Serrano and Cadaweng 2005). An increasing population also resulted in greater use of forest resources and increasing development of swidden fields, contributing to deforestation. Forest areas were managed by Ifugao families for resources, and also prevented soil erosion and provided water for rice and other agricultural fields, countering to some degree the problems derived from deforestation (Conklin 1980; Ibid). Still, changing climate has also influenced a reduction in water supply, with prolonged dry seasons in the early 1980s and a drought in 1991. The 1991 earthquake also negatively affected sources of water relied upon for agricultural production, changing the location of many sources (Ticsay 2005).

Other agriculturally related problems the *barangay* members identified were difficulty acquiring garden tools, improper maintenance of irrigation, soil zinc deficiency, and the presence of plant pests and disease. They also noted the prevalence of livestock pests.

Regarding their perceived difficulties in maintaining their and their families' health and well-being, they asserted a general state of poor health conditions. They also noted a lack of adequate amounts of potable water; the presence of stray animals and poor sanitation in their communities; inadequate pharmacy and health care facilities, including medicines to address health emergencies; high rates of malnutrition; and a lack of knowledge about family planning among many adults. They said this resulted in a large family sizes for many families in their *barangay*. They also perceived many parents to have a lack of knowledge of proper care of children.

Community members also discussed what they referred to as "massive poverty" in their community. They complained of low income and insufficient job opportunities. Both men and women in the meeting pointed to women being paid less than men for agricultural work, asserting that this gendered pay structure was problematic. There was some disagreement over this issue, however, since some of the participants argued that equalizing payment for women's agricultural labor with men's on family farms would be difficult for poor families who hire women for this work, particularly during the planting and harvesting seasons when labor needs are intensified.

Another issue raised was inadequate facilities and infrastructure in their community, including schools and roads. They said they have reduced access to education, due to the costs entailed in the education of their children, and the great distance of many of their homes from the schools. These problems have resulted in a low literacy rate among adults in their barangay. They also noted the high numbers of youth who drop out of school before completing high school. They cited a few additional reasons for this problem, including poor youth being enticed to earn money through wood carving, particularly male youth, which discouraged them from attending school (Fig. 15.5). Large family size was another reason offered, since older children in families are often asked by their parents to care for their younger siblings at home while their parents are working.

Other community problems they noted were clusters of homes, or *sitios*, being located at a far distance from each other, making travel and transportation between these areas difficult. Lack of quality leadership in the community was also perceived to be a problem they faced. Finally, for some *barangay* participants in the meeting who had converted to Christianity and strictly followed Christian ideology, the "pagan" religion, or the indigenous Ifugao religion, was viewed as a root cause of all problems. This was not a broadly shared view among Ifugao people, but it was an explanation that followed in part from a prevalent assertion among Filipino and foreign Christian missionaries that belief in Christianity and participation in Christian church groups would result in their acquiring good health and increased

Fig. 15.5 Ifugao man carving wood

wealth (Kwiatkowski 1998). They asserted that poor spiritual growth, negative attitudes, and the practice of pagan rituals were community problems.

I presented this set of problems derived from an international development program initiated meeting in one Ifugao *barangay* because the problems faced by many Ifugao people were expressed during this meeting by the people themselves. This meeting provided a key opportunity to gain insight into how members of one Ifugao community defined their difficulties, as they coped with changing cultural, political, and economic forces and the natural environment they depended on. Nevertheless, we must consider the influence of the international development agents in generating the responses derived from their participation in this discussion at the meeting. The Filipino facilitator employed by the international development organization steered the discussion toward defining problems that potentially would be addressed by the international organization. Problems that did not fall under this rubric may not have been expressed. In addition, attendees at the meeting did not include indigenous Ifugao religious leaders, or "native priests," resulting in their views supportive of the indigenous religion being neglected.

The problems noted by these meeting attendees can be characterized as being broad in scope, covering issues ranging from agriculture to access to potable water, health care, and education. Their active construction of the problems affecting their lives which they need to address included their interpretation of their changing highland natural and social environments. Their construction of their problems at this meeting included their perception of their incorporation into the market economy and nation-state, in which job opportunities, agricultural pay rates for women, and access to services and infrastructure that could improve their health and education play an important a role in their lives in conjunction with their agricultural production activities.

Coping Responses to Social, Cultural, and Environmental Change

While the difficulties that were expressed at this meeting do not comprise all of the concerns that Ifugao people face, they are some of the most common ones I learned about from Ifugao people I interviewed and spoke with. Different Ifugao people have responded to these problems in a variety of ways. Some responses have been successful, while others have not, or have led to new problems for individuals and families. Leatherman argued that when employing the concept of coping, it is important to emphasize that coping is a process in which the goals, needs, options, and constraints shaping human actions are contingent on changing historical conditions, and in which consequences of action create conditions for new problems and responses (Leatherman 1995:479). I will discuss some of the coping processes employed by Ifugao people to address the problems or challenges they faced, and explore some of the complexities involved in their responses.

One of the significant means of coping with changing social and environmental conditions, which has continuity with the historical practices of Ifugao people, was diversification of production as they cultivated their land and forest areas. Most Ifugao people grew rice in terraced irrigated rice fields, and cultivated rice, root crops, vegetables, and fruit on swidden fields as well. Approximately one-third to two-thirds of Ifugao subsistence foods were root crops, supplementing the rice that they raised or purchased (Brookfield 2001).

