Common Property Resource Management of an Afro-alpine Habitat: Supporting a Population of the Critically Endangered Ethiopian wolf (*Canis simensis*)

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Summary

In areas where national parks are unlikely to be economically viable or socially desirable, an alternative approach is required. Community-led conservation initiatives are one possible approach. Their eventual success requires both an understanding of the ecosystem itself and of the interaction between the indigenous population and the varying components of the ecosystem that they utilise. In this thesis I investigate the indigenous common property resource management system in the Guassa area of Menz in the central highlands of Ethiopia, and the consequences of resource utilisation by the community on the populations of rodents, and of the critically endangered Ethiopian wolf. The area traditionally has been, and still is, a valuable natural resource for the local community that depend on it primarily for thatching grass, firewood and grazing.

The indigenous resource management system was structured under an indigenous resource management institution, known locally as the *Qero* system, for around 400 years. The system was based on descent groups from founding fathers who agreed on division of the land in 17th century, and further supported by the authority of the church. The function of the *Qero* system was the regulation and equitable distribution of natural resources among the user community, and it functioned by enacting and enforcing various bye-laws. The *Qero* system declined in 1975 following changes in land-tenure and rural land reform introduced following the 1974 revolution. In the case of Guassa, incomers previously excluded from the resource gained equal access to the resource through their constituent peasant association. When it became apparent that the resource management system was declining, the community responded by establishing the Guassa Committee, which contains heavy community representation, but remains in line with the existing political and social order.

The community still generally retains a positive attitude to the Guassa area, and recognise its value in providing vital resources. However, opinions on the value of the resources, the success of past management, and the options for future management, all vary according to levels of past and present control, and distance of their village from the Guassa area. Peasant association members once excluded, but now enjoying prime control and living nearby, believe current management is effective, and wish it to continue. In contrast, peasant associations dominated by descent groups formerly in sole charge of Guassa, and living further away, see current management as ineffective and, rather than expecting any return to the *Qero* system, wish for an element of state control to correct ineffective community management.

The resources of the Guassa are widely used by the community. Grass is still collected for thatching, mainly in the dry season, from the dominant *Festuca* grassland community, but the closed season is not as rigorously enforced as under the *Qero* system. Firewood is also collected, mainly in the dry season, mainly from the *Euryops-Alchemilla* shrubland community. Cattle and other livestock are also grazed in the Guassa, which is an important dry season refuge, and mainly utilise the Mima mound community. Several species of rodent live in the Guassa grasslands and their community structure differs between habitat types and their activity differs between day and night. Nevertheless, the current levels of resource use by humans have no overall effect on community structure, but each rodent species is affected differently by each form of use in different habitats, some showing increases in abundance in relation to use and others showing decreases in abundance.

Rodents provide the main prey (88.1%) of the Ethiopian wolf, and rodent density was the main determinant of the habitats selected by the Ethiopian wolf. The home range sizes of individuals and packs, and group sizes, of Ethiopian wolves in the human-dominated Guassa area are similar to those in the relatively undisturbed landscape the Bale Mountains National Park. Furthermore, time spent foraging by wolves was not affected by the presence of humans or livestock closeby. Despite little apparent disturbance of wolves by humans or livestock, the Guassa area only supported a population of approximately 20 Ethiopian wolves, at a somewhat lower density than wolves in Bale Mountains.

Lacking data on population trends of wolves in Guassa, it was not possible to determine if this lower density arose from carrying capacity issues on the one hand or persecution as a result of alleged nuisance value to sheep on the other hand. Nevertheless, overall the local community had a positive attitude towards the wildlife of the Guassa in general, and to the wolf in particular, although many believed that the Ethiopian wolf population had declined. Predation of sheep was the main concern, although sheep loss per household was 0.01% per year

Although the indigenous resource management system was not designed to conserve wildlife, it has certainly allowed the continued co-existence of wildlife with the local community. As perhaps the second largest population of the critically endangered Ethiopian wolf remaining, the Guassa area represents an interesting model of community led management that has had the resilience to resist modernising forces. However, as the human population of the region continues to increase, it is important to ensure that the community continues utilise the natural resources sustainably. This will require the empowerment of the community so that they opt for continued sustainable conservation rather than de facto open access.

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Chapter One

1 General Introduction

In this thesis, I explore how an indigenous resource management system in the Central Highlands of Ethiopia has managed its common property resource for many hundreds of years. The resources in question comprise biodiversity-rich upland grassland that has supported a flagship species, the Ethiopian wolf (*Canis simensis*), which is one of the most critically endangered canids in the world. A major interest of this study is to explore how the Ethiopian wolf has managed to survive in this resource management system in the Gussa area of Menz, while it has become locally extinct in adjacent similar areas.

1.1 Systems of Biodiversity Conservation

The natural resource base has become greatly reduced and fragmented leading to a massive extinction of species (Myers, 1979). The current reduction in biodiversity seems destined to approach that of the great natural catastrophes at the end of the Mesozoic era, some 65 million years ago (Wilson, 1992; Barbier *et al.*, 1995).

The classic approach to wildlife conservation is characterised by a top-down approach, that includes the establishment and expansion of protected areas, enforcement of wildlife legislation and the assumption of ownership of wildlife resources by the state. Early formal wildlife management initiatives shared this approach with many other rural development initiatives in Africa. While these approaches have ensured the survival of populations of certain species and ecosystems, and contributed to the generation of foreign exchange earnings, they have been slow to integrate local people into resource management and decision-making activities. Local communities are faced with a rapidly diminishing natural resource base. Conflict between local communities and conservation authorities has escalated and law enforcement has become less practical and more costly. As the human population grows, demands on remaining resources have increased leading to environmental degradation and further conflict. Thus, it is important to examine as wide as a range as possible of viable options preventing biodiversity loss.

1.1.1 Establishment of Protected Areas

The idea that human beings should preserve, as well as conquer nature, originated in the last few hundred years. Isolating areas from human impact and development lead to a policy of protected area establishment dominated by the American (western) model of protection (Ghimire and Pimbert, 1997). This model, sometime referred as "fence and fine" view of natural resource conservation, was based on the fact that consumptive use of resources should be absolutely prohibited. This approach began with the creation of Yosemite and Yellowstone National Parks in the United States 125 years ago, although the original concept had evolved from previous efforts to set aside areas as hunting preserves for the rich or royal. Since then approximately 12,754 protected areas encompassing approximately 13.2 million km^2, over 8.81% of the earth's land surface, have been gazetted and established (IUCN, 1998).

While national parks make a crucial contribution to some of the universal functions of conservation, the American model of protection does not always translate very well in the tropics. In fact, it is difficult to find national parks in the developed or in the developing world that are effectively meeting all the functions for which they were designed. In a sample of 100 parks from 49 countries, Machlis and Tichnell (1985) identified 1611 threats to the parks. For example, some 95% of the parks in the tropics reported 'illegal' removal of wildlife and other resources as well as disrespect of the boundaries by the communities living adjacent.

The management of protected areas in developing countries all too often entails huge social and ecological costs. Thus, the general social consensus leading to designation of certain areas as national parks, reserves and sanctuaries was not, and is not, universally shared by the communities that this decision affected (Anderson and Grove, 1987; Ghimire and Pimbert, 1997). The costs are rarely perceived as likely to be significant during the process of designation and establishment, but may ultimately threaten the long-term survival and viability of protected areas. The devastating consequences of resettlement schemes for indigenous peoples are noteworthy in this context (Anderson and Grove, 1987; Gamaledinn, 1987; Colchester, 1997). A growing body of empirical evidence now indicates that the transfer of the 'fence and fine' approach to conservation to the developing world has had an adverse effect on the food security and livelihoods of people living in and around protected areas (Turton, 1987, 1995; Ghimire, 1994; Ghimire and Pimbert, 1997).

The top-down approach to the protection of wildlife has also entailed large management costs for governments (Leader-Williams and Albon, 1988; IIED, 1994), while most benefits have accrued to external interests without the communities who pay the costs of conservation. It has generally been assumed that the value of conserving wildlife is more than the costs it incurs. As a result, the system has rarely been analysed rigorously to determine whether the benefits are greater than the costs (Pimbert and Pretty, 1997).

On several occasions, local communities have been expelled from their settlements without adequate provision for alternative means of work and income. In other cases, local people have faced restrictions in their use of once common property resources. National parks established on indigenous lands have denied local rights to resources turning local people practically overnight from hunters and cultivators to poachers and squatters (Anderson and Grove, 1987; Colchester, 1994; Ghimire and Pimbert, 1997).

The current agenda for tropical conservation, therefore, reflects conflicts in social attitudes and inequalities of resource allocation (Iltis, 1983; Lewis and Kaweche, 1985). Conservation of complex ecological communities depends on maintaining the processes that determine their dynamics. It is the diversity of these processes, which is important, not the diversity of species *per se*. The rate at which all the processes occur quite naturally vary overtime and what is needed is to maintain a wide regime of management systems (Leader-Williams *et al.*, 1990).

Over the last 20 years, there has been a growing realisation of the importance of understanding the needs and perspectives of communities in conservation, through interactive communication between the resource managers and communities (Ghimire and Pimbert, 1997). This has led to the re-emergence of other approaches in the management of biodiversity. The approach that has evolved is aimed to involve local communities in the process of resource management and decision making through what is known as community-based conservation (Western and Wright, 1994; IIED, 1994).

1.1.2 Community-based Conservation

Community-based conservation intentionally includes a range of activities practised in various corners of the world that directly or indirectly lead to conservation. The co-existence of people and nature, as a distinct form of protectionism is the central precept of community-based conservation (IIED, 1994; Western and Wright, 1994; Barrow *et al.*, 1995; Leader-Williams *et al.*, 1996; Ghimire and Pimbert, 1997).

Defining community-based conservation precisely is difficult, because of the difficulties of achieving a coherent definition of the term "community". Should "community" be defined by ethnicity or traditions, by residency or by sense of a common purpose? Or, given the great influx and transition now seen in most societies, should it include immigrants, those in cultural transition and those with no ancestral ties to the land or to each other? In today's world, traditional communities are rife with internal conflicts and divergent interests and often split along economic, gender and social lines (Little, 1994).

In general terms, community–based conservation aims to involve rural people as an integral part of nature conservation policy. Community-based conservation has grown out of its own accord, but most importantly it recognises a neglected set of participants and acknowledges their significance in the conservation of the rural landscape. The key element of such programmes is that local communities participate in resource planning and management and that they gain economically from resource utilisation. It also promotes the legal and sustainable use of the wildlife and other natural resources. The underlying objective of community-based conservation is to demonstrate the positive role that wildlife and its habitats can have in land-use planning and in socio-economic development at local, regional and national level (IIED, 1994; Western and Wright, 1994; Leader-Williams *et al.*, 1996).

Community-based conservation is now a widely used strategy to save wildlife. It has its modern roots in the experience of conservationists working in developing countries during the 1970s. Conservationists came to realise that local people, who where commonly hostile to wildlife, had to be won over as supporters of their efforts (IUCN, 1980). It was increasingly realised that, without the co-operation of rural communities, wildlife conservation efforts would be doomed to failure. This was certainly true in Africa, where rural inhabitants often viewed wildlife conservation as a misguided venture that put wildlife protection before human needs (Anderson and Grove, 1987; Pimbert and Pretty, 1997). Although this response is primarily a present day reaction to people's economic needs, it also has strong roots in the colonial legacy that alienated rural African communities from conservation efforts. With conservation, Africans faced restrictions imposed by outside authorities that denied them the right to use resources. The policy was often based on a coercive form of protectionism that ignored the needs of African people (Metcalfe, 1994; Pimbert and Pretty, 1997).

A community-based approach can be effective because it harks back to pre-colonial African conservation practices that used community-led constraints to regulate resource use and is a means by which rural Africans will benefit materially from saving wildlife (McNeely and Pitt, 1985; Metcalfe, 1994). Therefore, the overall goal of community-based conservation is to re-instate rural communities as an integral part of conservation efforts (Murphree, 1994; Western and Wright, 1994; IIED, 1994; Leader-Williams *et al.*, 1996)

In its purest form, community-based conservation can change the relationship between rural people and government agencies. Its advocates stress that it changes the usual way of doing things by giving local people a strong voice in land-use decisions, instead of having them imposed from above (Chambers, 1983; Western and Wright, 1994). Decentralisation of resource management from the central authority to local communities is considered a first step forward for a successful community-based programme. This emphasis on participatory democracy gives community-based conservation somewhat a revolutionary and anarchic character (IIED, 1994).

Over the years, various initiatives have sought to increase active participation aimed at developing power and responsibility for resource management among the community. Hence, local people have become involved more actively in the generation and distribution of benefits. Examples of this approach include community game guard schemes and income-generating activities (Metcalfe, 1994). Such initiatives are frequently centred on communal land, often rich in wildlife and support low human population densities, around protected areas. These initiatives help communities to share the benefits of wildlife management and may reduce poaching levels. However, in the absence of stable local institutions they can entail greater costs for the community (Murphree, 1993).

Unfortunately, the majority of efforts carried out in the name of community-based conservation are passive participation schemes. Many simply aim to compensate local people for loss of access to natural resources by providing an alternative livelihood source, quite often simply comprising handouts (IIED, 1994; Songorwa, 1999). The assumption here is that the economic incentive to exploit restricted resources will be removed. These schemes are usually carried out under the auspices of government or donor-funded projects that view local people as passive beneficiaries. In such case, benefits are not always distributed equally, compensation is rarely proportional to the amount of income foregone, and the services provided do not address sufficiently the needs of the people. As a result, it is not easy for communities to develop a sense of ownership, and local people do not feel committed to the upkeep and maintenance of institutions and infrastructures. In addition, the adoption of various income-generating schemes often fails owing to lack of markets. In some cases, schemes become time consuming and so complicated that local people find it impossible to participate effectively (Campbell, 1991; Little 1994; Hoben, 1997; Hackel, 1999; Songorwa, 1999).

It is being increasingly recognised that the community ownership rights and their tenure over wildlife resources must be secured for sustainable wildlife management (Lynch and Alcorn, 1994). While there have been attempts to provide an administrative and legislative framework conducive to guaranteeing such rights, this approach to natural resource management is still in its infancy. Some community-based schemes have introduced consumptive and non-consumptive utilisation, which undoubtedly helps local people to appreciate the value of wildlife, to increase household income and to reduce poaching (Murphee, 1993; Metcalfe, 1994). However, experience shows that bringing together management, ownership, tenure rights and equitable distribution of costs and benefits is complicated. In many cases local governments are unwilling to devolve real responsibility and power to communities, or to pass on the full amounts of revenue generated. This is hardly surprising, as central grants to local governments are declining. Furthermore, schemes that use participatory processes for community empowerment can still fail where societies are highly stratified. In such situations conflicts have arisen between traditional authority and the participatory process. Further more, short-term commitment to the process has not helped to propagate sustainable impacts (Murphee, 1993; Alcorn, 1994; Songorwa, 1999).

For community-based conservation to be successful, it needs to be flexible enough to cope with a countryside inhabited by a growing number of extremely poor people who depend on a subsistence existence and whose greatest goal is to gain economic security. If wildlife conservation is to become a priority, it reduces peoples' long-term land-use options, because large areas of natural habitat must be preserved. This reality makes the widespread implementation of community-based conservation programmes problematic (Hackel, 1999).

Community-based conservation programmes are a more realistic approach in areas that are capable of attracting large revenues from tourism or hunting. However, the main concern here should also be the right of community to use the natural resources that were once denied to them. Equally, this can make programmes incapable of dealing with the current socio-economic situations for at least three main reasons. First, areas that cannot generate major revenue will not have the potential required for the conservation-based projects that rely on revenue sharing. Second, even in those areas where the revenue is expected to rise, there is a danger that communities may reject it for various reasons. Third, in many cases the revenue received by the community is low compared with other forms of land uses, and if a rural community accepted community-based conservation on its economic benefits, they might also reject it if a better economic alternative were available (Hackel, 1999; Songorwa, 1999).

1.1.3 Indigenous Common Property Resource Management Systems

Over the centuries, communities have developed time-tested ways to protect their natural resources. Sacred reserves were established, regular times for planting and harvesting were carefully observed and a close liaison was established with nature in all its forms. For example, the Aborigines of Australia call it "looking after country" while the Andean Incas referred to it as caring for *Pacha Mama* "Mother Earth" (Kemf, 1993). Undeniably, there are entrenched traditions among many communities to adopt a certain degree of stewardship of the land and its natural resources upon which the community depends (Berkes, 1989; Ostrom, 1991). The reasons for doing so are varied, but largely have to do with survival and with a responsibility to ensure continued legacy for generations to come. Various examples of well-documented common property resource management systems exist (McCay and Acheson, 1987; Acheson, 1987; Berkes, 1989; Ostrom, 1991; Shankahala, 1993; Craven and Wardoyou, 1993; Kemf, 1993).

Communities have demonstrated a concern for maintaining ecological processes, and often show a keen interest in the management and regulated use of common property resources (Alcorn, 1994). Indigenous communities have maintained resource management systems under complex and indigenous tenure rights that share benefits across their community and exclude non-community members. Indigenous common property resource management systems are in effect a partnership between individuals and their community. Therefore, they offer greater promise for conservation than 'fence and fine' systems of resource conservation (Redford and Stearman, 1989). Through intimate knowledge of their physical environment, communities have devised techniques for sustainable management through harvesting, improving, protecting and regeneration of natural resources. Rules and regulations enshrined within the traditions of the society ensure the smooth functioning of the system by co-ordinating the activity of each member (Berkes, 1989; Ostrom, 1991).

All common property resource regimes share two important characteristics. First, there is exclusion or controlled access of users to resources. Second, each user is capable of subtracting from the welfare of other users. Hence, common property resources are defined as a class of resources for which exclusion is difficult and joint use involves subtractability (McCay and Acheson, 1987; Berkes, *et al.*, 1989; Feeny *et al.,* 1990). Unlike open access, private and state property resource regimes, a common property resource regime has an identifiable community of users who hold the resource, who can exclude others and who regulate uses. Limited entry is achieved through closed membership and by control of the mode of appropriation, which effectively excludes non-members from access, in the process discouraging 'free-riding'. Originally, common property resources include renewable and non-renewable resources such as wildlife, forest, grazing land, fisheries, genetic resources, water, and oil deposits. In recent years, public parks and highways have also come to be considered as common property resources. Furthermore, wavelengths and the geosynchronous orbit of band space above the equator, in which most communication satellites are placed, have come to be regarded as global common property resources (Ostrom, 1986). The deep sea and Antarctic are now considered as other examples of global common property resources (Berkes and Farver, 1989).

The model of the "Tragedy of the Commons" proposed by Hardin (1968) is based on the critical assumptions that common property resources are doomed to over-exploitation and that resource users are unable to co-operate towards the greater community interest. Thus, the commons eventually become victims of resource depletion. However, case studies have indicated that resource users can, and do, co-operate (McCay and Acheson, 1987; Berkes, *et al.*, 1989; Feeny *et al.*, 1990; Kemf, 1993). Thus, important common property resources are not open-access but are managed under interactive traditional resource management systems and institutions (Berkes *et al*, 1989; Alcorn, 1997; Ostrom, 1997).

Common property management institutions are crucial for sustainable resource use and development. Above all, they are a reflection of the existing socio-economic, political and cultural situation of the community (Ostrom, 1991). Therefore, the effective functioning of a common property resource system depends on the existence of appropriate indigenous institutions. With many common property resource management systems, these institutions are local and informal, and community-based rather than government sponsored (Berkes, 1989; Ostrom, 1991, 1997).

1.2 The Ethiopian Experience

1.2.1 Historical Approach to Conservation

The wealth of wildlife and its use in Ethiopia is well documented by early chroniclers and travellers. Cosmos, an Egyptian monk, saw tame giraffes and elephants in Axum in 525 AD (Pankhrust, 1961; Gebre-Michael *et al.*, 1992). The Byzantine traveller Nonnosus reported seeing 5000 elephants at Yeha around 531 AD (Pankhrust, 1998). Around 570 AD, the Axumite king Kaleb rescued groups of Christians (who were persecuted by South Arabian princes) using chariots pulled by elephants and, indeed, this time in Arabian history is known as the Year of the Elephant (Levine, 1974). Around 246 BC, the live elephant trade was at its peak with Pharaoh of Egypt Ptolemy II (285-257 BC) obtaining supplies of elephants to use in the war against Syria (Pankhrust, 1998). Ethiopia has been trading in civet musk, ivory, leopard and lion skin and frankincense since the legendary Queen of Sheba, and Ethiopian Kings used to give live wildlife as presents to Egyptian sultanates to obtain Patriarchs for the Orthodox church (Hundessa, 1995; Pankhrust, 1998).

The first recorded indigenous conservation-oriented activity took place during the reign of Emperor Zerea Yacob (1434-1468). He noted the loss of forest cover on what is now known as Wachacha Mountain near Addis Ababa. Seedlings and seeds were collected from juniper forests areas elsewhere in the country, and the present

Menagesha area was replanted. This occurred over 550 years ago, and the area is today known as the "Menagesha State Forest". Indeed, this could be claimed as the oldest conservation area in Africa, or at least the oldest recorded formalised conservation effort on the continent (Pankhrust, 1989).

The first attempt to protect the wildlife of Ethiopia was made by Emperor Minilik II, who passed legislation to regulate hunting, especially of elephants in 1901 (Wolde-Meskel, 1950). In 1944 further legislation was passed to regulate hunting of wildlife to ensure that certain species were not over-hunted (Negarit Gazetta, 1944). These regulations can be seen as the modern formalised advent of wildlife conservation efforts in Ethiopia, and an indication that concerns for wildlife protection started.

1.2.2 Biodiversity and Conservation

Information on the distribution and abundance of wildlife species in Ethiopia at present is scarce. The two major ecological zones in the country are the Highland, which includes the North-western Highlands, the Central Highlands and the South-eastern Highlands, and the Great Rift valley and the low-lying areas (see Figure 2.1). These highland and low-lying areas are different ecologically and culturally. The highland areas support a predominately agrarian community that has evolved in the past 3000 years, while the low-lying areas are predominantly occupied by a semi-pastoralist communities.

An inventory of biodiversity in the country indicates a high degree of richness and endemicity. There are about 5000 species of plants of which, 12% are endemic. Of the 277 species of mammals recorded, 11.1% are endemic. A total of 861 species of birds are recorded among, which 3.3% are endemic. The total number of reptiles recorded is 201, of which 4.5% are endemic. Of the 63 amphibians species recorded, 38.1% are endemic (Yalden and Largen, 1992; Hillman, 1993; Yalden, *et al.*, 1996).

The highland areas, although extensively modified by man and densely settled, represent a unique ecosystem. Over 80% of the land in Africa higher than 3000m above sea level (asl) occurs in Ethiopia, and this may be a major reason why so many endemic animals and plants are found (Yalden, 1983; Kingdon, 1990). The great extent of these highland areas, and their isolation from other high altitude areas and their special environmental conditions of climate, soils, and topography, have all combined to result in the evolution of a unique Ethiopian highland flora and fauna, with its high levels of endemism. However, it is evident from the historical data available that the natural resource base of Ethiopia has been greatly modified by man, particularly in the highlands. The total area of highland currently under any form of protection is less than 0.5% of the highland area of the country and only the Southern-eastern and North-western Highlands have representative protected areas. In particular, no conservation area exists in the Central Highlands. The future survival of these highland ecosystems is under great threat as the uplands are increasingly used for agriculture and other human related activities.

Outside interest in the conservation of Ethiopian wildlife did not start until the 1960s. In 1961, a team from the former New York Zoological Society (NYZS) made a visit to the country and recommended the establishment of protected areas to preserve the larger mammalian wildlife of the country. The most important landmark in the conservation of Ethiopian wildlife came after the visit of the UNESCO Mission in 1963 following a request from the Ethiopian government (Huxley *et al.*, 1963). The UNESCO Mission recommended the establishment of three national parks at Awash, Simien Mountains and the Omo Valley, and a department responsible to deal with wildlife matters was established in 1965. This has evolved with time to the present Ethiopian Wildlife Conservation Organisation (EWCO). Since its inception, EWCO has been the sole government department of wildlife conservation in the country. There are now nine national parks, three sanctuaries, eight wildlife reserves and 17 controlled hunting areas (Figure 1.1). Of these conservation areas, only two national parks are formally gazetted (Simen Mountains National Park and Awash National Park). Wildlife conservation areas in Ethiopia fall into two groups:

- Principal wildlife conservation areas, which include national parks and sanctuaries, are areas where conservation has been active for sometime, and where a certain degree of infrastructure development has been reached. They comprise a total area of 32,000km^2 and cover 3.2% of the land surface of the country. They are located mainly in the lowlands, with only two (Bale and Simen Mountains National Parks) in high altitude areas.

- Secondary wildlife conservation areas, which include wildlife reserves and controlled hunting areas, areas where no development activity has taken place, and where management has been limited to the control of activities by hunting companies. They are essentially conservation areas ‘on paper’, with no conservation activity whatsoever taking place. The secondary wildlife conservation areas cover a total area of approximately 161,600km^2 or 16.2% of the total area of the land surface of the country (Hillman, 1993).

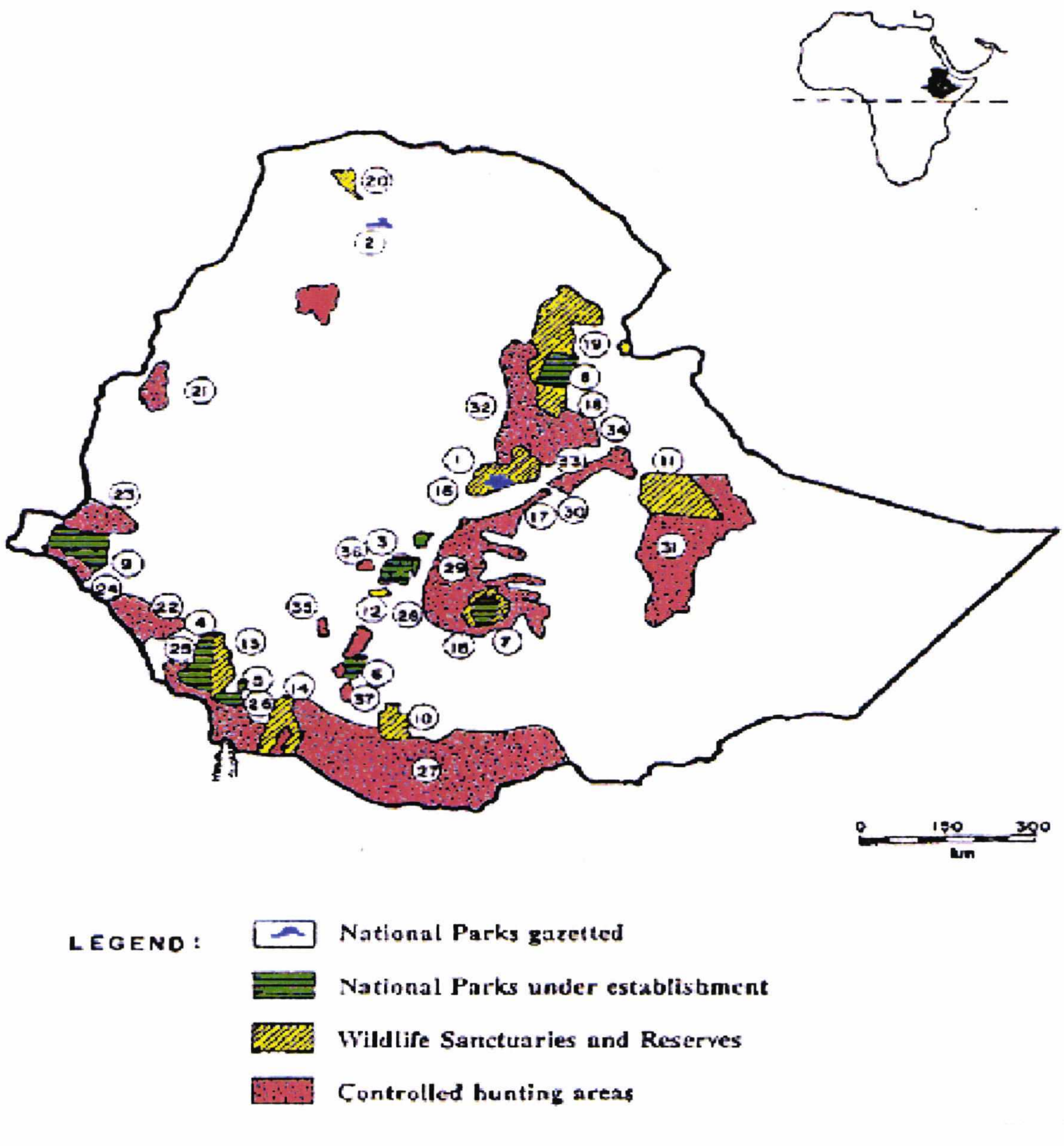

Figure 1.1 Official protected areas of Ethiopia.

Principal Wildlife Conservation Areas

National Parks 1. Awash, 2. Simen Mountains, 3. Abjata-Shalla Lakes, 4. Omo, 5. Mago, 6. Nechisar, 7. Bale Mountains, 8. Yangudi Rassa, 9. Gambella,

Sanctuaries 10. Yabelo, 11. Harer Elephant, 12. Senkelle Swayne's Hartebeest,

Secondary Wildlife Conservation Areas

Wildlife Reserves 13. Tama, 14. Chewbair, 15. Bale, 16. Awash west, 17. Alidege, 18 Gewane, 19. Mille-Sardo, 20. Shire,

Controlled Hunting Areas 21. Dabus, 22. Akobo, 23. Jikawo, 24. Tedo, 25. Omo West, 26. Murle, 27.Borena, 28. Bale , 29. Arsi, 30. Chercher –Arbagugu, 31 Hrerege-Wabi Shebele, 32. Awash West, 33. Afdem-Gewane, 34. Ereregota, 35. Maze, 36. Boye, 37 Segen.

The major problem in wildlife conservation in Ethiopia has been habitat destruction. The rapidly expanding human population is now increasing at 3% per year, and has turned most available land into agricultural land. The land above 1500m asl constitutes 65% of the total area of the country and is now inhabited by 80% of the population (Wolde-Mariam, 1991). The volcanic soil is relatively fertile and deep, and the existence of high altitudinal variation provides a wide range of environments suitable for the growth of a wide range of tropical, subtropical and temperate crops. A wide range of farming and land use systems has developed over several millennia. However, poor agricultural practices have destroyed the existing agricultural land through erosion, resulting in unprecedented clearing of new land for agriculture every year. This in turn has destroyed most of the natural areas in the country. The country's forests were estimated to cover 40% of the country's surface area in 1940, but they now cover less than 3%. There is a growing conflict between conservation and the increasing demand for land for agriculture and livestock development. These growing conflicts must be seen within the context of the levels of chronic poverty that exist in the country.

The second important factor explaining the decline of wildlife in the country is the influx of firearms. The first major influx took place in 1868, during Napier's expedition, who brought 44 elephant loads of firearms that he later presented to Emperor Yohannes (Moorhead, 1962). In subsequent years, the importation of firearms increased dramatically. During the 1936-1941 Italian war of aggression, there were 900,000 rifles and 1,700 machine guns. Armed settlers followed the southward expansion of Emperor Menelik II and the 1936-1941 Italian war of aggression resulted in a dramatic decline of wildlife in the country. Numbers of wildlife dwindled as bush meat became the only supply to the patriots during the war. When the war was over in 1941, the firearms left behind accelerated the decline of the wildlife (Gebre-Michael *et al.,* 1992).

Civil strife and war have also been an important factor in the decline of Ethiopian wildlife. The last three decades have seen many civil conflicts aided by modern weaponry. The Simen Mountains National Park was a victim of the devastating civil war of 1980s, when the park was totally closed and 95% of its infrastructure was bombarded or looted (Gebre-Michael *et al.,* 1992).

Just after the over-throw of the Military Junta (*Derg*) in 1991, a power vacuum was created in the country for a short period of time. During this time, the communities living adjacent to conservation areas killed large numbers of wildlife and demolished infrastructure, as most conservation areas had been established on communal land without the consent of the community. The post-civil war killing of wildlife and further destruction of infrastructure brought the last 40 years of conservation activity to a standstill. All the conservation areas have suffered a reduction of their wildlife numbers. The Bale Mountains National Park lost nearly 80% of its mountain nyala and 60% Ethiopian wolf populations. The Abijatta-Shalla Lakes National Park and the Senkelle Swayne's Hartebeest Sanctuary were totally destroyed and many of the other national parks were resettled following the change of government in 1991 (Gebre-Michael *et al.,* 1992; Tedlla, 1994).

Nevertheless, important biodiversity areas such as the Guassa area of Menz are found outside the formal protected area systems of the country and the fate of these areas lies in the hands of the community living adjacent. Hence, it is important these areas are given due consideration, both by the community and by the authorities in the country.

1.2.3 Community Involvement in Conservation

Realising the importance of conservation after the 1985 famine, the Ethiopian government launched an ambitious programme of environmental reclamation through community-based soil and forest conservation projects. It was supported by western donors and NGOs, who shared a common discourse about the interaction between population, environment and famine in Ethiopia. It was backed by the largest food-for-work programme in Africa and the second in the world, next to India (Campbell, 1991; Hoben, 1993; Admassie, 2000).

The rhetoric of these conservation projects was that there should be local control over the projects, which were regarded as community-based conservation. However, the reality remained that the local people contributed little to conservation. Under the disguise of community-based conservation, the land that was in the hands of the community was turned systematically into government land, with the government setting policy that reduced land use options (Campbell, 1991). These projects, in the name of community-based conservation, in fact restricted local people's access to highly needed land, which in turn has produced land shortage and over-use. Thus, conservation has worked against the people even if the rhetoric that accompanied the projects emphasised local participation and control by the community, and promised long-term benefits.

It is clear today that much conservation effort carried out in the name of conservation has been wasted or counterproductive in Ethiopia. The short-term and long-term benefits of conservation activities are uncertain to many communities living adjacent to the different conservation areas and conservation projects. Many factors have contributed to the poor performance of conservation projects. Not least among these were the neo-Malthusian environmental policy narratives used by government conservation agencies and donors alike to justify their conservation efforts, with little regard to regional or local agro-ecological conditions, and above all, the rural community (Turton, 1987; Hoben, 1997). Most of the conservation activities were based on inadequate scientific and technical knowledge. Furthermore, implementation was top-down and authoritarian (Turton, 1995; Admassie, 2000).

In the Central Highlands of Ethiopian, there are no officially protected areas, but there is a community where natural resources are protected for its sustainable use and for benefit of the entire community. In a country where most of the conservation efforts are failing, or in the process of doing so, it is notable that the community living near the Guassa area of Menz has been managing their natural resources in a sustainable way for at least the last 400 hundred years. Unlike similar areas in Ethiopia, the Menz community has managed the Guassa area for a wide range of purposes and has benefited from their sustainable management. Their protection of the natural environment has helped the survival of several endangered species of fauna and flora, one of the most important of which is the critically endangered Ethiopian wolf *Canis simensis*. The Ethiopian wolf is one of the most endangered canid in the world and survives on isolated mountaintops of Ethiopia.

1.3 The Ethiopian wolf

The Ethiopian wolf, *Canis simensis* Rüppel is the only true wolf species in Africa (Figure 1.2). The closest living relatives of the Ethiopian wolf are grey wolves (*C. lupus*) and coyotes (*C. latrans*), rather than jackals or the African wild dog (*Lycaon pictus*) (Gottelli, *et al.,* 1994). Throughout Ethiopia, the Ethiopian wolf is called by different names. In the Amahric speaking area of the Simen Mountains and Menz, it is called *Key Kebero* or *Kebero;* in the Wollo area, it is called *Seren;* and, in Gojam, it is called *Walge.* In the southeast of the country, in Arsi and Bale Mountains, among the Oromifa speakers, it is usually called *Jedella Ferda* but in few localities in the same area, it is also called *Arouaye* (Figure 1.2). The Ethiopian wolf crossed over from Asia during the Pleistocene period less than 1million years ago, when sea levels were lower, and Africa and the Middle East were connected. During the Pleistocene, the highlands of Ethiopia were predominately Afro-alpine moorland (Bonnefile *et. al.,* 1990), and these habitats were an ideal habitat for a variety of small mammals, particularly grass rats (*Muridae*). This Afro-alpine environment must have morphologically shaped the Ethiopian wolf as specialised rodent hunter (Kingdon, 1990; Gottelli and Sillero-Zubiri, 1992).

The Afro-alpine habitat, characteristically represented by few mountaintops in the Ethiopian highlands was widespread during the Pleistocene. During the last glacial period (70,000-10,000 years BP), the African tropics were generally colder and drier than at present. Consequently, the moorlands of East Africa Mountains were about 1000m lower than they are now (Bonnefile *et. al.,* 1990; Kingdon, 1990). Extrapolation of the present distribution of Afro-alpine habitat in Ethiopia suggests that up to 100,000km^2 of Afro-alpine habitat may have been available to the Ethiopian wolf and to its prey during the last glaciation (Kingdon, 1990; Gottelli and Sillero-Zubiri, 1992). The end of the Pleistocene brought climatic change and forced the extensive Ethiopian Afro-alpine moorlands to shrink to their present size, reducing the habitat available to the Ethiopian wolf by an order of magnitude. Only about 2% (22,750km^2) of the total land area of Ethiopia is above 3000m. Of this, less than 10% today consists of Afro-alpine steppes or mountain grasslands suitable for the Ethiopian wolf, which is now found only in a few localised mountains pockets (Yalden and Lagen, 1992; Gottelli and Sillero-Zubiri, 1992; Malcolm and Tefera, 1997; Marino *et al.*, 1999).

The Ethiopian wolf, which has also been called the Simien fox, Simien jackal or the Abyssinian wolf is an endemic species found only in high altitude areas of the Ethiopian Mountains above 3000m asl. (Figure 1.3). The Ethiopian wolf has been rare since it was first recorded by science. It is now one of two canid species listed by the IUCN Red List of Threatened Animals in the critically endangered category, the other species being the Red wolf (*Canis rufus*) (Ginsberg and Macdonald, 1990; Baillie and Groombridge, 1996; Sillero-Zubiri and Macdonald, 1997). Although the species is critically endangered, it is not listed by the Convention on International Trade in

Endangered Species of wild Fauna and Flora (CITES), since no poaching or trade occurs. However, the species is legally protected in the country from any type of use that may threaten its survival. With a total world population of only 450 to 500 individuals surviving in relict mountain tops, the Ethiopian wolf is the most endangered canid in the world (Ginsberg and Macdonald, 1990; Baillie and Groombridge, 1996; Sillero-Zubiri and Macdonald, 1997).

1.3.1 Taxonomy

The Ethiopian wolf is now considered to belong to the Order *Carnivora*, Infraorder *Canoidea*, Family *Canidae*, Subfamily *Caninae*, Genus *Canis*, and Species *simensis*. The Ethiopian wolf is one of the four canid species in Africa, the others being *C. aureus, C. mesomelas, C. audustus* and *Lycaon pictus*. The taxonomy of the Ethiopian wolf was confusing due to the lack of material on which to base its taxonomic classification. Different travellers at different time have given the species different names: *Canis sinus* Gervais; *Canis* or *Vulpes walqe* Heuglin; and, *Simenia simensis* Gray, the latter suggesting a monospecific genus *Simenia simensis* (Yalden *et al.*, 1980). More recent work has categorised it as a member of the genus *Canis* (Clutton-Brock *et al.*, 1976). The most recent phylogenetic analysis using mtDNA sequences suggested that *C. simensis* is a distinct species, with closer relationship to the grey wolf (*C. lupus*) and the coyote (*C. latrans*) than to any of the African canid species (Gottelli, *et al.*, 1994).

Two sub-species have been recognised as taxonomicaly distinct from the opposite side of the Great Rift Valley. The North-western Highlands and Central Highlands populations have been described as *C. s. simensis* and the South-eastern Highlands population as *C. s. ceternii,* based on brighter red coat coloration of some specimens from North-western Highlands and consistently longer nasal bones in those from South-east Highlands (Yalden *et al.,* 1980). However, a very recent study has indicated that the two possible sub-species are genetically identical at the level of mtDNA analysis (Gottelli *et al.*, 1994), but further work on the microsatelliteDNA has indicated some differences (Dada Gottelli, personal comm.).

1.3.2 Morphology

The Ethiopian wolf is the largest member of the genus *Canis* in Africa. It has a large body size, long legs, a distinctive reddish coat, with white under parts, white throat, white chest, and white upper tail markings and a darker tail tip that distinguish the Ethiopian wolf from other related members of the genus *Canis* in Africa. Its long legs and an elongated muzzle resemble the North American Coyote *(C. latrans)*. The pelage is soft and short with a distinctive bright tawny rufous colour with a dense whitish to pale ginger under fur in adults. The coat is rufous brown in pups and gets lighter as they grow old (Figure 1.2). During the breeding season and pregnancy, females tend to have light yellowish coloration. The ears are pointed and broad at the base. The tail is a thick black brush with the proximal white underneath. The guard hairs are short and the under-fur is thick, providing protection against the extreme low temperature on the top of the mountains. The Ethiopian wolf moults its coat early in the dry season. However, there is no evidence of seasonal variation in coat colour.

Male Ethiopian wolves are 20% heavier than females. The weight of an adult male ranges from 14.2 to 19.3kg with a mean of 16.2kg, while the weight of adult female ranges from 11.2 to 14.2kg with mean of 12.8kg. The mean body measurements of adult males are: head and body, 96.3cm; tail, 31.1cm; heart girth, 51.7cm; shoulder height, 59.3cm; hind-foot length, 19.9cm; and, length of ear, 10.8cm. The mean body measurements of adult females are: head and body, 91.9cm; tail, 28.7cm; heart girth, 47.0cm; shoulder height, 54.4cm; hind-foot length, 18.7cm; and, length of ear, 10.4cm. (Yalden *et al.,* 1980; Gottelli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994).