Production of rice on swidden fields allowed families to raise particular kinds of traditional rice varieties that were less available in recent decades, particularly with the introduction of high-yielding varieties of rice. Many Ifugao people cultivated glutinous rice on swidden fields, used for foods such as rice cakes, but more significantly for "rice wine" which was an important element in indigenous Ifugao religious rituals. The production of glutinous rice aided many Ifugao people in their continued engagement in meaningful indigenous religious practices that played a role in shaping their cultural identity. This was significant in the face of the introduction of new agricultural technologies, positions of employment, and Christian religious ideologies and practices. While most Ifugao people officially identified with a Christian religion, with 80% officially identifying as Christian on the 1990 census, in their everyday lives a large proportion of Ifugao people identified with and actively participated in both Christian religious and Ifugao indigenous religious rituals and other practices.[3]

While swidden farming allowed all Ifugao people to supplement their diets and incomes with root crops, especially the sweet potato, and other vegetables and fruit,

[3]Based on responses in the 1990 census, Catholicism was the most prominent Christian religion practiced in Ifugao, with 54% of Ifugao people identifying with this religion. Twenty-six percent of Ifugao people identified as Christians associated with Protestant or nondenominational churches, including Methodist, Evangelical, Espiritista, and Pentecostal churches.

swidden farming was most important to poor families who had few or no irrigated rice fields. Families continued to claim uncultivated areas of the mountainsides through active cultivation of the area. Swidden farming also supported animal production (such as water buffalo, pigs native to the region, goats, chickens, ducks, and dogs), since the root crops were used for feed for some animals. Swidden farming remains one of the most important coping mechanisms of poor people, as it supports their income and health, particularly their nutritional status. In addition to the cultivation of root crops, vegetables, and fruit on swidden fields, they are also grown in home gardens, dry terrace fields, and among rice plants. Cultivation of food on swidden fields and dry terrace fields, and in home gardens was significant for members of all social status groups, since this supported many of their productive and health needs, and cultural practices and identity.

Ifugao people also relied on forest products and their managed forest areas for resources, such as timber, medicinal plants, food, and wood for craft production, especially wood carving. In addition, paddy fish farming seems sustainable in this mountain environment. Fish and shellfish raised in irrigated rice fields and fish ponds were important sources of protein and income, and were encouraged by government agencies. Individuals also fished in rivers, although an environmentally damaging practice engaged in by some Ifugao people was the use of dynamite to facilitate catching the fish.

Agricultural diversification aided Ifugao people in various ways. For wealthy *kadangyan* or *bacnang*, and for middle class *natumok*, it could increase their wealth and enhance their opportunities. Agricultural diversification could have the same effect for poor *nawotwot*, but in many cases it mainly provided some stability in the face of vulnerability due to their poverty. Still, swidden farming, a component of agricultural diversification for many, was experienced as very difficult and time-consuming labor by most Ifugao people. It generally did not provide poor families with an adequate income to improve their economic position, and reduce their economic insecurity. Many farmers who were in a more secure economic position chose not to engage in extensive swidden cultivation, focusing on irrigated rice cultivation. With the growth of markets and the introduction of cash crop agricultural production, such as the production of vegetables and fruit as cash crops by the 1970s and 1980s, and coffee, introduced earlier by the US colonizers in some areas of Ifugao, farmers with access to markets had turned to this productive activity (Ticsay 2005). The introduction by the Philippine government and international development organizations of hybrid pigs that were fed commercial feeds reduced the need for root crops to raise pigs. Soil erosion and the introduction of rice in the local markets also influenced a reduction in swidden farming by the early 1990s.

New employment opportunities had emerged that could potentially enhance individuals and families' economic status, and provide a means of accessing modern services and goods through earning cash. This also led many Ifugao farmers to move away from swidden farming, and other farming activities for some. Government agencies provided most of the professional positions in Ifugao Province by 1992, such as in political leadership, education, health care, agriculture, and other government supported arenas. Wage labor was also an important source of income for many Ifugao families, as they coped with changing environmental and social conditions, often as a supplement to agricultural production. Tourism and craft production oriented toward local consumption and global exportation provided economic opportunities for some Ifugao men and women. Other business opportunities emerged with the growth of the market economy as well.

As Ifugao became further incorporated into the modernizing Philippine society, and educational opportunities increased during the twentieth century, there was a corresponding increase in the number of high school and college graduates. Education was viewed by many in all social status and class groups as an important means of enhancing their economic and social status. Following graduation from college, many young Ifugao men and women desired employment that matched their academic interests and new status as highly educated individuals. College educated men commonly attempted to avoid agricultural labor. With few professional positions available, many of these young men remained unemployed for an extended period of time after graduating from college, or migrated to urban areas or other provinces to seek employment. Some men and women migrated to live permanently outside of Ifugao. This has included migration to other provinces and cities within the Philippines. Increasingly, Ifugao people have also turned to transnational labor migration to improve their and their family's economic and social status.

While potentially beneficial for college educated individuals and other migrants and their families, these new orientations to labor and employment have had a negative effect on some farmers within Ifugao. Farmers I spoke with said locating agricultural laborers had been more difficult in recent years, such as for plowing fields, planting and harvesting rice, and particularly maintaining rice terraces. The new coping mechanisms of some Ifugao people, including seeking education, new forms of employment, and migration, created difficulties for other Ifugao people who pursued agricultural production within Ifugao. In many cases, members of the same family drew upon these different coping processes, resulting in some positive and negative impacts for the same family.

Most Ifugao people accepted a variety of forms of local and national government, NGO, and international program assistance that was offered to them, with the hope that it would improve their economic status, whether they were already financially stable or poor. These forms of assistance had led to improvements for some Ifugao families in regard to their economic status, health, and quality of life by the early 1990s. These institutions were also addressing some of the environmental problems Ifugao people faced, such as deforestation. Yet, these institutions and the development and aid programs they implemented had not significantly reduced the level of poverty experienced by the majority of people living in Ifugao Province. In addition, these intersecting programs commonly influenced women to view themselves as primarily responsible for the care and health of their children, and most did not address the devaluation of women's labor. Many women felt blamed by these institutions for the poor health and nutrition of their children.

With problems and changes that had been occurring, such as deforestation, reduced water supply, soil erosion, the 1991 earthquake and drought, illnesses, and few employment opportunities, poor Ifugao people coped with these issues through

Fig. 15.6 Ifugao women harvesting rice in an irrigated rice terrace

a variety of means, including many of those mentioned above. One important option for poor people remained paid or reciprocal agricultural labor (Fig. 15.6). When women and men did labor on other people's agricultural fields, women were generally paid less than men due to cultural ideas of gendered labor. Men were commonly viewed as engaged in more difficult and strenuous agricultural work than women, although this was disputed by some Ifugao women. Men were also generally paid more for wage labor outside of agriculture. More significant than this, though, was that there were more types of waged work commonly associated with male labor than with female labor, therefore more opportunities for nonprofessional men to earn cash. Some Ifugao women contested the practice of differential pay for men and women's agricultural labor, while other men and women resisted changing this practice. As I noted earlier, the latter asserted it would be a burden particularly for poor families to increase women's pay for agricultural labor. In this case, the coping mechanism employed by poor families to maintain low pay rates for women's agricultural labor had a negative impact on women. This negative impact was particularly experienced by poor, single women, especially those with children, and elderly women. These women and children were in a particularly vulnerable position economically and nutritionally. Some of these women addressed this vulnerability by moving out of their normative gendered labor and engaging in labor typically associated with men in order to earn higher wages. Also, some single mothers and elderly women received support from other family members, but not all of these women could rely on this form of support.