Figure 1.2 A male Ethiopian wolf (*Canis simensis*).

1.3.3 Distribution

The Ethiopian wolf is a localised endemic and is confined to some isolated pockets of Afro-alpine grasslands and heathlands in Ethiopia (Figure 1.3) (Morris and Malcolm, 1977; Yalden *et al.*, 1980; Yalden and Largen, 1992; Gotteilli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994; Yalden *et al.*, 1996; Malcolm and Sillero-Zubiri, 1997). The species is now confined to an altitude of 3000 to 4000m asl, but previous sightings of the species have been recorded below 3000m asl (Yalden *et al.*, 1980).

The Ethiopian wolf was first recorded in the Simen Mountain range in North-western Highlands. Relict populations still occur in the Simen Mountains including the Ras Dejen, which is the highest peak in Ethiopia (4,533m asl). The Simen Mountains range encompasses a total of 273 km^2 of suitable wolf habitat. In the Simen range, suitable wolf habitat is confined to the altitudes of 3700m and 4400m asl and distributed in four main areas interconnected by narrow habitat corridors. Of these areas, only the Geech Plateau is included within the Simen Mountains National Park, which was originally created to protect the endemic Walia Ibex (*Capra walia*). The Geech Plateau of the Simen Mountain National Park accounts for only small amount of available wolf habitat, and most the suitable habitat therefore, lies out side the park. On Mount Guna near Debre Tabor, a small wolf population occurs at present (Marino *et. al.,* 1999). The Ethiopian wolf is locally extinct in Mount Choke in the Southwest of Gojam (EWNHS, 1996; Marino *et al.*, 1999).

The North and the South Wollo Highlands in the Northeast of the country have been reported to have a relict population of the Ethiopian wolf. In the North Wollo area, Mount Abune Yoseph (4,190m asl) has a total area of 140 km^2 of important wolf habitat. The nearby areas of Abuye Gara (3,500-3700m asl) and the Delanta ranges (3,550 to 3750m asl) also contain a few populations of Ethiopian wolf. In the South Wollo area, the Amba Ferit range is the most important range for the distribution of Ethiopian wolf. In this range, localities like Denkoro, Guguftu and Kewa mountain ranges have few populations (Marino *et. al.*, 1999).

The North Shoa areas of Goshe-Meda-Ankober (3700m asl) and Kundi (3900m asl) used to have small Ethiopian wolf populations until recently. The last sighting of the wolf in these ranges of North Shoa was 1992 (Kenea Gaddisa Personal Comm.). At present the wolf population is locally extinct from these ranges. The Guassa area of Menz in North Shoa is one of the smallest unit of Afro-alpine area in Ethiopia. The area is a continuous area of suitable wolf habitat lying from 3200 to 3700m asl. The Guassa area is defined as a north-south extension of Afro-alpine range, bounded by a steep escarpment of the Rift Valley in the east and by low-lying agricultural areas of Menz in the west (see Chapter 2) (Ersado and Abuni, 1992; Tefera, 1995; Tefera and Tenagashaw, 1998).

The Arsi Mountains forms the second largest available habitat in the country, with 870km^2 of suitable wolf range. Suitable range lies between 3,200m and 4,100m asl. The Galama Range, connected to the west to Chilalo Mountain forms a suitable habitat at 3,300 to 3,400m asl. The isolated mountain peaks of Mount Kaka and Mount Inkolo provide an extra patches of suitable habitat of lesser importance in the Arsi Mountain range (Marino, *et al.*, 1999).

With more than 1000km^2 of suitable wolf habitat, the Bale Mountains comprises the largest area of Afro-alpine area in Ethiopia as well as in Africa. The mountain complex includes: Tullu Demitu (3900 to 4377m asl); Sanneti Plateau (3,800 to 4,000m asl); the flat valley bottom of Web Valley (3,400 to 3,500m asl); and, the lowest wolf range of Gaysay Valley comprising a montane grassland (3,000m asl). The Bale Mountains also contains the largest existing population of Ethiopian wolves (Morris and Malcolm, 1977; Hillman, 1986; Gottille and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994).

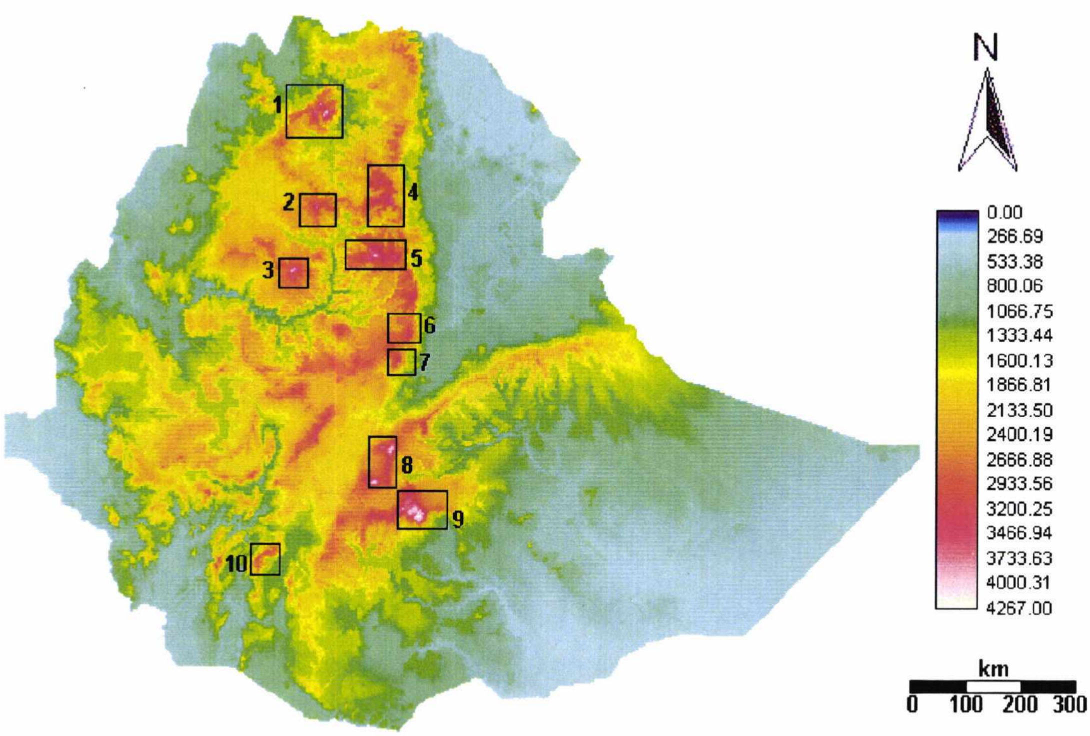

Figure 1.3 Distribution of the Ethiopian wolf.

(1. Simen Mountain 2.Mt. Guna 3. Mt Choke 4. North Wollo 5. South Wollo 6. Guassa, Menz 7. Goshe-Meda-Ankober 8. Arsi Mountains 9. Bale Mountains 10. Mount Guge).

1.3.4 Ecology and Behaviour

Ethiopian wolves live in packs, with a discrete social unit that communally shares and defends an exclusive territory. Unlike many carnivores, pack members forage and feed alone on small rodent prey, which they commonly dig out from their burrows. The Ethiopian wolf is most active by day, when it feeds almost exclusively upon diurnal small mammals (Sillero-Zubiri, 1994; Sillero-Zubiri *et al.*, 1995a; Sillero-Zubiri and Gottillie, 1995a,b). In the Bale Mountains, the Ethiopian wolf feeds primarily on the giant mole rat *Tachoryctes macrocephalus* and other species of *Murinae* rodents (Sillero-Zubiri *et al.*, 1995b). Other food items include rock hyrax *Procavia capensis*, young antelopes and lambs (Morris and Malcolm, 1977; Hillman, 1986; Yalden, 1988; Yalden and Largen, 1992 Gottelli and Sillero-Zubiri, 1990; Sillero-Zubiri 1994; Sillero-Zuberi and Gottelli, 1995a).

Ethiopian wolf home range in Bale Mountains averaged 6.4 km^2, with some degree of overlap. A typical Ethiopian wolf pack may contain 4-9 individuals. Pack members come together at night for social greetings and to conduct patrols at dawn and evening. The Ethiopian wolf does not normally use dens for sleeping and to rest at night. Only pups and nursing females have been observed to use dens. Wolves sleep in the open, either with family members or alone. A sleeping place is selected that provides cover from strong wind and cold at night (Gottelli and Sillero-Zubiri, 1990; Sillero-Zubiri, 1994; Silleo-Zubiri *et al.*, 1995b).

1.4 Aim of the study

The Ethiopian wolf survives where there is an Afro-alpine vegetation community and an associated rodent community (section 1.3.3). However, only in two wolf ranges, the Bale Mountains and the Simen Mountains does the species live in protected areas. In the rest of its range, the wolf population lives within human-dominated landscapes. Thus, nearly half the global population of this critically endangered species is found in these areas where there is no formal protection of wildlife. The aim of this study is to determine how well an indigenous common property resource management system in the Guassa area of Menz has served to benefit the survival of the Ethiopian wolf and other wildlife. Given, the theoretical conclusions about the conditions under which common property resources regimes operate (section 1.1.3), I predicted that the Guassa area of Menz would provide a secure range for the wolf, provided that the pre-conditions for common property resources management system is not adversely affected by modernising forces. Hence, this study specifically seeks to answer the following questions:

- What is the nature of indigenous common property resource management system of the Guassa area and how has it responded to change?
- What factors determine the attitudes of the user community towards the present management of the common property resource?
- How does the user community actually use the resource, and how does this mirror pattern of use under former traditional management system?
- What factors determine the ecology of rodents and how are rodents affected by current patterns of human resource use in the Guassa area?
- How is the ecology of the Ethiopian wolf affected by living in a human-dominated landscape in terms of diet, habitat quality and spatial organisation? and how does the Ethiopian wolf respond to the presence of humans and livestock in the area?
- What factors determine the attitude of the community towards the wildlife of the area in general and Ethiopian wolf in particular?

These questions are covered in sequence in the chapters, and have the overall objective of determining if common property resources regimes supporting human use offer viable alternatives to conserving the Ethiopian wolf in particular, and other species of endangered wildlife in general. My underlying thesis is that, if the Ethiopian wolf in Guassa lives in a common property resource management system, their future will be safeguarded as well as in any legally gazetted protected area, given current problems facing such areas.

1.5 Thesis Organisation

The first chapter of this thesis has already given an overview of the main themes that run through the study, comparing different systems of biodiversity conservation, efforts taken to safeguard biodiversity in Ethiopia, and the ecology and distribution of the Ethiopian wolf. The rest of the thesis successively follows different themes. Chapter 2 describes the study area and the general methods used throughout the study. Chapter 3 determines the nature of the indigenous common property resource management system in the Guassa area of Menz and tries to see the political and cultural system dynamics have affected the management of the common property resource. Chapter 4 examines the attitudes of the common property resource user community towards the present system of resource management and the options for future management. Chapter 5 examines how the common property resources is used, how the community values the resources of the area and the patterns determining resource appropriation. Chapter 6 examines the ecology of the rodent community of the Guassa area, and specifically at their abundance and survivorship given they are the major prey to the Ethiopian wolf population. Chapter 7 examines the extent of current resource appropriation and how community use of these resources affects the rodent prey population of the Ethiopian wolf. Chapter 8 compares the ecology and social organisation of the Ethiopian wolf population in the human-dominated Guassa area of Menz compared with the undisturbed protected area population in Bale Mountains National Park. Chapter 9 deals with the effect of human and livestock presence on the Ethiopian wolf population of the Guassa area. Chapter 10 investigates the attitude of the Menz community towards the wildlife of the area in general, and the Ethiopian wolf in particular. Chapter 11 summarises the lesson learnt from this study, and discusses their conservation implications both in terms of management recommendations for the Ethiopian wolf, in particular and for biodiversity management in general.

Chapter Two

2 Study Area and General Methods

2.1 The Guassa Area of Menz

2.1.1 Background Legend

According to local legend, the Guassa area used to grow the best *Teff*, known botanically as *Eragrostis teff*, the endemic plant that is used to make the Ethiopian's staple food (*injera*). A monk called Ache Yohannis used to live in the area. He was a very good and wise person, who took his duties seriously and gave blessings right across the land. Once upon a time, a woman was pregnant and claimed that she bore a child for the monk who was supposed to be celibate. Confused with the allegation of the woman, the public asked her to swear in front of him and the public. She did so, confirming that he was the father of her child and added "let me turn into stone if I tell a lie". Even as she was swearing, she was transformed into stone. The monk, not satisfied with this act of retribution, and angry with the populace for believing her, abandoned the area with a curse saying: 'let this land turn cold and bleak for evermore, and the rich agricultural land become scrub'. As he spoke the weather changed, and the land became the Guassa scrub-land of today.

Many years after the curse had reduced the area to poverty, the elders of the land decided to beg for mercy and forgiveness. They searched far and wide for the monk, but heard that he had long since died. It was then decided to search for his body and re-bury it in the area, in the hope that the monk's spirit would take pity on them. The bones were re-buried near Firkuta Kidan Mihret, but the land has still remained under the curse. It is also said that while the bones were being transported, a drop of blood fell to the ground, near Wolde Sheresher, where there is now a tall Juniper tree. The wind picks up whenever someone touches the tree. The Ache Yohanns commemoration now takes place on the 26 January every year and is observed throughout Menz. This story portrays the Guassa land as a bleak and unwanted curse, is a parable about poverty and its rationalisation through self-blame.

The forces of Ahmed Gragne[1] ravaged Menz in 1531 (Levine, 1965). Local legends concerning the history of Menz relate for the most part to the miraculous feats of strength that Ahmed Gragne is said to have performed there and to the resettlement of Menz after his defeat. The story speaks of the founding of Menz (*Aqgni Abbat*) by three men, Mama, Lalo and Gera. Although their deeds are recorded only in the form of legend, Mama, Lalo and Gera were historical personages, who appear to have lived in the latter part of the 17th century (Mekuria, 1949; Levine, 1965). Mama, Lalo and Gera were sent by one of the kings from Gondor to settle and govern the territory. As the story goes, the king offered them as much land as their horses could cross in a single day. They set out from the Adabay River now on the western boundary of present day Menz. The result of their long day journey was the present tripartite division of Menz into Mama Midir, (the present Wogeri area), Lalo Mider (the present Mollale area) and Gera Mider (the present Gera area). As Gera's horse was the strongest in the race, he managed to win the largest area.

2.1.2 Location

Ethiopia consists of three major high plateau regions divided by the Great Rift Valley and by the Abaye (Blue Nile) Gorge. These three highland blocks are known as the North-western Highlands, the Central Highlands and South-eastern Highlands (Figure 2.1). The North-western Highlands are the largest highland massif. The Guassa area of Menz is located in the Central Highlands.

[1] Leader of the Muslim invasion, who invaded the Christian dominated highlands of Ethiopia to expand the domination of the Muslim world from the south-east between 1527-1540. Originally known by the name Imam Ahmad Ibn Ibrahim, later popularly known as Ahmed Gragen, (see Phankhurst, 1998).

The Central Highlands Plateau is situated above 2000m asl, and occupies the central portion of the Ethiopian highlands (Figure 2.1). It extends westwards into eastern lowlands and forms a crescent-like region draining into the Abaye (Blue Nile) and the Awash rivers. The surface consists of a plateau into which the important tributaries of the Abaye and Awash rivers have cut deep gorges, isolating the tableland from the North-western Highlands in the north, the Afar lowlands in the east and the Great Rift Valley in the south and south-west.

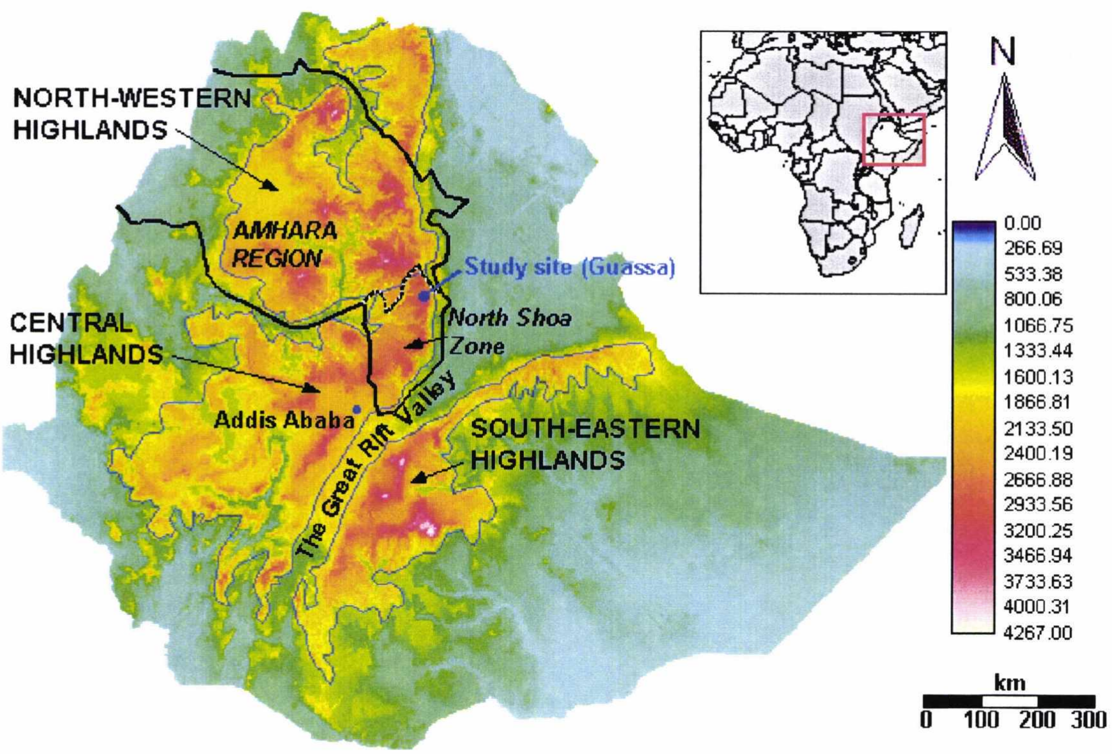

Figure 2.1 Map showing the highland blocks of Ethiopia, the Amhara Regional State and the North Shoa Zonal Administration in relation to the study site.

The Guassa area of Menz occurs in the Amhara Regional State, within the North Shoa Zonal Administration (Figure 2.1) and in Gera-Keya Woreda (district) (Figure 2.2). The Guassa area is 265 km north-east of the national capital of Addis Ababa by road, and 135 km north of Debre Birhan, the capital of North Shoa Zone. The capital of the

Gera-Keya Woreda is Mehal Meda, and 17km from the Guassa area. The Gera-Keya Woreda is divided into 28 peasant associations of which 8 are considered to be the direct descendants of the pioneer fathers Asbo and Gera who owns the land of the Guassa area and the adjacent agricultural land. These eight peasant associations are: Chare; Daregegne; Gedenbo; Gragene; Kewula; Kuledeha; Qwangue; and, Tesfomentir (Figure 2.2).

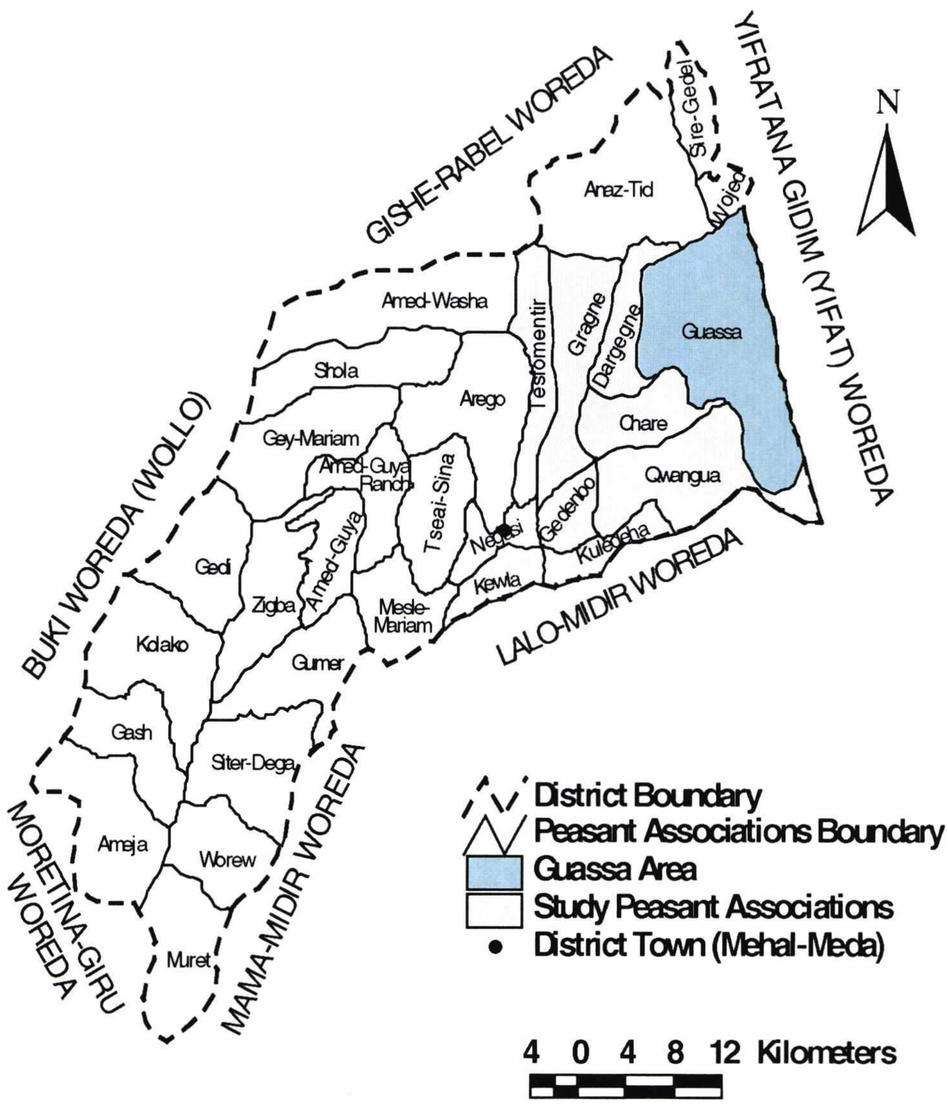

Figure 2.2 Map showing the Gera-Keya Woreda, and its constituent peasant associations together with the position of the Guassa and the neighbouring Woredas.

The Guassa area lies at latitude 10^0 15'- 10^0 27'N and longitude 39^0 45'- 39^0 49'E. The total area of the Guassa is 98.45km^2 (Figure 2.3). The Guassa area forms part of the western edge of the Great Rift Valley. Its altitude ranges from 3200 to 3700m asl (Figure 2.3). The Guassa area is rugged and its plateau is cross-cut by various gorges and river valleys that flow westwards. The eastern part consists of abrupt cliffs that form the Great Rift Valley, and where there are sharp elevation changes within a short distance. The eastern escarpment drops in altitude from 3600m asl to 1000m asl within a distance of 50 km and a further 50 km stretch leads to the Awash plain (500m asl) forming the floor of the Great Rift Valley. The west of the Guassa falls away steadily towards Mehal Meda (3000m asl).

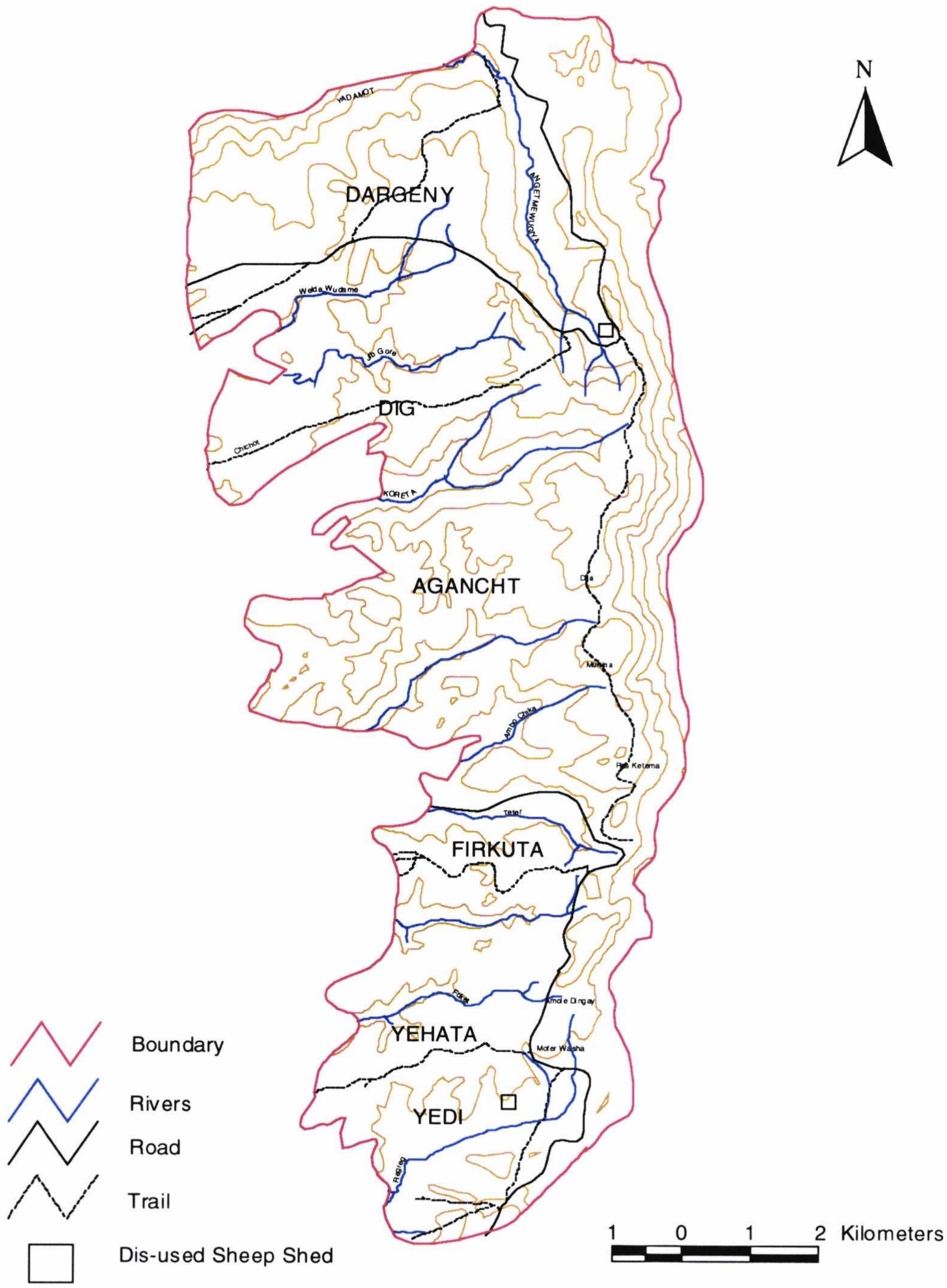

Figure 2.3 The Guassa area of Menz, showing its boundaries and watershade.

2.1.3 Geology and Soil

The pre-Cambrian rocks that underlie the whole of Ethiopia consist of complex metamorphic rocks of many different grades and types. Igneous rocks constitute an important proportion of the pre-Cambrian rocks. More recent rocks from the Mesozoic era overlie the pre-Cambrian rock in most parts of the Central Highlands. Volcanic activity during the Tertiary period resulted in the extrusion of large quantities of flood lava, which now cover most of the Central Highlands. These lava flows occurred in a series of layers to form the Trap series (Mohor, 1963).

The formation of the Guassa area during the Oligo-Miocene was a result of tectonic and volcanic activity. The lava covered all the previous rock formations that had been formed prior to the formation of the Rift Valley. The Guassa area now contains 15-26 million year old Miocene rhyolites and basalts sometimes referred as an Alaji-Molale formation and 20-26 million year old Oligo-Miocene Termaber basalts and phonolites (Zanettin and Justen-Visentin, 1974). On the plateau of the Guassa area the following formations of Trap series lava have been distinguished: Ashangi basalts; Aiba stratoid basalts; Alaji rhyolites; tratoid basalts; and, Termaber basalts linked to central volcanism (Zanettin and Justen-Visentin, 1974).

The Central Highland's soil is characterised by two principal types, originating from the disintegration of volcanic substrates intermingled with sand and limestone. These comprise: black clay soil (Vertisols); and, reddish-brown heavy loam (Red soil). The former type appears on flat plateaux and in the bottoms of valleys. The latter appears on valley slopes and well-drained areas. Generally the soil of the Guassa area is deep and humic. However, on higher ground, the soil is shallow, and highly mineralised.

2.1.4 Climate

The climatic map of Ethiopia divides the country into three broad climate types, which are further subdivided into nine classes. The three main climate types recognised are: dry; tropical rainy; and, temperate rainy (Gemachu, 1990). Under this classification, the Central Highlands of Ethiopia are characterised as the temperate rainy climate type, with distinct dry and wet months. However, considerable variation occurs in the climate of the Central Highlands of Ethiopia as a result of variation in altitude and the size of the mountain blocks.

The nearest meteorological station to Guassa is at Mehal Meda, some 17 km away, but information from this station is incomplete. A maximum-minimum thermometer was placed at the project station in Mehal Meda that was read once every 24hr. A hygrometer was also placed in Mehal Meda to record the relative humidity twice a day (0800hr and 01400hr). Rainfall data for the Guassa area were collected by a standard rain gauge comprising a steel cylinder of 5 inch (12.7cm) diameter, capable of containing one month's rainfall and placed near the disused sheep shed (Figure 2.3). Readings were made on the last day of each month.

The climate of the Guassa area is affected by northerly winds, which blow throughout the year. There is high rainfall, frequent hailstorms and occasional snow at higher altitudes in wet season. There are frequent frosts in the dry season. Therefore, the climate of the study area is unfavourable for most crops, but the surrounding farming communities grow barley and some pulses outside the Guassa area.

2.1.4.1 Rainfall

Guassa lies in an area influenced by the Equatorial Westerlies and the Indian Ocean air streams. This means the area receives its rain from two different sources at different times of the year. In the Ethiopian highland rainfall increases with altitude, until 3,800m asl, above which it begins to fall again (Gamachu, 1977; Hillman, 1986). Rainfall of the study area is characterised by one main rainy season (*Kiremet or Meher*) in June, July, August and September and minor rainy season (*Belg*) in February, March and April (Figure 2.4, 2.5). However, showers of light rain can occur in any month of the year.

The annual rainfall for Guassa is in the range of 1200mm -1600mm. Over the study period the mean annual rainfall for the Guassa area was found to be 1540mm (Figure 2.4). A high annual total of 1764mm was recorded in 1997, due to the effects of *El Niño*. The rainfall at Mehal Meda is lower than in Guassa, in the ranges of 800mm - 1000mm (Figure 2.5).

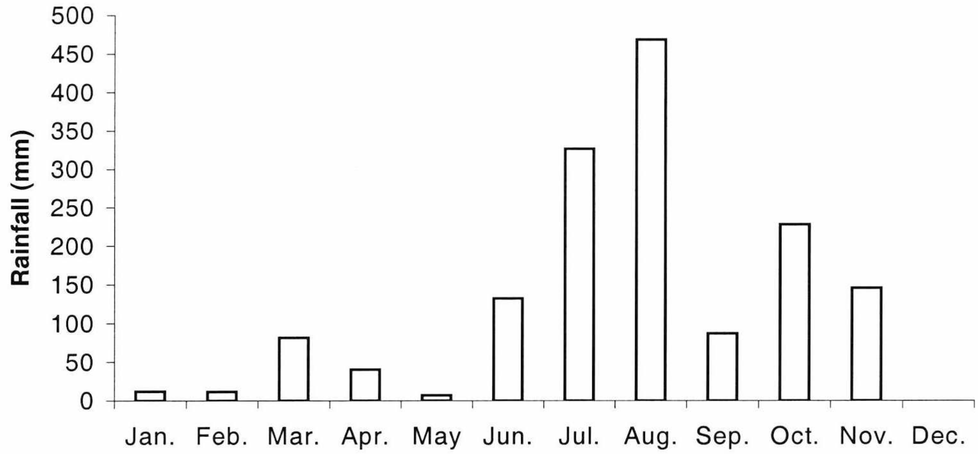

Figure 2.4 Mean monthly rainfall Guassa area over 1997-1998.

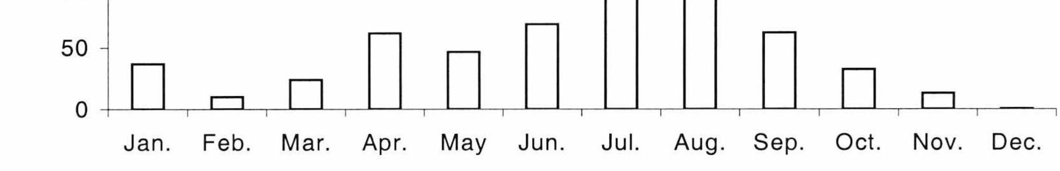

Figure 2.5 Mean monthly rainfall in Mehal Meda over 1992-1999.

2.1.4.2 Temperature

No temperature records exist for the Guassa area, but the temperature record from the nearby Mehal Meda is available (Figure 2.6). The temperature of the area is characterised by mild day temperatures and cold night temperatures. In the driest months (December, January and February) the day time temperature can rise to 21^0C while at night it can fall to -7^0C, a diurnal fluctuation of 28^0C. The diurnal temperature variation is lower in the wet season with a day time temperature of 12^0C and night temperature 3^0C at night. This fluctuation is expected to cause high temperature stress on the flora and fauna of the area. In the early dry season frost is very common and fog can be seen any time of the year.

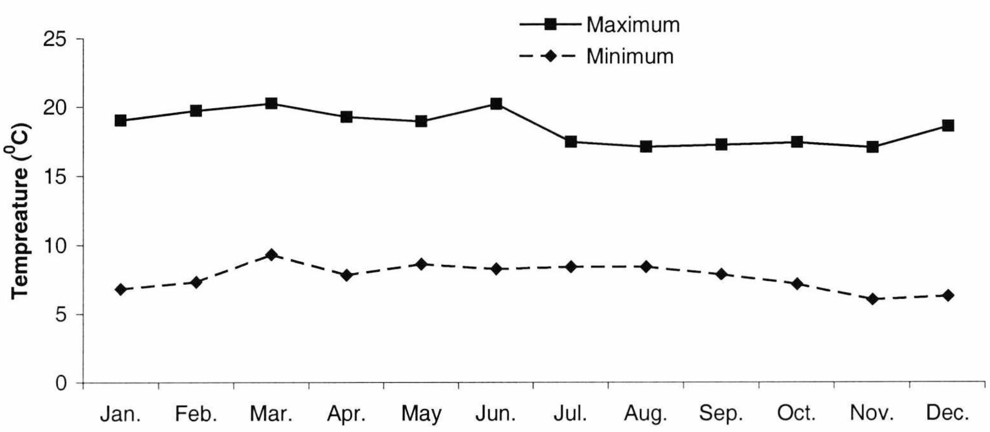

Figure 2.6 Mean monthly temperatures in Mehal Meda over 1992-1999.

2.1.4.3 Humidity

No relative humidity records exist for the Guassa area but the relative humidity from nearby Mehal Meda is available (Figure 2.7). Values of relative humidity are highest in the wet season and lowest in the dry season. Humidity is generally lower in the dry months than in the wet season, lowest relative humidity recorded in the months of April, May and June (Figure 2.7).

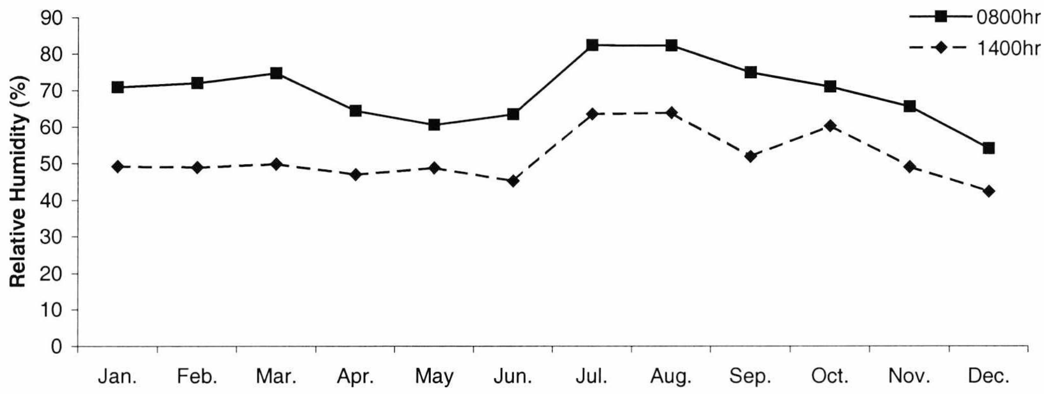

Figure 2.7 Relative humidity in Mehal Meda over 1997-1998.

2.1.5. Habitat Types

The vegetation of the Guassa area is characterised by a high altitude Afro-alpine vegetation, within which different vegetation communities exists (Figure 2.8).

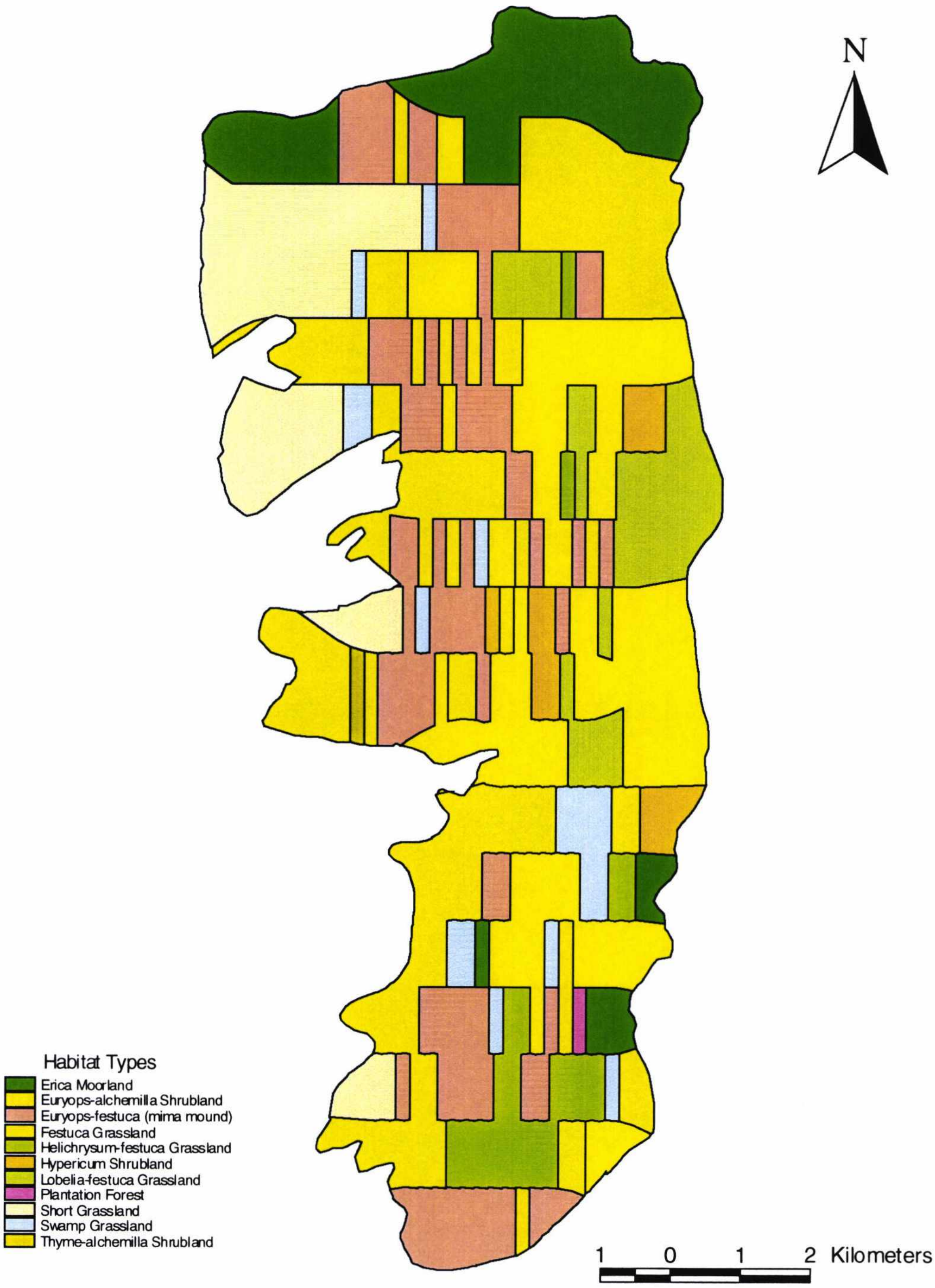

Figure 2.8 The different habitat types in the Guassa area, as characterised along line transect laid out in an east-west direction (see section 2.2.2).

2.1.5.1 *Festuca* Grassland (Guassa Grassland)

Festuca grassland (Guassa grassland) occurs where the drainage is good and the soil is deep. It grows on steep to moderately steep slopes up to an altitude of 3500m asl (Figure 2.9). The species that are common in *Festuca* grassland are: *Festuca abyssinica; F. simensis; F. richardii; F. macrophylla; Andropogon abyssinicus; Poa schimperina; Trifolium burchellianum; Trifolium multinerve; Alchemilla abyssinica; Alchemilla* sp.; *Senecio vulgaris; Thymus schimperi; Helichrysum formosissimum;* and, *Artemesia* sp.

This habitat is common on the hills of Ras Ketema, Sefed Meda, and in the southern hills of Yedi and covers 19.9% of the Guassa area. It is the most important vegetation community in the Guassa area as far as human use is concerned. The Guassa area derived its name from this vegetation community.

Figure 2.9 View of *Festuca* grassland in the Guassa area

2.1.5.2 *Euryops-Alchemilla* Shrubland

Euryops-Alchemilla shrubland occurs on flat and gentle slopes and well drained areas, and is restricted to areas above 3200m asl. Common plant species of this vegetation community are: *Euryops pinifolius; Alchemilla abyssinica; Kniphofia foliosa; Thymus schimperi; Urtica simensis; Anthemis tigreensis; Echinops steudneri; Ferula communis; Hebenstretia dentata; Swertia erythraeae; Agrostis graclifolia; Geranium arabicum; Kalanchoe deficiens; Senecio gigas; S. vulgaris;* and, *S. schultz.*

This is the most extensive habitat type and covers 21.7% of the total area. The shrubby vegetation of *Euryops pinifolius* is extensively used as firewood by the communities living adjacent to the Guassa area.

Figure 2.10 View of *Euryops-Alchemilla* shrubland in the Guassa area.

2.1.5.3 *Euryops-Festuca* Grassland (Mima mound)

Euryops-Festuca grassland or Mima mound is usually interspersed with scattered mounds, that can reach a height of 1.5m and a diameter of 5-10m (Figure 2.11). These mounds consists of highly organic and deep soil, that is made by the activity of the rodent community, the most important of which is the Common Mole Rat (*Tachyoryctes splendens*). Common plant species of this vegetation type comprise: *Euryops pinifolius; Festuca abyssinica; F. richardii; F. macrophylla; F. simensis; Agrostis gracilifolia; A. kilimandscharica; Andropogon amethystinus; Alchemilla abyssinica; Anthemis tigreensis; Thymus schimperi; Rumex abyssinicus; Cirsium vulgare; Hebenstretia dentata; Hypericum peplidifolium; Lobelia rhynchopetalum;* and, *Haplocarpha rueppellii.*

The mounds are predominantly covered by *Euryops* and *Alchemilla* while the area in between the mounds is covered pre dominantly by *Festuca abyssinica.* This habitat accounts for 15.5% of the total area of Guassa. This habitat commonly used as dens by Ethiopian wolves during the breeding season, and it is important for human use, as long as the *Festuca* (Guassa) grass is dominant. Otherwise it is commonly used as grazing ground for livestock.

Figure 2.11 View of *Euryops-Festuca* Grassland (Mima Mound).

2.1.5.4 *Helichrysum-Festuca* Grassland

This vegetation community is found on high ground and hill tops, where the soil is poor. The plants commonly found in this habitat type are: *Helichrysum splendidum; H. gofense; H. formosissimum; Sencio vulgaris; Festuca abyssinica; F. simensis; Andropogon abyssinicus; Pinnisetum* sp.; *Alchemilla abyssinica;* and *Echnnops* sp.. This habitat accounts for 4.4% of the total area of Guassa. This habitat is little used by humans, since the *Helichrysum* shrub produces lots of smoke when burnt.

Figure 2.12 View of *Festuca -Helichrysum* Grassland.

2.1.5.5 *Erica* Moorland

Erica moorland is commonly found on higher ground areas with shallow and well-drained soil. Plant species common in the *Erica* moorland vegetation type are: *Erica arboria; Thymus schimperi; Trifolium burchellianum; Alchemilla abyssinica; Helichrysum splendidum; kniphofia foliosa; Swerti abyssinica; Rubes abyssinicus; R. stedneri;* and *Urtica simensis.* This habitat accounts for 10.4% of the total area of Guassa. The *Erica* shrub is collected for firewood mainly in the wet season.

2.1.5.6 Swamp Grassland

The Swamp grassland is an area that is permanently or temporally inundated in the wet season. Common plant species of this habitat type are: *Carex monistachia; Carex fischeri; Hydrocotyle mannie; Alchemilla* spp.*; Swertia shiperi;* and, *Kniphofia isoetifolia*. This habitat accounts for 3.7% the total area. It is completely different from other habitats in species composition and was taken as an important habitat in this study. In terms of human use the swamps provides a year round green grass to cut and carry home. However, where coarse (*Carex* spp.*)* grass are dominant it is less desirable as a source of fodder.

2.1.6 Fauna

2.1.6.1 Mammals

In the Guassa area of Menz, two shrews and six rodent species are recorded. *Crocidura thalia* and *C. baileyi* are the most widespread of the endemic shrews in Ethiopia (Yalden and Largen, 1992). They are found on both sides of the Great Rift Valley above the ranges of 2700m asl to 3550m asl (Yalden *et al.,* 1976). The rodents recorded in the Guassa area include: porcupine *Hystrix cristata*; common mole rat *Tachyoryctes splendens*; the unstriped grass rat *Arvicanthis abyssinicus*; the harsh-furred rat *Lophuromys flavopunctatus*; the Abyssinian meadow rat *Stenocephalemus grisecauda*; and, the groove-toothed rat *Otomys typus*. Two of the rodent species *(A. abyssinicus* and *S. grisecauda*) are endemic to Ethiopia.

The endemic large mammal fauna of the Guassa area includes: the Ethiopian wolf *Canis simensis*; gelada baboon *Theropithecus gelada*; and, Abyssinian hare *Lepus starcki*.

The gelada baboon is the only living member of the once wide spread genus *Theropithecus* and is only found in the highlands of Ethiopia. The present day distribution of the gelada is limited to the steep escarpments and gorges that border the eastern side of the Central Highlands and the North-western highlands of Ethiopia. There are no records of gelada in the west part of the country and in South-east Highlands, despite the apparent suitability of the habitat. The gelada baboon is a graminivorous primate predominantly feeding on fresh shoots of grass and to a lesser extent on roots and seeds of grasses. The gelada social system consists of a hierarchy of social groupings. The basic group is the reproductive unit that consists of breeding males (1-4) and females (1-10) and their dependant young, collectively called band. A single band of gelada may contain 2-10 reproductive units, plus one to three all-male groups, (non-breeding males of young ages), that shares a common foraging and sleeping area. The ranging areas of different bands overlap and can mix easily, without any aggression to form a big gelada troops (Dunbar, 1992). The population of gelada baboon in the Guassa area is stable and can be seen all year round. The killing of adult male geladas for head-dresses is a common practise by Oromo people and has been an important factor in the population dynamics of the gelada (Dunbar, 1992). However, this practice is not common among the Amhara people living adjacent to the Guassa area.

Record of other large mammal species in the Guassa area include: grey duiker *Sylvicapra grimmia;* klipspringer *Oreotragus oreotragus*; common jackals *Canis aureus*; spotted Hyena *Crocuta crocuta*; civet *Viverra civeta*; rattel *Melivora capensis*; Egyptian mongooses *Herpestes ichneumon*; and, serval cat *Felis serval.*

Among the mammal species recorded in the Guassa area seven species are endemic to Ethiopia. Therefore, the Guassa area harbours 22.6% of the endemic mammal fauna of Ethiopia.

2.1.6.2 Birds

To date 111 bird species have been recorded in the Guassa area of Menz, which harbours 12% of the 861 species of birds recorded for Ethiopia. There are 14 endemic species of birds accounting for 48.3% of the endemic birds of Ethiopia. The range restricted and globally endangered Ankober serin *Serinus ankoberensis* and the endemic spot-breasted plover *Vannellus melaocephalus* are fond in greater number in Guassa area than anywhere else in the country. The Ankober serin is restricted at the northern part of Guassa, shows how a patch within a larger area can be important for a particular species. Three species of birds on the Guassa list are near threatened and two species are vulnerable (EWNHS 1996). Among the 111 recorded species 34% are Afro-tropical Highland Biome restricted species. One of the striking features of the avifauna of the Guassa area is the high density of birds of prey species, which is as a result of the high density of rodents occupying the area (Chapter 6). The area also serves as a wintering ground for 38 species of palearctic migrants and intra-African migrants.

2.1.6.3 Reptiles and Amphibians

Few reptiles and amphibians have been recorded for the Guassa area, which may be due to the low ambient temperature at this altitude. Two snakes, Abyssinian slug-eater *Duberria lutrix* and side-striped grass snake *Psammophylax* sp. as well as two toed species *Bufo kerinyagae* and *Ptychadena* sp. and a skink *Mabuya megalura* are common on the tall grassland. No fish species is recorded in Guassa.

2.1.7 Human Population

The population of Gera-Keya Woreda was estimated in 1994 to be 133,542 of whom 94% are rural. Mehal Meda, the capital of the Woreda (district), accounts for 85% of the urban population (CSA, 1995). The population is predominantly Amhara, which is one of the largest groups in the country. Their language is Amahric, a Semitic language descended from Geez, the ancient and liturgical language of Ethiopia, which at present is only used in the Orthodox Church. Amharic is also the official language of the country. The religion of the population is Monophysite Coptic Orthodox Christianity. The Menz area is the heartland of highland Christian Ethiopia, because it is in the geographical centre of the highlands. It was also an area in which the capitals of the kingdom were located in the old times and provided a large proportion of the governing elite. Most of the rulers of the country came from Menz, from the beginning of what is called the restored Solomonic Dynasty (1270 AD), until the over-throw of Emperor Haile Selassie I by the 1974 revolution.

More than 80% of Menz is highland and the high mountain ranges with their steep and eroded slopes have to support the expanding population. The rural population was based on subsistence production in peasant holdings. The household is a central concept in the area, in common with the rest of Amhara society. The area is perceived as having a homogeneous population, compared to the diversity of coexisting cultures elsewhere in Ethiopia.

2.1.8 Economy

The dominant economic activity in Menz is farming. The land holding throughout the entire Woreda varies between 0.75 to 3.5ha per household with average holding of 1.4ha. There are two farming seasons in the area corresponding to the short and long rainy seasons. The highland population heavily relies on these two cropping seasons in a given year, unlike lower parts of the country where farming is a one season activity. The importance of the *Belg* (short rainy season) is strongly emphasised in Menz and all is good as long as the *Belg* crop is good. *Belg* harvest accounts more than 50% of the total harvest in most highland areas of Ethiopia, since most of the flat agricultural fields will be flooded during the long rains. However, the *Belg* rains recently have been very unpredictable. The dominant crops of the area are barley, beans, lentils, and wheat. Barley is the single most important crop for subsistence, and three land-races have been recognised from Menz called *Ferke, Mawge* and *Temej*. *Ferke* is planted in the short rainy season and *Mawge* and *Temeje* are planted in the main rainy season. If the *Belg* rains start early, there is an opportunity for double cropping with relatively fast growing crops, like lentils or chick peas in the low-lying areas. In contrast, in higher altitude areas frost and water logging can be a problem preventing double cropping.

Land is ploughed in January to February for the short rains *(Belg)* crop and in June or July for the main rainy season (*Meher*) crop. The main draught animals are oxen, although horses and donkeys are used sometimes, due to impoverishment and the consequent shortage of oxen. It will take a man and his oxen one day to plough a 0.25ha under normal conditions in Menz. All farming related activities of ploughing and harvesting are men's work. In contrast, domestic activity is almost exclusively the work of women.

A major environmental threat in Menz is soil erosion. On average 80 tons of soil per ha per year is lost due to erosion on cultivated land. Soil erosion in the cultivated areas of the highlands is in the order of 10-15 times higher than for an average cultivated slope. Consequently, within 80 years of cultivation, it is predicted, that there will be less than 10cm soil remaining in many highland areas of Ethiopia (Hurni, 1986).

Livestock has been a key element of the economy in the mixed farming systems of northern Ethiopia. In Menz, the role of livestock in subsistence strategies has increased because of the unreliability of cultivation. It is nevertheless important to stress the close relationship between crops and livestock in the production system. Livestock need to be fed from the land and its products, while land needs to be cultivated with livestock. Livestock dung fertilises the land and the yield from the land is threshed using livestock. The livestock holding in Menz is low compared to other parts of the country, and only a few households can keep different forms of livestock. The average household owns one cow, a pair of oxen and one donkey while some household's own horses or mules. Sheep are the most common form of livestock in every household.

Unlike most parts of Ethiopia, spinning of wool in Menz is an important household economy. Tradition holds that wool has long been spun in Menz. Until a decade ago, the main clothing was *Bana* or *Zitett*, blankets made out of wool as protection against severe cold. Woollen *Banas* or *Zitett* are worn by men and women in Menz as warmer alternatives to the more common cotton *Gabi* or *Shemma*, and other locally made cotton blankets worn in many parts of Ethiopia. Wool also contributes to the household economy as a readily marketable product.

Menz is on the edge of the region that suffered the 1985 famine and was one of the areas where a government resettlement programme took people to different parts of the country (Pankhurst, 1992; Tafesse, 1995). Endemic poverty and famine have been experienced in the area depending on the harvest. In attempting to understand the cause of this poverty, various different factors have been suggested including: neo-Malthusian population growth; inhospitable physical landscape; isolation from centres of economic activity; environmental degradation; small land holdings and property regimes; limited technology; and, the nature of burdensome state tributes (Pankhurst, 1992; Wolde-Mariam, 1991; Admassie, 2000).

2.2 General Methodology of the Study

Detailed description of materials and methods, as well as of data analysis techniques, are presented in the relevant chapters. This section simply presents an overview of field data collected and the analytical methods used throughout the thesis.

2.2.1 Rodents Study

Rodents were studied using snap and live trapping methods.

2.2.1.1 Snap-trapping

Snap-traps were used to collect data on the relative abundance of rodents, their habitat preferences, activity and reproductive patterns. Snap trapping was conducted every two months in six habitat type for one calendar year of 1997. Traps were set at the beginning of each day from 0600hr-1800hr for day trapping and from 1800hr-600hr for night time trapping. From caught rodents the following data were collected: time (day or night); species; sex; age; standard body measurements; and, reproductive state as whether pregnant, lactating, and hymen perforation in females and testis position for males were recorded.

2.2.1.1 Live trapping

Live traps were used to collect data on survival rate, density and biomass of rodents. The live trapping activity was carried out in the three main habitat types every two months for two calendar years of 1997 and 1998. Captured animals were toe clipped and released. Trapping sessions lasted for three consecutive days preceded by one day of pre-baiting. Data on the species, sex, age, mark, site of capture and weight were recorded.

2.2.2 Large mammals Study

Line transects were used to collect data on the densities of wild and domestic herbivores, as well as of people collecting firewood and cutting grass. Transects were laid 1 km apart using the Universal Transverse Mercator (UTM) gridlines on a map of 1:50,000 scale (EMA, Ataye, 1992) and with the help of a Global Positioning System (GPS) 40 (Garmin International, Lenexa Ks 66215, USA). A total of 18 transects with a total distance of 71 km were marked in the study area. The beginning and end point of each transect was relocated using the GPS allowing determination of transect length. Transects were traversed on foot every two months from December 1996 to November 1998. Data on: the date; time; species; sex; age (juvenile, sub-adult, adult); group size; activity; and, environmental aspect (slope and habitat), were collected. Sighting distances from the transect line was determined by visual estimation.

2.2.3 Ethiopian Wolves Study

2.2.3.1 Diet and Feeding Behaviour

The diet of the wolf was studied by analysing faeces. Faeces encountered were collected and labelled with date, age, habitat and location. After drying, the contents of the faeces were identified to allow the calculation of the frequency of prey occurrence in each sample, and the percentage of rodents in the diet by volume.

The foraging behaviour of the Ethiopian wolf was studied by observation during focal watches. All activities related to feeding behaviour, prey identification, stalking, and capture attempts, whether successful or not were recorded.

2.2.3.2 Habitat Preference and Spatial Organisation

Coat pattern, body shape and other natural markings such as deformities, were used to identify individual wolves. In addition, five individuals were radio-collared. Observations were made on known individuals from an unobtrusive distance. Activity and the number of individuals in each group were recorded every 15 minutes, and their positions were recorded using a GPS. Each radio-collared wolf was followed once in a week. All sightings of known individuals were plotted to estimate individual home range and pack home range size. Wolf presence in a particular habitat during observations was used to calculate habitat preference.

2.2.4 Extent of Human Use and Their Effect on Rodents

The Menz community uses the Guassa area habitat types for different purposes: including livestock grazing; cutting of grass; and, collection of firewood. The density of grazing livestock and people utilising the study area was determined from the line transect data (see 2.2.2). Levels of different uses by livestock and humans in different habitats was determined using an instantaneous scanning method (Altmann, 1974). The total time each user spent in the area and the time spent grazing or collecting firewood was recorded. Off take rate was determined by measuring the total amount of grass or firewood taken by anindividual collector, as well as by measuring the patch area used to collect the resource. The effect of human use on the rodent population was studied by setting a snap trapping session in different use types of grass cutting, firewood collection, and grazing.

2.2.5 Social Survey

Information on the indigenous resource management system and on the resource use pattern of the community around the Guassa area was studied by using a combination of RRA/PRA and an individual interview methods.

2.2.5.1 RRA/PRA Methods

The RRA/PRA methods used in this study were based on Chambers (1992).

- A pre-appraisal dialogue was conducted among the user communities through group discussion as an introduction to the area and the people.
- Semi-structured interviews were conducted with key informants of the community to establish facts on:
  - time lines, chronologies of events, and listing of major events in a village with dates;
  - trend analysis, accounts of the past, of how the environment has changed, ecological histories, changes of land use and cropping patterns, changes in

customs and practise, changes and trends in human population, migration, fuel used, source of energy, and the cause of changes;

- land use calenders by season or by month, crop yield, agricultural labour activity, non-agricultural labour activity, and food consumption;
- key probes, questions that can lead directly to key issues such as, what new practices have you or others in this village experimented with in recent years? What resource you can get from the wild?; and,
- triangulation, information on the same subject generated through the different methods and techniques described above were cross-checked to ensure information gathered form the communities around the Guassa area was consistence. (Appendix I).

2.2.5.2 Individual Interviews (Questionnaire survey)

Individual interviews are increasingly used in studies of natural resource management and resource use patterns, and to investigate attitudes of communities (Infield, 1988; Balakrishnan and Ndhlovu, 1992; Newmark *et al.*, 1993; Admassie, 2000).

In this study, a structured and a semi-structured questionnaire interview were administered to households living adjacent to the Guassa area. The questionnaire was divided into different topics. Introductory questions included particulars of the interviewee's age, place of residence, education level, and family size. The second part of the questionnaire was directed towards matters related to the household economy. The third, part was directed towards the resources of the Guassa area and the importance attached to these resources at the household level. The fourth part was directed at the management system of the common property resource. The fifth part was directed at the Guassa area resource use pattern regime. The final part was directed at the wildlife of the Guassa area in general and the Ethiopian wolf in particular (Appendix II).

Pilot testing was conducted to check the reliability and validity of the questionnaire. Checks were made for variation in answers, given that a similar response has little value in later analysis. The pilot survey also helped to ensure the phrases of each question were understood by the respondents, to avoid redundancy between two or more questions, and to check for a logical flow of ideas between questions. The pilot survey also helped to organise the questionnaire so that respondents and researcher understood clearly the objectives and the time needed to conduct each interview.

Participants from eight peasant associations who make use of the Guassa area were identified. The eight peasant associations that participated in this study were: Daregegne; Chare; Qwangue; Gragene; Gedenbo; Kewula; Tesfomentir; and, Kuledeha (Figure 2.2). These peasant associations are mainly located in the west of the Guassa area at a maximum distance of 26 km from the Guassa area. A total of 504 households were interviewed in this study.

2.2.6 Data Analysis

All data from the snap-traps were analysed using Generalised Linear Models (GLM). GLM has three important properties comprising: the error structure; the linear predictor; and, the link function. In the past, the only tool available to deal with non-normal error structures was transformation of the response variable or the adoption of non-parametric methods. Nowadays, the recognition of various error structures and the development of appropriate statistical methods allows non-normal error structures to be analysed (Dobsen, 1990; Crawley, 1993). The snap-trap data on rodent numbers were analysed using both Poisson error structure and a binomial error structure. The advantage of the Poisson error structure and binomial error structure over the linear regression methods with count data is that a linear model can lead to prediction of mean values and proportional values. GLM with a Poisson structure was used to analyse total number of rodents caught regardless of habitat and time (Chapter 6), and of habitat and use type (Chapter 7).

Population estimates and survival rates of rodent communities were analysed using the Programme MARK, a Windows 95 based programme, and the Jolly programme (Cromack, 1964; Jolly, 1965; Lebreton *et al.*, 1992).

Wild and domestic animal densities as well as density of firewood collectors and grass cutters were estimated using the DISTANCE 3.5 Release 5 programme (Buckland *et al.*, 1993).

The individual and pack home range sizes of Ethiopian wolves were estimated using a Minimum Convex Polygon (MCP), using the GIS-based Arcview programme. The MCP was selected in order to make a comparison with another similar study of the species in the Bale Mountains (Sillero-Zubiri, 1994). Home range use was also estimated with the programme Home Ranger, Version 1.5 which used a powerful kernel method.

Social survey data were analysed by using parametric and non-parametric tests to explore relationships between socio-economic variables and factors affecting experience and attitude. Multivariate analyses were also performed using binary logistic regression for dichotomous dependant variables and one or more continuous or categorical independent variables (Freeman, 1987). Logistic regression was selected, as it is more flexible over discriminant analysis and logit multiway analysis with no continuous dependant variables.

The parametric and non-parametric statistical analyses used in this study largely follow Zar (1984) and Freeman (1987).

Chapter Three

3 Indigenous Common Property Resource Management

3.1 Introduction

The past few decades have witnessed the importance of understanding historical and existing natural resource use and management systems. Until very recently, conservationists and policy makers paid little attention to indigenous common property resource management systems and did not accord them any credibility. Recent interest in indigenous resource management systems arose from the failure of many conservation projects and the search for viable and sustainable alternatives to current models of resource use. Renewed interest is partly due to a new found pride in traditional values and institutions, both in developing and developed countries. However, most cultures and practises, in the developing world emphasise responsibility and a vested interest in the community, rather than on individualism (McCay and Acheson, 1987; Little and Brokensha, 1987; Berkes and Farver, 1989; Lalonde, 1993; Wavey, 1993; Alcorn, 1997).

The term "common property resources" applies to those resources for which there exist both communal arrangements for the exclusion of non-owners and for the allocation of resources, as well as legitimate claims on collective goods for members of recognised groups (McCay and Acheson, 1987; Berkes and Farver, 1989). In many cases, common property resource users co-operate in the exclusion and appropriation of the valuable resource that is governed under traditional rules. There exist rules concerning who may use the resource; who are excluded from using the resource; and, how the resource should be used with a minimum of internal strife or conflict among the users. Rules mutually agreed upon by all members of the group provide an efficient means of conflict resolution. Often users themselves point out that their local rules serve primarily to reduce conflict in resource use, over and above other possible functions (Berkes and Farver, 1989).

Indigenous common property resource management systems promote the ideals of communal welfare and responsibility. From the nomads of Arabia to native Amerindians, such principles are enshrined in the codes of resource appropriation and protection. It is no accident that traditional resource management systems are almost totally community-based. These traditional resource management systems have been of interest to a number of national and international organisations in recent years. For example UNESCO and IUCN have produced several volumes and have a working group on traditional knowledge (McNeely and Pitt, 1985).

Hence, this chapter aims to understand the dynamics of the indigenous common property resource management system that operated in the Guassa area of Menz, and how it has been affected through government-sponsored changes and its subsequent replacement by another form of common property resource management. Information on the past and present common property resource management regimes will be reviewed based on the following questions:

- What factors determine past and current membership of, and exclusion from, the user group?
- What institutional arrangements were and are used in the management of the common property resources?
- How was and is authority transmitted between generations?
- What constituted an agreement between members and what sanctions and corrective measures were applied when members departed from agreed rules and conventions?

- What detrimental changes have occurred to affect the smooth operation of the traditional common property resource management and how have these changes been accommodated to retain the resilience within the system?

3.2 Materials and Methods

The following research methodologies were used to gain an understanding of the past and the present system of indigenous resource management system in the Guassa area, based on Chambers (1992).

3.2.1 Pre-appraisal Dialogue (Group Discussion)

First I aimed to obtain a general overview and to trace historical trends in common property resource management. Hence, I undertook a pre-appraisal dialogue by using a group discussion method that has well-known advantages and, contrary to common belief, that allows sensitive issues to be more freely discussed in groups, when individuals would not wish to discuss them alone with a stranger (Chambers, 1992). More generally, groups can build up collective and creative enthusiasm, which can especially lead to showing, sharing and familiarising new ideas and concepts with an outsider. Participants in group discussion fill in gaps that are omitted by other members of the discussion group, and add or correct detail. Groups have an overlapping knowledge that covers a wider field and provides an opportunity for cross-checking (Chambers, 1992). Participants of the group discussion can hear each other's responses, stimulate one another and consider each other's presence when responding, even if they do not necessarily have to reach consensus. On the negative side, disadvantages have been indicated, such as dominance of a group by one or more individuals (Patton, 1990).

A separate group discussion took place in each of the eight peasant associations that make use of the Guassa area. Group discussion participants were invited to the discussion on a date and place selected by themselves. In many cases, the discussion was conducted after peasant association members' meetings, or during church gatherings, or around their homesteads. The size of group discussion meetings varied from 8 participants to 74 participants with an average of 35 participants. Open-ended questions on the history of the area, past and present management practices, types of resource use, historical and present distribution and abundance of species of wildlife were all discussed. Discussion results were recorded and used to establish further detailed discussion points, which formed the basis for key informant interviews.

3.2.2 Key Informant Interviews

Key informant selection involves enquiring who are experts and seeking them out (Chambers, 1992). In this study, the participants of the group discussions nominated key informants. Most of the participants were elderly people whom the participants of the group discussion thought to have a good knowledge of chronologies of events and local histories. The key informant interviews were conducted with a written checklist of open-ended questions. Topics discussed included: people's accounts of the past; how things have changed; ecological histories; changes in land use and production patterns; changes and trends in wildlife populations; changes in resource use pattern; and, causes of changes and trends (Appendix I). The key informant interviews were conducted after the pre-appraisal dialogue (group discussion) by making special appointments with key informants individually. A total of 126 key informants from eight peasant associations participated in this exercise.

3.3. Results

3.3.1 System of Indigenous Common Property Resource Management before 1975

The group discussion and key-informant interviews revealed that the pioneer fathers (*Aqgni Abat*) of Menz, Gera and Asbo, started the indigenous management of the Guassa area in the 17^{th} Century, following the defeat of Ahmed Gragen. At the outset, Gera noticed an expanse of open land in the eastern part of Menz and demarcated the Guassa area as his pastureland. Asbo also noticed this and demanded a 'use right' in the area. This resulted in a confrontation and Lalo and Mama (Lalo and Mama are pioneer father for Lalo Mider and Mam Mider, respectively, close to the Guassa area) intervened to arbitrate between the two pioneer fathers. Eventually, it was decided that Gera and Asbo should race their horses, and that the boundaries between Gera and Asbo should be drawn where the horse fell. The race was run and Asbo's horse fell at what is now called Deja Hill in the middle of the Guassa area. To this day, the Deja Hill has remained as the boundary between the Guassa resource available to descendants of Asbo and Gera, respectively.

The pioneer fathers set the Guassa area aside for the primary purpose of livestock grazing and use of the guassa (*Festuca)* grass. The right to use the resources of the Guassa area depended on the land right and tenure system that prevailed in Menz, known as *Atsme Irist*. *Atsme Irist* was a right to claim a share of land held in common with other rightful landholders based on an historical ancestor. Those who can establish kinship through either parent may enter a claim to a share of the land from elders controlling the allocation. Hence, under *Atsme Irist*, the Menz people who could trace their descents from the pioneer fathers, Asbo or Gera, could use the Guassa area.

To promote the rational use of resources in the Guassa area, the members of the land holding group *(ristegna)* in the *Astme Irst* land tenure system adopted an indigenous institution to manage the common property resources, known as the *Qero* system. The

Qero system worked by choosing a headman (*Abba Qera* or *Afero*) who was responsible for protecting and regulating use of the Guassa area. The Asbo and Gera areas each had one *Abba Qera* (*Afero*). The *Abba Qeras* were mostly elected anonymously in the presence of all users of the common property resource. To elect their respective *Abba Qeras*, the Asbo descendants met at Kemagna Gur whilst the Gera descendants met at a locality known as Sefi Ber. To be elected as *Abba Qera* a candidate had to be able to trace his ancestral lineage through his patriarchal or matriarchal line to Asbo or Gera. The terms of office of *Abba Qera* could last from a few years to a lifetime, depending on the performance of the office holder. The *Abba Qeras* gave their vow in front of the head priest to look after the common property resources of the Guassa area. Inefficient *Abba Qeras* were deposed by the users, whenever they felt the *Abba Qeras* had failed to fulfil their duties.

The user communities of the Guassa were further subdivided at a *Tabot* or *Mekdes*[2] (parish) level. The Asbo side users were organised under the six parishes of: Zata; Akebel; Yedamot; Kuria; Yahala; and, Jara. The Gera side users were organised under eight parishes of: Anjere; Dewos; Ketanit; Kewula; Wodaka; Duwat; Gedenbo; and, Argano. Our group discussion and key informants interview participants pointed out that the organisation of the user community into parishes gave the Guassa area the status of consecrated land, under the protective patronage of the church. Each parish had one headman esquire (*Aleqa* or *Chiqa-shum*) who was answerable to their respective *Abba Qera*.

The *Qero* system could entail the closure of the Guassa area from any type of use by the community as long as 3-5 consecutive years. The length of closure largely depended upon the growth of the *Festuca* grass and the need felt by the community.

[2] Tabot is an icon-like replica of the Arc of the Covenant, central to the belief of Ethiopian Coptic Orthodox (Monophesite) Church. It is kept in the Holy of Holies, which is called Mekdes of each church. In rural Ethiopia particularly among the elders it also represents the church and the parish.

Several times, it was suggested that the length of closure depended on the success of crop harvest and on the frequency of drought in the area.

When the *Abba Qera* of both Asbo and Gera felt that the Guassa grass was ready for harvest *(le akme Adam siders)*, they would announce to the rightful owners of the Guassa user community the date of the opening, either at church ceremonies, market places, burial ceremonies (*Ider*) or other public gatherings. On the particular day of the opening, before anybody touched the grass, a respected head priest from the area gave his blessing (*Egziabhire yeftahi*) and the senior *Abba Qera* announced the official opening of the resource for use. Then any user who could trace his descent from Asbo or Gera had the full right to cut as much grass as he could. The area was usually opened at the height of the dry season of that particular year, usually around February. Once the grass cutting was over it was the turn of livestock to graze the Guassa area.

When the wet season approached, the community prepared to leave the Guassa area. The date of closing was culturally predetermined as the 12 July (*Hamle Abo*) following the opening. The reason for this particular date is that it is the breaking day of the "Apostle's Fasting" (*ye hawariat som*), which is the second biggest fasting season next to Lent for the Coptic Orthodox Church.

Prior to 1941, the user communities used to pay a levy (*giber*) to the king through their respective *Abba Qera*. The levy for using the Guassa area was nine cloaks and an unknown number of sheep. During the reign of Emperor Haile Selassie I, the payment of tax in kind was abolished and payment was replaced by money. From 1941 to 1974 everybody with the use right to the Guassa area had to pay one *Birr*[3]. The *Abba Qera* collected this and kept the receipts in his own name to later show the to the people.

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[3] Birr is the local currency of Ethiopia, US$1= 8.20 Birr at present.

3.3.2 Enforcement of Rules in the Management of Common Property Resource before 1975

Laws were enforced for the protection of the common property resource under the *Qero* system. This worked by enacting various bye-laws and by the entire community working together under the leadership of the two *Abba Qeras*. The *Abba Qeras* frequently patrolled their respective areas with the household heads (*gollmassa*) on dates chosen by the *Abba Qeras*. Every able male household head was obliged to go out on patrol, and failure to participate would result in severe punishment for absentees. In some instances, punishment could result in burning down of the absentee's house.

Rules were in place that prohibited the use of the Guassa area during the closed season. Various bye-laws were enacted by the user community to enforce the protection of the common property resources. All informants made reference to punishments where someone found cutting or grazing livestock in the Guassa area during the closed season was supposed to pay:

> *100 daula of gomen zer* (100 sacks of cabbage seeds);
> *Irtib yeanbessa lemd* (a wet lion skin);
> *Andi kolet barya* (a one-testicled servant);
> *yebirr zenezena* (a silver pestle); and,
> *Yekechemo mukecha* (a mortar made out of a shrub which never grows a stem).

None of these items were available in Menz and some of them were not available anywhere at all! Hence, these penalties were taken as the price for violation of community rules because, if impossible to obtain, no one would dare to touch the common property resource in the closed season. In addition, if someone was found violating the bye-laws and unable to meet the prescribed penalties, he was stripped of his *Astme Irst* right of owning land and, thereby, was forced to evacuate Menz.

When someone was found cutting grass in the Guassa area, the most effective and highly enforced bye-laws were those that involved a serious beating. Furthermore, if someone thatched his house using *Festuca* grass that was cut during the closed season, his house was burned down. If livestock was found grazing, the livestock was slaughtered and the skin would be given to the parish church to make a drum (*kebero*). The following is how a 65 year-old key informant from Quangwe described one of the incidents that took place in his lifetime:

> "We were patrolling the Guassa area in 1969 with the *Abba Qera* Ato Wolde Sheresher. We found one cow, which strayed from her owner the night before. It was found grazing in the Guassa and the *Abba Qera* told us to shoot it and we immediately shot the cow. The *gollmassa* on the patrol ate the meat and the *Abba Qera* took the hide to be given to the church. The owner of the cow was my neighbour Ato Bealchew who was so upset, but there was nothing he could do. He had to accept it, it was the *Qero*. This was how we used to look after our Guassa."

If a trace of freshly cut *Festuca* grass was found in someone's homestead, or if someone was seen to have made a fresh rope, he was considered to have cut the guassa, and measures were taken by the *Abba Qera* of his area. If fresh dung was found in the Guassa area, it was the responsibility of the local esquire to find out as whose cattle had been in Guassa.

3.3.3 Change in the Management of Common Property Resource after 1975

In 1974, a popular uprising (*Abiot*) swept the country. One of the most popular mottos of the revolution was "Land for the tiller" (*meret larashu*). The 1974 uprising was hijacked by a military junta called the *Derg* as a vanguard to the revolution. On March 4th 1975, the *Derg*, proclaimed the nationalisation of all rural land and dissolved the relationship between tenant and landlord, and between customary tenure and privileges. The proclamation abolished private and community ownership of land and replaced this with state ownership. Therefore, the proclamation gave a uniform usufruct right to all farmers within the framework of state ownership of the land. The same proclamation also provided for the formation of peasant associations by farmers. Hence, the *Qero* system of the Guassa area, was abolished together with its associated common property resource management rules and enforcing mechanisms.

One of our 59 year-old informants from Gedenbo Peasant Association described the situation of Guassa management after the 1975 land reform as follows:

> "When the revolution came (*Abiot sifeneda*) we were told everybody is equal, there is no difference amongst people and everybody has a right to use the land regardless of his birthright. The same thing happened to Guassa. There was no *Qero* or *Abba Qera* to look after it. Those people whom we used to exclude from the Guassa management became owners of the Guassa overnight and everybody start to scrabble for the resource."

According to another 51 year-old informant from Chare Peasant Association:

> "Following this destruction of the Guassa area we the people, who had no choice of any other material to thatch our houses and with nowhere to go to collect firewood, formally complained to the Woreda administration in 1977. The administration at first ignored our grievance. Later, with repeated nagging of the administrator by our elders, the Woreda administration at last agreed the Guassa area should be protected. Following this agreement the Woreda clearly notified us to stop the use of the old bye-laws which were working under the *Qero* system on the pretext that they oppose the right of individuals and are reactionary. The community bye-laws were replaced by a monetary fine (*afelama*) to the Woreda Ministry of Finance Office and wrong doers should be prosecuted by the law at the local court."

The responsibility for enforcing the laws was given to the peasant associations (*kebles*) adjacent to the Guassa area. The *kebles* had to conduct patrols using the local militias and either to charge any offenders at the local court to which they have to pay the designated fine (*afelama*), or to pass the case to the district police station to be charged at the district court. As the new common property resource managers, a Guassa Committee was formed from the user community to replace the former *Abba Qeras* and to oversee the activities of the peasant associations towards the protection of the Guassa area. This resulted in a complete transfer of power from the parishes to the newly formed state machinery. It also gave power to the people who were previously marginalised from the resource use. For example, Ferkuta, Yeata, and Yedi came under the Qwangue peasant association and became the guardian of the Gera area, while the Asbo side became the responsibility of Dargegne peasant association.

One 64 year-old informant from Gragne Peasant Association describes the Guassa management scenario as follows:

> "Since the revolution the Guassa was only once or twice closed properly. I remember clearly in 1982 we got news that the Guassa farmed from the Yifat side. Then we went out and pulled their crop and destroyed their farm, and later a serious conflict broke between us and the Yefat people. The local administration had to intervene to stop this situation and after a big problem they stopped coming again. After that it closed only for a few months in the wet season and it will be open again in the dry season. I think there are lots of people who need the guassa grass and the number of livestock has increased, so closing it for long period like in the old days has become a problem."

Most respondents described the management of the Guassa since the 1975 Agrarian Reform as ineffective and very bureaucratic. There was little protection by the local militia which has only infrequently taken action against offenders, because of corruption and inefficiency.

One 58 year-old respondent from Gedenbo Peasant Association described the situation as follows:

> "The Woreda does not care about the Guassa because they always tell us you have to catch the offenders in the act of cutting (*Ige kefinge*). Otherwise it is not possible to accuse somebody of cutting grass. Then the people started cutting it at night when no one can see them. The police do not understand how we value the guassa grass, they do not know that the guassa grass is "our cloth, bread and butter" (*libsachin ina gursachin*), we cannot afford to buy corrugated iron sheets to cover our house. The only cloth we have is the guassa grass."

Our informants led us to understand that sale of the Guassa grass has increased in the last few years. An 67 year-old informant from Tesfomentier Peasant Association describes the situation as follows:

> "It was a taboo and an insult in our forefathers' time to sell guassa grass. How can someone sell something which is not his own property? We got the Guassa from our forefathers and we should hand it to our children as we received it. The situation is different, now the guassa grass has become a commodity to sell and buy in the market. Since 1994 it is the only product to be taken to the market, when the drought intensifies the poor take the guassa grass to buy some barley."

3.3.4 The Present Management of the Guassa Area

Most respondents indicated that the Guassa area is managed by the Guassa Committee formed from the user community. At present, the entire Guassa area users from the eight peasant associations select members of the Guassa Committee. The main function of the Guassa Committee is to control illegal uses of the Guassa area during the closed season. The Committee usually uses the local militia from the adjacent peasant associations of Dargegne, and Qwangue to conduct patrols. Illegal users may be prosecuted in the local courts while repeated offenders will be taken to the Woreda police. The activity of the Guassa Committee is supervised by the Woreda Administration Council and an evaluation of their activity is undertaken whenever the Woreda Administration Council thinks is appropriate. What has actually been found was that *afelama* paid by illegal users for violating the law at present is smaller for those living in adjacent communities than for those living at greater distances.

3.3.5 Summary of Changes in Management by Peasant Associations

Eight peasant associations were included in this study (see Figure 2.2) based on previous and present management control of the Guassa area (Table 3.1). These peasant associations have boundaries drawn around them that are based on political and topographic considerations, rather than including homogenous kinship descent groups. Nevertheless, the group discussions and key informant interviews were able to characterise the peasant associations in terms of their past and present levels of management control, in order to serve as the basis for understanding differences in attitudes of the user communities around Guassa (see Chapters 4 and 10).

Group discussion and key informant interviews showed that members of some peasant associations living nearby Guassa were marginalised from the past management on the pretext that they were not direct descendants of Asbo or Gera. Key informants mentioned that residents of Yedi, Ferkuta and Yehata villages (*Gote*), which now form the biggest proportion of the present Qwangue Peasant Association, were born outside the legitimate marriage of Gera, which in the *Atsme Irist* land right system is regarded as an important criterion for land distribution. The right to own land in the *Atsme Irist* land right system was based principally on tracing ancestral lineage from both parents. Fewer members of some other peasant associations fall in this category of marginalised users, namely Chare and Dargegne. In all cases, the marginalised were settled in agriculturally marginal land close to Guassa, while the rightful owners remained settled in the low-lying agriculturally productive land further from Guassa (Table 3.1).

Table 3.1 The key characteristics of different peasant associations, including distance from the Guassa, and their inclusion or exclusion from the common property resource.