As I noted above, poor families relied on borrowing food, money, or other resources in order to cope with their poverty or crises they experienced, from family, friends, or patrons of higher status and class groups. The latter often charged interest on loans to poor people, making this coping strategy one that, in times of crisis, generally led to survival but also further impoverishment of the poor.

Conclusion

Ifugao people lived in and adapted to the mountain environment of Ifugao in ways that enhanced many Ifugao people's lives, culturally, economically, and politically, by the early 1990s. Yet, they have also faced cultural, social, and environmental shifts that have necessitated the deployment of creative strategies to cope with changes that caused difficulties for them. In this chapter, I have discussed the experiences of Ifugao people I conducted research with during the early 1990s to assess the diverse ways that Ifugao people have coped with new challenges. Their responses to these challenges have taken place either within or outside of Ifugao Province. The transnational migration of Ifugao people has tended to create new global social networks of Ifugao people, as they have sought to enhance their lives and those of their extended families. I have suggested that the diverse labor and social practices engaged in by Ifugao people in the face of social and environmental change have enhanced the ability of their culture and kin groups to thrive and change in relation to their shifting social and natural environments. But, as I have further argued, this process has also been an uneven one among different social groups, since the poor, and particularly poor women, have faced some of the most challenging conditions as they have negotiated their changing social, cultural, and natural environments.

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Chapter 16
Culturally Mediated Provision of Ecosystem Services: The *AGDAL* of *Yagour*

Pablo Domínguez

Introduction

There has been a wide international recognition of the potential contribution of traditional systems of communal natural resources management to current practices of sustainable development (Ostrom 1990; Neves-Garca 2004; Folke et al. 2007). Nevertheless, little research has been conducted regarding the still existing traditional institution of communal natural resource use and preservation in Morocco (Auclair and Al Ifriqui 2005). One of such still existing institutions is *agdal*, which can be defined as a seasonal prohibition of access to a given agro/sylvo/pastoral resource, in order to allow the resource a resting time during the most sensitive period of growth (e.g., the 3 months of spring in the case of the Yagour High Atlas Mountain pastures that we will analyze in detail in this chapter). The dates, resources, and spaces affected by this prohibition are established according to the community's own history, territorial heritage, political structure, and economic strategies. The political body that makes such decisions and oversees it execution is the tribal assembly (*jamaa*) composed of the heads of all households that use the resources. The *agdal* management system aims at optimization of productivity of the resources as well as assurance of a sustainable extraction and redistribution of the resources among its users. Such administrative scheme most frequently leads to (1) the maintenance of dense plant cover, a consequence of prohibition of the biomass removal for several months (Hammi et al. 2007), and (2) higher rate of biodiversity conservation within the *agdal* managed space than in non or less *agdal* managed spaces (Kerautret 2005; Alaoui-Haroni 2009; Dominguez and Hammi 2010).

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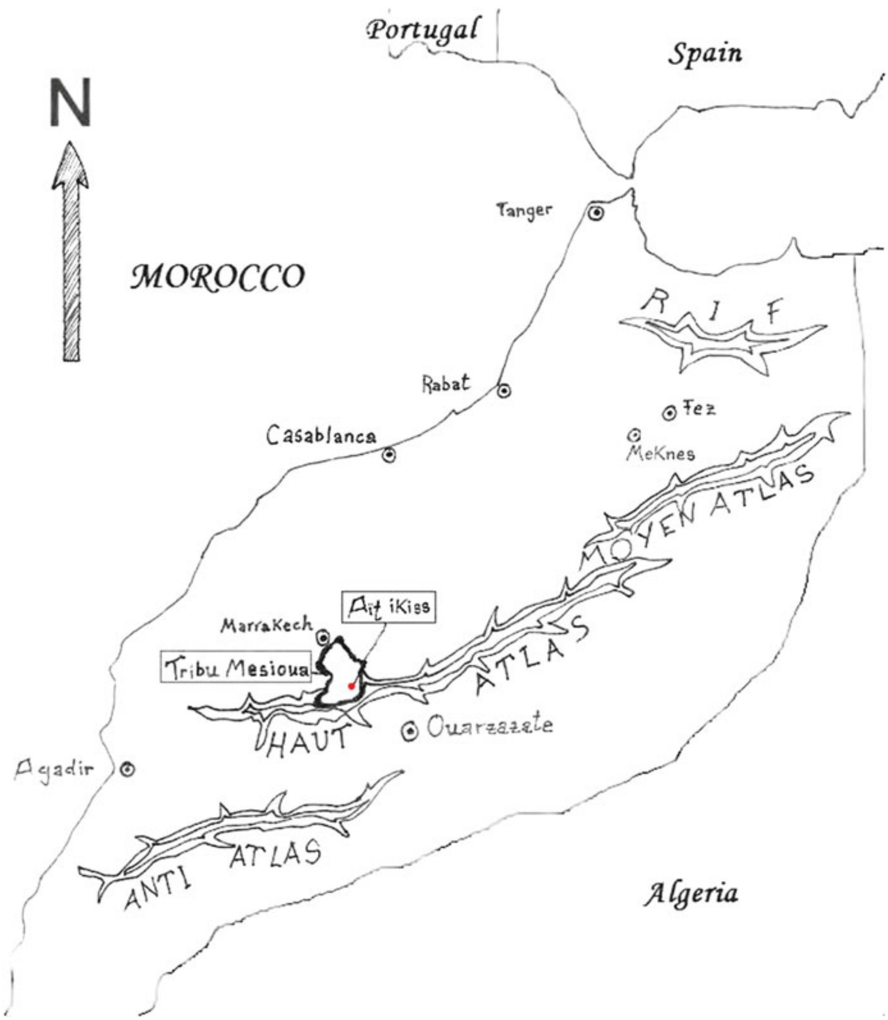


Fig. 16.1 Geographic location and borders of the *Mesioua* tribe and the *Ait Ikiss* group in the High Atlas

The territory of *Yagour* is a pastoral area of more than 70 km² that belongs to the *Mesioua* tribe (Fig. 16.1). It is located in a very difficult to access region, only 50 kilometers away from Marrakech. The study area stretches from 1,900 meters above sea level (masl) up to the peak of the sacred mountain of *Meltsene* reaching almost 3,600 masl. The *Yagour* is particularly used as a summer pastoral land, receiving more than 7,000 people each year from almost 50 nearby villages and hamlets (maximum 10 km distance) with about 25,000 inhabitants in total.