Peasant Association	**Mean $\pm$ SE Distance from Guassa**	**Peasant Association Members Included in pre 1975 Traditional Management**	**Peasant Association Members Incorporated in to Management only after 1975 Agrarian Reform**
Chare	6.4 ± 0.23	Partly included	Secondary controllers and resource users
Dargegne	2.1 ± 0.12	Partly included	Prime controller using their local militia
Gedenbo	11.5 ± 0.33	Totally included	Secondary controllers and resource users
Gragne	8.5 ± 0.21	Totally included	Secondary controllers and resource users
Kewula	19.8 ± 0.55	Totally included	Secondary controllers and resource users
Kuledeha	19.59 ± 0.46	Totally included	Secondary controllers and resource users
Qwangue	1.8 ± 0.12	Excluded	Prime controller using their local militia
Tesfomentier	17.26 ± 0.72	Totally included	Secondary controllers and resource users

After the 1975 Agrarian Reform, the management of Guassa area started to decline and the Guassa area was nearly changed into an open access resource. However, the community realised the consequences of open access and responded automatically by re-instating a common property resource regime. Based on the prevailing political and social order, it was considered appropriate to pass the management to the peasant associations living adjacent to the Guassa area (Table 3.1). Likewise, the Woreda Administration Council passed a directive regarding Guassa area management. Based on this, the management of the Asbo side was given to Dargegne Peasant Association and the Gera side management was given to Qwangue Peasant Association. This resulted in marginalisation of the former rightful owners of the Guassa resource from its management. Finally, a decision was made to form the Guassa Committee from all users in each peasant association. The main activity of the Guassa Committee is to mobilise the militia from the adjacent peasant associations to conduct patrols.

3.4 Discussion

Previous studies in Ethiopia have documented common property resource regimes amongst a variety of groups (Admassie, 2000). However, this is the first detailed study of common property resource regimes in Menz in the Central Highlands. This study has provided the first description of the *Qero* system that has once operated to control resource use in Guassa, but that has now been replaced by modernising forces. The *Qero* system showed all the hallmarks of a classic common property system. The system has showed powers of resilience following the 1975 Agrarian Reform in Ethiopia and an institution for common property resource management still exists in the Guassa area.

3.4.1 Indigenous Management System of Common Property Resource: The *Qero* System

In response to tensions among individuals seeking access to resources, indigenous resource management institutions arose to ensure continued access to the resources and to restrict use by outsiders (Mantajoro, 1996; Ostrom, 1991, 1997). Indigenous resource management institutions for resource management include a wide variety of forms, rules and common understanding about how problems are formally addressed and solved in a particular community. Sometimes institutions are formed formally, with electoral procedures for specified tasks and rules that outline the rights and duties of all members. In other cases, institutions are not formally constituted, but still manage to regulate the use of the resources over a long period of time (Little and Brokensha, 1987).

Indigenous land tenure systems in Ethiopia were varied and evolved through a complex of processes before they were suspended by the 1975 Agrarian Reform. The major forms of land right and land tenure system operating in Ethiopia were *Atsme Irist* and *Gult*. Features of these tenurial systems has been analysed by Welde-Meskel (1950), Pankhurst (1961), Hoben (1973), Markakis (1974), and Rahmato (1984, 1994). However, the indigenous common property resource system of Guassa has not been described previously, and this study has provided the first such description.

The *Atsme Irist* land right and land tenure system worked by conferring inalienable usufruct rights equally to all living members of cognatic descent groups who could trace their lineage to a particular pioneer father (*Aqgni-abat*) who was credited with the original clearing or establishing of a recognised claim to the land. Those who could establish kinship through either parent could enter a claim to a share of the land from elders controlling the holding and allocation of land. This in effect, is a descent corporation. That is, a person could inherit *Atsme Irist* from either parent because of ambilineal decent principles prevail in *Atsme Irist* areas (Hoben, 1973; Cohen and Weintraub, 1975).

The *Qero* system was an indigenous common property resource management institution that arose based on the existing *Atsme Irist* indigenous land tenure system. The rules of exclusion governing access to the use of the Guassa area resource were aspects of the *Atsme Irist* land tenure system that conferred usufruct right on the living members of a group tracing their lineage to the pioneer fathers Asbo and Gera. Only those persons who could prove their lineage to these two pioneer fathers were recognised as full members of the user community (*ristegna*) and permitted to exploit the common property resource on an equal footing. Needless to say, all persons who did not belong to the two *ristegna* groups of Asbo and Gera were excluded.

The *Qero* system was organised on the basis of two formally elected headmen (*Abba Qera*). The roll and function of the *Abba Qera* was to mobilise the beneficiary communities for equitable resource distribution, and to enforce the bye-laws for protecting the common property resource. This indicates that it was a formal institution, which was established in response to a need to regulate the use of the common property resource in the Guassa area. Rules of protection and utilisation, as well as their enforcement, were essential aspects of the *Qero* system. These rules were tied up with the traditional tenure system and reflected the prevailing feudal system. Thus, the commons were not outside the overall socio-economic and political system, but rather were an integral part of it. The management of the common property resource was part and parcel of the wider tenurial and administrative system.

The common property resources of the Guassa area have been managed for hundreds of years by these rules, which were enforced by the members of the community acting individually and in groups. Outsiders, and even rightful owners, not abiding by the rules and regulations governing the mode of resource appropriation and enforcement of the law were excluded. The protection of the common property resources were reinforced with the prestige, power and authority of another local level institution, the parish. Hence, the rules of protection and utilisation and their enforcement operated and survived by leaning on another more hallowed institution, the church. In the process, the Guassa area become a kind of sacred entity, equivalent to what Durkheim (1965) called "the extraordinary contagiousness of sacred character".

The Guassa area has not been brought under crop cultivation, despite the general craving for land in Menz, due primarily to its peculiar physical attributes. The Guassa area is above the tree-line, and neither trees nor crop cultivation yield the expected results. Hence, there is no permanent human settlement in the area. However, the Guassa area plays an important role in the economics and survival strategies of the communities living adjacent. Therefore, it is not surprising that the community has a vested interest in safeguarding the Guassa area.

3.4.2 The Decline of the *Qero* System

The Guassa area shows what happens when the rules by which common property resources were traditionally managed suddenly collapse under pressure from modernising forces. The reason behind the Guassa's demise, and the subsequent suffering of those who depend on its resources, is easy to pin-point. In Menz the undermining of the *Qero* system is no doubt the most debilitating impact of the 1975 Agrarian Reform. The transformation of land ownership from communal tenure into the state or public land tenure system, abolished the regularity of the *Qero* system. Thus, a common property regime that formerly provided assurance that the resources on which all rightful owners collectively depended would be available sustainably, is no longer fully functional. The same assurances cannot be provided by the adoption of different property rights, in this case state ownership, since the approaches for sustainability and equity are different.

The common property resources of Guassa are now managed in theory by the newly formed peasant associations, which are the new state machinery for the administration in rural communities. The peasant associations are structured on the basis of geographical location rather than on the natural bonds that exist amongst the communities. Hence, the old system whereby communities were structured on the bases of kinship and parishes, both of which are tremendously important to communal belief and unity, are no longer fully functional. The formation of peasant associations abolished the social structure under the pretext that "everybody is equal", but it was not able to come up with another socially acceptable form of structure to replace the old. This resulted in eroding the sense of "belongingness" in the community, thereby creating tension and conflict between the old and the newly authorised users (Table 3.1).

On the basis of information obtained from the group discussion and key-informant interviews, three important factors are responsible for the decline of effective management in the Guassa area, namely: institutional failure; repeated land re-distribution; and, villagisation.

- Institutional failure due to changes brought by the 1975 Agrarian Reform was singled out as the most important factor in the decline of the *Qero* system. The change in the management of the resource resulted in the transfer of decision making from exclusive community-based protection to local government authority. The latter in turn passed accountability to the present resource managers, the Guassa Committee, without considering the size and concern of other communities who believe they are the rightful resource owners. Some of the present administrators of the common property resource were in fact previously marginalised from resource use in the *Qero* system as they are not the direct descendants of the pioneer fathers (Table 3.1). Indeed, they are accused of being inefficient in enforcing the present protection law (*afelama*). The amount of time spent patrolling the Guassa area now is very minimal, and it has been shown elsewhere that illegal harvesting of resources can only be reduced by increasing detection rates through intensive patrolling (Leader-Williams and Milner-Gulland, 1993).

- Two major and five minor redistributions of land have taken place since the 1975 Agrarian Reform in Menz. Other studies in the Central Highlands have found that 85.5% of households have less land than before the 1975 Agrarian Reform (Wolde-Mariam, 1991; Admassie, 2000). Whenever land redistribution has taken place, this has also brought a partial or complete change of farmland. This repeated redistribution of land has decreased the size of private crop and grazing land holdings, which has ultimately increased pressure on the Guassa area for grazing and for encroachment as agricultural land. In turn, this has resulted in the inability of the community to be self-sufficient in food production, as well as to lose interest in land management practices.

- The villagisation programme is another state-sponsored social change that seriously affected the Menz population. The Ethiopian villagisation campaign began in late 1985. Its aim was to move the majority of the rural population into the new villages by the end of 1995. The policy was part of the revolutionary *Derg* government's drive towards agrarian socialism in an undeveloped, pre-dominantly peasant-based, rural society. Although the physical focus was on creating a new spatial physical structure, moving people closer together into a grid-patterned village, the change was intended to have a radical and uplifting effect on the social and political life of the peasantry (Pankhurst, 1992; Tafesse, 1995). The impact of the villagisation programme in the Guassa area was an extensive collection of guassa grass for thatching. Communities living far from the Guassa area, up to a day's walk, came to collect the grass, which increased the number of users to a very high levels. Another influence of the villagisation programme was that increased distances to other grazing lands, and the problems of livestock management, forced people to move their livestock into a semi-permanent residence in the Guassa area. This was because there was no area in the villages where livestock could graze under the watchful eye of a household member. If left unsupervised, the animals were likely to trample someone's crops.

Pressure from within and from outside forced the then military government to abandon its villagisation programme in March 1990. Peasants quickly responded to this by abandoning the new villages and going back to their former homesteads. Although the villagisation programme is now shelved, its impact has nevertheless, remained in the area.

The whole cost of these exercises was resented by the community, mainly due to the mismatch between the different perceptions of government and of local communities which later led to absolute poverty.

3.4.3 The Existing Management of the Common Property Resource

Gibbs and Bromley (1989) described common property resource management institutions as having the capacity to cope with changes through adaptations. This in turn leads to the stability of the management system and an ability to cope with surprises or sudden shocks, which further increases the resilience of the system. This has been evident in the Guassa area. When the *Qero* system was abolished, the community complained to the local administration, and the *Qero* system was then formally replaced by the Guassa Committee, which is a different form of community-based management institution for the management of the Guassa resource. Nevertheless, the effectiveness of the Guassa Committee is highly impaired by its lack of absolute authority in the management of the common property resource. The peasant associations close to the Guassa area exercise more authority than the Guassa Committee and formal complaints about the management of the area always have to be addressed to the district administration. Any Guassa Committee decision on the management of the area in turn has to be approved by the Woreda Administration Council, and the committee's function is solely reduced to patrolling the area.

Because the common property regime has been re-established through the Guassa Committee, the next chapter examines the attitudes of the user community towards present and future management of the Guassa area.

Chapter Four

4 Attitude towards the Present Common Property Resource Management System

4.1 Introduction

The failure of human societies to prevent a wide range of environmental degradation is often discussed in terms of common property mismanagement (Godland *et al.*, 1989; Kothari, 1997). Many developing countries suffer from this environmental mismanagement, and among the causes of environmental mismanagement, the breakdown of traditional common property management systems is perhaps the most important (Berkes, 1985; Godlnd *et al.*, 1989). Common property management systems fall under great pressures from outside forces, like inappropriate government polices, and from unjustified economic projects. However, most effective common property resource management systems have the capacity to cope with changes through adaptations and by reducing conflicts (Gibbs and Bromley, 1989; Alcorn, 1997).

The last chapter described how indigenous common property resource management worked under the *Qero* system in the Guassa area of Menz, and how its subsequent replacement by the Guassa Committee resulted in the weakening of the management of the common property resource. Institutional arrangements, such as rules and conventions, are clearly important elements in resource conservation, translating claims on resources into property rights for some and in to duties for others (Murphree, 1993). Their efficiency, equitability and sustainability determine their capability to be resilient and to accommodate sudden changes in the system, as well as their capacity as development and conservation tools (Gibbs and Bromley, 1989).

When the management systems and the associated institutions in common property resource management are forced to change due to external forces, the problems encountered by the owners of the common property resource in terms of resource appropriation and regulation of resource use, as well as the struggle to bring back some form of resource use regulation, is an important element in the study of common property resource management.

Given the changes in the institutional arrangements for managing the resources in the Guassa area, and the weakening of the present management as a result of changes imposed by modernising forces, this chapter examines the present attitudes of the community living adjacent to the Guassa towards the management of the common property resource management after the 1975 Agrarian Reform. Specifically, by examining attitudes of users in different peasant associations, I aim to compare opinions and attitudes of users that were once in charge of the Guassa area, but now live more distant to it, with opinions of those who have more recently been included in the management of Guassa following the 1975 Agrarian Reform, and now live closer to the Guassa area. Following a basic demographic and social description of those respondents interviewed in eight peasant associations, I examine the following:

- views on the effectiveness of the *Qero* system between those included and formerly excluded from its management institution;
- views on the effectiveness of present management by those now included in the management, and the former managers who have witnessed widened access to the resource; and,
- what factors might determine different views between users.

4.2 Materials and Methods

A structured and semi-structured questionnaire interview was conducted among a sample of household heads from the Guassa user communities in eight peasant associations (see Figure 2.2 and Table 3.1). The interview began with questions to elicit demographic and socio-economic data, including respondents' age, sex, residence, family size, marital status and other information associated with the economic activities of the household. The interview continued with a series of dichotomous questions requiring negative or positive responses regarding the past and present management of the Guassa area. The Likert Scale of measurements of 1-5, with a value of 5 indicating strong positive response and a value of 1 strong negative response, was used to assess the degree of importance that the household attached to particular resources or factors (see Appendix II).

The questionnaire was administered to household heads in a random manner on the basis of first come, first served, and alternating male and female respondents as much as possible. The sampling was designed so that not less than 5% of or not less than 50 household heads were interviewed in each peasant association. The reason why the lower limit is expressed both as a percentage and in terms of a minimum number was due to the widely differing sizes of peasant association membership. Thus, Kewula peasant association had 509 members while Quangue peasant association had 1427 members, based on the 1994 Population and Housing Census of the area (CSA, 1995). Therefore, this approach helped the data collected to be within a reasonable and statistically meaningful sample (Patton, 1990). A total of 504 individuals were interviewed across the eight peasant associations (Table 4.1).

The data were later analysed using non-parametric and parametric statistics (Chi-squared test and one-way ANOVA), to examine relationships between socio-economic variables and factors affecting experience and attitudes. The Tukey test was used to identify real difference after a one-way ANOVA test. Multivariate analysis was also performed, using logistic regression for binary dependent variables and one or more continuous, independent variables (Freeman, 1987). Forward logistic regression was used, with criteria for entry and exit to the model specified at significance levels of $p<0.05$. Logistic regression was selected because it is related and answers the same questions as discriminant function analysis, and the logit multiway frequency analysis with discrete dependant variables. However, logistic regression is more flexible than the other techniques. Unlike discriminant function analysis, logistic regression makes no assumption about the distribution of the predictor variable. In logistic regression, the predictor does not have to be normally distributed, linearly related, or of equal variance within each group. Nor does the predicator need to be discrete, but it can be any mix of continuous, discrete and dichotomous variables. Logistic regression analysis is especially useful when the distribution of responses on the dependant variable is expected to be non-linear with one or more of the independent variables (Tabachnick and Fidell, 1996).

The dependent variable was taken as dummy of 0 if the response was negative and of 1 if the response was positive. The explanatory variables examined during the logistic regression include: peasant association; age; sex; length of residence in the area; education level; martial status; family size; distance of village from the Guassa area; and, household capital or wellbeing score (total livestock and grain production of household calculated at present value).

4.3 Results

4.3.1 Demographic and Economic Patterns

The Guassa area user communities at present comprises eight peasant associations found within a maximum radius of 26 km west of the Guassa area (see Figure 2.2 and Table 3.1). The populations of these peasant associations have increased since 1994 (Table 4.1). Human population density living adjacent to the Guassa area is now high with >80people/km^2 (Figure 4.1).

Table 4.1 Area, number of households and population size from 1994 to 2000 in eight peasant associations around the Guassa area, shown with sample sizes of households included in the interviews.

		1994		1997		2000		Sample
Peasant Association	Area **(Km^2)**	***HH**	**Population size**	**HH**	**Population size**	**HH**	**Population size**	**size**
Chare	39.03	830	3622	1326	3785	1339	4374	50
Dargegne	46.68	939	3894	1061	4075	1077	4708	82
Gedenbo	40.32	730	3443	1242	3598	1262	4157	50
Gragene	68.23	1337	5651	2100	5905	2021	6825	54
Kewula	64.13	509	3777	1265	4145	1275	4786	6
Kuledeha	40.53	718	3470	1021	3626	1075	4190	64
Quangue	82.30	1427	6366	1877	6652	1979	7685	92
Tesfomentir	43.35	1047	4377	1453	4569	1537	5281	46
Total	**424.57**	**7537**	**34600**	**11345**	**36355**	**11565**	**42006**	**504**

**HH = Households numbers*
Data from CSA, 1995 and District Administration Council.

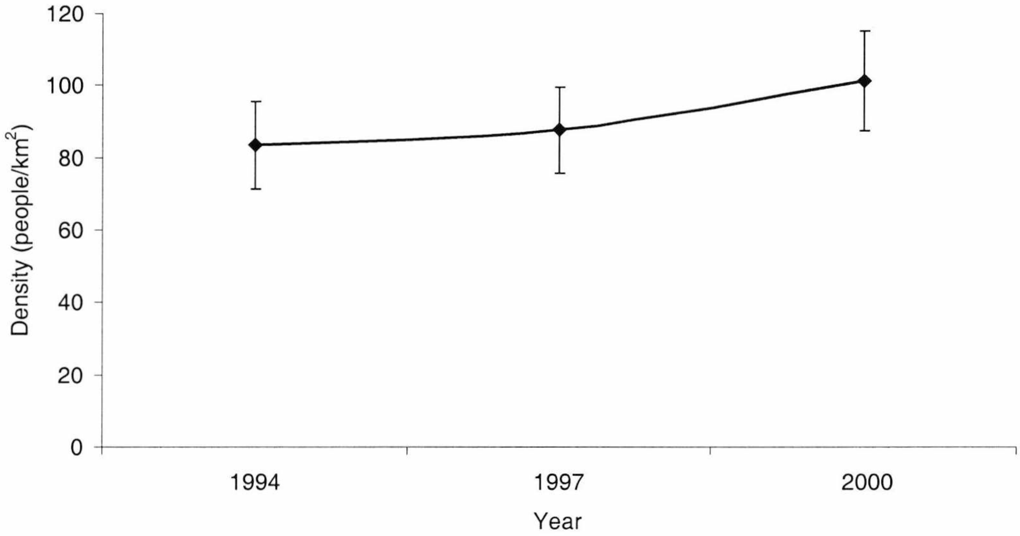

Figure 4.1 Change in population density of people living around the Guassa from 1994 to 2000, shown as mean $\pm$ SE of eight peasant associations.

The ages of interview respondents ranged from 15 to 88 years (Figure 4.2). Male respondents were generally older than female respondents ($F_{1\ 503} = 6.62$, $p<0.05$).

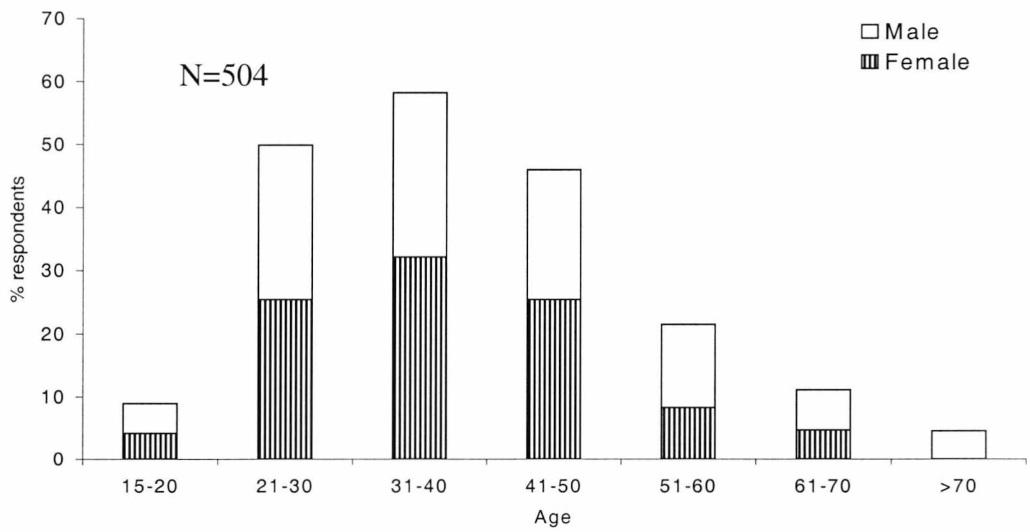

Figure 4.2 The age classes of 504 respondents from the eight peasant associations combined.

The lengths of residence in the area ranged from 3 to 88 years. Male respondents had resided considerably longer in the area than female respondents ($F_{1,503}$=12.18, p<0.001).

Family size ranged from 1 to 12. There was a difference among the peasant associations in terms of family size ($F_{7,496}$ =3.49, p<0.001). Households in Chare had the largest families, while those at Kuledeha had the smallest (Figure 4.3).

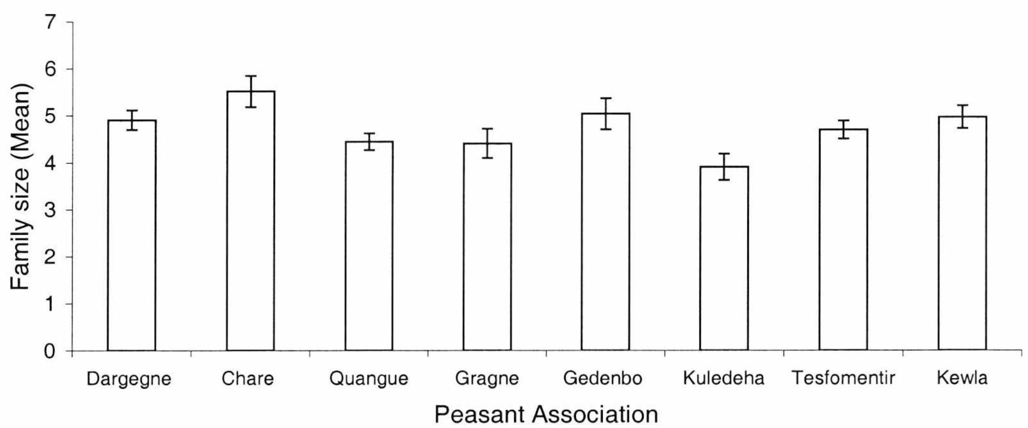

Figure 4.3 Mean ± SE of family size of respondents from the eight peasant associations.

Most respondents (70.8%) had no formal education, while only 24.8% had a church or primary school education and 4.4% had a junior or secondary school education. Levels of education differed among the peasant associations (χ^2=45.43, df=14, p<0.001). Respondents from Tesfomentir were generally more educated while respondents from Gedenbo had the least education (Figure 4.4).

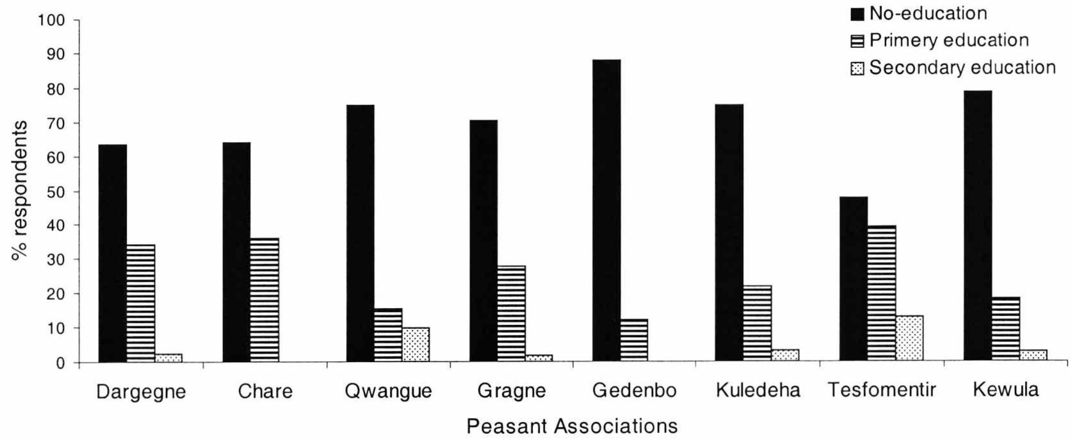

Figure 4.4 Different levels of education among respondents from the eight peasant associations.

The main economic activity of the user community is subsistence agriculture, practised as a combination of crop farming and livestock keeping. Most (94.6%) of the male respondents were farmers and most (83.3%) females were housewives. The basic resource that supports the subsistence agricultural economy is the land. The current land tenure system in Menz is based on a usufruct right, in which residence in a particular peasant association gives equal rights to the land under the jurisdiction of that peasant association. The average land holding in the study area was 1.8 ± 0.06 ha, and individual land holdings were closely related to family size ($r=0.51$, $p<0.01$).

Individual land holdings differed across all peasant associations ($F_{7,493}=2.39$, $p<0.05$). The Tukey test could only show differences ($p<0.05$) between the extremes of Kuledeha and Qwangue peasant associations (Figure 4.5).

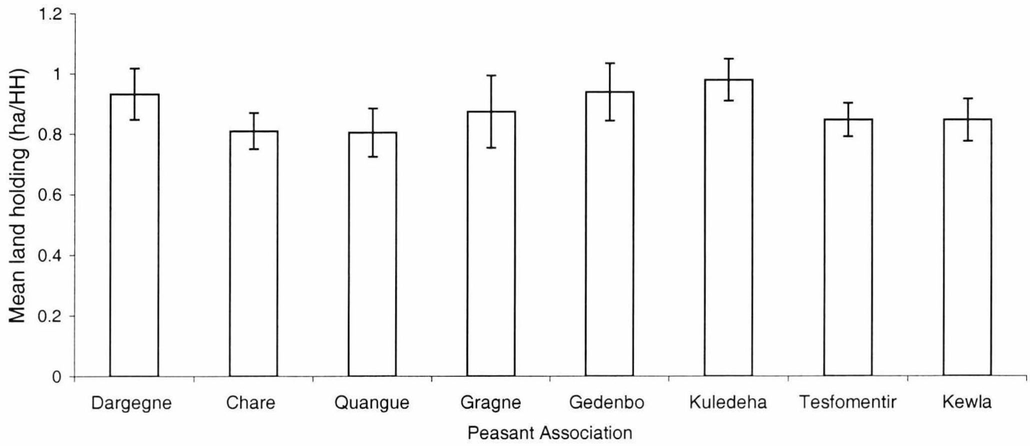

Figure 4.5 Mean ± SE of land holding (ha) per household among respondents in different peasant associations.

The production of grain per household differed between peasant associations ($F_{7,484}$=2.77, p<0.01). However, the Tukey test showed significant difference between Kewula and Dargegne (p<0.01) and between Kewula and Tesfomentir (p<0.005). Thus, Kewula produced the least grain per household, while Tesfomentir and Dargegne produced the most.

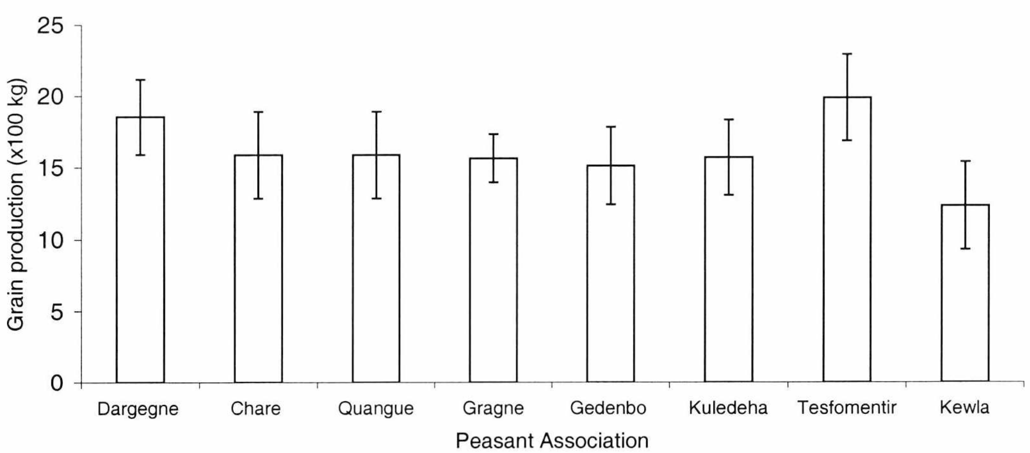

Figure 4.6 Mean ± SE of grain production (kg) at household level among respondents in different peasant associations.

Next to farming, the other major economic activity of the Guassa user community is livestock keeping. The major types of livestock kept by the people around Guassa are cattle, sheep, and equines (donkey, horses and mule). Indeed, most (89.9%) households own livestock. Cattle provide the necessary labour for ploughing and for threshing crops after harvest. Cattle also provide the household with milk, other milk products, meat and income. There was a difference between the number of cattle owned by each household in different peasant associations ($F_{7,456}=3.52$, $p<0.001$). Using the Tukey test, there was a difference in mean holding of cattle in Kewula compared with Dargegne ($p<0.001$), Gedenbo ($p<0.01$), Gragne ($p<0.01$), and Qwangue ($p<0.001$). Thus, Kewula had the least cattle per household (Figure 4.7).

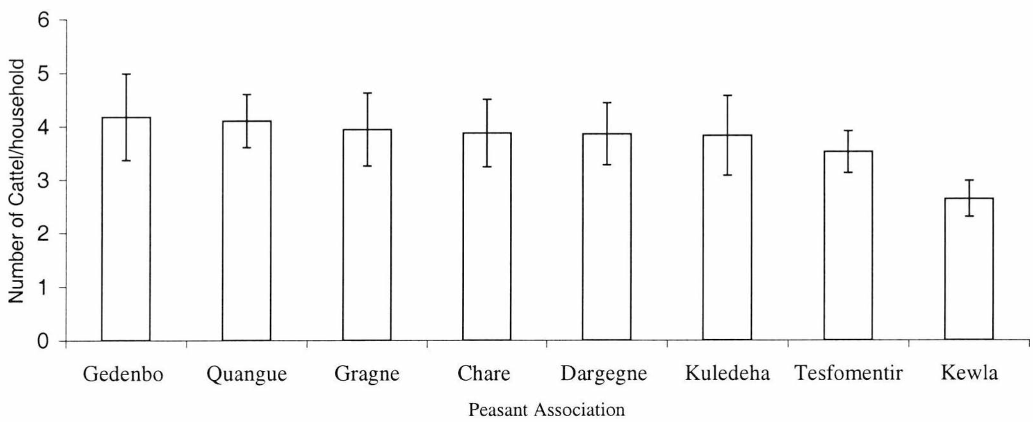

Figure 4.7 Mean $\pm$ SE of holding of cattle per household among respondents in different peasant association.

Sheep are an important stock in Menz because they provide wool and can easily be converted into cash. Few (6.7 %) households did not have sheep but sheep holdings differed between peasant associations ($F_{7,462}=11.5$, $p<0.001$). Using the Tukey test, the mean sheep holding of Kewula compared with those in Dargegne ($p<0.01$), Gedenbo ($p<0.01$), Gragne ($p<0.01$) and Qwangue ($p<0.001$). Thus, Kewula also had the smallest holding of sheep per household in the study area (Figure 4.8).

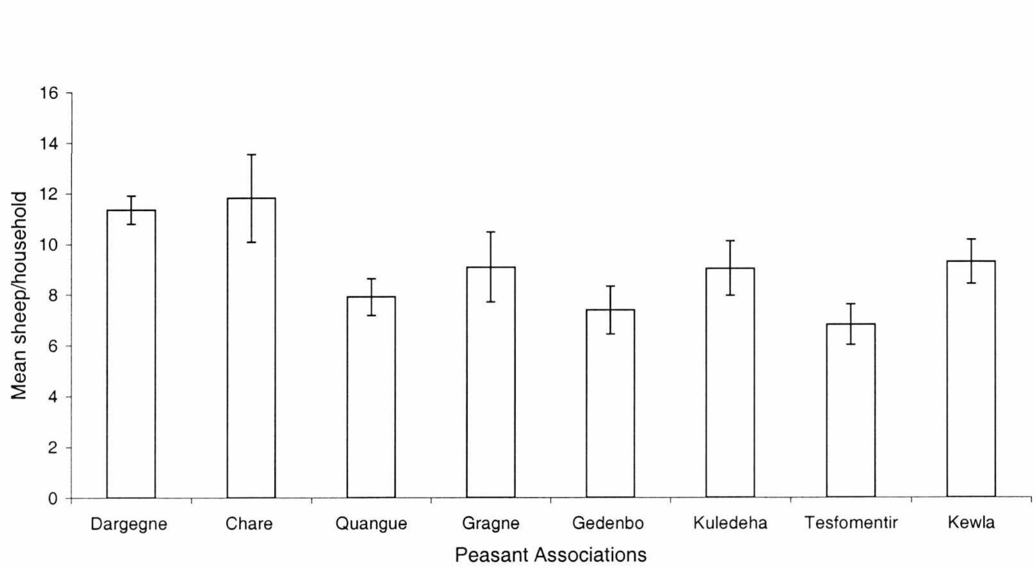

Figure 4.8 Mean $\pm$ SE holding of sheep per household among respondents in different peasant association.

Equines are also important in the household economy for providing transport for humans, for fuelwood collection, for grass collection and for taking products to market. To a lesser extent equines are used for farming and threshing. Only 4.8% of households had no transport animal. Households had a mean of 1.4 $\pm$ 0.2 equines with no difference ($F_{7,472}$= 1.79, $p>0.05$) across the peasant associations.

The most common off-farm activity in Menz is wool processing (*Bana* or *Zitet*), in which 61.3% of the respondents were engaged. In contrast, weaving cotton was practised by only 7.9% of the respondents, while 4.4% were engaged in carpentry and 3.2% were involved in petty trading. A few (3.6%) respondents worked as daily labourers in the nearby town during non-farming seasons.

4.3.2 Attitudes towards the Common Property Resource Management System

The community regarded the protection of the Guassa area as important for various uses. In the view of the users, non-consumptive uses are of differing importance, shown decreasing order: protection of natural heritage for the next generation; as wildlife habitat; as water catchment; for its aesthetic value; and, to attract rain (Figure 4.9).

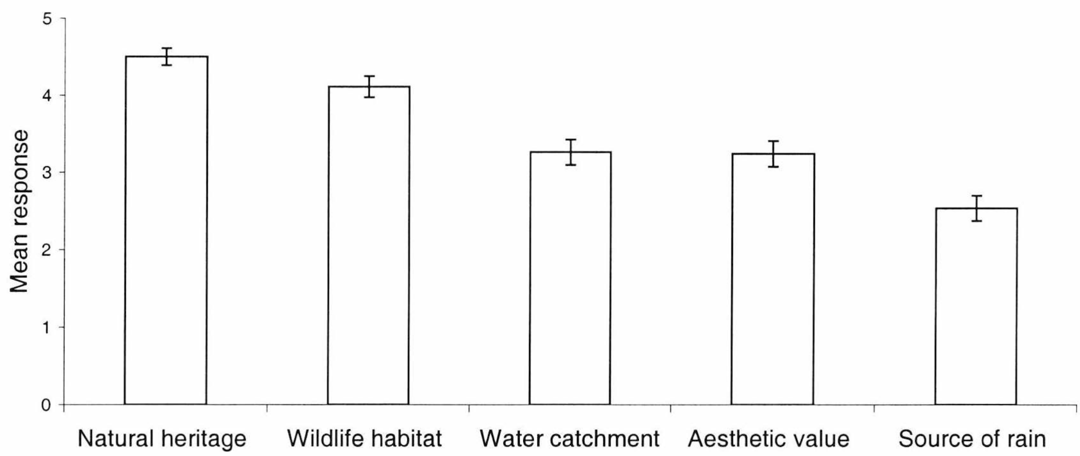

Figure 4.9 Mean $\pm$ SE of values placed upon non-consumptive use of the Guassa area by all respondents.

4.3.2.1 Success of Habitat Conservation

Many users (66.1%) thought that the Guassa area had decreased in size over the last 20 years, but there was a marked difference of opinion on this matter between the peasant associations (χ^2=68.62, df=7, p<0.001). Most respondents from Kewula (87.9%), Tesfomentir (78.3%), Kuledeha (78.1%), and Gedenbo (76.0%) have noticed a change in the size of the Guassa area. In contrast, most respondents from Qwangue (65.2%) and Dargegne (43.9%) thought that the size of Guassa area has not changed (Table 4.2).

Table 4.2 Views of respondents from the eight peasant associations on the changes in size of the Guassa area

Peasant Association	**n**	**Decreased** (%)	**Not decreased** (%)
Chare	50	66.0	34.0
Dargegne	82	56.1	43.9
Gedenbo	50	76.0	24.0
Gragne	54	74.1	25.9
Kewula	66	87.9	12.1
Kuledeha	64	78.1	21.9
Qwangue	92	34.8	65.2
Tesfomentier	46	78.3	21.7
Total	504	66.1	33.9

Male and female respondents held different views on changes in the size of Guassa (χ^2= 14.27, df=1, p<0.001), with most male (72.3%) acknowledging a decrease of the Guassa area, and only 56.0% of females noticing any change. No differences were observed between those of different age groups (χ^2= 4.38, df=6, p>0.05), lengths of residence (χ^2= 4.19, df=5, p>0.05) or levels of education (χ^2=0.34, df=2, p>0.05).

The distance of the respondents' villages from the Guassa was associated (χ^2=52.18, df=3, p<0.001) with the assumption that size of the Guassa area has decreased over the last 20 years. Most respondents (52.0%) from areas near to Guassa assumed that the size of Guassa area has not decreased over the last 20 years, while more respondents living at greater distance believed it has decreased (Table 4.3).

Table 4.3 Views of respondents on the change in size of the Guassa area in relation to distance from Guassa.

Distance (km)	n	**Decreased** (%)	**Not decreased** (%)
≤5	196	48.0	52.0
6-10	112	70.5	29.5
11-15	86	86.0	14.0
>15	110	78.2	21.8

Various factors have been indicated as reasons for the change in size of the Guassa area (Figure 4.10). Farming by the communities living adjacent to the Guassa area, plantation forestry in the southern side of the Guassa area by the Department of Forestry Ministry of Agriculture and, continuous encroachment by neighbouring Yifat Woreda, residents were singled out by the community as the main factors responsible for the reduction in size of the Guassa area.

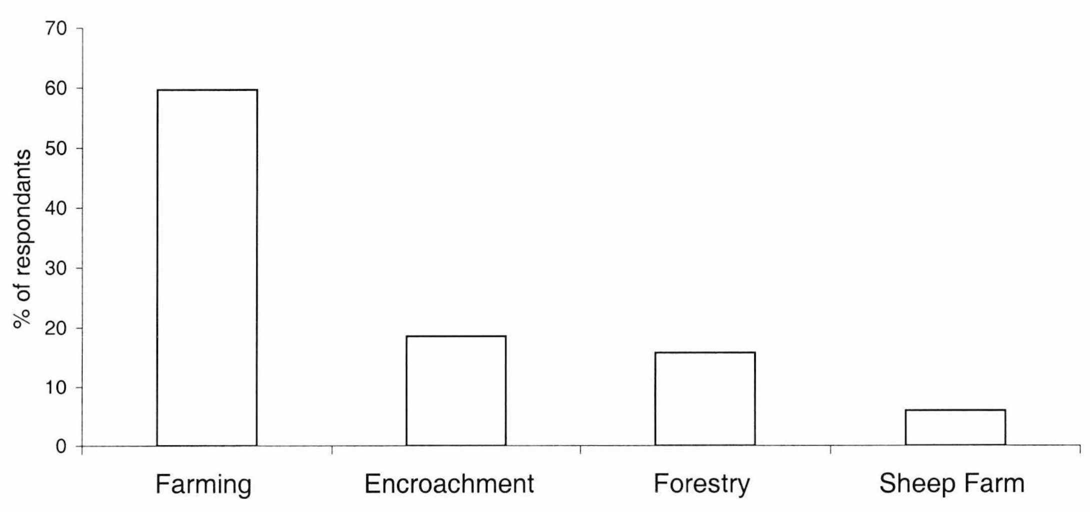

Figure 4.10 Factors affecting the size of the Guassa area for all respondents combined.

4.3.2.2 Knowledge of Past and Present Management Systems.

All of the respondents acknowledged the effectiveness of the *Qero* system in the management of the area and in protecting the resource from outside forces. Furthermore, almost all (99.6%) pointed out that protection was undermined following the 1975 Agrarian Reform in the country.

Regarding the present day management of the Guassa area, most (57.7%) respondents believed the area is managed by the communities through the Guassa Committee. In contrast, 34.1% of respondents believed the Woreda Administration Council is responsible for the management and a few (8.1%) respondents attributed the present day management both to the Guassa Committee and the Woreda Administration Council. The peasant associations held different (χ^2=33.77, df=14, $p<0.01$) view as to who is responsible for the present day management of the Guassa area. Most respondents in Chare (68.0%), Gedenbo (64.0%), Qwangue (63%) and Dargegne (62.2%) believed the community through the Guassa Committee is managing the Guassa. At Tesfomentir, 50.0% of respondents attributed the present day protection to the Woreda Administration Council, but 17.4% of respondents attributed the current management to both the Guassa Committee and the Woreda Administration Council (Table 4.4).

Table 4.4 Views of respondents from eight peasant associations as who is managing the Guassa area at present.