The *agdal* of the *Yagour* is, above all, a space characterized by green grasslands symbolizing the idea of life in the environment abundant in water. The cultural representations associated to it by herders often make reference to a mystic place.

Fig. 16.2 Rock carving in *Yagour* interpreted as showing the *Maltsene* Mountain and the *Yagour* River in the middle. (Photo by B. Romany)

In the *Yagour*, the rites of fecundity and pastoralism were probably present in the Paleoberber herding societies of the Bronze Age (4000 to 2500 BP), as the profusion of engraved symbols on the red sandstone of these pastoral *Olympus* (Auclair and Al Ifriqui 2005) demonstrates (Fig. 16.2).

The term *agdal* (plural: *igoudlane*) has complex etymology and meanings. *Agdal* is a root of words used in the region stretching from the Atlantic coasts of Morocco to the *Aïr* of southern Algeria (Lefébure 1979). It can also be found in Tunisia where a similar collective natural resource management arrangement exists for fruit trees. All of it points out a more than likely widespread of such collective institutional arrangements in the past. Although the most common meaning in the High Atlas Mountains, where the presented study is based, is the temporary prohibition to access a particular space or resource after the agreement imposed by the tribal assemblies (*jmaa*) (Auclair and Al Ifriqui 2005), other meanings of this term are also present. Mahdi (1999) mentioned that E. Laoust translated the meaning of the verb *agdal* as "to herd animals in a grassland." In other places in Morocco, *agdal* means seed tank, or refers to a great water container, a small private plot with thick grass due to constant artificial irrigation, a woman's abundant hair … , etc.

Al Faïz (2002) stated that *agdal* has also spread among the non-Berber societies far beyond the Atlas: "During its nine centuries of history, the city of Marrakech has accumulated an impressive green heritage. It is in this city where the art of gardens

Fig. 16.3 *Tagdalt* (little *agdal*) of a Berber cemetery with an evident ecological result (pool of biodiversity and point of seed diffusion) (photo credit P. Dominguez 2004)

was born in the 12th century […] [It is] a new style, that of the "Almohade garden" (the *Agdal* of Marrakech) […], with huge orchards, large pools, water pavilions… […] because its creators were not just servile imitators of the oriental model […] The Berbers from the High Atlas saw in these growing city gardens, the familiar enclosure of their mountains […] They called it *agdal* to conserve this evocation of green pastures and the memory of their *alpages* […] Once the immense enclosure of the *Agdal* of Marrakech was completed, the Almohades exported it as far as they could. The same model of gardening was used in Rabat, Gibraltar, and Seville," all far away from the heart of the Atlas and most of them beyond Morocco.

Besides the magnificent landscape that sculpts and contains the institution of *agdal*, numerous legends accompany its presence in these mountains. Among the stories on *Yagour,* one often told is that of *a man dressed in white, riding a white horse, who appears every year at the time of the herding prohibition on the Yagour in order to save the agdal from dishonest stealers, punishing them in several ways*. Another story refers to *the 360 saints who walk around together to watch over the Yagour with their horses and camels*, and symbolizes long caravans, long voyages, and testimonies of allegiance and respect. Legends also identify many spaces around *Yagour* situated near saints' graves or cemeteries, that are called *tagdalt* (little *agdal*) and have abundant vegetation, protected permanently from cattle and humans. Such protection is achieved mainly through the force of the beliefs and taboos that are present around these sacred places (Fig. 16.3).

The system of *agdal* is an ancient and inherently Moroccan form of gardening, or maybe even of the whole Maghreb. Proved to resist climate variations and social change throughout centuries (Ilahiane 1999), *agdal* has survived and continues to structure the territory, natural resources, and landscapes of the High Atlas Mountains. In fact, *agdal* encourages dense plant cover, and biodiversity through its specialized and planned land use. The plant cover is also denser in *agdal* managed spaces than surrounding areas, as its spaces are ungrazed from spring to summer, and forests are only cut in winter, etc. At the same time, the *agdal* of *Yagour* contributes to the local economy, mainly in three ways. First, the *agdal* managed territory brings in up to 20% of the annual fodder for cattle (Dominguez et al. 2012). But more importantly, the contribution of *agdal* in terms of fodder arrives in the middle of the summer, when other pastures have nothing to offer. Secondly, *agdal* provides fundamental manure to enrich agricultural sectors, making these much more productive. Finally, *agdal* brings in increasing income through the emerging ecotourism surrounding the discovery of the natural and cultural heritage of *agdal* in the region. As we can see, *agdal* proves to be multi-adaptable and highly resilient, resisting collapse for centuries and still reformulating itself without decline. Through life histories we have been able to trace the existence of *agdal* of Yagour to 150 years ago, but it is undoubtedly older, as shown by toponymy, geographical extension of the same type of practices within and outside of Morocco, and also rock carvings dated to different time periods.

Case Study

In particular, we carried out an in-depth study of the *Ait Ikiss* group, which comprises about 640 people who occupy four different habitats: *Azgour/Tifni, Ikiss, Warzarzt*, and *Yagour n'Ikiss* (Fig. 16.1). The *Aït Ikiss* belong to the *Mesioua* tribe, who are all patrilineal. As in other Berber societies, all the decisions about the household's use of agro-pastoral resources are made by the male who is the household head, and in his absence, by the oldest adult male of the family (depending on the family structure, it can be a brother, the eldest son, etc. …). The *Aït Ikiss*, and the rest of the mountain *Mesioui*, are defined in Morocco as mainly nonorthodox Sunni Muslims who sustain indigenous beliefs and practices as a result of a long cohabitation and reformulation between pre-Islamic religions and earlier Islam. They organize activities and manage their communal territory through the above mentioned tribal assemblies (*jmaa*). The seasonal *agdal* prohibitions imposed in their territories are decided by the *jmaa* and are watched over by *jmaa* nominated members that serve as guardians (locally called *Ait Rbains*). When the *Ait Rbains* report an infraction, graduated sanctions are usually established by the *jmaa*, according to the type of offences. The extensive pastures of the *Ait Ikiss* and dense humid grasslands of the highlands mainly situated in the *Yagour n'Ikiss* habitat (about 5 km^2) are the most important basis for the existence of the local agro-pastoral system. But other spaces and resources are also important to this system, as we will see later (Fig. 16.4).