Peasant Association	n	Guassa Committee (%)	Woreda Administration (%)	Both (%)
Chare	50	68.0	28.0	4.0
Dargegne	82	62.2	35.4	2.4
Gedenbo	50	64.0	28.0	8.0
Gragne	54	53.7	38.9	7.4
Kewula	66	56.1	27.3	16.7
Kuledeha	64	54.7	32.8	12.5
Qwangue	92	63.0	34.8	2.2
Tesfomentier	46	32.6	50.0	17.4
Total	504	57.7	34.1	8.1

Male and female respondents held a different (χ^2= 27.83, df=2, p<0.001) view as who is responsible for managing the area at the present time. Most (65.9%) male respondents attributed present day management to the Guassa Committee, while 48.0% of females attributed the management to the Woreda Administration Council. Similar proportions of males (8.7%) and females (7.3%) considered that both the Guassa Committee and the Woreda Administration Council manage the area. No difference was observed in views between age groups (χ^2=21.16, df=12, p>0.05), length of residence (χ^2=10.98, df=10, p>0.05) or level of education (χ^2=1.37, df=4, p>0.05).

The distance of the respondents' villages from the Guassa was associated with a different understanding (χ^2=21.04, df=3, p<0.01) of who is currently managing the Guassa. Most respondents from nearby areas (<5km) suggested the Guassa Committee was responsible. As distance from the Guassa increased, numbers of respondents attributing the current management to the Guassa Committee decreased, while those attributing the present management to both the Guassa Committee and the Woreda Administration Council increased (Table 4.5).

Table 4.5 Views of respondents on the responsibility for present day management in relation to distance from Guassa.

Distance (km)	n	Guassa Committee (%)	Woreda Administration (%)	Both (%)
≤5	196	65.8	32.1	2.0
6-10	112	52.7	36.6	10.7
11-15	86	58.1	30.2	11.6
>15	110	48.2	38.2	13.6

4.3.2.3 Effectiveness of Present Management

Most (98.6%) respondents acknowledged the current existence of a penalty for using the Guassa area in the closed season. However, most (60.9%) respondents thought that current management was ineffective (Table 4.6). However, respondents from each peasant association differed (χ^2=42.07, df=7, p<0.001) in their views of the effectiveness of current management. Most of residents from Dargegne (56.1%) and Qwangue (54.3%) considered current management as effective, whereas most respondents from the other peasant associations considered the protection ineffective (Table 4.6).

Table 4.6 Views of respondents from the eight peasant association on whether or not present day management is effective.

Peasant Association	n	Effective (%)	Not Effective (%)
Chare	50	40.0	60.0
Dargegne	82	56.1	43.9
Gedenbo	50	20.0	80.0
Gragne	54	40.7	59.3
Kewula	66	18.2	81.8
Kuledeha	64	39.1	60.9
Qwangue	92	54.3	45.7
Tesfomentier	46	26.1	73.9
Total	504	39.1	60.9

No difference in views was observed between those of different age groups (χ^2=5.59, df=6, p>0.05), sexes (χ^2=0.86 df=1, p>0.05), lengths of residence (χ^2=6.04, df=5, p>0.05) or levels of education (χ^2=1.37, df=2, p>0.05).

The distance of respondents' villages from the Guassa was associated with different opinions (χ^2=34.11, df=3, p<0.001) on the effectiveness of present day management. As distance from the Guassa to the villages increased, more respondents considered the Guassa management to be ineffective (Table 4.7).

Table 4.7 View of respondents on the present day of Guassa management in relation to distance.

Distance (km)	n	Effective (%)	Not Effective (%)
≤5	196	54.6	45.4
6-10	112	33.0	67.0
11-15	86	30.2	69.8
>15	110	24.5	75.8

The respondents thought that various factors were responsible for the ineffectiveness of current management. Most respondents strongly agreed that lack of ownership arising from the decline of the *Qero* system and drought were the most important factors (Figure 4.9).

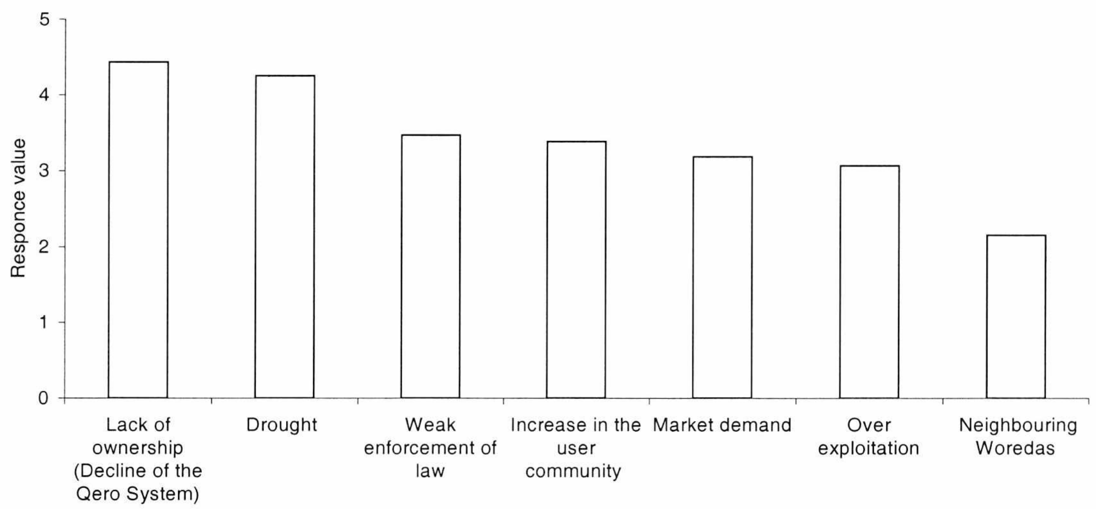

Figure 4.11 Problems identified by respondents as reasons for ineffective management of the Guassa area.

4.3.2.4 Preferred Options for Future Management

On options for the future management of the Guassa area, 11.5% of the respondents thought that only a return to the *Qero* system would make management effective. In contrast, 49.2% thought that the management should remain under the hand of the community, but with new laws and enforcement. A few (18.7%) respondents suggested their willingness for the government to completely take over the management of the area and for them to use the resources when it was decided by the administration. Another 20.6% of respondents suggested that the area should be under the management of both the state and the community. This was based on their belief that, nowadays the communities entitled to the resource are varied, and perhaps community rule by itself could not stop further degradation of the resources.

Peasant associations differed (χ^2 =40.81, df=21, p<0.01) in their views as to who should be responsible for future management of the Guassa. All the peasant associations generally favoured community protection, but with varying degrees of support (Table 4.8).

Table 4.8 Views of respondents from peasant associations on suggested future management options.

Peasant Association	n	Community (%)	*Qero* System (%)	State (%)	Community & State (%)
Chare	50	32.0	22.0	28.2	18.0
Dargegne	82	53.7	9.8	23.2	13.4
Gedenbo	50	44.0	10.0	20.0	26.0
Gragne	54	51.9	14.8	16.7	16.7
Kewula	66	39.4	10.6	19.7	30.3
Kuledeha	64	45.3	10.9	10.9	32.8
Qwangue	92	67.4	8.7	12.0	12.0
Tesfomentier	46	45.7	8.7	23.9	21.7
Total	504	49.2	11.5	18.7	20.6

A difference in opinion was also observed among different age groups (χ^2 =41.69, df=18, p<0.001). Most (69.9%) of the youngest (<20 years of age) and 50.0% of the oldest (>70Years of age) age groups wanted the future management to be undertaken by the community alone. However, the older respondents favoured the return of the *Qero* system more than the younger ones. Most middle aged respondents favoured the combined protection of the area by the state and community.

Male and females also differed (χ^2 =46.32 df=3, p<0.001) in their views as to who should manage the Guassa area. Most (59.0%) male respondents suggested that the management should be given to the community, while 17.0% favoured the joint management by the state and the community together. A few (14.4%) males wished to see the return of the *Qero* system. Among female respondents, 36.0% favoured community management, 30.6% favoured state management and 26.4% favoured management by the state and community together.

Views as who should be responsible for the future management of the Guassa area also differed (χ^2 =26.50, df=15, p<0.05) with the length of residence in the area. Those who had lived in the area for longer period were less committed to community conservation than more recent arrivals.

The distance from the respondents' villages to the Guassa was also important (χ^2 =17.36 df=9, p<0.05) in determining views on the options for future management. Respondents living close to the Guassa mostly suggested that the community should be responsible for future management. As distance from Guassa increases, respondents increasingly favoured joint management by community and state. Nevertheless, few people wished to see a return of the *Qero* system and views on this remained constant at all distances from the Guassa (Table 4.9).

Table 4.9 Views of respondents on suggested future management options for the Guassa in relation to distance.

Distance (km)	Community (%)	*Qero* System (%)	State (%)	Community & State (%)
≤5	57.1	11.7	18.9	12.2
6-10	46.4	11.6	19.6	22.3
11-15	45.3	11.6	15.1	27.9
>15	40.9	10.9	20.0	22.7

4.3.2.5 Factors Determining Attitudes to Management

Factors described in section 4.2 that might explain attitudes towards the present management were examined with logistic regression only for those questions that produced dichotomous responses as the dependent variable.

The model for factors that might have played a role in determining whether or not respondents from the user community thought that the size of the Guassa had decreased over the years explained 73.8% the variance. The peasant associations in which the respondents reside was important in determining their responses and respondents from Dargegne and Qwangue were most likely to say the area has not changed in size. Furthermore, males were most likely to say the size of the area has decreased (Table 4.10).

Table 4.10 Factors determining answers by respondents on whether the Guassa area has decreased in size based on a logistic regression.

Variable	B	SE	df	Significance
Peasant Association		0.47	7	0.000***
Chare	-0.79	0.43	1	0.098
Daregegne	-1.25	0.49	1	0.004**
Gedenbo	-0.21	0.49	1	0.667
Gragene	-0.26	0.48	1	0.596
Kewula	0.62	0.52	1	0.239
Kuledeha	-0.01	0.49	1	0.984
Qwangue	-1.97	0.42	1	0.000***
Sex (Male)	0.82	0.21	1	0.001***
Family size	0.13	0.05	1	0.191
Constant	0.27	0.45	1	0.547

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

The model for factors that might have played a role in determining whether or not respondents thought that present day management was effective explained 65.1% of the variance (Table 4.11). Age, level of education, family size and distance from the Guassa area were important in determining their response. Older age groups were more likely to think the protection is effective, whereas participants with secondary level education, with larger family sizes and living far from the Guassa were more likely to think the present day protection is ineffective.

Table 4.11 Factors determining the answers by respondents on whether or not present day management is effective, based on the logistic regression.

Variable	B	SE	df	Significance
Age	0.018	0.01	1	0.016*
Education	0	0	2	0.018*
Education (1)	-1.39	0.50	1	0.057
Education (2)	-1.42	0.52	1	0.006**
Family size	-0.10	0.05	1	0.035*
Distance	-0.07	0.13	1	0.000**
Constant	1.30	0.57	1	0.022*

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

4.4 Discussion

Many communities world-wide face serious environmental degradation, including deforestation, overgrazing, soil erosion, overexploitation of biodiversity and severe air and water pollution problems, often associated with common property mismanagement (Godland *et al.*, 1989). There are three major categories of environmental mismanagement related to common property resources. The first category is the misuse or breakdown of traditional (indigenous) common property resource management systems. Such misuse or breakdown typically occurs as a result of various far-reaching changes in the circumstances involving natural-resource utilisation. In turn these are often motivated by: breakdown of traditional value systems, which often directly or indirectly encourages resource conservation; by increased participation in market economies, which encourages the over-exploitation of resources otherwise previously harvested for local subsistence; increased centralisation of power and application of inappropriate rural development policies and legislations; population growth, which entails the overe-xploitation of natural resources to meet subsistence needs; and, technological changes, which often makes it physicaly, easier to exploit more (Berkes, 1985; Achenson, 1987; Godland *et al.*, 1989).

The second category is economically and socially unjustified development projects or policies. A wide variety of governmental policies in developing countries provide explicit or implicit incentives for natural resource consumption in excess of economically or environmentally optimal levels, thereby encouraging mismanagement. For example, development of infrastructures which are not economically or ecologically justifiable under any form of cost-benefit analysis; changes in land tenure policy, which require clearing of natural habitat to gain entitlement to the land; and, tax exemption, in which various governments provided substantial tax reductions to projects involved in massive forest clearing projects and wetland draining, and to mining companies (Devlin and Grafton, 1998; Godland *et al.*, 1989)

The third category is economically justified but, environmentally in appropriate development projects that result in mismanagement of common property resources. Environmentally unsound forms of development are usually justified economically through a variety of cost-benefit analysis techniques (Devlin and Grafton, 1998).

Many of the above factors have impacted the Guassa area. Nevertheless, this study has shown clearly that the community in Menz consider the Guassa area to be important for their livelihoods and on many occasions described it as “our cloth and bread and butter”. They consider it to be an important heritage to be conserved and passed to the next generation (Figure 4.9). The community realise the importance of the Guassa area as a source of water and a wildlife habitat. Most of the streams and rivers draining the area have their sources in the Guassa area.

4.4.1 Attitudes to Past Management

Many respondents have noticed a decrease in the size of the Guassa area due to farming by the people living adjacent to it (Figure 4.10). The neighbouring Woredas and the adjacent peasant associations have been implicated as the prime cause of farming along the boundary. The areas affected are the low-lying valley bottoms, which are regarded as agriculturally productive. However, any changes over the last 20 years are viewed differently, as evidenced by the responses and the logistic model (Tables 4.2, 4.3, and 4.10). Respondents from Daregene and Qwangue peasant associations mostly believe there has been no change in the size of the Guassa area. However, these peasant associations border the Guassa area (Figure 2.2) and most of the blame for using the Guassa in the closed season rests with them. Furthermore, current management activities are largely carried out by the militias from these nearby peasant associations. Hence, their attitude to any decrease in size may arise from defending themselves from blame for the failing to protect the Guassa area adequately.

The development of a sheep farm and a forestry plantation during the early 1980's have been mentioned as factors responsible for the reducing the size of the Guassa area. The former Relief and Rehabilitation Commission and UNICEF initiated the sheep farm with the objective of improving the quality of sheep production in the area through cross-breeding with imported breeds. The farmers were not impressed by the initiative, since they found that the quality of the local breeds were superior in providing meat, wool and skin, while the cross-breeds where only good only for meat or wool production. Then, like many other government sponsored development projects established without the consent of the community, it failed and the project property as well as its infrastructure was looted and destroyed during the 1991 change of government.

The Ministry of Agriculture initiated a plantation forest project at the southern edge of Guassa on the pretext of community forestry. The trees planted were exotic species and gave no benefit to the community at all, except through the employment of a few forest guards. The cold climate and other ecological factors, which were not considered at the beginning of the project, have stunted the growth of the trees, and after 15 years, some of the forest stands still remain at sapling stages.

All the community members acknowledged the *Qero* system as the most effective common property resource management institution. However, most community members accepted that it is no longer possible to operate by the laws of the *Qero* system under the present socio-economic order of the country. Nevertheless, most respondents believe that the community is still managing the Guassa area, but few think that the Woreda Administration Council has responsibility in the management of the area (Table 4.4). The peasant associations of Chare, Dargegne, and Qwangue living closest to the Guassa believe it is managed by the community, because of most of the Guassa Committee members and the militias patrolling the Guassa area are from their peasant associations (Table 4.5). Most of the residents of these peasant associations are people who were marginalised during the *Qero* system and did not hold land before 1975, even if they were accepted as descendants of the pioneer fathers. No *Abba Qera* had ever been elected to the management of the Guassa area from their area. Hence, they where forced to settle on agriculturally marginal land and to use the Guassa only when it was open. However, after the 1975 Agrarian Reform they gained equal right to the management of the Guassa area like the other peasant associations.

4.4.2 Attitudes towards Present and Future Management

Most respondents acknowledged the ineffectiveness of the present system of common property resource management, except for those from Dargegne and Qwangue (Table 4.6). Hence, the responses and the logistic model show the importance of distance of the village in explaining the effectiveness of the current management (Table 4.7 and 4.11), with respondents from villages further away more likely to say that the current management is ineffective. The age of respondents and their level of education were also important in determining their response (Table 4.11). Thus older and more educated people tend to believe current management was ineffective.

Various reasons have been given for ineffectiveness of the present day Guassa management (Figure 4.11). The lack of ownership of the Guassa resource by the community once the *Qero* system was abolished, the interference of the local administration, and the frequency of drought which in turn forces the opening of the area for livestock grazing, have all made management difficult. Other factors like: weak law enforcement; an increase in the number of people making use of the Guassa area; market-led demand for the guassa grass (*Festuca* grass); over-exploitation of the resource when it is open; and, illegal use by neighbouring Woreda, have all been mentioned as important factors in reducing the effectiveness of the present day management.

Views on the best approach to the future management of the common property resource showed that the majority of the respondents thought that the community should manage the area (Table 4.8). However, peasant associations differed in their views, with most respondents from the near by peasant associations of Dargegne, Qwangue and Gragne indicating their preference for community management. In contrast, peasant associations farther from the resource preferred a combination of state and community protection of the resource (Table 4.9). This could be because nearby and formerly marginalised peasant associations are now responsible for the management of the resource (see Table 3.1) and they wish to continue with that responsibility. In contrast, respondents from peasant associations found further from the Guassa, who were in charge of managing the Guassa before 1975 (see Table 3.1), see current management as ineffective (Table 4.6 and 4.7), and wish to ensure joint management as means of improving its effectiveness (Table 4.8 and 4.9).

Given these different views on the management and use of the Guassa area, in the next chapter I will examine the actual patterns of use of the common property resource by the community.

Chapter Five

5 Use of Common Property Resources in the Guassa Area

5.1 Introduction

A crucial question in conservation is how to conserve renewable natural resources and the abiotic elements of the environment in the face of changing human use patterns. Given that the livelihood of many people depends on the environment, the current challenge facing many nations is no longer deciding whether conservation is a good idea. Rather, it is important to know how it can be implemented in the national conservation interest and without affecting the livelihood of communities dependant on them (WECD, 1987; McNeely 1984; Anderson and Grove, 1987).

In recent years, the idea of common property resource use has been adopted as a 'holistic approach' to natural resource management. This requires attempts to provide for the subsistence and cultural needs of local people, while also preserving natural and cultural resources (McNeely 1984, 1988, Sharma, 1990). However, the difficult challenge has been to continue the harvest of renewable natural resources without fostering a "Tragedy of the Commons" (Hardin, 1968), as is seemingly associated with unconstrained access to natural resources in situations of *de facto* open access. Several authors have suggested that the key to avoid resource abuse is by effective management of the commons by an institution and by promoting economic incentives (Neeting, 1976; Feeny *et al.*, 1990; McNeely, 1988; Ostrom, 1991; Murphee, 1993).

Communities engaged in subsistence agriculture as a way of life attempt to optimise their production systems by using a diversity of crop-livestock systems, supplemented by resources taken from natural ecosystems (Kothari, 1997). Therefore, biodiversity is critically important to people's livelihoods in the following ways:

- in providing many diverse subsistence requirements that a rural community requires for survival, including: fodder; fuel; housing; farming and household implements; and, spiritual sustenance (Craven and Wrdoyour, 1993; Haverkort and Miller, 1994; Kothari, 1997);
- in providing an element of livelihood stability, in that the failure of one element of biodiversity does not lead to collapse since alternative elements are usually available (Redford and Stearman, 1993; Kemf, 1993);
- in allowing local communities a degree of self-reliance and independence from the market and government, since many goods and services can be obtained locally; and,
- in providing a variety of products that can be bartered and sold in markets by rural communities, thereby enabling them to gain access to goods and services that are not locally available (Haverkort and Miller, 1994; Kothari, 1997).

These points make it clear that any strategy for the conservation of biodiversity needs to be sensitive to a dependence on natural resources. Approaches that restrict local access to biological resources without the provision of adequate alternatives are bound to generate suffering and hostility, and will never be socially sustainable. Indeed, such approaches can force existing practises towards unsustainability as the self-regulation and restraints practised by the community break down as people have to extract their required resources illegally (Anderson and Grove, 1987; Ghimire and Pimbert, 1997). Conversely, approaches that ensure sustainable access to livelihood resources enhance the benefit that the local population can derive from natural ecosystems. Such approaches attempt to discourage unsustainable practises through enabling and persuading rather than through force. Such an approach will generate public support locally, which alone can make conservation efforts effective (Bodmer, 1994; Metacalfe, 1994; Leader-Williams, *et al.*, 1996).

Regulated common property resource use has been an old tradition in the Guassa area of Menz, which was formally managed by an indigenous institution set aside for controlling resource use by the community (Chapter 3). This institution helped to maintain rational and sustainable resource use in the area until 1975, when it was challenged by government-sponsored changes. Unfortunately, most government sponsored changes and polices often exacerbate the tendency for biodiversity resources to be overexploited and for the decline of common property management regimes (Godland *et al.*, 1989; Ostrom, 1997). Nevertheless, the communities around Guassa still foster a positive attitude to the area, although with some reservations (Chapter 4). Hence, this chapter identifies the types of resources and the existing common property resource use pattern in the Guassa area of Menz, and it addresses the following questions:

- What resources are currently harvested by the community living around the Guassa area and to what uses are these resource put?
- What are the current patterns of resource harvesting and what factors determine the current levels of resource use?
- To what extent do current patterns and levels of resource use differ from patterns described under the *Qero* system?

5.2 Materials and Methods

Primary information on the types of resources, and on the pattern of resource use, in the Guassa area were collected by group discussions and from key informant interviews among eight peasant associations (see Chapter 3 and Appendix I). Based on these group discussions and key informant interviews, a semi-structured questionnaire was prepared (see Chapter 4 and Appendix II) to investigate the value attached to different types of uses enumerated by the community. Different uses were later divided into primary and secondary uses, based on the value attributed to each type of use by interviewees.

The densities of users, including grass cutters, firewood collectors and livestock, were estimated using a line transect sampling method (Burnham *et al.*, 1973; Buckland, *et al.*, 1993). This transects were laid out 1km apart, covering the entire study area in east-west direction. A total of 71 km of transect was traversed every two months from December 1996 to December 1998 (see Chapter 2). Numbers of users observed cutting grass or collecting firewood, and the total number of livestock (cattle, sheep and equines), seen were recorded in each category.

The data were analysed using the computer software DISTANCE 3.5 Release5, to estimate the user density in the Guassa area. DISTANCE is a software program that analyses line transect data to estimate density of populations (Buckland *et al.*, 1993). Distance sampling is based on the assumptions that individuals on or close to the transect line are more likely to be detected than individuals far from the line, and that individuals are randomly distributed. It also assumes that individuals are detected at their initial location, prior to any movement in response to the observer. The programme uses statistical techniques to select the model that best fits the rate of decline in sightings. There is a maximum distance beyond which negligible numbers of animals are detected, described as "Transect width". The rate at which the number of individuals sighted declines with distance from the transect line is described by the detection function, g(x), while to estimate reliably estimation of g(x) requires good number of sightings (n) preferably n>60, although n=40 may be adequate for some purposes (Buckland *et al.*, 1993). In this study, each transect count failed to reach the minimum sample size required. Therefore, the transect data over the two year period were pooled by months as suggested by Buckland *et al.*, (1993). The analysis then provided density (n/km^2), 95% confidence interval of population estimate, and standard error of grass cutters, firewood collectors, and different types of livestock (cattle, sheep and equines) grazing in the area, for each pooled sampling period.

A multiple regression of continuous variables was used to determine important factors that affect resource use in the area. For grass cutting, firewood collection, and grazing, the explanatory variables entered include: age; length of residence; family size; distance from Guassa; and, wellbeing score. The number of trees owned was entered as explanatory variable for firewood collection, and for the total number of livestock owned was entered for grazing.

5.3 Results

5.3.1 Important Resources Harvested

The Menz population harvests various types of natural resources from the Guassa area. The community attaches different degrees of importance to the different ways that resources are used (Figure 5.1) allowing their sub-division into primary and secondary uses (Table 5.1). Thatching material was considered to be the most important resource from the Guassa area, followed by grazing and firewood. Other types of uses were considered secondary.

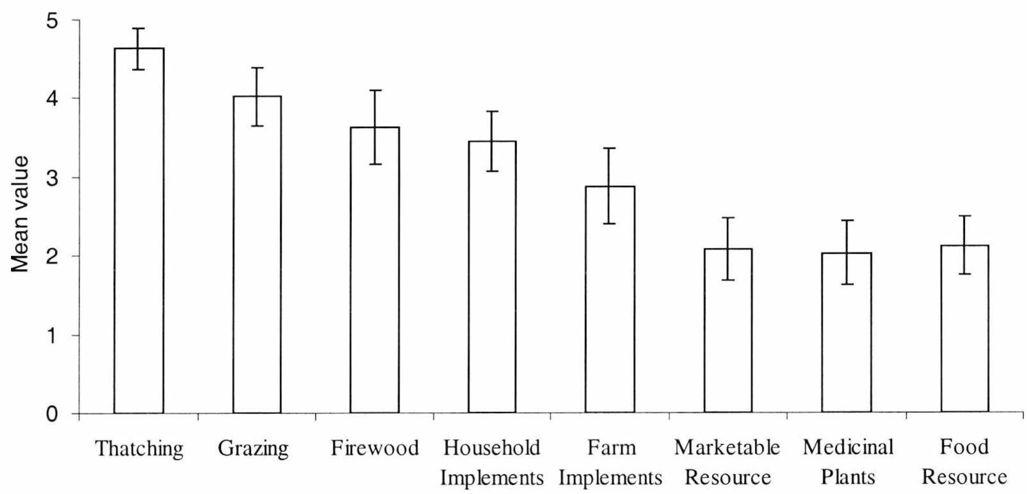

Figure 5.1 Mean ± SE of values the usefulness of different Guassa area resources to the user community.

Table 5.1 Resources used in the Guassa, divided into primary and secondary uses.

Primary uses	Secondary uses
Grass cutting (thatching)	Household Implements
Grazing	Farm Implements
Firewood	Marketable Resources
	Medicinal Plants
	Food Resources

5.3.1.1 Guassa Cutting

The main grass cut is the Guassa grass, which taxonomically comprises 4 species of the genus *Festuca* (see Chapter 2). However, the Menz community identifies two types of Guassa grass, based on the growth form and the way it is collected. Guassa grass that is cut from individual tussocks, when it reaches its maximum height, and without containing a mixture of other grasses or herbs, is called "*Kwchera*". In contrast, Guassa grass that is cut before it has grown to maximum height, and occurs with other grass species and herbs is called, "*Naso*". The use to which each is put depends on the type of the *Festuca* grass. For example, "*Kwchera*" is commonly used for thatching, making ropes, baskets, and torchs, whereas "*Naso*" is used to mix mud for plastering walls and floor mat (*Guzguz*).

Guassa grass is used primarily for thatching. Nearly all respondents' houses (96.5%) are thatched using the Guassa grass, which makes good thatch for two reasons. First, Guassa grass can grow up to 40-120cm in height, and is cylindrical in cross-section with very narrow leaf-blades, thus reducing the presence of air pockets during thatching compared with other grass species growing in high altitude areas. Second, a roof thatched with Guassa grass lasts much longer, up to 15-20 years compared with roofs thatched with other grasses growing at high altitude, such as (*Carex monistachia* and *C. fischeri*), which only lasts 5-10 years. These two properties of Guassa grass, which is not available for thatching in other areas, place it at a premium.

Table 5.2 Different uses of the Guassa grass (*Festuca*) in Menz.

Primary use of the Guassa grass	**Secondary use of the Guassa grass**
Thatching	Baskets for different uses in the household (*Sifet, Mesob*)
Mixed with mud to plaster wall	Mattress
Rope	Farm implements, whip (*Girafe*)
Floor mat (*Guzguaz*)	Torch
Marketable product in urban areas for plastering and as floor mat.	Fodder
	Rain hut (*Gessa*)
	Brush (*Mure*) particularly used tp paint wall

Peasant associations differ (χ^2=147.73, df =28, p<0.001) in their views of the importance of Guassa grass for various uses. Almost all respondents (>90%) from six peasant associations saw the Guassa area as a very important source of grass. However, slightly fewer (>70%) residents from Kuledeha, and even fewer (>40%) from Kewula, saw the area as a very important source of grass (Figure 5.2).

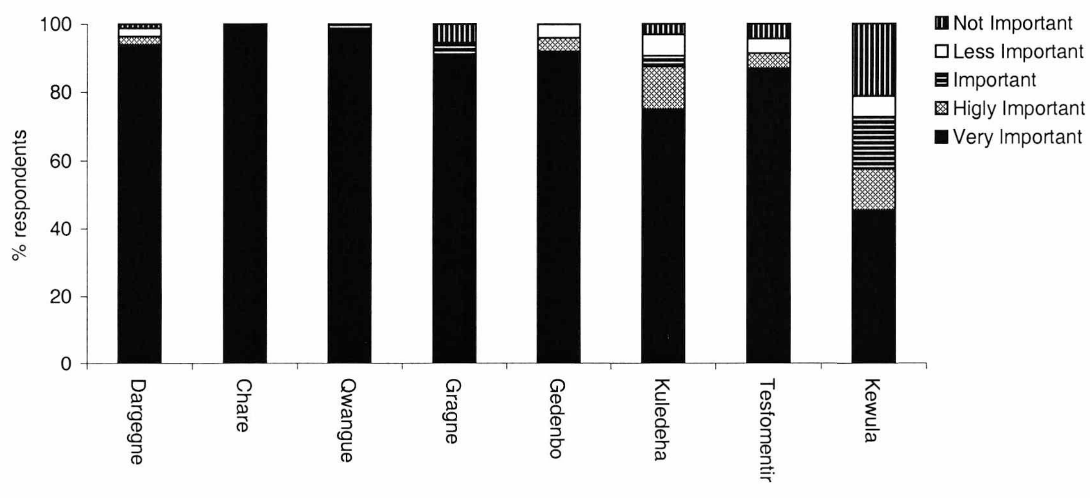

Figure 5.2 Degree of importance attached to the Guassa area as source of Guassa grass (*Festuca* grass) among eight peasant associations.

Male and female respondents held different view (χ^2=15.56, df =4, p<0.05) on the Guassa area as a source of grass. More females (93.8%) than males (80.1%) saw the Guassa area as a very important source of grass for various uses. There was also a difference (χ^2=42.49, df =24, p<0.01) between age categories and most (>85%) respondents over 31 years of age considered the Guassa area as a very important area for grass harvesting, whilst younger people did not considered it so important.

5.3.1.2 Firewood Collection

Most respondents (84.7%) described livestock dung (*Kubet*) as the major source of energy in Menz. Dung is used in combination with woody vegetation to provide energy for cooking and, to a lesser extent, for producing heat in the cold months of the year. Dung is collected in the homestead area from the cattle pens and from livestock grazing areas. Women prepare the dung from individual pens, while children who are cattle herders collect dry dung from grazing areas to bring home in the evenings.

Nevertheless, firewood is also an important resource collected from the Guassa area. Many (64.5%) respondents indicated that they collect shrubby vegetation in the Guassa area as firewood. The most commonly collected plant species is *Cherenfi* (*Euryops pinifolius*). Other species including: *Erica* or *Asta*, (*Erica arboria); Nechilo* (*Helichrysum splendidum)*; St. John's wort or *Ameja* (*Hypericum revolutum)*; and, dry giantlLobelia or *Gibra* (*Lobelia rhynchopetalum),* are collected to a lesser extent. There is a change in the type of vegetation collected during the wet and dry seasons. *Cherenfi* is collected mainly in the dry season and piled to dry in the house for use year round. In contrast, *Asta* is collected mainly in the wet season to compensate for the shortage of fuel and due to its ability to burn while wet.

Peasant associations differed (χ^2=425, df =28, p<0.001) in how they saw the Guassa area as a source of firewood. Most respondents from Dargegne (81.7%), Chare (84.0%), Qwangue (93.5%) and Gragne (79.6%) saw the Guassa area as a very important area to collect firewood. In contrast, All respondents (100%) from Kewula considered the Guassa area not an important for firewood collection (Figure 5.3).

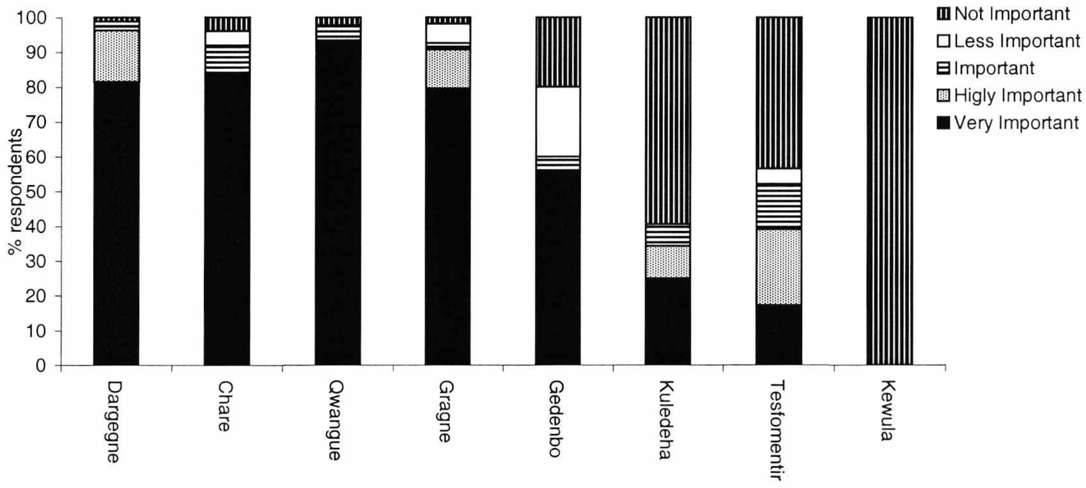

Figure 5.3 Degree of importance attached to the Guassa area as source of firewood among the eight peasant associations.

Male and female respondents held different (χ^2=18.73, df =4, p<0.001) views on the Guassa area as a source of firewood. Most female respondents (68.4%) and fewer male (50.8%) respondents considered the Guassa area as a very important source of firewood. At a household level, collection of firewood is shared among the family, with 41.1% collected by females alone, 39.1% by males alone, 10.5% by males and females and 9.3% collected by all members of the household. There was also a difference (χ^2=49.0, df =24, p<0.001) between different age categories in how they saw the Guassa area as source of firewood. Most respondents (>60%) between the ages of 31 to 69 considered the Guassa area important as a source of firewood, while few younger (<31years) or older (>70 years) shared this view.

Few (39.7%) respondents had a private wood-lot, but among those people who did not use the Guassa area for firewood collection, 64.3% had private wood-lots. The common species of trees planted in private wood-lots are *Eucalyptus* trees (*Ecualyptus* *globules*, *E. camadulensis* and *E. saligna*). However, these are used more frequently for construction purposes and only as firewood in the wet season, when drying *Cherenfi* and dung is difficult.

5.3.1.3 Livestock Grazing

The Guassa area provides a dry season refuge for the livestock of the adjacent communities. Most of the livestock that grazes in the Guassa area originates from the eight peasant associations. During prolonged droughts livestock from more distant peasant associations stays in the Guassa area in a temporary pens, to avoid long journeys from the homesteads on a daily basis.

Peasant associations differed (χ^2=361.22, df =28, p<0.001) in how they saw the Guassa area as grazing land. Most respondents from Dargegne (95.1%), Qwangue (95.7%) and Chare (76.0%) considered the Guassa area as a very important grazing area, whereas few respondents in Kewula (12.1%), Kuledeha (25.1%) or Tesfominter (26.1%) considered it to be very important (Figure 5.4).

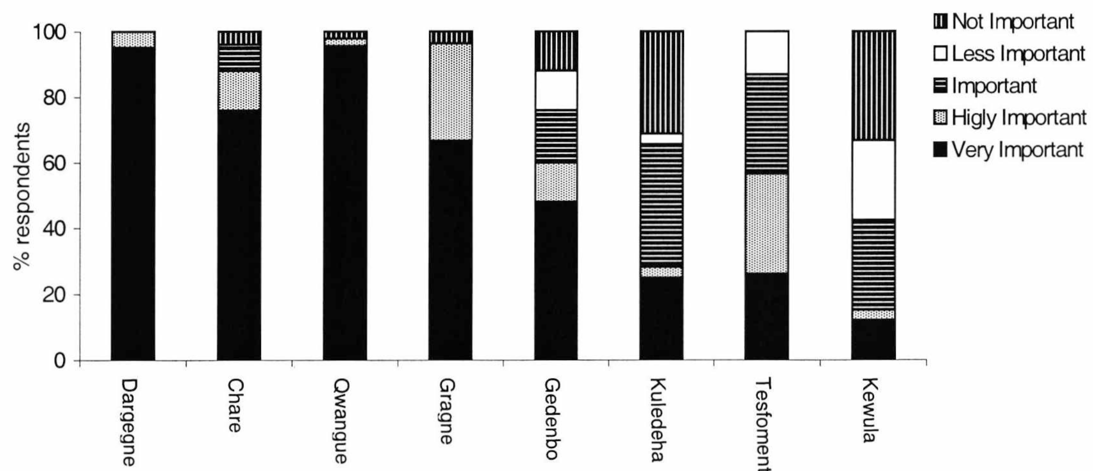

Figure 5.4 Degree of importance attached to the Guassa area as grazing area among eight peasant associations.

Male and female respondents differed (χ^2=15.57, df =4, p<0.01) in their view how the Guassa area is important as a grazing land. More females (69.9%) than males (53.1%) considering it as a very important grazing area. Age of respondents showed a difference (χ^2=36.68, df =28, p>0.05), and almost all (92.9%) respondents over 70 years of age and most of (>60%) respondents over 31 years of age, considered the Guassa area very important grazing land.

5.3.2 Patterns of Harvesting Resources

5.3.2.1 Guassa Cutting

The Guassa area is the only place where Guassa grass can be cut, during this study period Guassa grass collection was illegal. The density of illegal Guassa grass collectors in the Guassa area showed a seasonal pattern (Figure 5.5). It was highest in early wet season months June and July with an estimated density of 2.4$\pm$0.5 /km^2. In contrast, density of grass collectors was lowest at the height of the wet season in the months from August and September, with an estimated density of 1.3$\pm$0.4 grass cutters/km^2. Mean density of grass collectors was found to be 1.8$\pm$0.4/km^2. Based on the size of the area, this suggests a total estimate of 235$\pm$47 at the highest collection season, and 127$\pm$25 at the lowest collection season.

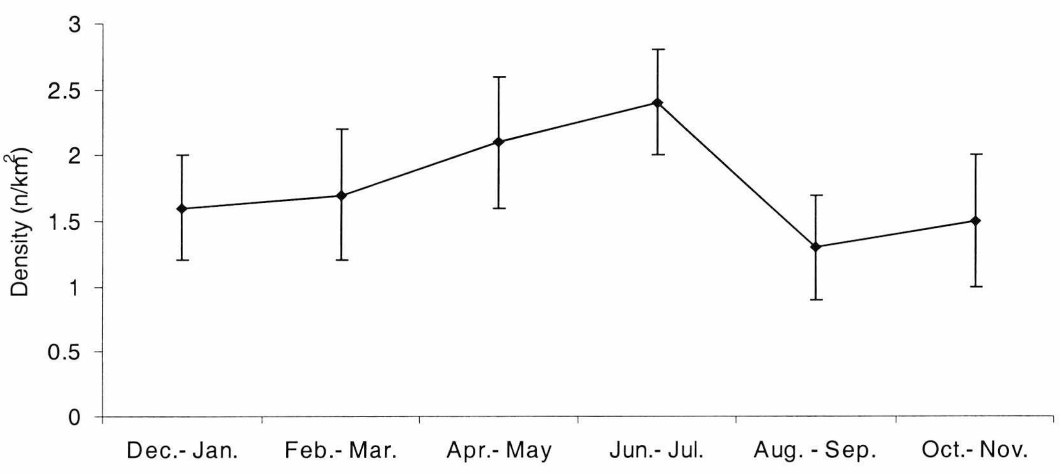

Figure 5.5 Seasonal change in the density of grass collectors in the Guassa area from December 1996 to November 1998, shown as mean $\pm$ SE for the two years combined.

5.3.2.2 Firewood Collection

Peasant associations differed (χ^2=312.67, df=7, p<0.001) as to where they actually collect their firewood. Most respondents from Dargegne, Qwangue, Chare and Gragne collect firewood from Guassa while few from Tesfomentir and none from Kewla did so (Table 5.3).

Table 5.3 Percentage of respondents who use the Guassa area as source of firewood.

Peasant Associations	n	Firewood from Guassa (%)	Not from Guassa (%)
Chare	50	92.0	8.0
Dargegne	80	98.8	1.3
Gedenbo	50	64.0	36.0
Gragne	54	87.0	13.0
Kewla	66	0.0	100
Kuledeha	64	40.6	59.4
Qwangue	92	97.8	2.2
Tesfomentir	46	8.7	91.3
Total	502	64.5	35.5

The frequency of collecting firewood ranged from 1-10 times/month/household and mean collection frequency was 3.2 ± 0.09 times/month/household. The frequency of collection significantly correlates with family size (r^2=0.13, P<0.001). Households with larger family size collected more frequently than smaller households. Patterns of firewood collection varied seasonally (Figure 5.6). The density of collectors was highest in the early wet season months of June and July (4.5 $\pm$0.8), due to the need to accumulate enough fuel for the wet season. The density of collectors was lowest at the height of the wet season months of August and September, (1.1 $\pm$ 0.3) and in the dry season of February and March (1.2 $\pm$ 0.4). The mean density of firewood collectors in the Guassa area was 2.14 $\pm$ 0.58 /km^2. Estimate of firewood collectors in the high collection season was 440 $\pm$ 49, and in the lowest collection season it was 78 $\pm$ 19.

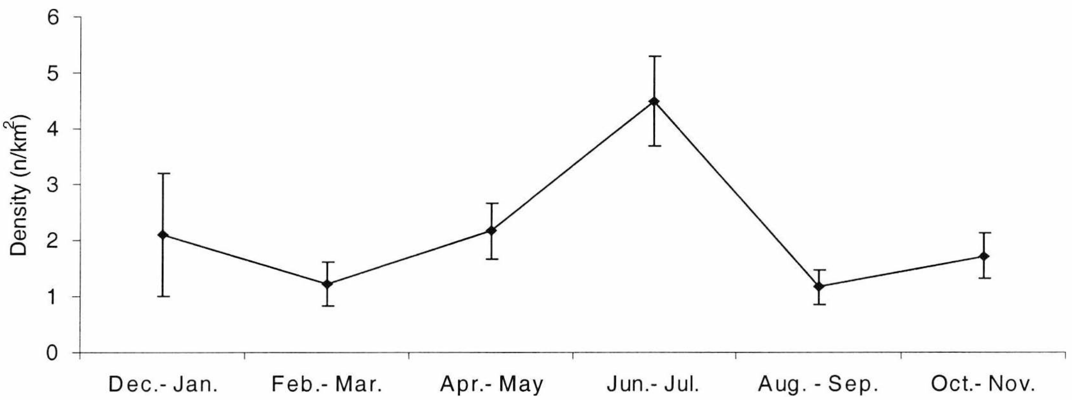

Figure 5.6 Seasonal change in the density of firewood collectors in the Guassa area from December 1996 to November 1998, shown as mean $\pm$ SE for the two years combined.

5.3.2.3 Livestock Grazing

Peasant associations differed significantly in the number of months they used the Guassa area for grazing ($F_{7,414}$ = 223.98, p<0.001). Most of residents from Dargegne and Qwangue graze their livestock for most of the year (10-12 months). In contrast, most respondents from Kewla uses the Guassa area for less than 4 months and some respondents from Kuledeha never uses the Guassa area for grazing (Table 5.4).

Table 5.4 Use of the Guassa area for grazing by different peasant associations.

Peasant Associations	n	Never uses	≤3 Months (%)	4-6 Months (%)	7-9 Months (%)	10-12 Months (%)
Chare	42	0.0	0.0	57.1	42.9	0.0
Dargegne	82	0.0	0.0	0.0	2.4	97.6
Gedenbo	48	0.0	4.2	70.8	25.0	0.0
Gragne	54	0.0	0.0	24.1	53.6	22.3
Kewla	66	0.0	27.3	60.5	12.2	0.0
Kuledeha	54	12.0	0.0	29.6	58.4	0.0
Qwangue	90	0.0	0.0	0.0	13.3	86.7
Tesfomentir	46	0.0	0.0	83.5	17.4	0.0
Total	504	4.4	3.9	32.7	28.6	30.4

Cattle, sheep and equines (mainly donkeys and a few horses and mules) are all grazed in the area. Densities of all species vary seasonally with the peak densities in early wet seasons months (Figures 5.7, 5.8 and 5.9).

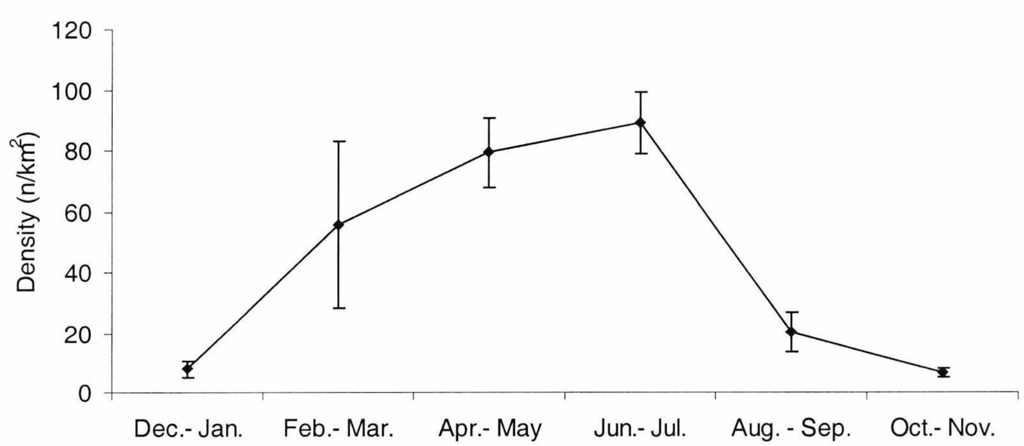

Figure 5.7 Seasonal change in the density of cattle in the Guassa area from December 1996 to November 1998, shown as mean ± SE for the two years combined.

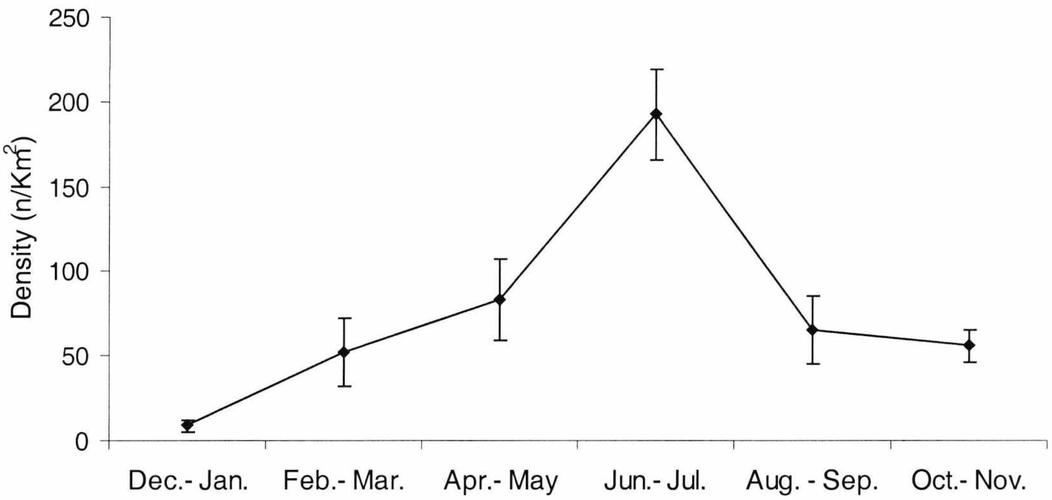

Figure 5.8 Seasonal change in the density of sheep in the Guassa area from December 1996 to November 1998, shown as mean $\pm$ SE for the two years combined.

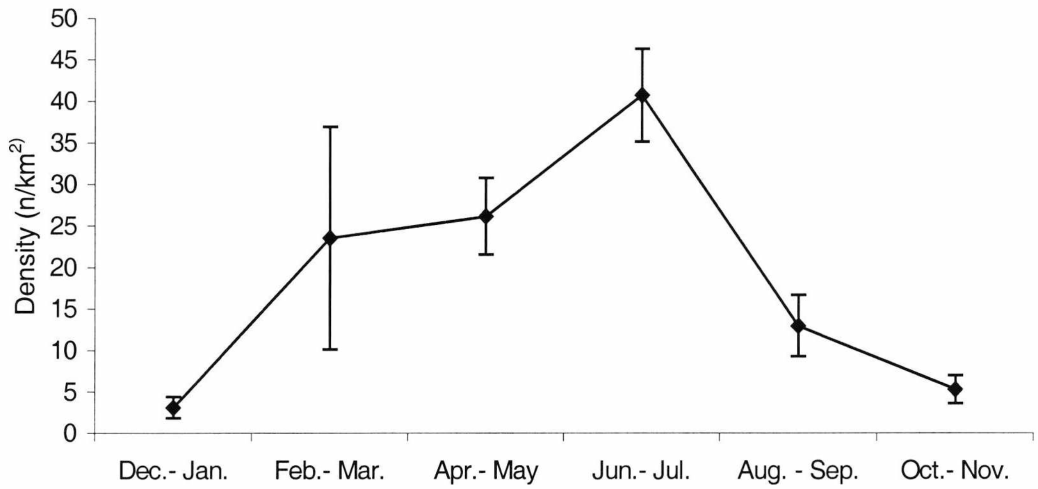

Figure 5.9 Seasonal change in the density of equines in the Guassa area from December 1996 to November 1998, shown as mean $\pm$ SE for the two years combined.

The highest density of cattle was recorded from February to July, while the lowest densities of cattle and equines were seen August to January (Figures 5.7, 5.8 and 5.9). In contrast low densities of sheep were seen from October to January and they showed a sharp increase and reached a peak density in months of June and July. Sheep are the most abundant livestock in the Guassa area, followed by cattle and equines (Table 5.5).

Table 5.5 Livestock population estimates in the Guassa area from December 1996-November 1998

Months	Population Estimate		
	Cattle	Sheep	Equines
December – January	776 ± 275	837 ± 152	305 ± 24
February – March	5472 ± 796	5132 ± 1386	2301 ± 366
April – May	7767 ± 2250	8209 ± 1777	2561 ± 458
June – July	8754 ± 2185	18843 ± 2586	3990 ± 1041
August – September	1986 ± 750	6385 ± 1599	1268 ± 338
October – November	646 ± 338	5463 ± 1678	520 ± 191

5.3.3 Factors Determining Use of Resources

5.3.3.1 Guassa Cutting

The multiple regression for grass cutting showed that the most important explanatory variable was distance from the Guassa area ($r^2=0.6$, $F_{3,500}=106.97$, $p<0.001$), which alone explained 40.0% of the variance in the model. Respondents living at increasing distances from the Guassa differed ($\chi^2=76.89$, df=12, $p<0.001$) in the degree of importance attached to the Guassa area as their source of Guassa grass. Most respondents (>90%) living at distances of <10km considered the Guassa area as very important for Guassa grass. However, the degree of importance tended to decrease at distances >11km (Table 5.6).

Table 5.6 Importance of the Guassa area as a source of Guassa grass in relation to Distance.

Distance (km)	n	Very Important (%)	Highly Important (%)	Important (%)	Less Important (%)	Not Important (%)
≤5	196	96.4	1.0	1.0	1.0	0.5
6 - 10	112	93.8	0.0	1.8	0.0	4.5
11 - 15	86	65.1	11.6	2.7	7.0	7.0
>15	110	72.7	9.1	3.6	5.5	9.1

5.3.3.2 Firewood Collection

The multiple regression for firewood collection also showed that the most important explanatory variable was distance from the Guassa area (r^2=0.7, $F_{5,486}$ =90.46, p<0.001), which alone explained 51.0% of the variance in the model.

The distance from Guassa affected (χ^2=296.29, df=12, p<0.001) which respondents collected firewood. Most (59.0%) firewood collectors lived within 5km of the Guassa area, while fewer (28.7%) of the collectors lived within 6 to 10km distance, and very few (6.7%) of the collectors lived at a distances >11. The importance of Guassa as a source firewood decreases as distance from the Guassa increases (Table 5.7).

Table 5.7 Importance of the Guassa area as a source of firewood in relation to Distance.

Distance (km)	n	Very Important (%)	Highly Important (%)	Important (%)	Less Important (%)	Not Important (%)
≤5	196	89.3	6.1	2.6	0.5	1.5
6 - 10	112	72.3	5.4	6.3	9.8	6.3
11 - 15	86	25.6	9.3	4.7	4.7	55.8
>15	110	10.9	7.3	5.5	1.8	74.5

5.3.3.3 Livestock Grazing

The multiple regression for grazing in the Guassa area the most important explanatory variable was distance from the Guassa area (r^2=0.6, $F_{6,485}$=106.97, p<0.001), and distance explained 40.0% of the variance in the model.

The importance of the Guassa area as a grazing land varied (χ^2=277.27, df=12, p<0.001) with different distance categories. Most respondents at a distance of <5km and <10km considered the Guassa area as a very important grazing area. In contrast more respondents at distance of >10km considered it not important (Table 5.8).

Table 5.8 Importance of the Guassa area as a grazing land in relation to Distance.

Distance (Km)	n	Very Important (%)	Highly Important (%)	Important (%)	Less Important (%)	Not Important (%)
≤5	196	93.9	5.1	0.0	0.0	1.0
6 - 10	112	66.1	17.9	8.9	0.0	7.1
11 - 15	86	27.9	16.3	20.9	18.6	16.3
>15	110	16.4	7.3	36.4	12.7	27.3

Distance from Guassa also affects the duration of grazing in the Guassa area ($F_{3,478}$ =234.75, p<0.001). Most (72.7%) respondents living within a distance of 5km from the Guassa area graze their livestock from 10-12 months in a year, while most villages (88.6%) within the distance of 6-10km graze their livestock from 4 months to 9 months. Most (63%) respondents living at distances over 10km from the Guassa area graze their livestock for 4 to 6 months. Only 4.1% of the respondents use the Guassa area for less than 3 month and most of these respondents live at distances over 10 km or above from the Guassa area.

5.4 Discussion

Rural populations typically require various resources for their livelihoods including: food; water; fuel; pasture; fodder; medicines; materials for construction; and, implements and products to exchange or sell in markets. Traditional societies have always met these requirements from natural resources, both renewable and non-renewable, derived in most cases from ecosystems immediately surrounding them. At least 3,000 species of plants have been used throughout history as food alone and, some 21,000 species have been used for medicinal purposes (Kothari, 1997; Sharma and Shaw, 1993). This study has shown clearly that, by having protected the common property resources in the Guassa, local people can, and still do, put these resources to a wide range of uses.

5.4.1 Grass Cutting

One of the main reasons for protecting the Guassa area is for the *Festuca* grass, which is used for various purposes by the community (Table 5.2). However, peasant associations have different views about the value of the Guassa area as a source of grass. Peasant associations further from Guassa need the grass mainly for thatching, and a house thatched with *Festuca* grass lasts from 15-20 years. Hence, peasant associations further away rarely need the grass since they do not have to thatch their houses very often.

Rope is also an important product of the *Festuca* grass, which is braided and used for various purposes in the household and on farms. For example, during construction the wooden part of a roof is tied by Guassa rope. Also rope is used for loading donkeys, and as a farm implement to tie the ploughshare and the yoke together, as well as to tie the yoke to the ox's shoulder. Whips made out of *Festuca* grass braided in a particular way (*Zab*) are another important farm implement to encourage oxen when ploughing.

In Menz men often sit in a group to braid rope. Someone supplies the *Festuca* grass of the *Kwchera* variety and those people sitting together co-operate in braiding. At the end everyone can take the rope he has braided if he so wishes, but the person who brought the grass cannot lay claim to the rope. When asked why the person who braided the grass is allowed to take the rope, the people answered that "the *Festuca* grass belongs to everyone and no one can put a claim on the grass unless he made some use of it", and this is a deeply rooted belief among the people of Menz.

In the household, materials like mattresses and different baskets are made from *Festuca* grass. *Festuca* can also be strewn on the floor as a loose-mat (*Guzguaz*), and both it and a mattress made from *Festuca* are believed to deter fleas. This may be due to the coarse nature of the grass when it dries, which makes the movement of fleas difficult. In the absence of kerosene for lighting in the evenings, young boys and girls make torches using the *Festuca* grass to provide light while the evening meal is served.

Another important use of the *Festuca* grass is its value as a marketable product that increases household income. The grass may be sold in markets far from the area, for example in Mollale market that is 45km from the Guassa area and Arb Gebeya, which is on the Yefat side 25km from the Guassa. Indeed *Festuca* grass from the Guassa area has been sold in markets as far as Debre Birhan and Debre Sina, which are 150km and 110km from the Guassa area, respectively. This distance selling is undertaken to avoid being seen by other members of the community who may report the incident to the local militia or to the Guassa Committee. The grass intended for market is carried inside a sack so that no one can see it. Sale of the *Festuca* grass takes place at night in the nearby towns or by having a regular customer who readily takes the grass without being seen. In the markets of Mollale and Arb Gebeya, a human load of *Festuca* grass can cost from 7-10 birr, whereas a donkey load costs 35-40 birr. According to our informants, the money is used to buy spice and barley when harvests of crops fail. This is why the community often refers to the *Festuca* grass as "*libsachin na* *gursachin*" (our cloth, butter and bread). The value of the *Festuca* grass as a survival resource for the poorer households during drought is of paramount importance, as a donkey load of *Festuca* can buy up to 25kg of barley in the nearby market.

Illegal collecting of *Festuca* grass takes place all year round but the peak is at the beginning of the rainy season in June and July (Figure 5.5). The increase in the numbers of people in these months corresponds with a decline in their stocks of grain. Households with no livestock to sell, or with no extra income, are more likely to engage in the sale of *Festuca*. However, the sale of *Festuca* grass was once regarded in the society as an inferior activity in which those with farmland were not expected to engage. However, declines in soil fertility, continued reduction of farmland due to frequent redistribution of farm plots, coupled with the increased frequency of drought, has tremendously affected the subsistence agriculture. Hence, the majority of households now depend on the Guassa area for grass to sell as a survival strategy during hard times.

5.4.2 Firewood Collection

Consumption of vegetation biomass for domestic energy in developing countries is a cause for concern, and the impending "firewood crisis" has dominated the forestry and conservation development agenda since the 1980s (Eckholm, 1975; FAO, 1983). The vulnerability of developing countries to energy shortages was highlighted by Openshaw (1974), who indicated that about 80% of all households in developing countries use firewood as their primary source of energy. According to a study conducted by FAO (1983), 50% of the rural population in the developing world face imminent shortages and about 2400 million people in the developing world face an acute shortage of firewood. The demands for firewood by rural people in developing countries is linked to deforestation, lack of alternative total energy demands, low agricultural productivity and poor nutrition (Mahapatra and Mitchell, 1999). The continued dependence of the rural populace on biofuels, especially the demand for a domestic energy source, affects both biodiversity and agriculture (Montalembert and Clement, 1983).

In Ethiopia vegetation biomass is a major source of energy. Rural households depend on wood, agricultural residues, and livestock dung as a source of fuel for domestic energy. Most of the natural forest in Menz has been cleared for a long time. The Central Highlands of Ethiopia have been an important centre of Ethiopian politics. In fact, it was the heart of the past political struggle and socio-political conditions caused the Ethiopian monarchs to roam permanently, which in turn forced the kings to change their capital after every few years. When moving to a new place, the king was followed by large number of soldiers and other attendants. Whenever such a crowd spent a few nights in one place, the need for firewood was huge. The area through which the monarchs travelled or settled with their multitude of followers must have been considerably impoverished. As soon as the forests receded beyond manageable distances, the camp was moved to where sufficient forest remained for fuel and construction. The monarch and his followers lived at the expense of the peasantry, through whose lands they passed, and whose resource they soon exhausted. Changes in the location of a capital city often occurred after the destruction of forests, and the consequent depletion of firewood (Pankhurst, 1998).

The Menz communities have to depend on the Guassa area as a source of fuel. The bushy vegetation occurring at high altitude is the only plant matter that can be collected as a source of fuel. *Cherenfi* (*Euryops piniflius*) is the most common shrub used as firewood in Menz. The plant is usually collected by uprooting with using a small axe or by pulling it out of the ground by hand. It is not good at providing the required amount of energy and it produces lots of smoke. However, its abundance in the Guassa area has made it the most important firewood for the community. *Erica* (*Erica arboria*) is an excellent firewood compared to *Cherenfi,* but little *Erica* bush is left in the Guassa area and those that are found are in constant use by the community. *Erica* is a usually collected in the wet season since it has a capacity to burn quickly even when wet. *Ameja* (*Hypericum revolutem*) is another bush collected as firewood and can grow up to the height of a small tree, but it never has the chance to grow to that height in the Guassa area, so it always found as a bushy thicket. *Amja* is usually collected to make brooms or various household and construction materials rather than firewood. All the firewood plant species collected in the Guassa area have a low calorific value and do not provide constant heat. Therefore a mixture of livestock dung and the bushy vegetation from Guassa is commonly used to get long-lasting heat.

Seven out of eight peasant associations heavily depend on the Guassa area as a source of fuel (Table 5.3). Peasant associations close to the Guassa area use it more frequently than those living further away. Nearly 60% of the users live within 5km of the Guassa area. The density of firewood collectors in the Guassa area show a clear seasonal pattern with highest densities in early wet season months of June and July (Figure 5.6), each household has had to accumulate enough firewood to last the wet season. At this time of the year, male members of the household finish working in the fields to attend other household activities such as collecting and accumulating firewood for the wet season.

A few households own private wood-lots. Among the households who do not dependent on the Guassa area for firewood, most (64.3%) have private wood-lots. In general, tree planting is not often practiced at present in Menz, even though the community suffers from a critical shortage of firewood. Following the nationalisation of all rural land during the 1975 Agrarian Reform, forests and private tree plantations in the country were nationalised. Hence, planting of trees has ceased because of uncertainty about the future access to the trees that are also nationalised. As a result, there is a chronic shortage of firewood and other forest products (Hoben, 1993; Admssie, 2000).

The rainy season is a particularly difficult time for collection of all types of fuel, which in turn affects the choice of fuel in the household and increases the dependence on dung as a source of fuel. Livestock dung, whether from cattle, sheep or equines is an important source of fuel in the Central Highlands of Ethiopia. There is a decrease in availability and consumption of wood with increased elevation, while the use of livestock dung increases with altitude (Wolde-Mariam, 1991). The community also uses dung in the building of huts, for making household furniture and as a fertiliser. These uses are usually complementary to the value of dung as fuel, since ash, the by-product from the burned dung can be reused in buildings and as fertiliser. As a result of its various uses, its different types and modes of collection, there are at least 14 Amharic names for what is called "dung" or "manure" in English. It is conventional wisdom to assume that the vocabulary attached to a particular concept expands in proportion to its importance to the community. The examples often cited are that of Somali pastorialists who have 29 names for camels, and the Inuit who have a large array of terms for snow.

Dung is rarely used exclusively as fuel, but is mixed with the shrubby vegetation collected as firewood from the Guassa area to provide the necessary energy required in the household. The combination adopted by the household depends upon types and quantities of livestock owned, in particular, whether they are brought home at night or herded in the Guassa area. The supply of labour, in particular whether it is male or female, affects the volume and frequency of off-take of fuel resource, as men are expected to travel greater distances, they are more involved in Guassa firewood collection, while women are more involved in dung preparation and firewood collection around the homestead. Households owning a donkey for carrying firewood enjoy an advantage over those households depending on human labour alone. Ownership of a wood-lot and any such supplies reduce dependency on dung.

Poorer households were most dependent on dung, for three reasons. First, because they are less likely to have their own wood-lot. Second, if they have to buy it, dung is cheaper than wood. Third, they very much depend on the Guassa area for firewood, which in itself is not enough to provide the necessary energy unless combined with dung. However, poor households were also less likely to own livestock, sometimes having none at all. Such households therefore have less access to dung collected from the pen and have to depend on the dung collected from the grazing areas like the Guassa area, on which nobody can lay claim.

Some of the factors which influence the need for biofuel and its subsequent rate and pattern of consumption are population and economic growth, wood availability and social structure (Barnes, 1990; Marufu *et al.*, 1997). In situations of economic stagnation, accompanied by significant expansion of poverty, as is the case in many rural parts of Ethiopia, a constant increase in the demand for cheap fuel energy is inevitable. The most common alternatives to firewood in rural Africa is livestock dung, which happens to be a valuable fertiliser in these communities. The adverse effect of its substitution therefore results in increased soil erosion, a decline in agricultural productivity and enhanced environmental degradation leading to greater loss of biodiversity and famine.

There is a growing concern among government agencies and conservation communities about the adverse impacts that using wood as the predominant energy source places on the environment in the developing world. However, it has been argued that, by applying environmentally sound land management practices and balancing economic growth with population growth, firewood related deforestation and its consequences can be curtailed to a large extent. Moreover, when compared to land clearing for other uses such as agriculture, firewood use turns out to be a minor contributor to deforestation at the present time. When sustainably used, wood biomass is a cheap and a renewable energy source, especially suitable for rural economic activities in the developing world (Abbot and Homewood, 1999).

5.4.3 Livestock and Livestock Grazing

Ethiopia's estimated livestock population is about 78.4 million, and in 1990 was believed to have been the largest population in Africa. About 72% of the cattle, 74% of the sheep, 34% of the goats and 65% of the equine population are in the highlands, which accounts for 65% of the total area of the country. Livestock production plays an important role in the economy and contributes 33% of the agricultural share of the

GDP, equivalent to 15% percent of the country's GDP and 16% of its exports (Wolde-Mariam, 1991).

Livestock are an essential component of the subsistence production system of the rural economy. A farmer's life without livestock is simply unthinkable. Moreover, it could be argued that the importance of livestock has increased as a consequence of the closer control exerted by the state. For example, after the 1975 Agrarian Reform, land was redistributed, but livestock were not. The role of livestock in subsistence strategies has increased from time to time because of poor crop cultivation. The relationship between crops and livestock is important in the production system. Livestock need to be fed from land, while land needs to be cultivated and fertilised with livestock power and dung, and the yield from the land is threshed using livestock. In fact it may be said that all farm activity in the Ethiopian highlands revolves around animals and the farmer's own labour.

In Menz, the Guassa area is an important grazing land which helps as a refuge for the livestock population when private and cultivated fields become devoid of any grazing resource, particularly during drought. There are four sources of fodder available to any household in Menz:

- The first source is private pastureland (*Kelo*), allocated to each member of the peasant association, together with a cultivatable field. Following the 1995 Agrarian Reform, most households were allocated small grass plots, which could be up to 0.5ha in size. Mostly these plots are closed in the wet season and looked after by the owner. The grass is cut and piled in the homestead and given to the milking cows and to oxen during the ploughing season. After the hay is harvested, the area will be again used for grazing. Those without livestock in the peasant association are also entitled to have a grazing plot, but they normally allow the grass to grow, and then cut it for sale.

- The second source of fodder is agricultural land that has been harvested (*Karmia*). Just after the crop has been harvested, livestock are allowed to graze in the straw of barely and wheat fields. The straw provides rough poor quality fodder, but the weeds that grow in the field and its margins are important fodder. It was generally accepted that households close to harvested fields are free to take their livestock there to graze without regard to the ownership of the plot.

- The third source of fodder is crop residues or chaff (*Geleba*) after threshing of crops in the homesteads. This source of fodder can be stored for use when necessary. The husks and chaff are generally stored in two different piles from which the livestock are fed as required. Cattle can eat the chaff from all harvests, whereas small stock cannot digest the chaff from wheat and barley. Therefore, small stock can be fed from the remains of other crops, such as lentils and beans. Households with no livestock can use their chaff as a source of income. A donkey load of barely and wheat chaff costs from 10 birr to 20 birr depending on the time of the year.

- The fourth source of fodder is the Guassa area itself, which is an important grazing land for the people of Menz. However, peasant associations have different views on the Guassa area as a source of pasture (Figure 5.4). Chare, Daregene, Quangwue and Gragne peasant associations expressed their high dependence on the Guassa grazing land. However, Kewula, Kuledeha and Gedenbo use the area as grazing land to a limited extent and the period of the year that they use the Guassa area vary considerably (Table 5.4.).

Seasonal patterns of grazing by cattle, sheep and equines were heaviest in the early wet season (Figures 5.7, 5.8 and 5.9). The livestock population reaches its peak from April to July and starts to decline in August to September, dropping to its lowest numbers in December to January (Table 5.5). This seasonal pattern has been followed since the time of the *Qero* system, in which all livestock grazing had to leave the Guassa area starting from mid July (Chapter 3). The reason for this was to give a break to the Guassa area and to allow the opportunity for maximum re-growth during the rainy season. At this time, livestock can be herded around the homestead and on the *Belg* fields (short rain cultivation plots) until the grass is well matured on private grazing plots, and until the *Mehir* (wet season crop) is harvested. Another important factor that may have led to lower livestock densities at this time could be the climate of the Guassa area. In the rainy season, the weather gets colder (see Figure 2.6) and is difficult for cattle herders to stay out in the cold climate. Also the presence of dense fog in the rainy season makes it very difficult to look after livestock and increases the risk of livestock predation by hyena, jackal or wolf. Use of the Guassa by livestock from February through to July only occurs because forage in private grazing plots and crop residues has become diminished. Also, sources of water have become limited during these months of the year in many villages.

The distance of a village from the Guassa area is an important factor in determining its importance grazing land and the duration of the grazing periods (Table 5.8). Livestock from nearby villages stay for longer in the Guassa area than villages from faraway. This is associated with the time it takes to travel to the Guassa and back to the homestead in the evening. Although this seems to have little effect on the livestock (Western and Finch, 1986), it brings difficulty to the mode of herding. Distant villages have a system called *Guassa-tera* during the height of the grazing season, whereby livestock owners stay in the Guassa area overnight to look after their livestock. The *Guassa-tera* works by a number of households (5-10 households) with livestock joining together and making a rota, usually of two people at a time to look after the communal livestock in the Guassa area. The sheep rota is usually separate from the cattle rota, and distant villages prefer to keep their sheep in the homestead, since herding them is difficult and taking them to the Guassa area risks losing stock to predators. According to the *Guassa-tera*, the amount of time each person spends in the Guassa area depends on the number of livestock he owns. Usually it is one day (24 hr) per cow or per 5 sheep. If someone fails to turn up for their turn in the rota, they will be fined according to the agreed bye-laws, which is usually a local beer and bread, or a fine of 5 birr.

Only men are involved in the *Guassa-tera*, and the idea of a woman becoming involved is thought to be preposterous. In practice, this means that households without adult men are excluded from a free and relatively abundant form of pasture. Very often such households keep their livestock with a relative who has the required form of labour in a scheme known as *Ribbi*. Under this system, the livestock owner and the livestock herder divide equally all offspring produced during the lease period and usually half the wool shorn from the sheep. The *Ribbi* system of redistribution of stock and stock loan has various advantages of risk avoidance to the owner and helps to establish the nucleus of a herd for the lessee. A similar system exists in the pastoralist communities of East Africa (Homewood and Lewis, 1987; Homewood and Rodgers, 1991). According to these authors, the system helps to disperse family herds over a range of ecological conditions and geographical ranges. They are also used to foster the reciprocal stock friendship necessary to rebuild the herd in the event of drought or an epidemic.

Given the high level of importance of the Guassa area for grass cutting, firewood collection and grazing for Menz community, the next two chapters look, first, at the basic ecology of the rodent population in the Guassa area and second, the effects of use upon the rodent population.

Chapter Six

6 The Rodent Community of Guassa

6.1 Introduction

The Ethiopian highlands are known for their high level of plant and animal endemism (Yalden, 1983; Kingdon, 1990; Yalden & Largen, 1992; Hillman, 1993). The large number of endemic species has been attributed to the extent of high altitude areas in the country compared to the rest of Africa, and to the isolation of these mountain blocks from other similar areas (Yalden, 1983). Most of the rodent fauna (60%) of the country is confined to the highlands and there are at least 14 endemic species of rodent, all from the North-western, Central and South-eastern highland plateaux (Yalden and Largen, 1992). Six endemic species are confined to high altitude, Afro-alpine moorland above 3000m asl, four endemic species occur in mountain grassland, and the remaining four endemics occur in mountain forest areas.

A few studies of rodent biology have been conducted in the South-eastern Highlands at the Bale Mountains (Yalden, 1975, 1985, 1988; Hillman, 1986; Gottelli & Sillero-Zubiri, 1990; Beyene, 1986; Sillero-Zubiri 1994; Sillero-Zubiri *et al.*, 1995a,b; Lavrenchenko *et al.*, 1995), but even fewer studies have been conducted in the North-western Highlands at Simen Mountains (Müller, 1977; Hurni, 1986, Güttinger *et al.*, 1998). The catalogue of Ethiopia's mammals describes the distribution of rodents in the country from various field studies and from museum specimens (Yalden *et al.*, 1976; Yalden and Largen, 1992; Yalden *et al.*, 1996). Studies of systematics have been undertaken on a few species (Bekele *et al.*, 1993; Bekele and Corti, 1994; Capanna *et al.*, 1996; Bekele, 1996; Capula *et al.*, 1997).

Ecological studies of the rodent communities in Ethiopia are important in their own right, given their high levels of endemism. In addition, the Ethiopian wolf heavily depends on rodents for its survival (Morris and Malcolm, 1977; Sillero-Zubiri, 1994; Sillero-Zubiri *et al.*, 1995a;b; Sillero-Zubiri and Gottelli, 1995a; Malcolm, 1997). Thus, studies of the rodent community are important to assess habitat quality for wolves and as a predictor wolf density. Despite this, ecological studies of rodent communities in Ethiopia have been very sketchy. Although, the Central Highland of Ethiopia is very rich in small mammal fauna, no detailed ecological studies have been conducted on the rodent communities. Hence in this chapter I determine the following:

- species composition and abundance;
- activity and habitat preference; and,
- survival, density and biomass of rodents in the Guassa area.

These data serve to understand the basic ecology of rodents in the Guassa area and as a basis on which to build in later chapters on an understanding of how human use of the area affects rodents (Chapter 7) and to assess prey type and availability as a predictor of Ethiopian wolf habitat quality (Chapter 8).

6.2 Materials and Methods

6.2.1 Field Data Collection

6.2.1.1 Snap Trapping

Snap trapping of rodents in the Guassa area was conducted bi-monthly from January 1997 to December 1997. Trapping was conducted in six habitat types: *Festuca* Grassland (FG); *Euryops-Alchemilla* Shrubland (EA); Mima-Mound (*Euryops-Festuca* Grassland) (MM); *Erica* Moorland (EM); *Helichrysum-Festuca* Grassland (HG); and, Swamp Grassland (SG). These habitats were selected on the basis of the area they occupy (see Figure 2.8) and of being an important habitat for the Ethiopian wolf. The first three represent the main habitat types and the rest represent the minor habitat types (see Chapter 2). Rodents were trapped using a line transect of 50 traps set at 10m intervals. Traps were baited with a mixture of peanut butter and barley flour. Traps were pre-baited for one day, trapping started the following day and continued for two consecutive days and nights. Traps were set in the early morning (0600 to 0700hr), and animals caught from 0600hr to 1800hr were recorded as day trappings, and those caught from 1800 to 0600hr the next morning as night trappings. The traps were re-set for the next day's trapping session at 0600hr to 0700hr.

The following data were collected from rodents caught in the snap traps: species; habitat; sex; age; weight (gm); and, body measurements. In addition, time (day/night), reproductive state of the animal, whether pregnant or lactating was recorded. Identification of species was carried out at the Natural History Museum of Addis Ababa University and at the Bale Mountains National Park Museum.

6.2.1.2 Live Trapping

Live trapping of rodents was conducted bi-monthly for two years from January 1997 to December 1998. Only the three main habitat types were sampled, comprising: *Euryops-Alchemilla* Shrubland (EA); *Festuca* Grassland (FG); and, Mima Mound (*Euryops Festuca* Grassland) (MM). Live traps (Sherman, Tallahassee, FI, USA) with collapsible aluminium doors at both ends were used. A total of 49 live traps were set in a grid of 7x7 traps with 10m between each trap, over a total area of 0.49ha. Traps were baited with a mixture of peanut butter and barley flour. Traps were pre-baited for one day before trapping started. Trapping was conducted over three days at each trapping session. Traps were set in the morning (0700hr) and were checked three times a day for caught rodents, which were collected at dusk (1800hr). All animals caught without previous marks were toe clipped, as described by Halliday (1996). A single toe, or a combination of two toes, were removed with scissors, allowing identification of up to 99 individuals per species. The clipped toes of all previously marked animals were noted.

6.2.2 Data Analysis

6.2.2.1 Snap Trapping

All data from the snap trap exercise were analysed using Generalised Linear Models (GLM) (Dobsen, 1990; Crawley, 1993). First, I analysed the total number of rodents caught, independent of habitat and time, using GLM with a Poisson error structure. Second, I analysed the total number of rodents, independent of species and time. Thirdly, I analysed the total number of rodents independent from species and habitat, to determine if there was a difference in the mean number of rodents caught during the day and night.

Following these analyses, the two independent variables of habitat (expressed as variable with six categories) and time (a variable with two categories) were fitted to the model to see if there was an interaction. Terms were analysed using GLM with a Poisson error structure, which takes the form of a chi-square distribution.

Subsequently, a GLM with a binomial error structure was used to determine whether there was any difference in the proportion of individuals species caught in different habitats at different times of the day. The response variable was the number of individuals of each species that were caught in each trapping session in each habitat type at each trapping time (day/night). The binomial denominator was the total number of individuals, regardless of species caught in each trapping attempt in each habitat at each time. Initially, I fitted species, habitat and time and later removed factors (species, habitat, time) that were not significant. It was found that the data were over-dispersed, since the ratio of residual denominator to raised degrees of freedom was >2, so the dispersion parameter was estimated (Crawley, 1993). Following this I aimed to determine which factors were interacting by creating a full model. Factors that were not significant were removed (dropped) in order to determine the deviance that is explained by the full model. Significance was assessed using the method described above. A prediction was made to determine the proportional abundance, activity pattern and habitat preference.

6.2.2.2 Live Trapping

The live trap data were used to estimate density and population size using the DOS-based Jolly programme. The Jolly programme was selected to estimate population size because it allows survival rates to vary over the period of capture and, therefore, it is more realistic biologically than other programmes (Donnelly and Guyer, 1994; Krebs, 1999). The Jolly programme estimates both population size as well as survival rates and gains. Each estimate has an associated standard error, as appropriate for interpreting estimates of the population size and for forecasting for new observations. Jolly programme requires several sampling periods, but only the most recent recapture is considered in its calculations. Therefore, capture histories are required for all individuals (Donnelly and Guyer, 1994).

The density of each species in every habitat type was calculated based on a population size estimate provided by Jolly programme. The biomass was calculated by taking the average weight calculated for each species from the snap trap exercise. The mean population estimates were extrapolated to area size in km^2, rather than to sampling area size, to allow a meaningful comparison.

To estimate survival, I used the Cormack-Jolly-Seber (CJS) method, which uses live animal re-captures that are released alive from an open population (Cromack, 1964; Jolly, 1965, 1982; Lebreton *et al.*, 1992). The common character of this method is that it can be applied to time-dependant survival and recapture rates of a single group of individuals in an open population, and that it otherwise follows the main assumptions of Jolly-Seber method (Lebreton *et al.*, 1992; Krebs, 1999). Survival rates were estimated using the Programme MARK, a Windows 95 interface programme, which estimates survival estimates from marked animals, when they are re-encountered at a later time. The time intervals between re-encounters for Programme MARK do not have to be equal, but it was assumed to be one interval if not specified. In this study one interval between successive trappings was taken as the actual time between successive capture mark and release times. The basic input to Programme MARK is the encounter history for each animal, and each animal was labelled with 1 when recaptured, and with 0 if it was not caught at a particular trapping session. Parameters were constrained to be the same across re-encounter occasions using the parameter index matrix (PIM) (White and Burnham, 1997). The programme provided a set of common models for screening data by numerical maximum likelihood ratio techniques. The number of estimable parameters was used to compute the Akaike Information Criterion (AIC) value. Four different types of models were tested for their best-fit. These models were: Phi ( ) = no change in survival; P ( ) no change in recapture; Phi (t) change in survival over time; and, P (t)= change in recapture over time. The best-fit model was selected by taking the lowest AIC value (White and Burnham, 1997).

Female reproductive patterns were assessed by comparing the proportion of lactating and pregnant females caught relative to the total number of females caught in each month during snap trapping.

6.3 Results

6.3.1 Habitat Preference and Activity Pattern of Rodents

Snap trapping across all six habitat types resulted in the capture of the following mammals (Figure 6.1): *Lophuromys flavopunctatus* (n=526); *Arvicanthis abyssinicus* (n=307); *Stenocephalemys griseicauda* (n=278); and, *Otomys typus* (n=100), as well as one shrew, *Crocedura baileyi*. Since only one *C. baileyi* was caught, it was excluded from later analyses.

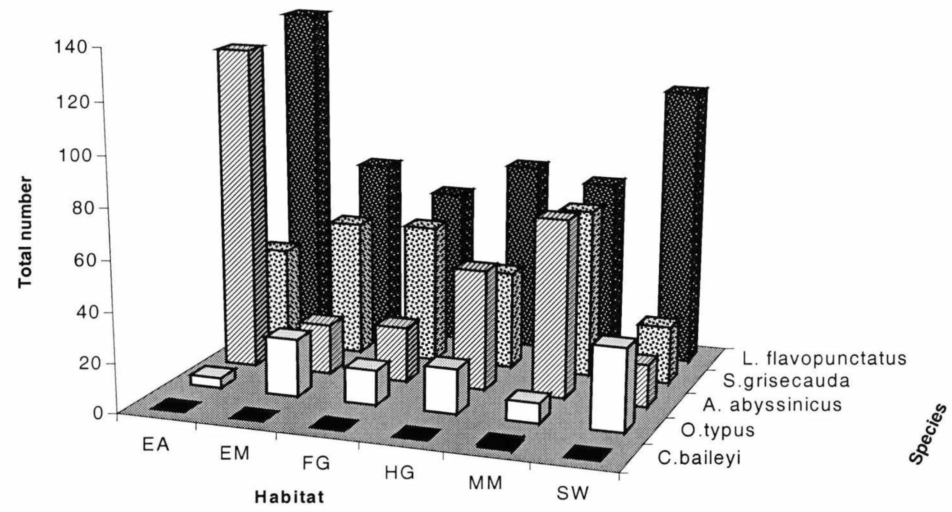

Figure 6.1 Total number of rodents caught in the study period across all habitat types.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

There was an overall difference (χ^2=15.9, df=3, p<0.05) in the total numbers of each species caught across the six habitat types (Figure 6.2), but no difference (χ^2=10.0, df=5, p>0.05) between numbers of all species caught across different habitats (Figure 6.3). Therefore, the analysis showed that *L. flavopunctatus, A. abyssinicus* and *S. griseicauda* are more common than *O. typus*, irrespective of habitat type

Figure 6.2 Estimated mean ± SE number of individual species across all habitat types.