The studied groups still follow more or less the pattern of the old tribal organization, described by a British anthropologist Ernst Gellner as *segmentary structure* (Gellner 1969). It is characterized by fitting one social group (*segment*)

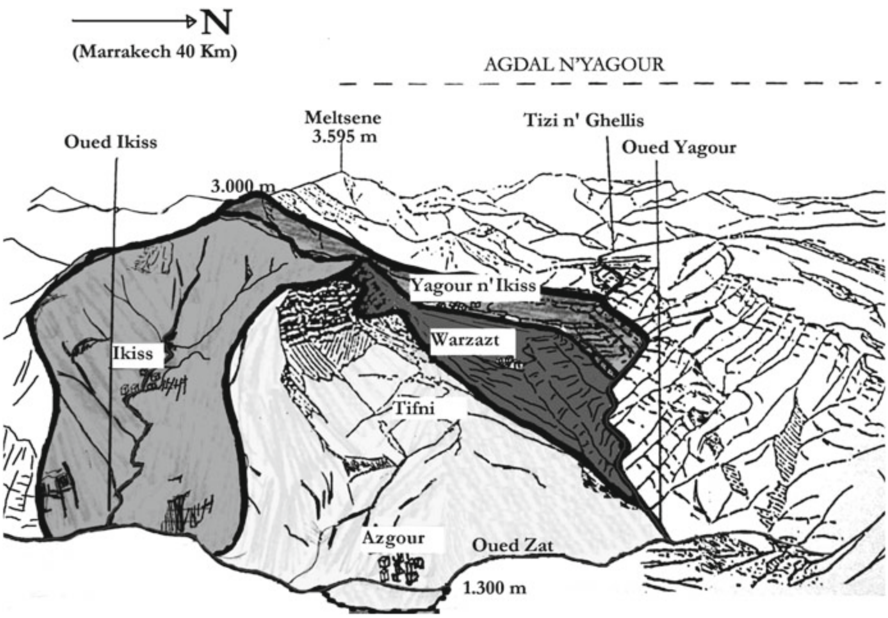


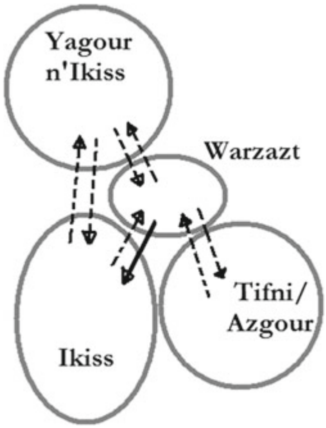
Fig. 16.4 Territory of the *Ait Ikiss* and their four habitats (after Dresch 1939)

into another, from the smallest to the largest, like the Russian dolls (Evans-Pritchard 1970). For example, the *Ait Ikiss* continue organizing themselves in tribal groups, subgroups, villages, clans, and nuclear families. They speak *Tachelhit* as their mother tongue, a southern Moroccan Berber dialect. In addition, practically all men and some of the younger women speak Arabic. They learn this language through television, administrative procedures, in schools established in the area around the 1980s, and through social/professional relationships (only men in this case). The local agro-pastoral sector contributes 75% of the income, which is usually combined with seasonal emigration or engagement in some specialized local professions such as masonry, smithery, or others of the sort (Bellaoui 1989). Locally practiced animal husbandry concerns mainly cows, sheep, and goats.

Collective Spatial Organization of the Tagdalts System of the Aït Ikiss

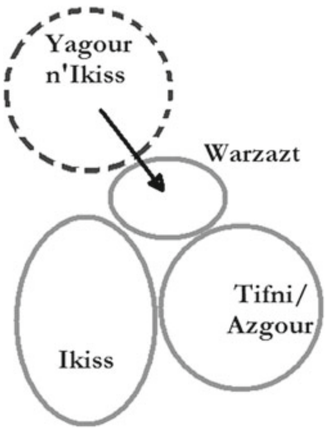
This area with heavy winter snow and a harsh climate suffers from fodder shortages for the herds during winters and especially in dry years at the end of summers. It is thus a challenge for these agro-pastoralists to manage the use of the territory in time and space in order to meet the nutritional needs of their livestock, and to ensure soil fertility in the cultivated areas by means of animal manure (Genin et al. 2012). With this in mind, agro-pastoralists regulate access to the resources by means of various *agdals*. All these *agdals,* as a whole, are locally named *tagdalts* (small *agdals*) in contrast to large tribal *agdals* managed by several villages and tribal groups. The discussed below agro-pastoral calendar reflects the choices people have regarding restrictive herding periods which dictate the rhythm of displacements of animals and people, in relation to the availability of different natural resources throughout the year. There are five major episodes of movements in the annual cycle.

28 September–28 March



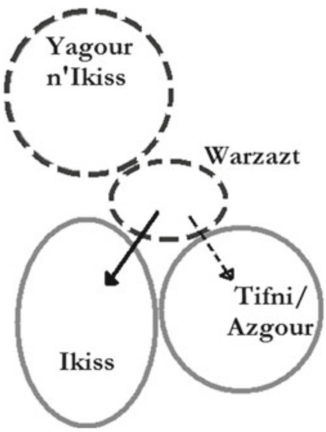
On September 28th, after 2 months of herding prohibition, the *agdal* (or *tagdalt*) of *Ikiss* opens up. Until this date the prohibition affects not only herding but also gathering walnuts and other fruits. From this date onwards, all spaces are opened and there are multiple movements of people and animals. In any case, it is nut gathering at the end of September which dictates the main movement of peoples (main displacement is always indicated with a solid line arrow on the diagrams and other movements are represented by dashed lines). At this time, most of the people leave for *Ikiss* because that is where most of the walnut trees are located. The village of *Ikiss* is the location where most of the *Ait Ikis* population spends the autumn and winter seasons. One of the reasons for this is walnut gathering, but people move there mainly because it is located at lesser altitude (1,700 m), and the weather is not as cold as in *Warzazt* (2,000 m) or *Yagour n'Ikiss* (2,200 m). Another important reason for living in *Ikiss* is because it is the hometown of the entire group (hence their name, *Aït Ikiss* meaning "those from *Ikiss*") from where, throughout the last century, some have moved to other habitats. Thus, *Ikis* has more well-built houses and is better suited for spending the winter. *Tifni* is mainly an area for sheepfolds and *Azgour*, although lower and with a better winter climate, has less agricultural lands and is an old sheepfold that was transformed into a village only at the arrival of the twentieth century, after the construction of the road at the bottom of the valley. It is less equipped in terms of infrastructure.