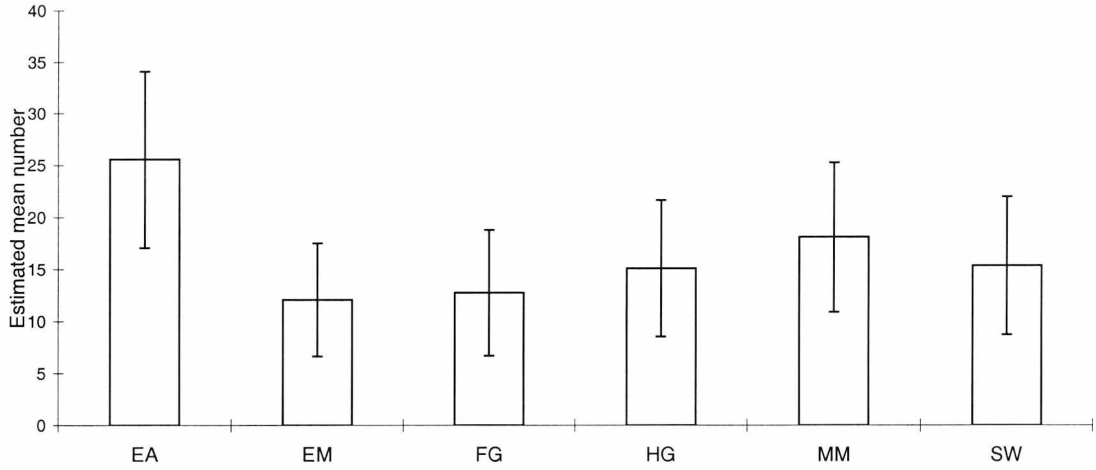

Figure 6.3 Estimated mean $\pm$ SE number of all species caught across different habitat types.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

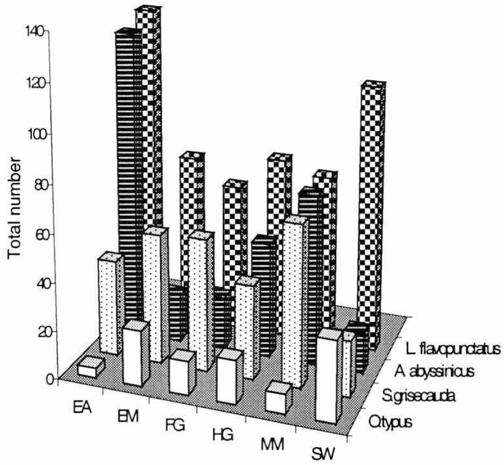

Figure 6.4 Total number of rodents caught during the day across each habitat type.

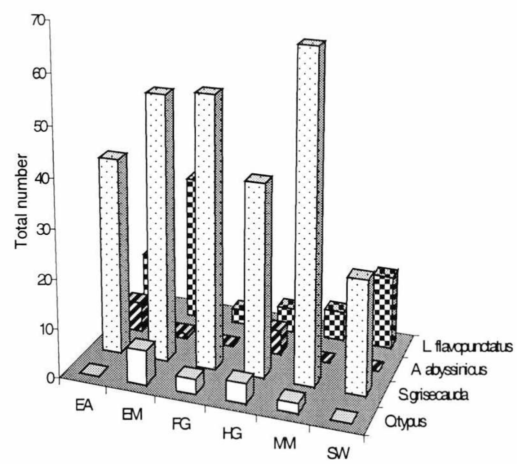

Figure 6.5 Total number of rodents caught during the night across each habitat type.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

The number of different species of rodents caught across all six habitat types have been further sub-divided in to those caught during the day (Figure 6.4) and the night (Figure 6.5). There was a difference (χ^2=23.97, df=1, p<0.001) between day and night captures, with more rodents caught during the day than at night (Figure 6.6).

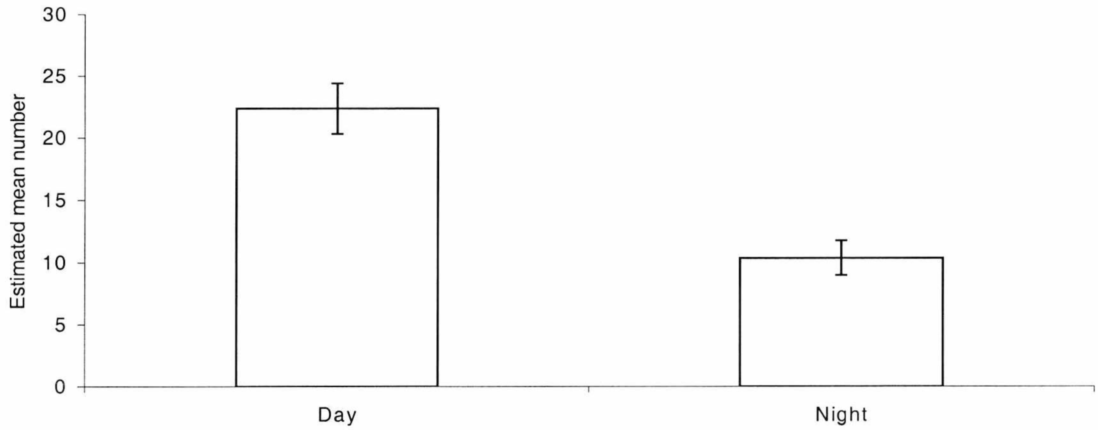

Figure 6.6 Estimated mean ± SE number of rodents caught during the day and night.

There was an interaction (χ^2=13.51, df=3, p<0.01) between the number of each species caught and time. Therefore, the analyses showed that *L. flavopunctatus, A. abyssinicus* and *O. typus* are primarily diurnal, while *S. griseicauda* was almost exclusively nocturnal (Figure 6.7).

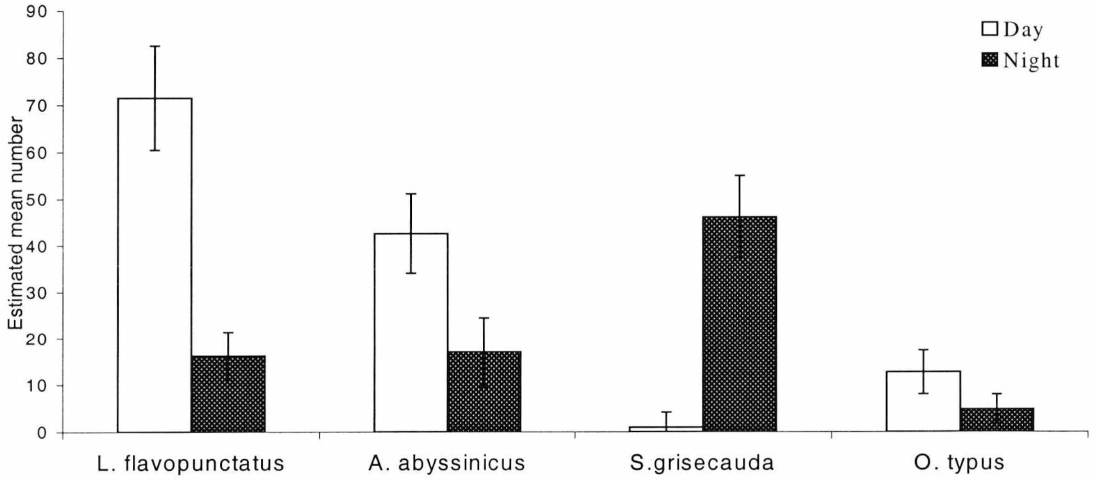

Figure 6.7 Estimated mean ± SE number of rodents of each species during day and night.

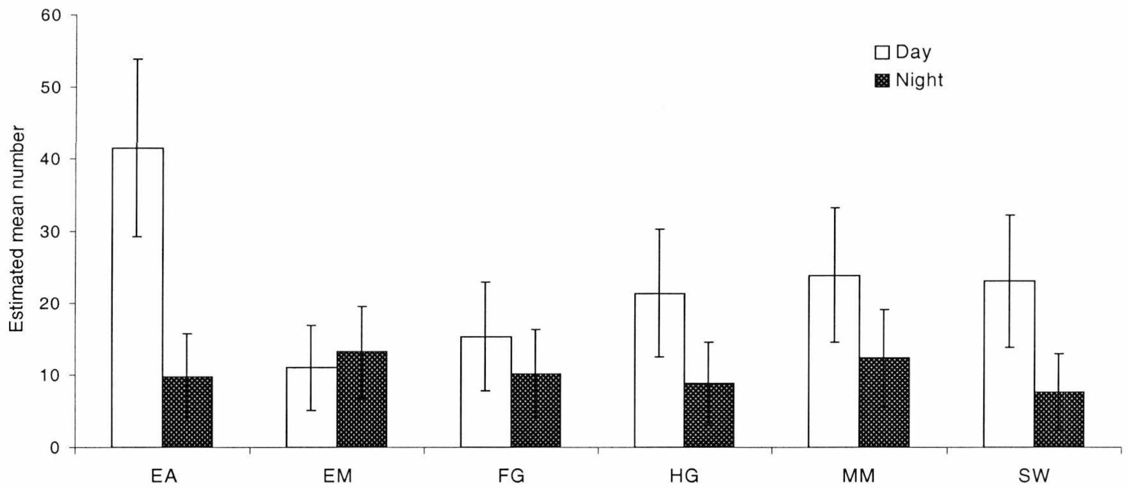

Figure 6.8 Estimated mean ± SE number of rodents caught in each habitat during day and night.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

There was also an interaction (χ^2=13.14, df=5, p<0.05) between the number of rodents caught in each habitat type and time (Figure 6.8). However, there was no interaction (χ^2=12.67, df=15, p>0.05) between the three factors together. The full model explained 75.5% of the deviance and showed that there was an interaction between species and time (χ^2=179.6, df=3, P<0.001), and an interaction between species and habitat (χ^2=79.3, df=15, P<0.001). The predicted mean proportional estimates of rodent abundance are shown separately for day (Figure 6.9) and night (Figure 6.10), based on the full model.

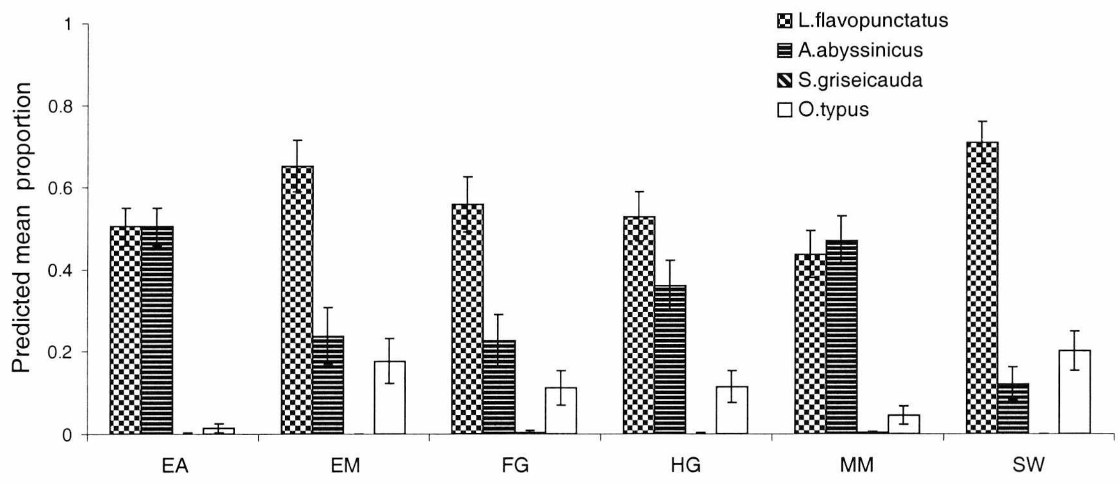

Figure 6.9 Predicted mean ± SE proportion between habitat and species during the day.

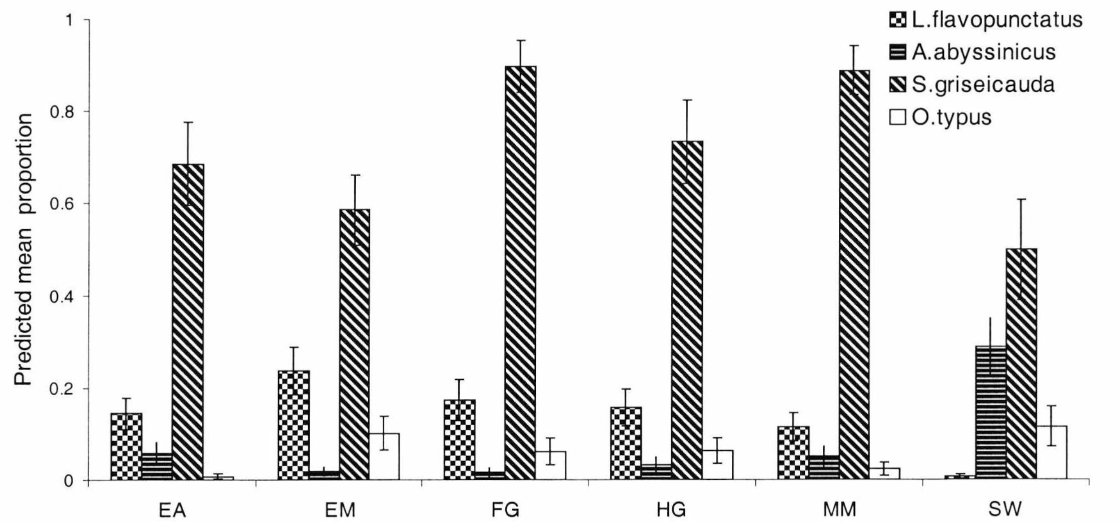

Figure 6.10 Predicted mean ± SE proportion between habitat and species during the night.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

In *Euryops-Alchemilla* shrubland, the model predicted more *L. flavopunctatus* and *A. abyssinicus* and few *O. typus* during the day (Figure 6.9), but more *S. griseicauda* at night (Figure 6.10). In *Erica* moorland, the model predicted *L. flavopunctatus* as the most common diurnal rodent followed by *A. abyssinicus*, but more *O. typus* on *Erica* moorland than on *Euryops-Alchemilla* shrubland (Figure 6.9). During the night, the model predicted more *S. griseicauda* than all other species in *Erica* moorland (Figure 6.10). The model predicted fewer *A. abyssinicus* during both day and night in *Erica* moorland than in *Euryops-Alchemilla* shrubland (Figures 6.9 and 6.10).

In *Festuca* grassland, the model also predicted that *L. flavopunctatus* was the most common diurnal rodent, while *O. typus* was least common. The model predicted similar proportions of *L. flavopunctatus* and *O. typus* in *Helichrysum-Festuca* grassland and in *Festuca* grassland, but *A. abyssinicus* was more abundant in *Helichrysum-Festuca* grassland (Figure 6.9). At night, the model predicted a higher abundance of *S. griseicauda* in all habitats, except for swamp grassland where it was least abundant (Figure 6.10).

The model predicted a similar abundance of *L. flavopunctatus* and *A. abyssinicus* in Mima mounds during the day, but a higher abundance of *L. flavopunctatus* and very few *A. abyssinicus* in swamp grassland during the day. However, relatively more *O. typus* occurred in swamp grassland than the other habitat types during the day (Figure 6.9). At night, in the Swap grassland the model predicted higher abundance of *A. abyssinicus* than the rest habitat types and lower abundance of *S. griseicauda* than the rest habitat types (Figure 6.10).

6.3.2 Population Estimates for the Rodent Community

Live trapping of marked individuals showed that population estimates for the three diurnal species of rodent (*L. flavopunctatus A. abyssinicus* and *O. typus*) varied widely over months and years across the three main habitat types of *Euryops-Alchemilla* shrubland, *Festuca* grassland and Mima mounds (Figures 6.11, 6.12 and 6.13).

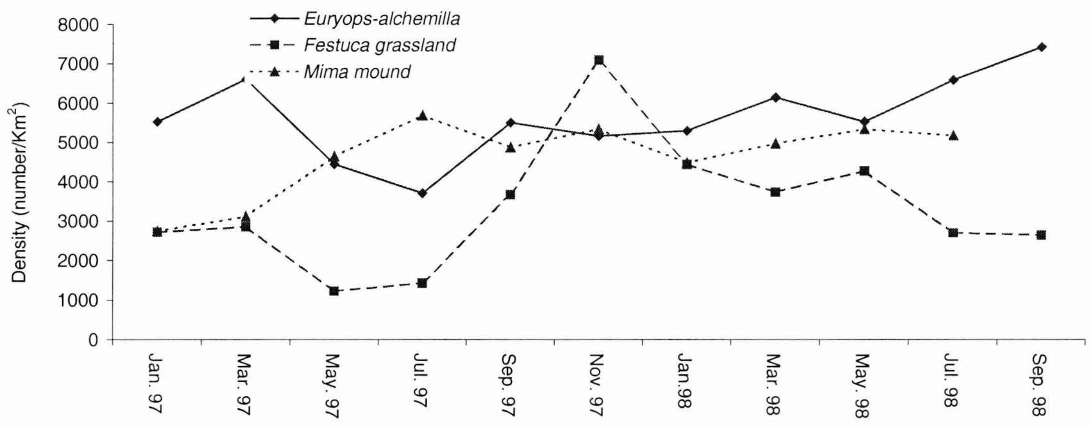

Figure 6.11 Population density estimates of *L. flavopunctatus* in three different habitats, over all months and years of the study.

Based on the data from Figure 6.11, the overall mean density of *L. flavopunctatus* across all months and years was found to be 5632±86.8 individuals/km^2 in *Euryops-Alchemilla* shrubland, 3343±134.5 individuals/km^2 in *Festuca* grassland, and 4637±97.0 individuals/km^2 in Mima mounds.

Based on the data from Figure 6.12, the overall mean density of *A. abyssinicus* across all months and years was found to be 5548±274.0 individuals/km^2 in *Euryops-Alchemilla* shrubland, 2876±339.1 individuals/km^2 in *Festuca* grassland, and 1647±90.4 individuals/km^2 in Mima mounds.

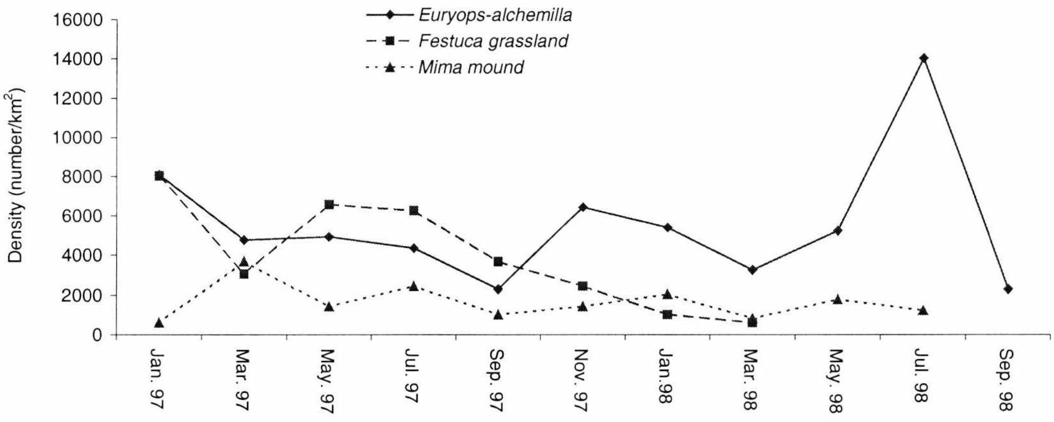

Figure 6.12 Population density estimates of *A. abyssinicus* in three different habitats over all months and years of the study.

Based on data from Figure 6.12, the overall mean density of *O. typus* was found to be 984±56.7 individuals/km^2 in *Euryops-Alchemilla*, 1512±97.0 individuals/km^2 in *Festuca* grassland, and 771±64.3 individuals/km^2 in Mima mounds.

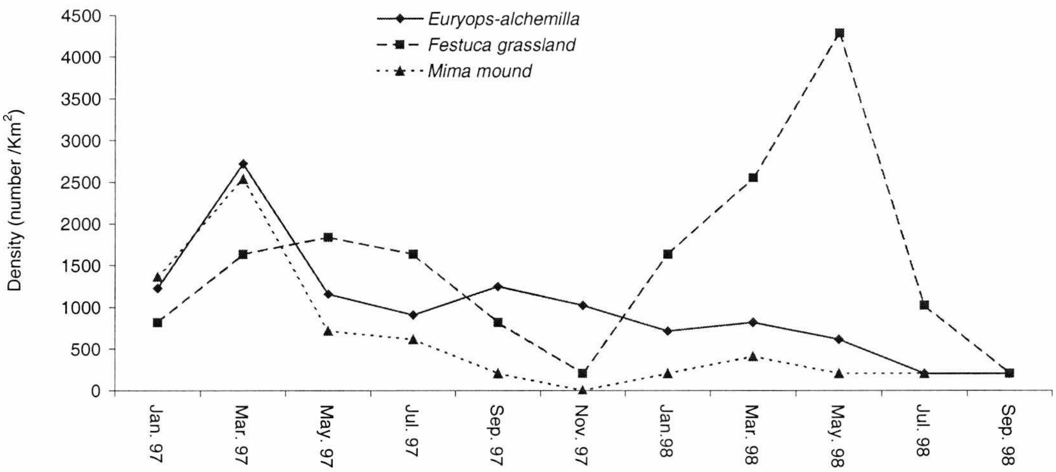

Figure 6.13 Population density estimates of *O. typus* in three different habitats over all months and years of the study.

Table 6.1 Correlation matrix between population density estimates of rodents in relation to estimates of other diurnal species occurring in the same habitat.

Species and Habitat	*A. abyssinicus* EA	*L. flavopunctatus* EA	*O. typus* EA	*A. abyssinicus* FG	*L. flavopunctatus* FG	*O. typus* FG	*A. abyssinicus* MM	*L. flavopunctatus* MM	*O. typus* MM
A. abyssinicus EA	1.0								
L. flavopunctatus EA	0.2	1.0.							
O. typus EA	-0.3	-0.3	1.0						
A. abyssinicus FG				1.0					
L. flavopunctatus FG				-0.5	1.0				
O. typus FG				-0.2	-0.1	1.0			
A.abyssinicus MM							1.0		
L. flavopunctatus MM							-0.1	1.0	
O. typus MM							0.6	-0.8**	1.0

Level of significance, shown with ** = p<0.01.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; and, SW=Swamp grassland.

A correlation matrix of the mean population estimates (Table 6.1) showed that there is a significant negative association (r=-0.8, p<0.01) between *L. flavopunctatus* and *O. typus* in Mima mound habitat. Further, non-statistically significant, positive and negative associations were observed between *A. abyssinicus* and *O. typus* in Mima mound habitat, and between *A. abyssinicus* and both *L. flavopunctatus* and *O. typus* in *Festuca* grassland habitat. In *Euryops- Alchemilla* shrubland, both *A. abyssinicus* and *L. flavopunctatus* showed a non-significant negative associations with *O. typus* (Table 6.1).

Based on the mean body weights of the three species of rodents (*A. abyssinicus* = 103gm, *L. flavopunctatus* = 69gm and *O. typus* = 143gm) and the mean density of each species in different habitats (see data in Figures 6.11, 6.12, 6.13), the mean biomass per km^2 showed wide differences between species and habitats (Figure 6.14).

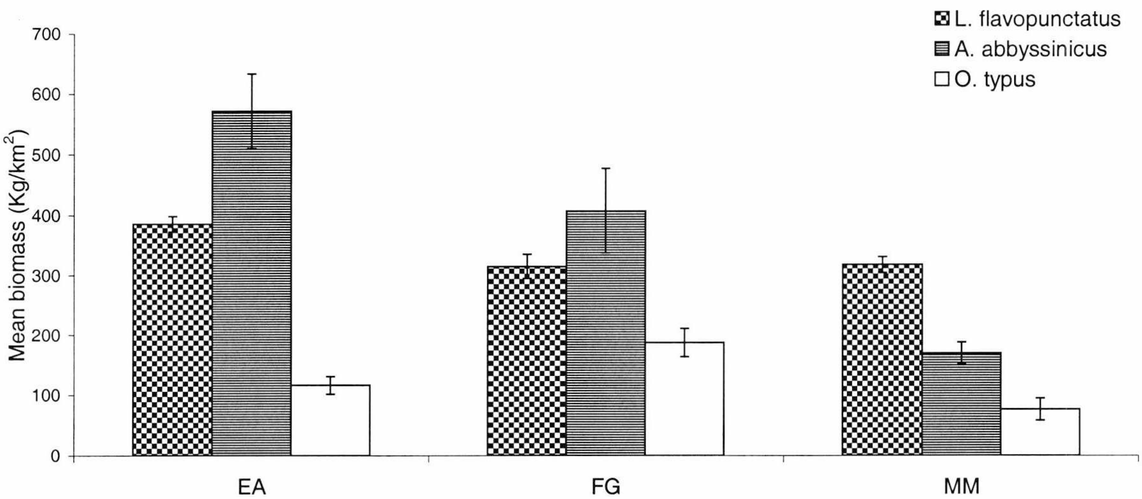

Figure 6.14 Mean ± SE biomass of the three diurnal rodents in the three main habitats.
Habitat key: EA=*Euryops-Alchemilla* shrubland ; FG=*Festuca* grassland; MM=Mima mound

No correlation (r^2=0.12, p>0.05) was observed between rainfall and total rodent biomass. Similarly no correlation was observed when the amount of rainfall was lagged one month (r^2=0.14, p>0.05) or when average rainfall was taken for two consecutive months (r^2=0.19, p>0.05).

6.3.3 Survival Estimate from Marked Animals

The best-fit models for the survival probabilities of the three diurnal rodent species showed considerable differences in the three main habitat types (Table 6.2), and this will be discussed for each species separately.

Table 6.2 Best-fit models for survival estimates of the three diurnal rodents in the three habitat types.

Species	Habitat	Model	AICc	Weight AIC	Deviance
L. flavopunctatus	*Euryops-Alchemilla*	Phi( ) P( )	512.74	0.99	246.68
	Festuca grassland	Phi( ) P(t)	277.35	0.83	131.82
	Mima mound	Phi( ) P( )	366.70	0.99	189.79
A. abyssincus	*Euryops-Alchemilla*	Phi( ) P( )	335.23	0.95	141.12
	Festuca grassland	Phi(t) P(t)	229.11	0.98	53.96
	Mima mound	Phi( ) P( )	92.72	0.99	35.42.
O. typus	*Euryops-Alchemilla*	Phi(t) P(t)	231.91	0.94	53.96
	Festuca grassland	Phi( ) P( )	74.14	0.99	41.47
	Mima mound	Phi( ) P( )	53.32	1.00	32.60

Models used indicated by Phi ( ) = no change in survival, P ( ) no change in recapture, Phi (t) change in survival over time, P (t)= change in recapture over time.

6.3.3.1 Survival of *L. flavopunctatus*

The best-fit model for *L. flavopunctatus* in *Euryops-Alchemilla* shrubland was the one with no change in survival rate or in recapture rate over time (Table 6.2). Its survival probability was very high (>0.9) and its recapture probability was high (0.7) in *Euryops-Alchemilla* shrubland (Table 6.3).

Table 6.3 Probability of survival and probability of recapture for *L. flavopunctatus* in the three main habitats.

	Euryops-Alchemilla		*Festuca* grassland		Mima Mound	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE
Phi( )	0.97	0.003	0.96	0.001	0.97	0.004
p(.)	0.69	0.341	0.28	0.243	0.68	0.041

The best-fit model for *L. flavopunctatus* in *Festuca* grassland was the one with no change in survival rate over time but with a change in recapture rate (Table 6.2). Its survival probability was very high (>0.9), but its recapture probability was very low (0.3) in *Festuca* grassland (Table 6.3).

The best-fit model for *L. flavopunctatus* in the Mima mound habitat was the one with no change in survival rate or in recapture rate over time (Table 6.2). Its survival probability was very high (>0.9) and recapture probability was also high (0.7) in the Mima mound habitat (Table 6.3).

6.3.3.2 Survival of *A. abyssinicus*

The best-fit model for *A. abyssinicus* in *Euryops-Alchemilla* shrubland was the one with no change in survival rate or in recapture probability over time (Table 6.2). Its survival probability was very high (>0.9) and the probability of recapture was low (0.5) in the *Europs-alchemilla* shrubland (Table 6.4).

Table 6.4 The probability of survival and probability of recapture of *A. abyssinicus* in the three main habitats.

	Euryops-Alchemilla		*Festuca* grassland		Mima Mound	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE
Phi( )	0.97	0.007	0.0	0.0	0.87	0.026
p(.)	0.50	0.056	0.0	0.0	0.57	0.156

The best-fit model for *A. abyssinicus* in *Festuca* grassland was the one with a change in survival and a change in recapture probability over time (Table 6.2). Hence, its survival probability in *Festuca* grassland declined over time to 0 at the end, and its recapture probability was also very low (0).

The best-fit model for *A. abyssinicus* in the Mima mound habitat was the one with no change in survival rate or in recapture over time (Table 6.2). Its survival probability was very high (0.9) and its probability of recapture was high (0.6) in the Mima mound habitat (Table 6.4).

6.3.3.3 Survival of *O. typus*

The best-fit model for *O. typus* in *Euryops-Alchemilla* shrubland was the one with a change in survival rate and in recapture rate over time (Table 6.2). Its survival probability and recapture probability showed marked change over time and the probability had fallen to 0 at the end of the study (Table 6.5).

Table 6.5 Probability of survival and probability of recapture for *O. typus* in the three main habitats.

	Euryops-Alchemilla		*Festuca* grassland		Mima Mound	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE
Phi( )	0.0	0.0	0.94	0.023	0.93	0.023
p(.)	0.0	0.0	0.23	0.094	0.53	0.151

The best-fit model for *O. typus* in *Festuca* grassland was the one with no change in survival rate or in recapture rate (Table 6.2). Its survival probability was very high (0.9), but the probability of recapture was very low (0.2) in *Festuca* grassland (Table 6.5).

The best fit model for *O. typus* in Mima mound was the one with no change in survival rate or in recapture rate over time (Table 6.2). Its survival probability was very high (0.9) and the probability of recapture was low (0.5) for *O. typus* in the Mima mound habitat (Table 6.5).

6.3.4 Reproductive Patterns

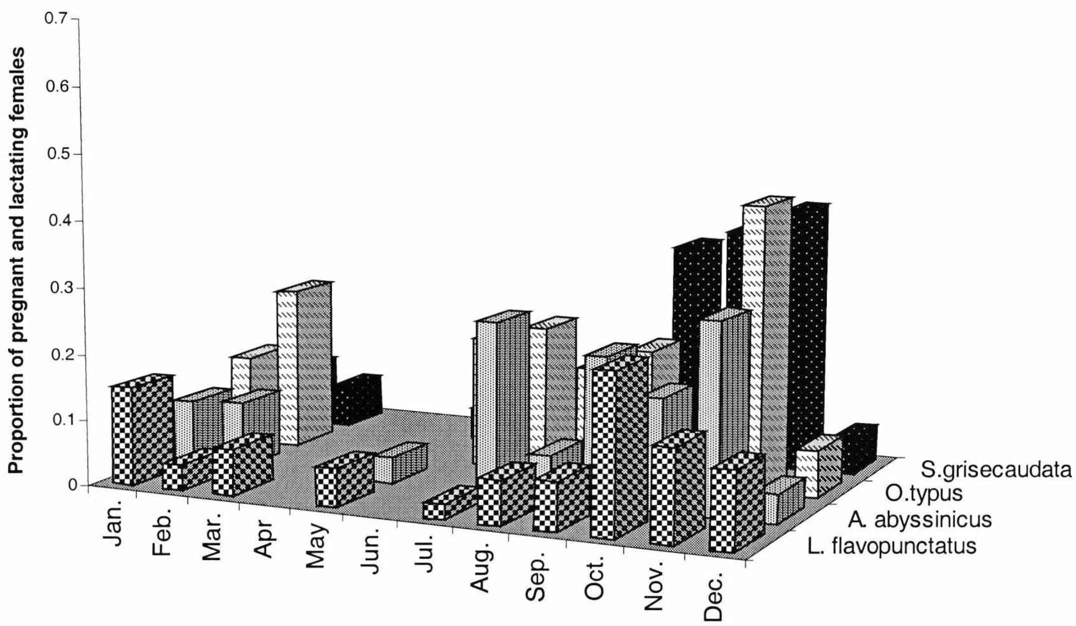

Figure 6.15 Proportion of lactating and pregnant female rodents caught.

A high proportion of pregnant and lactating female rodents were observed for most species between the months of July and December (Figure 6.15). There was a difference in the number of pregnant and lactating females observed in different months for all species: *L. flavopunctatus* (χ^2= 30.5, df=11 p<0.001); *A. abyssinicus* (χ^2=59.33, df=11, p<0.001); *S. griseicauda* (χ^2=28.57, df=11, P<0.001); except for *O. typus* (χ^2=15.0, df=11, p>0.05). No correlation was observed between rainfall and the number of pregnant and lactating females for any species. However, when the previous month's rainfall was compared with the number of pregnant and lactating females, there was a significant relationship for *A. abyssinicus* only (r^2=0.6, P<0.05). However, when average rainfall of two months was taken no significant correlations were observed for any species.

6.4 Discussion

This is the first study of rodents in the Central Highlands of Ethiopia and it has shown that there are four species of *Murinae* rodents, of which two (*A. abyssinicus* and *S. grisecauda*) are endemic to the Ethiopian highlands. *S. grisecauda* has been recorded in the mountain blocks of the North-western Highlands of the Simen Mountains and South-eastern Highlands of the Bale Mountains. *A. abyssinicus* has not been recorded in the Bale Mountains, but is only known to occur in the North-western Highlands. Rodent species diversity is not as high as in other mountain blocks in the country (Yalden *et al.*, 1976, Hillman, 1993; Yalden *et al.*, 1996). Clear patterns of abundance, habitat use and survival have been established for each species.

6.4.1 Habitat Preference and Activity Pattern of the Rodent Community

Habitat preference is one of the most important factors influencing species co-existence (Pimm, 1991). Habitat selection may have evolved as a result of past competitive effects, but only weak inter-specific competition may now be necessary to maintain habitat selection. Therefore, the coexistence of species may be explained by considering resources availability and by considering the ways in which a species utilises habitat and interacts with other species (Schoener, 1983a).

Snap trapping and live trapping caught four *Murinae* rodent species, characteristic of Afro-alpine moorlands in Ethiopia (Yalden *et al.*, 1976; Yalden and Largen, 1992, Sillero-Zubiri *et al.*, 1995). More *L. flavopunctatus, A. abyssinicus,* and *S. grisecauda* were caught than *O. typus*, but all four rodent species were caught in the six habitat types found in Guassa. There was no difference in the number of rodent species caught in each habitat type, but there was a difference in the total number of each species caught in different habitat types. *L. flavopunctatus* was abundant in all six-habitat types, but it was most abundant in Swamp grassland and *Erica* moorland. *A. abyssinicus* was most abundant in *Euryops-Alchemilla* shrubland and Mima mound habitats, while it was least abundant in Swamp grassland. *S. grisecauda* was abundant in all habitat types, but its abundance was highest in *Festuca* grassland and Mima mound habitats. *O.typus* was most abundant in Swamp grassland and *Erica* moorland (Figures 6.9, 6.10).

Most rodents in Afro-alpine habitat show a diurnal activity pattern. Among eight species studied in the Bale Mountains, only three of them were nocturnal (Yalden, 1988; Sillero-Zubiri *et al.,* 1995a). The extreme low temperatures experienced at night at high altitude could impose limitations on the activity patterns of rodents, which also differed in Guassa area. *L. falvopunctatus*, *A. abyssinicus* and *O. typus* were predominantly diurnal species (Figure 6.4, 6.7 and 6.9), although the proportions of *L. falvopunctatus* and *A. abyssinicus* caught at night was slightly higher than *O. typus*. In contrast, *S. grisecauda* is strictly a nocturnal species (Figures 6.5, 6.7 and 6.10).

Some rodent communities, including those of Afro-alpine habitats are adapted to extreme temperatures by burrowing underground. Different habitat types may also be associated with varying thermoregulatory functions. Hence, there was more pronounced activity of *L. flavopunctatus, A. abyssinicus* and *O. typus* at night in *Erica* moorland and Swamp grasslands, both of which have dense and tall vegetation (up to 50cm). In contrast, *S. grisecauda* has a larger body size and is active by night, and is fairly abundant in all habitat types except for Swamp grassland. The thermoregulatory adaptation of *S. grisecauda* could be achieved by lowering its metabolic rate. As well as environmental constraints, competition and predation may be important in determining the structure of the rodent community. The diet of these species is poorly studied, but from general observations they are predominantly herbivores. However, *L. flavopunctatus* also takes a small proportion of invertebrates (Kingdon, 1974; Yalden, 1988). Issues of predation will be covered later in Chapter 7 and 8.

6.4.2 Population Estimates of the Rodent Community

Density estimates of the three common diurnal species in the three main habitats fluctuated over time. The densities of *L. flavopunctatus* and *A. abyssinicus* were higher in *Euryops-Alchemilla* shrubland than in the other habitat types, while their densities were lowest in Mima mound and *Festuca* grassland, respectively. However, a marked difference was observed between the two species in the Mima mounds, where the densities of *L. flavopunctatus* was higher than of *A. abyssinicus* (Figure 6.11 and 6.12). The density of *O. typus* was low in all habitat types compared to the other two species (Figure 6.13). However, the density of *O. typus* in the *Festuca* grassland was relatively higher, the habitat least preferred by the other two species. Overall, the density of rodents was highest in *Euryops-Alchemilla* shrubland, followed by *Festuca* grassland, and lowest in Mima mounds. The biomass of rodents followed similar pattern to density (Figure 6.14).

The similar abundance of *L. flavopunctatus* and *A. abyssinicus* in the *Euryops-Alchemilla* shrubland may be explained through the partitioning of resources in the same habitat type. Both are herbivorous species, but of two other similar species occurring at similar densities in the Bale Mountains, one was noted to feed on monocotyledons and the other to feed on some dicotyledons and invertebrates (Yalden, 1988).

Both *L. flavopunctatus* and *A. abyssinicus* are major food items for the Ethiopian wolf. Living together can also decrease predation, either when the predator is confused by large numbers of prey or even if some individuals are taken there is still a better chance of survival through in the safety in numbers (Krebs, 1994).

6.4.3 Survival Estimates of the Rodent Community

The probability of survival of any species may vary with individual characteristics such as age, sex, body weight, genotype or phenotype, and also it is a function of biotic and abiotic environmental variables. Intra-specific and inter-specific competition and predation can also affect the probability of survival (Krebs, 1994).

L. flavopunctatus showed a high probability of survival and recapture in all the three habitat types, with no change in survival and recapture over time (Table 6.2). *L. flavopunctatus* is the most abundant species in the Guassa area and seems to favour long vegetation cover (Figure 6.9).

A. abyssinicus showed a high probability of survival in *Europs-Alchemilla* and Mima mound habitats. However, in *Festuca* grassland there was a change in the probability of survival and recapture over time (Table 6.2). This change could be due to the habitat type, given that *A. abyssinicus* is least abundant in *Festuca* grassland. Where the grass is long, *A. abyssinicus* abundance decreases. Thus, *A. abyssinicus* is found in dry localities with short grass cover in the Simen Mountains (Güttinger *et al.*, 1998), and feeds on a variety of grass species but they prefer to feed on herbaceous vegetation (Kingdon, 1974). Hence, the coarse *Festuca* grass will not be the best choice for the species. Furthermore, when the numbers of *Otomys* are high, the abundance of *Arvicanthis* declines (Kingdon, 1974), as also shown by the negative associations of *O. typus* and *A. abyssinicus* in two habitat types in Guassa (Table 6.1).

No change in survival of *O. typus* in *Festuca* grassland and Mima mound habitat was observed. However, a change in survival rate and recapture over time has been observed in the *Euryops-Alchemilla* shrubland (Table 6.2). *O. typus* is a species which prefers a humid locality (Güttinger *et al.*, 1998). In the Guassa it has also been shown that the species is most abundant in Swamp grassland and *Erica* moorland habitat and is lest abundant in *Euryops-Alchemilla* shrubland (Figures 6.9, 6.10).

6.4.4 Reproductive Patterns of Rodent Community

Most of the rodent species in the Guassa area showed very little reproductive seasonality. There was a marked absence of pregnant or lactating females in April and June for most of the species except *O. typus*, which was recorded breeding throughout the year. *Otomys* is also known to breed throughout the year in other parts of Africa and to have a very low reproductive rate, with one or two litters at a time (Kingdon, 1974). Hence, their low reproductive rate may be balanced by a non-seasonal breeding pattern. *L. flavopunctatus* showed signs of breeding in all months except April and

June, but showed a peak of breeding from July to January in the Guassa area (Figure 6.15).