28 March–20 April (Approximately)



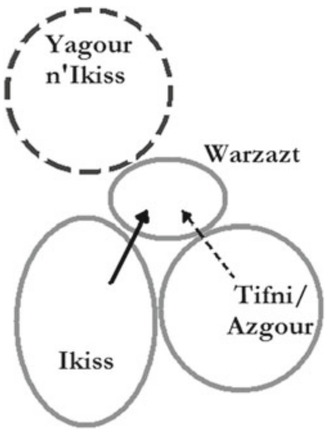
On March 28th the whole of *Yagour* is put in *agdal* for 3 months (areas under the *agdal* prohibition are marked with dashed circles), mainly in order to promote the growth of graminaceous plants. In fact, it takes several weeks to enforce the prohibition because there are always herders who attempt local political maneuvers to stay as long as they can. Presently, the prohibition is only imposed from about mid-April every year. At this time, approximately 50 adult shepherds of the *Aït Ikiss* leave *Yagour*. People who have been herding their sheep in *Yagour* come down to *Warzazt* at this time. Caprines and bovines are kept away from the colder regions all year except late spring and summer, mostly in *Ikiss* and a very small minority in *Azgour*.

20 April (Approximately)–20 May (Approximately)



Warzazt is the second high altitude habitat of the *Aït Ikiss*, and the most extensively cultivated. According to the shepherds, the month of May is the most critical period for the growth of the pastoral plants at *Warzazt*, although the dates seem to be starting to move with the apparent climatic change that locals say they have noticed. Winter seems to becoming increasingly shorter and snow melts earlier, so people start moving the opening dates earlier. Thus, in mid-spring, the herding prohibition is also imposed on *Warzarzt*, in order to allow the grass to grow back, particularly the strips between the cultivated fields which are especially productive by the fact of being permanently irrigated. At the time of prohibition, the 20 families who have their main houses in *Warzarzt* (mainly sheep herders) are obliged to move with their herds down to the *Tifni* sheepfolds at 1,900 m (on the way to *Azgour*), and especially to *Ikiss* at 1,700 m.

20 May (Approximately)–10 July (Approximately)

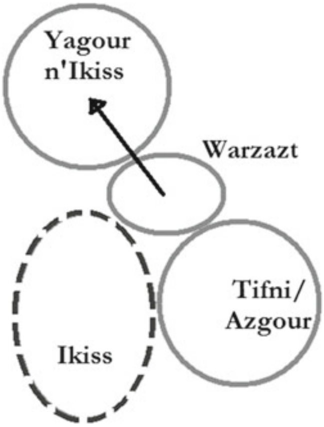


After 1 month of *agdal*, *Warzarzt* reopens again (around May 20th), but not before celebrating the annual ritual in honor of the local female saint, *Lalla Tacheïkht*. To ensure not only the community's health and protection in the highlands, but also that of their animals and a prosperous summer period, all the families come together with food for a ritual group meal or *maarouf*. The people cook butter, they bring in with them and those who do not have butter bring rice, pasta, or couscous. All of the food is shared equally, among the rich who contributed more and the poor who contributed less, in front of the saint's tomb. At the same time, animals such as goats, up to seven for the whole community in 2006, are sacrificed (only by males) for the collective meal, and the blood is supposed to be consumed by spirits (*djin*) that help the saint to guarantee a good period in the summer pastures.

This brings about an opposite migration of people going up from *Ikiss* and *Tifni* towards *Warzarzt*, where about a month later (at the end of June) the barley harvest starts. During this period, virtually all the *Aït Ikiss* migrate towards the highlands.

Also, the two shops in *Warzarzt*, which had been closed since September, reopen with the arrival of the people. In fact, the two shop owners (former local herders themselves) and the *fqih/imam*, move with the group from *Ikiss* to *Warzazt*. Just beforehand, they sacrifice animals in the hope of a good stay in the high pastures.

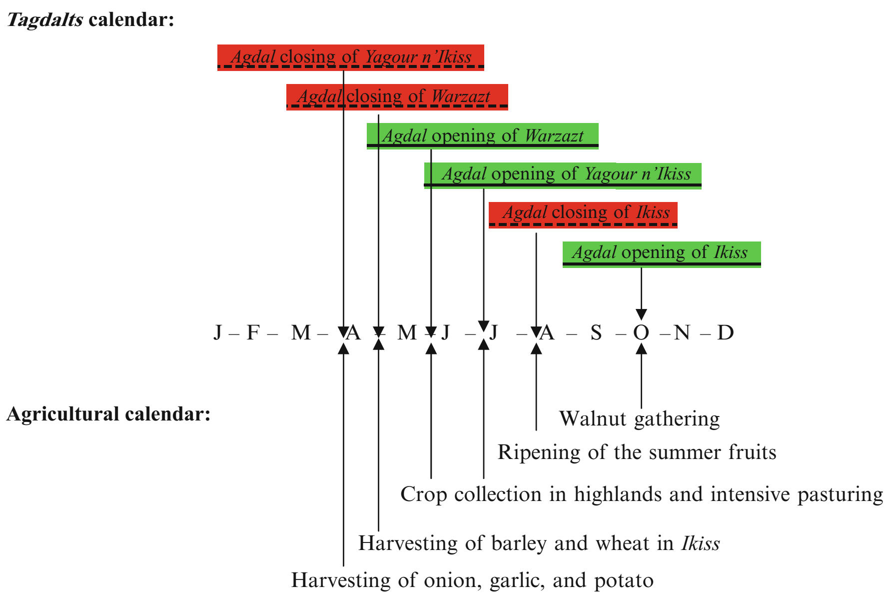
End of June/Beginning of July–28 September



At the beginning of summer, the *Yagour n'Ikiss* opens up again. Depending on the ecological conditions of the year, the *Yagour* opens up at around the beginning of July, according to the decision made by the *jmaa*. Until the 1970s, the opening of *Yagour* took place on a set date, the first Friday (the big Muslim day of prayer) after the start of the Berber summer, the 28th of July, and it was blessed by the family of the macro-regional saint, *Sidi Boujmaa*. Nevertheless, the present growing demography, cultural contact with external Islam, and climatic changes, have forced this date to be brought forward and have made it flexible, adapting it to the climatic variations and needs of every year. Thus, depending on the year, at the end of spring or beginning of summer, the migrant *Aït Ikiss* take their animals up the slopes leading to their richest pastures and prepare to enjoy the most abundant period for the community, which is seen by many children as the holiday period. Presently the descendants of the saint *Sidi Boujmaa*, receive only sporadic visits (four or five decades ago they used to be many) from people who want to give them vegetables, butter, or other alimentary products, or sacrifice an animal, in the hope of receiving the blessing of this great saint, from the beginning of the summer onwards.

The opening of the *agdal* of *Yagour* is an event of great local importance because it provides excellent grazing for the herds, and also an opportunity for the people to meet the inhabitants of other, lower villages altitude after over 9 months of staying apart. Other ritual sacrifices of animals and festive events also take place at this time all over the territory. In those areas that are most favorable for agriculture, the harvesting of cereals is carried out just a few days before the opening of *Yagour* or in the following weeks. At the same time, the *Ait Ikiss* assembly authorizes the collection of fodder for the winter season, where (only during the first 3 days after the opening of *Yagour*) families can mow as much pasture as they can. A few weeks later, in mid-July, following the same community logic, the *Ikiss* area is put in *agdal* too and herding becomes prohibited once again. This prohibition particularly helps to protect fruit trees in the valley that are ripening at just this time, and also the lowland pastures that had previously been grazed, and which may be severely affected by summer drought. Only every 15 days or so, the fruit tree *agdal* is lifted at *Ikiss* to prevent the rotting of certain fruits that had ripened on the trees before the 28th of September, when the whole *agdal* prohibition at *Ikiss* is officially lifted. When all the people return to their winter houses which they left 4, 5, or 6 months earlier, they hold one last ritual meal or *maarouf*, in which they honor once again the locally buried saint, that of *Ikiss* (*Lalla Tacheikht*). In this way, the end of the cycle is reached, the whole system returns to the situation shown in the first diagram and after the gathering of the walnuts, most of the people stay in *Ikiss.*

As we have observed, the dates and access rules to the renewable resources of the *Ait Ikiss* are closely related to pastoral and agricultural requirements, and also to the system of production (availability of good pasture, mowing of fodder for the winter, fruit trees, cereals, horticulture, grass strips between the terraces, animal manure as agricultural fertilizer, etc.). Below is a schedule for the various *tagdalts* of the *Aït Ikiss* in relation to the agricultural calendar. The schedule evolves with time affected by different socio-ecological changes that take place as new products and economic or ecological conditions are incorporated to the routine. It reveals the overlap between the *tagdalt* and the pastoral and agricultural calendars.



Discussion

This study examined diverse aspects of the *tagdalts* system followed by the *Ait Ikiss*, an adaptive and traditional Berber mode of administrating access to the communal natural resources with its own history and endogenous development. In the last centuries the territory has been appropriated by different users (Dominguez 2010), and *agdal* rules have been updated to fit the particular circumstances at each period. Through the research presented in this study, we have gained better understanding of an ingenious system of agro-pastoral land rotation that has evolved through time until its present forms, which has been observed. Currently, as the study area is concerned, the system has been adjusted to enforce prohibition of herding in different locales during some months of spring and summer in order to maintain sufficient animal fodder all year round, but also to make it compatible with the emerging local agricultural capabilities. At the same time, it remains closely linked to a complex but also changing cosmological system, a holistic set of rules and beliefs which shows concern in the conservation of the biophysical environment, the performance of local economy, and the maintenance of social cohesion, and cultural continuity. Overall, this analysis reveals the importance of the four pastoral lands of the *Ait Ikiss* and explains the collective action embedded in the institution of *agdal*, and helps in answering the question why it endured through centuries even if it has constantly kept evolving and still continues to do so (Dominguez et al. 2010). The answer, in my opinion, is because the *agdal* has always played a crucial role within the local agro-economy, and all of it through the compatibility of local meaning and justice. The indigenous profile of the institution, its local emergence as the result of local negotiation linked to each historical environment, but always built and rebuilt in a certain context of meanings and cultural heritage, gives the *agdal* a character and a legitimacy, which cannot be simply replaced with other external, western, or global proposal.

The herding prohibition discussed here allows the vegetation's flowering, reproduction, fructification, and establishment of young seeds and thus promotes the continuity of the pastoral ecosystems. Also, the *agdal* protection and the nonintensive exploitation of the lands encourages a denser plant cover than that which could be found if spaces were herded simply as "open access" (Kerautret 2005). Thus, *agdals* appear to possibly help fight erosion as well. Also, the system of different *agdals*, closing and opening of places at different times, involves an *ecological mosaic* effect throughout the whole territory of the *Ait Ikiss* due to a specialized and differentiated use of the four key sites discussed above. Backing up or inhibiting the expression of different species depending whether one *agdal* or another is applied also fosters genetic plant diversity (Dominguez and Hammi 2010) and entertains a *pool of biodiversity* that serves as a point of diffusion of different seeds (Auclair et al. 2007).

Concerning the performance of the local economy, we found that the *agdal* management of the pastures fosters continuity and durability of the pastoral economy by creating the conditions for sustainable existence of the people within the current ecosystem, as discussed above. In fact, the current system based on ecological and economic equilibrium would simply collapse and change its essence should the *tagdalts* disappear, since without the resting period the pastures would lose their *carrying capacity* and ability to reproduce and regenerate the vegetation. Moreover, the fodder contribution accumulated after the herding prohibitions in all the areas controlled through *agdal*, arrives in late spring, summer, or the end of summer, when other pastures are dry and when fodder demands are higher as young animals are still being milked or mothers are pregnant with the second annual offspring. This gives an extra economic value to the fodder that has been accumulated during *agdal* prohibitions. In fact, natural grasses of *Yagour* can seasonally reach the cost as tilled barley!

Nevertheless, it would be too reductionist to limit the analysis to the ecological durability of the system or the *tagdalts'* economic productivity, since the *agdal* has other less materialistic or quantitative functions. First, it gives equal access to pastures for the entire community and highlights a certain social justice among herders. All *Ait Ikiss* benefit from the collective nature of the *tagdalts*, which is the fruit of the agreement of all users who participate in managing of these grasslands and securing access to them for all shepherds. Such arrangements prevent conflicts as *agdal* prohibitions are always imposed after negotiation during the local assembly. *Agdal* is in fact also a tool for social justice that regulates competition among the users. Although it is always the richer herders with more cattle who will make the most profit from the communal pastoral resources, as the *agdal* only establishes a limit for collective time use and not the number of livestock grazing, they will never be allowed to herd during the critical prohibition periods. While the "majority" of users still maintain the rules of *agdal,* the poorer will always have a way of stopping the richer owners. In this way, but also through the emotional appropriation of the territory, *agdals* also participate in local identity building and the feeling of "belonging" to a certain group that regulates rights and duties over those commons.

On a more general cultural level, *agdal* is also one of the main vehicles of a complex cosmological system that gives meaning to the social organization and to the inhabitants' own lives, which is also a value in itself. We have seen how a migration towards the *agdal* managed pastures is an occasion of intense deployment of social and cultural activities, a meaning of normality, of local homeostasis, mixed with a *frenzy* of religious celebrations, as discussed in Sect. 2. All of it takes place in a totally multidirectional and interconnected way and contributes to consolidating the collective discipline that assures the success of this management model of the *agdal*, and by doing so, gives a sense and importance to the activity and its existence. The migration towards the *agdal* is multidimensional and not acknowledging it would distort any analysis. This is a type of social organization where the sacred, traditional, or new formulations of the sacred, hold an important place and give "meaning" to the material activities. The *tagdalts* in turn involve meanings and rites that contribute effectively to the social cohesion and the reproduction of the ecological and cultural order. What we could finally conclude from this discussion is that if we want to have a more complete and holistic vision of the whole practice, an eco-anthropological and transdisciplinary approach is necessary to show all the dimensions of such dynamic collective action around natural resource management as *agdal* systems.

Conclusions

We conclude here that the system of communal management of the *agdal* must be seen and encouraged as a socioculturally resilient, economically sustainable, and ecologically enriching approach to land use. In fact, the system of *agdal* could be used as a tool for designing local developments as it has shown its pertinence through the centuries and different epochs. The *agdal* of *Yagour* is an example of evolutionary "conservationism," which puts forward the role of human agro-pastoral activities in the maintenance, landscaping, and conservation of the environment rather than the "preservationism-sanctuarism," which would exclude humans and their different activities from environmental conservation. In this sense the *agdals* could become a fundamental tool of extensive gardening and territorial management that should not be ignored. This argument should be taken into account if we consider that we are discussing an institution with a very long history and a strong local legitimacy, supported by real competences in matters of renewable resource management.

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Chapter 17
Afterword

Ludomir R. Lozny

There are four chief reasons for this book at this time. Mountain regions provide critical goods and services to a considerable portion of the world's population occupying or drawing upon mountain ecosystems within 40° from the Equator. Much of the fresh water sustaining human activity originates in mountain snow packs and glaciers. After millennia of relatively successful human adaptation to mountain ecosystems we are now witnessing changes and the increasing vulnerability of mountain ecosystems caused by human activities and governmental policies. Finally, since mountainous regions are frontier zones of competing polities and refuge areas for dissident communities, they often are inherently difficult to control by centralized authorities. As a consequence they fuel or contribute disproportionately to political violence.

There have been several significant attempts by anthropologists to combine the results of ethnographic research on cultural adaptation into more comprehensive and comparative analyses. These attempts have followed two general courses: (1) the comparison of the adaptation of similar cultures or similar technological systems to different environments, and (2) the comparison of the adaptations of different cultures to similar ecosystems. The presented book generally follows the latter approach but it offers discussions on human cultural adaptation to mountain ecosystems viewed in synchronic and diachronic scales. Although there is a well-established literature on mountain ecosystems very few books present human cultural adaptability to mountain ecosystems in a comprehensive manner which includes archaeological, ethnographic, and ecological data. Such an approach has not been offered yet.

Mountain ecosystems have been less studied because they do not offer a readily defined set of problems for human exploitation as do, for instance, tropical forests or arctic habitats. But two reasons why we should pay more attention to mountain

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ecosystems seem especially significant: (1) mountainous landscapes change fast and cultures disappear and they need to be recorded, and (2) mountain regions are of interest as cultural responses by mountain populations to environmental change provide clues for us all. Critical to understanding mountain cultural adaptations is our comprehension of human decision-making and how people design short- and long-term strategies and the presented book offers such outlook. The essays in this book discuss human cultural responses to key physical [environmental] and cultural stressors associated with mountain ecosystems, such as industrialization and infrastructural change, aridity, quality of soils, steep slopes, low productivity, centralized political decision-making as well as human impacts on mountain ecosystems in general. Also considered are transient phenomena such as El Niño in the Andes, deforestation and erosion, and the possible effects of climate change. Mountain populations cope with the stressors by adopting specific cultural strategies, such as seasonal migrations, integration of pastoral and agricultural production, animal crossbreeding, use of crop varieties, a mixture of communal and household control of land, trade, crop diversity, diversification of activities, and innovative scheduling of productive activities. Cultural adaptational strategies usually relate to altitudinal verticality which allows for exploitation of various ecological zones, diversification of diet, and access to a multiplicity of resources. Low productivity is mitigated through trade and exchange and seasonal migration. Mountain regions also provide data on past environmental change, for example ice cores from the Andes and the Himalayas or pollen data from the Alps and the Pyrenees presented in this volume.

The book is addressed to graduate level students and researchers, botanists, conservationists, ecologists, geographers, archaeologists and cultural heritage planners, anthropologists, governmental, regional, and global policy-makers, and policy-making institutions concerned about conservancy and development.

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