The Afro-alpine rodent community in the Bale Mountains also showed a seasonal pattern of reproduction, the reproductive season starting in the early wet season and ending in early dry season (Sillero-Zubiri, *et al.*, 1995a). In the tropics where rainfall is seasonal, many rodent species show a seasonal pattern with a reproductive peak at the end of the rainy season (Kingdon, 1974). In the Simen Mountains, reproductive seasonality occurs in *L. flavopunctatus*, with breeding peaks during and just after the rainy season, and no reproduction in the dry season (Güttinger *et al.*, 1998).

In the year when this trapping exercise took place, there was exceptionally heavy rainfall, which lasted up to mid-November. For example, the amount of rainfall in October (420.1mm) and November (280.9mm) 1997 was much higher than the 36mm and 10.5mm of rain recorded in the same months in 1998. This heavy rainfall at the beginning of the dry season may have triggered reproduction among seasonal breeding rodents. For example, increased amounts of rainfall due to the effect of an *El Niño*-Southern Oscillation caused a delay in the operation of density-dependant factors and resulted in rodent outbreaks in Chinchillas National Reserve in Chile (Lima *et al.*, 1999).

Having established some of the basic ecological parameters of the rodent community in the Guassa area, and given the extensive value placed on the area by people collecting resources (Chapter 5), in the following chapter I will look at the human community resource off-take and its effect on the rodent community of the Guassa area.

Chapter Seven

7 Extent of Human Use and Effects on the Rodent Community

7.1 Introduction

Most landscapes in the Ethiopian highlands have been influenced by farming, grazing, firewood collection, and grass cutting. Over the years, these traditional practises have created a mosaic of different habitats arranged in intricate patterns at different spatial scales that are likely to have an effect on the associated animal communities. Nevertheless, the study of small mammal assemblages in the Ethiopian highlands has mostly concentrated on distributions associated with geographical features like altitude (Yalden, 1988; Yalden & Largen, 1992). Indeed, most studies of African small mammal communities have concentrated in general on factors influencing population dynamics in relation to abiotic factors such as rainfall and the resulting density-dependant and density-independent population processes (Liers *et al.*, 1997). However, several rodent studies in Africa have reported correlations between the distribution of rodents and habitat variables like ground cover (Happold and Happold, 1987; Kerley, 1992; Monadjem, 1997). Equally, little research has been conducted on the effects of human use on the habitats of the rodent community (Delany and Happold, 1979; Kessing, 1998), despite the importance of human activity on the distribution and survival of rodent species, that in turn will affect their main predators.

Studies investigating rodent population dynamics elsewhere in Africa have shown the effect of various human use patterns on abundance and composition of the small mammal fauna (Delany and Happold, 1979; Stephenson, 1993). The effects of habitat change will differ between species (Beatly, 1976; Emmons, 1984; Phal *et al.,* 1988). The first species to disappear are usually those that are least abundant within the community, or those that specialise on particular vegetation types (Terborgh and Winter, 1980; Emmons, 1984). It has been documented that species favouring dense vegetation may even increase following disturbance (Jeffery, 1977; Kasenene 1984, Happold and Happold, 1987). Vulnerability to disturbance depends on factors like body size (Burbidge and Mckenzie, 1989; Bennet, 1990) and the position of a species on the r-K continuum of the life history strategies (Laurance, 1991). Some species seem to benefit from the microhabitat heterogeneity created by human use (Kessing, 1998).

Having determined in previous chapters the main uses to which humans put the Guassa area (Chapter 5) and the basic ecology of the rodent community (Chapter 6), this chapter has the specific aim of determining actual levels of human use of key Guassa vegetation communities and how this affects the abundance of rodents. A sound understanding of the extent and effects of human use are a prime importance for understanding distribution of the dependent predator population (Chapter 8). Hence, in this chapter I examine all the following questions:

- What is the extent of different types of human use comprising grass cutting firewood collection and grazing; and,
- its effect on the rodent community of the Guassa area of Menz.

7.2 Materials and Methods

7.2.1 Extent of Human Use

7.2.1.1 Data Collection

Resource off-take as a result of grass cutting and firewood collection was estimated using an instantaneous scan sampling method, as described by Altmann (1974) and Dunbar (1978). The following were recorded: the time a grass cutter or firewood collector started and stopped the activity; the type of habitat where the collection took place; the method used to collect the resource; and, the mode of transport used. Once collection had been completed, collectors were asked if they were willing to allow their bundle of grass or firewood to be weighed. If they granted permission, weight was measured to the nearest kg using a Salter 50kg spring-balance. When the weight was greater than 50kg, the sample was divided into separate parts which were individually weighed and summed. The patch used to collect that particular bundle was measured with a tape to estimate the area of the collection patch.

7.2.1.2 Data Analysis

A least-squares regression analysis was used to explore the relationship between the wet weight of resource, wheather grass or firewood, collected on each harvesting trip and the area of the patch. From the relationship the resulting prediction model was used to estimate total off-take by the user community and the total amount of resource available in a particular habitat type. A total area of 25.9 km^2 was available for cutting Guassa grass and of 46.9 km^2 of small shrubs was available for firewood collection. The mean annual densities of grass cutters and firewood collectors were obtained from line transect data analysis (seeChapter 5). The frequency of firewood collection for each household and total number of households using the Guassa area as a source of firewood were obtained from interview results (see Chapter 5).

The biomass of livestock in the Guassa area was calculated from the line transect data, which provided livestock density and population estimates for different types of livestock (see Chapter 5). The livestock biomass was later converted into Tropical Livestock Units (TLU). One TLU = 250kg, which is equivalent to one ox or one breeding cow, or 0.1 TLU = sheep or goats, or 0.5 TLU = donkeys (Le Houérou and Hoste, 1977; ILCA, 1991).

The relationships derived by Coe *et al.* (1976) for the density of African herbivores and Le Houérou and Hoste (1977) for livestock density in the Sahelo-Sudanian Zone, were used to determine whether or not the Guassa area might be overstocked. Stocking density was estimated by comparing the ratio of actual (observed) livestock biomass density to the expected livestock biomass density on the basis of mean annual rainfall (A/T). The expected livestock biomass density was estimated from the relationships established by Coe *et al.* (1976) and Le Houérou and Hoste (1977) between herbivore biomass density and rainfall. An A/T ratio of >1.0 indicates potential overstocking (Homewood and Rodgers, 1991).

7.2.2 Effects of Human Use on the Rodent Community

7.2.2.1 Data Collection

A snap-trapping exercise was conducted to assess the effect of different types of human use on the rodent community. Only the effects of the three main types of human use namely: grass cutting; firewood collection; and, livestock grazing were investigated (see Chapter 5). A paired sampling design was adopted in which: an area where grass cutting had taken place was compared with uncut area; an area where firewood collection had taken place was compared with uncollected area; and, a grazed area was compared with an ungrazed area. Furthermore, sampling was conducted only in the habitat where most use takes place. Therefore, the effect of grass cutting was assessed by selecting a predominantly *Festuca* grassland that had been cut and remained uncut. The effect of firewood collection was assessed by selecting areas of a predominantly *Euryops-Alchemilla* shrubland that had been used and unused for firewood collection. Similarly, the effect of grazing was assessed by selecting a grazed and ungrazed area of predominantly a Mima mound.

Snap traps were set in a 5x6 grid of 30 traps with 10m spacing between each trap. Traps were baited using a mixture of peanut butter and barley flour. Traps were pre-baited for one day, trapping started the following day and continued for two consecutive days and nights in each trapping session in both dry and wet seasons. Three wet season trappings starting from July 1998 to September 1998, and another three dry season trappings starting from November 1998 to January 1999, were conducted for each used and unused habitat type. Traps were checked in the morning (0600hr) and in the evening (1800hr) local time. Data on the species caught, their sex, age (adult, sub-adult and juvenile) and, weight were collected.

7.2.2.2.Data Analysis

All data were analysed using generalised linear models (GLM). First, I analysed the total number of rodents caught in the six trapping session, independent of species, using a GLM with a Poisson error structure with season (dry and wet) as a co-variant (Crawley, 1993). The two independent terms of habitat (a variable with three categories) and of treatment (a variable with two categories), and their interaction, were fitted. Terms then were dropped from the full model and their significance was assessed by examining the resulting change in deviance. The change in deviance through dropping terms from a GLM with a Poisson error structure approximates to a Chi-square distribution, the significance of which was assessed by comparing the change in deviance with the critical value of the Chi-squire distribution with the appropriate degrees of freedom. Dropped terms were reinstated into the model if their removal led to a significant decrease in the regression analysis. If the ratio of residual degrees of freedom to residual deviance was greater than two, the data were considered as over-dispersed (Crawley, 1993) and the scale parameter was calculated.

Second, I analysed the proportion of rodents of each species caught in each habitat and for each treatment, using a GLM with a binomial error structure. The response variate was the number of each species caught in each replicate, and the binomial denominator was the total number of rodents caught in that replicate. Three independent terms and their interactions were fitted, comprising: species (a variable with four categories), habitat (a variable with three categories) and treatment (a variable with two categories). Again if the data were over-dispersed, the scale parameter was estimated.

7.3 Results

7.3.1 Extent of Human Use

There was a strong positive relationship (r^2=0.71, $F_{1,25}$=61.55, p<0.001) between the wet weight of grass cut and the area from which the grass was collected, (Figure 7.1). The mean weight of grass collected was found to be 42.9 $\pm$ 4.4 kg per cutter (n=27) during the study time. The mean density of grass cutters seen in the Guassa area was 1.8 $\pm$ 0.4 people/km^2 (see Chapter 5). This gives a total of 176.4 grass cutters for the entire Guassa area during any census period. Making the extreme assumption that this number of people cut of grass every day, the total number of cutters will be 21549 people/year. Based on the equation derived from the regression analysis (Figure 7.1), the predicted annual off-take was estimated to be 924.5 tonne of wet grass biomass per year. Likewise, based on the total area of Guassa grass habitat, and the equation derived from the regression analysis (Figure 7.1) the total standing biomass was estimated to be 24396.6 tonne. Hence, the annual off-take was estimated to be 3.8% of the total standing crop of wet grass biomass.

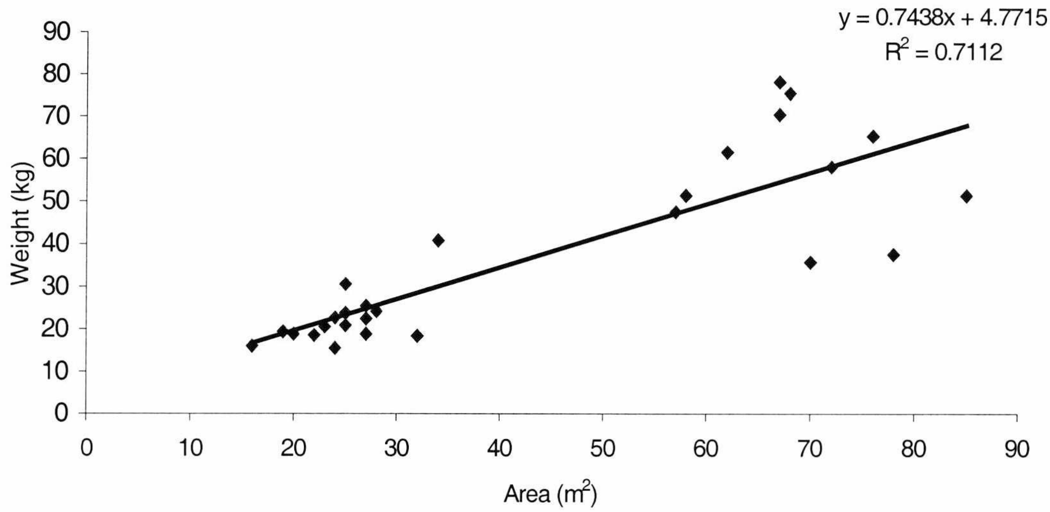

Figure 7.1 Relationship between the weight of grass collected and area used to cut grass.

There was also a strong positive relationship (r^2=0.67, $F_{1,68}$=136.34, P<0.001) between the amount wet weight of firewood collected and the area used for collecting the firewood (Figure 7.2). The mean weight of firewood collected by each collector in each trip of firewood collection was found to be 45.7 ± 2.52kg per collector (n=70). The mean density of firewood collectors seen in the Guassa area was found to be 2.1 ± 0.6 (see Chapter 5). The mean frequency with which each household collected firewood was 3.2 ± 0.09 times per month (n=502). Total number of households collecting firewood from the Guassa area was estimated to be 64.5% of the total households (see Chapter 5), based on this and from the total household count (see Chapter 4) it was estimated that 7459 households collect firewood form the Guassa area. Based on the monthly collection frequency and mean collection weight, the annual off-take rate of firewood was estimated to be 13032.4tonne of wet woody biomass. Likewise, based on the total area available for firewood collection and the equation derived from the regression analysis (Figure 7.2) the total amount of standing woody biomass was estimated to be 39850.5tonne. Hence, total of off-take was found to be 32.7% of the total available wet woody biomass that can be harvested as firewood in the Guassa area.

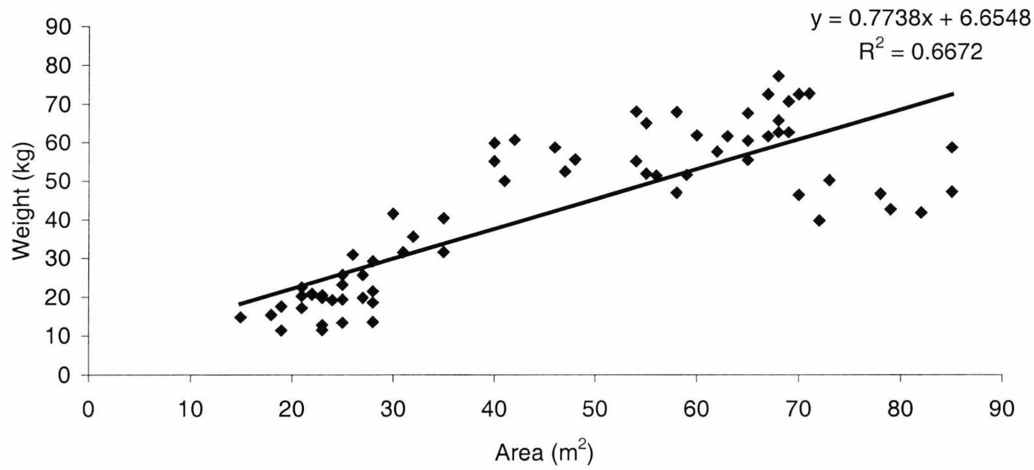

Figure 7.2 Relationship between the weihgt of firewood collected and area used to collect firewood.

Table 7.1 Livestock biomass density in the Guassa area.

Months	Cattle Biomass (kg/km^2)	Sheep Biomass (kg/km^2)	Equine Biomass (kg/km^2)	Total Biomass (kg/km^2)
December – January	1980	214	388	2736
February – March	13960	1309	2936	18206
April – May	19815	2094	3266	25175
June – July	22330	4808	5088	32225
August – September	5065	1629	1617	8311
October – November	1647	1393	662	3703

The highest total livestock biomass density 32225kg/km^2 was observed in the months of June and July, and the lowest livestock biomass density 2736 kg/km^2 was observed during December and January. Based on the six estimates the actual mean biomass density observed for the Guassa area was 15033.7 kg/km^2 (Table 7.1).

For the average annual rainfall of 1540mm/year received in the Guassa area, the Coe *et al.*'s (1976) linear relationship predicts a biomass density of 15848.9kg/km^2, while Le Houérou and Hoste's (1977) linear relationship predicts a biomass density of 15822.5kg/km^2, and their curvilinear relationship predicts a biomass density of 15392.5kg/km^2. The mean predicted biomass density for Guassa area based on these three theoretical biomass densities was 15687.9kg/km^2. Hence the A/T ratio in the Guassa area was found to be 0.96, which is just less than the A/T ratio of >1.0 that indicates potential overstocking (Homewood and Rodgers, 1991). Nevertheless, the dry season A/T ratio is 2.05, when cattle are brought to the Guassa as a refuge (see Chapter 5), while the wet season A/T ratio is 0.17, when cattle are taken to the homesteads.

7.3.2 Effects of Use on the Rodent Community

A total of 643 rodents was caught by snap trapping. The number of rodents caught of each age group did not differ (χ^2=6.08, df=2, p>0.05) between habitats that was used and unused for resource collection. Similarly, the numbers of rodents caught of each sex (χ^2=1.32, df=1, p>0.05), or in each season (χ^2=3.7, df=1, p>0.05) did not differ between used and unused habitats. Therefore, all subsequent analysis considered the total numbers of each species caught, irrespective of age group, sex, or season (Figure 7.3).

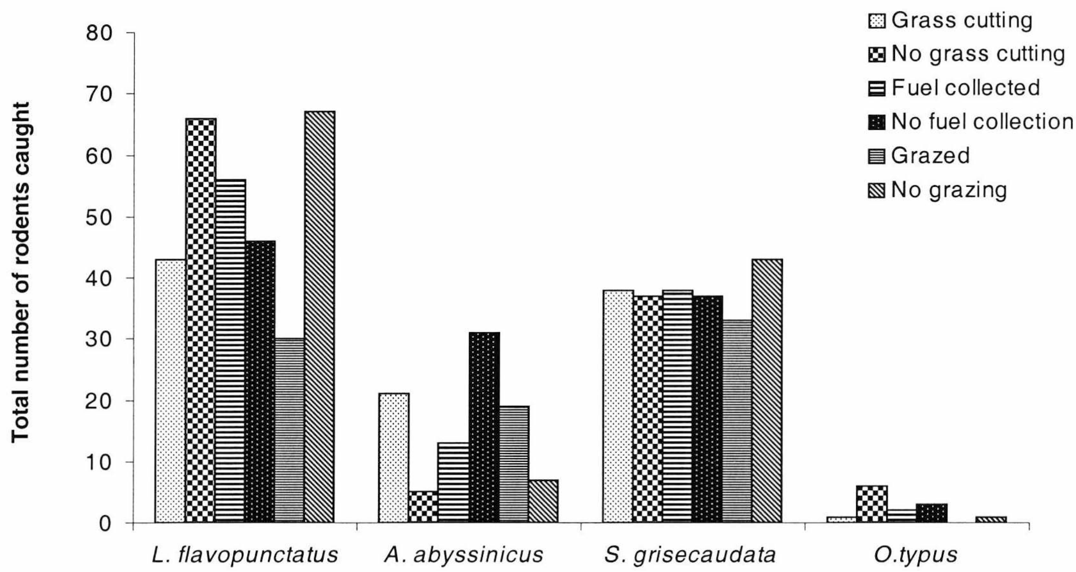

Figure 7.3 Total number of rodents caught in areas of used and unused.

The total number of rodents caught regardless of species did not differ (χ^2= 0.55, df=5, p>0.05) between habitat and treatment. The full model was significant (χ^2=276.9, df=23, p<0.001) and explained 69.8% of the deviance. However, the proportion of each species varied between habitat and treatment. The full model indicated a significant interaction (χ^2=16.4, df=6, p<0.05) between species, habitat and treatment (Figure 7.4). Therefore, each species in the rodent community of the Guassa area responded differently to the different forms of resource use.

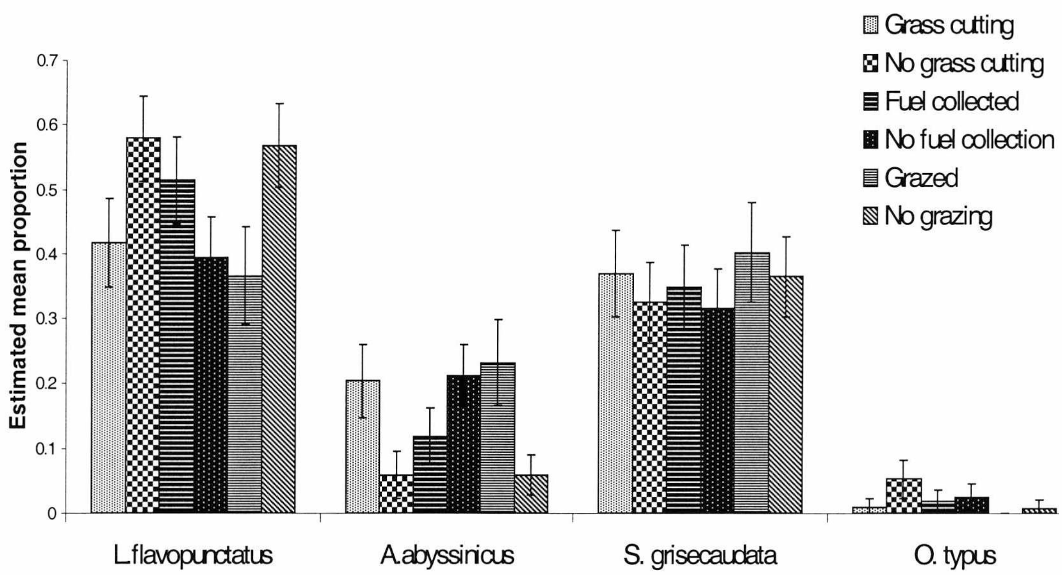

Figure 7.4 Predicted estimates of mean ±SE proportions for each species of rodent caught in used and unused plots.

The model showed that *L. flavopunctatus* responded negatively to grass cutting and grazing, but positively to firewood collection (Figure 7.4). Hence, its abundance was higher where firewood collection had taken place than areas where no firewood had been collected, but its abundance was lower in cut and grazed areas. In contrast, *A. abyssinicus* responded positively to grass cutting and grazing, but negatively to firewood collection. Hence its abundance was higher in cut and grazed areas than in uncut and ungrazed areas, but its abundance was lower in areas where firewood had been collected. In further contrast, *S. griseicauda* did not respond to any form of human use, its abundance was similar for all treatments (Figure 7.4). In yet another contrast, *O. typus* appeared to respond negatively to all forms of human use, although as the least abundant of the four species in the Guassa area, differences were hard to detect (Figure 7.4).

7.4 Discussion

This is the first study of the effects of human use upon habitats occupied by rodents, and the consequent effects upon the relative abundance of the rodent communality, that in turn form important prey to many carnivores. The study has shown clearly that use of the Guassa area is currently relatively light for grass cutting. However, firewood collection appears to remove a large amount of the available standing crop, while livestock stocking densities are high, especially in the dry and early wet season. At the current levels of use, different species in the rodent community have responded differently. In several cases, comparing types of use with different species, there is higher abundance with human use than with out.

7.4.1 Extent of Human Use

Off-take of grass from the Guassa area is estimated to remove only 3.7% of the total standing crop of available grass biomass. At existing off-take rates, it is difficult to conclude that grass cutting is threatening the future of the Guassa area. Equally, estimate was made with the mean number of grass collectors derived from the line transect data (Figure 5.5) and assuming there will be at least 174 people cutting grass every day of the year. Hence, this has probably over-estimated off-take, since the number of people cutting grass varies according to season (Figure 5.5) and to the day of the month. In Menz, 13 days in every month are regarded as Saint's days including Sundays, when no physical work like collecting grass, firewood, and farming, is performed. This will reduce the number of days that are available for collecting grass. However, even including these days as working days, the off-take rate still does not appear to be great.

Off-take of firewood from the Guassa area is estimated to remove 32.7% of the total standing crop of available wet firewood biomass. Although, higher than the off-take of grass, at the current firewood collection rate in the Guassa area, there was no evidence that collection of the shrubby vegetation has resulted in overexploitation, but no evidence is available from this study that production matches off take. However, methods of collection that result in partial or complete clearing of the bushy vegetation, which is an important habitat for rodents, may have a pronounced effect on certain species of rodents (Figure 7.4).

No over-stocking is indicated in the Guassa area when considering the annual mean biomass density of livestock. The A/T ratio of actual livestock biomass density to that expected on the basis of mean rainfall was 0.96:1, which does not show overstocking following Homewood and Rodgers (1991). Much evidence exists for a relationship between mean rainfall and pasture production (Lamprey, 1975; Phillipson, 1975; Cote, *et al.*, 1976; Le Houérou and Hoste 1977; Deshmukh, 1984; Homewood and Rodgers, 1991). Mean rainfall is not the only factor that determines pasture production. However, in tropical and sub-tropical areas, rainfall is correlated with a number of other climatic factors such as rain variability, number of rainy days, length of dry and rainy seasons and potential evapotranspiration. Although the relationship between rainfall and pasture production is satisfactory, it suggests that pasture yields would increase indefinitely as rainfall increases. However, this is not the case, since other limiting factors such as soil condition and fertility, temperature and water logging also affect productivity.

During the rainy season consumable forage of grass and forbs is 70% of the above ground biomass, but this decreases to 30% during the dry season, based on assumption that the wet season lasts on average for 3 months and the dry season for 9 months (dry season = <50mm rainfall/month) (Le Houérou and Hoste, 1977). This suggests that the Guassa area could accommodate more density of livestock, based on the above argument, because there is low evapotranspiration as a result of low temperature and high moisture throughout the year and high solar radiation for most part of the year. Gamachu (1991) described the negative relationship between altitude, evapotranspiration and radiation on Ethiopian mountains, in which evapotranspiration decreases as altitude increases. The Guassa area receives more than 50mm of rainfall at least on 7 months of a year (see Figure 2.4), which indicated more productivity according to Le Houérou and Hoste (1977) and Coe *et al.* (1976). Hence, the Guassa area may support high level of grass and herb productivity throughout the year. Furthermore, the presence of extensive swampy areas may also increase overall productivity of the Guassa area. However, the presence of low night temperatures and frost in some months may considerably offset the expected increase in productivity.

The ability of a given area to support a certain size population of animals on a continuing basis may be altered by both long and short term variation in climate and particularly by precipitation (Phillipson, 1975). However, the broad relationship between biomass and rainfall is just an index of stocking rate rather than a clear management tool (Field and Laws, 1970). Management decisions thus have to depend largely on evidence of vegetation change or on the response of herbivores making use of the area.

7.4.2 Effects of Use on the Rodent Community

In general, human activity can affect rodent populations in three major ways. First, direct alteration of habitat can destroy burrows and increase soil compaction. Changes in soil compaction in turn can result in vegetation changes, the impact of which may be delayed impact for small mammal populations (Mwenedera *et al.*, 1997). Second, loss of cover can increase exposure of small mammals to predators. Studies have shown that a reduction of cover for small mammals can increase predation rates (Birney *et al.*, 1976; Grant *et al.*, 1982). Finally, human use can decrease vegetation biomass, and forage availability. If human use involves sharing food resources, this would be an example of exploitative competition. Competition has been identified through laboratory and field experiments in which the exclusion of one resource user can result in the abundance of another (Schoener, 1983a). Human use as a competitor or as an agent of disturbance in savannah ecosystem can cause local extinction of common small mammal species (Keesing, 1998). In a long-term experimental study in a temperate desert assemblage, removal of a dominant competitor increased the species diversity of the remaining small mammal community (Valone and Brown, 1995).

This study, however, has shown various kinds of relationship between different types of human use and different species of rodent in the Guassa area of Menz. It was found that the total number of rodents, regardless of species, did not vary between habitat and use type, suggesting that human use does not affect the total rodent biomass found in the Guassa area. However, it was found that, the proportion of each species varied between different habitat types and use types (Figure 7.4). The diversity of small mammal species has not been affected between the used and unused areas, except that *O. typus* was absent in areas where grazing had taken place. The demographic factors responsible for fluctuation in the size of small mammal populations in the Guassa area are not known, but the sex and age ratio of each species did not differ between each use type in used and unused habitats. Similar results have been observed in highlands of Kenya, where no demographic changes in survivorship nor any detectable differences in per capita recruitment between grazed and ungrazed land had occurred (Keesing, 1998).

L. flavopunctatus prefers a natural heather bushland or forest with long grass cover and avoids humid conditions (Yalden, 1988, Güttinger *et al.*, 1996). In the Guassa area also *L. flavopunctatus* is the common species on Mima mounds and *Euryops-Alchimella* shrubland, indicating a preference for long vegetation cover. Grass cutting and grazing was found to have a negative effect on the abundance of *L. flavopunctatus*. Therefore, grass removal due to cutting or grazing would be expected to cause a reduction in abundance (Figure 7.4) In contrast, removal of firewood allows a better undergrowth of herbs and forbs that are an important source of food resulting in increased abundance of *L. flavopunctatus*. Similar results were observed on the Zomba Plateau, Malawi (Happold and Happold, 1987). *L. flavopunctatus* was more common in young pine plantations than in older plantations and was present only when the plantation was dominated by dense grass and herbs, no longer occurred when the growth of dense grass and herbs was suppressed.

A. abyssinicus generally avoids high altitude long grass and prefers short grass, open areas and drier sites (Güttenger *et al.*, 1996; Kingdon, 1974). In the Guassa area it is also common on *Euryops-Alchemila* and Mima mound habitat types. Grass cutting and grazing were found to have a positive effect on the abundance of *A. abyssinicus. A. abyssinicus* tolerates a certain degree of grazing impact and even inhabits high altitude cultivated fields in the Simen Mountain National Park (Güttenger *et al.*, 1996). The collection of firewood collection probably causes a reduction in the abundance of *A. abyssinicus,* because the mode of collection involved uprooting of the *Euryopes* shrub. In turn this often results in open areas of sometimes a bare ground, which totally alters the habitat for the species and may increase the risk of predation.

O. typus is typically adapted to long grass and humid areas, especially swampy grassland dominated by *Carex* sp. and along water courses and in Guassa its abundance was higher in swamp grassland than other habitat types. Its disappearance from grazed land may be attributed to a decrease in moisture as a result of foliage removal, which decreases infiltration and increases run-off. In other parts of Africa where human activity is high, it has been shown that the abundance of the genus *Otomys* decreases (Monadjem, 1997; Monadjem, 1999). Also, where the grass is more prone to fire, and when there is less secondary herbaceous growth, it has been noted that there is decline of *Otomys* (Kingdon, 1974). *O. typus* are naturally most vulnerable to aerial predators in more exposed vegetation (Kingdon, 1974). Augur buzzards *Buteo rufofuscus* are major predator of *O. typus* and the density of Augur buzzards in the Guassa area is very high. Indeed, *O. typus* remains are common in pellets of birds of prey in the area. *O. typus* is a relatively slow moving rodent, which depends heavily on hearing to escape enemies and on sound communication with conspecifics. Hence its slow movement in exposed habitats may increase the risk of predation, while living in dense vegetation is an effective anti-predator strategy. The low numbers of *O. typus* caught in Guassa makes it hard to draw valid conclusions about the effect of use. However, in areas where grazing had occurred the species was totally absent.

In Central Highlands of Ethiopia, there is an increase in plant diversity following grazing, due to the activity of livestock. Therefore, livestock in free-grazing systems may be an important but less recognised influence on vegetation structure. Nevertheless, the influence of livestock on botanical composition and species richness will depend on stocking rates (Mwenedera *et al.*, 1997). Hence, grazing can have an insignificant effect on vegetation cover, particularly where soil moisture is high and where the slope is low. However, vegetation biomass is reduced significantly as grazing increases from moderate to very heavy (Mwenedera *et al.*, 1997). Where plants cannot compensate sufficiently for the biomass removed by grazing animals, net primary productivity (NNP) of plants consistently declines as the intensity of grazing increases. In some cases plants are able to compensate for boimass removal upto some level, and in such cases grazing enhances NPP (McNaughton, 1983).

Woldu and Mohammed-Saleem (2000) found an increase in annual plants and a decline of perennials following grazing. In areas where livestock grazing occurs, grazing fields are continually seeded by livestock manure. This favours the growth of annuals in the families of *Asteraceae* and *Fabaceae*, which form a very important and nutritious diet for the rodent community (Woldu and Mohammed-Saleem, 2000). The patterns of occurrence of annual and perennial plant species clearly follow the pattern of rainfall. The presence of rainfall for most of the year in the Guassa area has probably encouraged continuous availability of fodder for the rodent community. However, there are various ways that livestock can alter the vegetation. Livestock grazing, results in a reduction of vegetation cover and biomass, and livestock grazing is known to affect pasture land through soil compaction. These effects vary with stocking density, soil type, soil moisture content and the general micro-climatic condition and vegetation type (Wood and Blackburn, 1983). Similarly, infiltration rate and the soil moisture vary over time and space, because of variation in climate, vegetation and intensity and duration of livestock use (McCalla *et al.*, 1984; Mwendera and Mohammed-Saleem, 1997).

The results of this study indicate that there are varying consequences for the abundance of species of small mammal in response to anthropogenic influences. An increase in small mammal abundance due to human use might be beneficial for carnivore and avian predators. However, any increase in small mammal abundance that might result in compensatory consumption of vegetation could have negative consequences on forage quality. Nevertheless, the study has highlighted the importance of modified habitats and their importance in determining abundance of small mammals in a human-dominated landscape. Species that are capable of surviving on the modified habitats will increase, whereas those who cannot tolerate human use will disappear.

These differences are likely to have important consequences for predators such as the Ethiopian wolf, the ecology of which in the Guassa area of Menz is described in the next chapter.

Chapter Eight

8 The Ethiopian Wolf Population in Guassa

8.1 Introduction

The Ethiopian wolf is an endemic species confined to isolated pockets of Afro-alpine grasslands and heathlands of Ethiopia (Morris and Malcolm, 1977; Yalden *et al.*, 1980; Yalden and Largen, 1992; Gotteilli and Sillero-Zubiri, 1992; Sillero-Zubiri 1994; Yalden *et al.,* 1996; Marino *et al.*, 1999). The species is currently confined to altitude above 3000m asl, although, earlier sightings of the species were recorded at lower altitudes below 3000m asl (Yalden *et al.*, 1980). The Ethiopian wolf has become critically endangered as a result of:

- its specialised niche that has resulted in a restricted distribution to Afro-alpine grassland, the area of which have shrunk greatly since the Pleistocene due to gradual climatic warming (Yalden, 1983; Kingdon, 1990);
- recent habitat loss and fragmentation as a result of increased high altitude subsistence agriculture and high human population pressure (Hurni, 1986; Wolde-Mariam, 1991);
- direct human persecution and negative attitudes associated with alleged domestic stock predation; and,
- the presence in wolf range of domestic dogs which affect wild canids by direct competition and aggression, by acting as a disease vector and by introgression and out-breeding depression (Sillero-Zubiri *et al.*, 1996a; Laurenson *et al.,* 1998).

Early records from Simen Mountains described the Ethiopian wolf as living and hunting in packs for small game animals and domestic stock (Rüppell 1835 in Yalden *et al.*, 1980). More recent accounts referred to single animals or to small groups (Morris and Malcolm, 1977). However, the most recent work has shown that

Ethiopian wolves live in discrete packs that communally share and defend an exclusive territory and forage alone on small prey in the day time (Gottelli and Sillero-Zubiri, 1990; Gottelli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994, Sillero-Zubiri and Gottelli, 1995a,b).

Ethiopian wolves are most active by day, and feed almost exclusively upon diurnal small mammals in the high altitude Afro-alpine rodent community. Digging prey out is the most common technique used to catch rodents. In the Bale Mountains, the Ethiopian wolf feeds primarily on the giant mole rat *Tachoryctes macrocephalus* and on other species of *Murinae* rodents (Morris and Malcolm, 1977; Gottelli and Sillero-Zubiri, 1990; Sillero-Zubiri, 1994; Sillero-Zuberi and Gottelli, 1995a,b; Sillero-Zubiri *et al.*, 1995b). Other food items include the rock hyrax *Procavia capensis*, and young antelopes and lambs (Morris and Malcolm, 1977; Hillman, 1986; Yalden, 1988; Gottelli and Sillero-Zubiri, 1990; Yalden and Largen, 1992; Sillero-Zubiri 1994; Sillero-Zubiri and Gottelli, 1995a; Malcolm, 1997).

No detailed ecological studies have been carried out to date on the Ethiopian wolves living in the Central and North-western Highland blocks, nor on Ethiopian wolves living in human-dominated-landscapes. There are some clear ecological differences in the structure of rodent communities between the different highland areas, notably the absence of the giant mole rat from the Central and North-western blocks (Yalden *et al.*, 1976; Yalden and Largen, 1992). Furthermore, large possibly competing carnivores are absent or live in lower densities in human-dominated landscapes, while livestock carcasses may provide additional sources of food. Carnivore social organisation is known to be highly adaptable under different ecological conditions (Macdonald, 1992; Schaller *et al.*, 1996). Hence, this chapter aims to compare the ecology and social organisation of Ethiopian wolves in the human-dominated Central Highland area of Guassa with the undisturbed South-eastern Highland area of Bale Mountains National Park. For Ethiopian wolves in Guassa, I examine the following:

- their density and population estimate;

- their diet and feeding behaviour; and,
- their habitat preference and spatial organisation.

Throughout, I compare the ecology of Ethiopian wolves in Guassa with those in Bale Mountains, to determine in particular whether or not Ethiopian wolves have been affected in response to a human-dominated landscapes.

8.2 Material and Methods

8.2.1 Population Estimate

The density of the Ethiopian wolf population in the Guassa area was estimated using the line transect method (Burnham, *et al.*, 1979; Buckland *et al.*, 1993) (see Chapters 2 and 5).

The data was analysed using the computer programme DISTANCE 3.5 Release5, to estimate Ethiopian wolf density in the Guassa area. Buckland *et al.* (1993) recommend that for DISTANCE analysis the number of sightings should be >60 for more reliable estimation. The sighting of wolves during transect sampling was low, so all Ethiopian wolf sightings were pooled together to produce an overall density estimate for the whole study.

8.2.2 Diet and Feeding Behaviour

8.2.2.1 Faecal Sample Analysis

Faecal analysis can be used to identify prey items of carnivores (Putman, 1984). A total of 348 faecal samples was collected from the Guassa area from January 1997 to December 1998. Faecal samples were not collected from areas of human activity to reduce the risk of collecting domestic dog faeces. Each sample was labelled with the date of collection, and habitat type.

All faecal samples were air-dried. Each dry sample was broken carefully by hand and its contents were examined using a hand-held lens. The content of the sample was sorted and categorised as bones, teeth, hair, feather or vegetable matter. All bones, teeth, and hair were compared with a reference collection for each rodent species of hair, teeth, and bone that was kept for this purpose from the snap trapping exercise. Wool from sheep and hair from the Abyssinian hare was also added to the reference collection. The presence of any of the body parts of particular rodent species was recorded for every sample collected.

Two statistics were calculated from the faecal data. First, since any one sample could contain multiple prey items, the proportion of a particular prey item that occurred in all samples was calculated (Ciucci *et al.*, 1996). Second, for each sample contained in a faecal sample, the volume of that species of rodent or sheep, or Abyssinian hare, feather or vegetable matter that is contained the sample was also calculated.

8.2.2.2 Foraging Behaviour

The foraging behaviour of the Ethiopian wolf was studied during focal watches of known individuals (Altmann, 1974), either bearing radio-collar or with a recognisable coat pattern. Individuals were followed on foot and watched with binoculars from a distance. All activities related to feeding and hunting, both successful and unsuccessful, were recorded. A total of 536 watches were conducted with observation periods lasting from <5 minutes to 1.5hr, which were discontinued only when the wolf disappeared from sight.

The density of *Murinae* rodent prey species in different habitat types was estimated as described in Chapter 6. The density of the common mole rat *Tachyoryctes splendens* was sampled by counting active burrows using a 5m radius circular plot along the transects used to census wild and domestic animals. The density of the common mole rat was calculated following Reid *et al.* (1966), Jarvis and Sale (1971) and Jarvis (1973).

To determine preference for each rodent prey category, their volume in the diet and their biomass was used to calculate the Chesson index (Chesson 1978; Vos, 2000), as follows:

$$\mu = rn^{-1}(\sum_{j=1}^{m} r_j n_j^{-1})^{-1}$$

Where r = the volume of each prey category in the diet;

n = relative biomass of the same prey category in the area;

m = number of prey categories; and,

μ = Chesson index of preference.

The sum of μ across all possible species or prey categories equals 1, and the larger the values for individual species or prey categories, the more preferred is the prey.

8.2.3 Spatial Organisation and Habitat Preference

8.2.3.1 Habitat Preference

The habitat preference of Ethiopian wolves was based on the proportion of time all wolves were sighted in a particular habitat. First, I used linear regression analysis to examine whether there was a relationship between the area of a given habitat in the Guassa area and the proportion of times that wolves were sighted in that particular habitat. Second, I examined whether wolves actively used some habitats in preference to others, by dividing the proportion of time wolves spent in each habitat type by the proportion of the study area that consisted of that habitat. A score >1 suggests that the wolf prefers that particular habitat and a score <1 suggests that the wolf avoids that habitat. Lastly, I used multiple regression to determine habitat preference. The densities of rodents in each habitat type and the size of each habitat type in the Guassa area were taken as explanatory variables, whereas the proportional sighting of wolves in each habitat type was taken as the dependent variable.

The quality of Ethiopia wolf habitat was classified based on the biomass of available rodents in each habitat type.

8.2.3.2 Radio Tracking

Wolves were trapped using leg-hold Victor Traps (Soft-catch 1.5 and No 3, Woodstream Corporation, Lititiz, Pennsylvania). Traps were placed where wolves were repeatedly sighted in the early months of the study. Three to four leg-hold traps were used per trapping site. The traps were pre-baited with dead sheep for one day and trapping commenced the following day. Traps were checked from a distance using binoculars every 1-2 hours in daytime and in the evenings. Once caught, a wolf was blindfolded and traps were removed from the legs as fast as possible. Caught animals were sedated using 4-5mg/kg of Zoletil™ (Zoletil™ 100mg/ml), administered by hand syringe (Sillero-Zubiri, 1996). A total of 5 animals were caught in March 1997 and fitted with radio-collars (Biotrack, Dorset, UK), weighing 200gm each and with sufficient power to last for 2 years. Radio-collared individuals were selected on the basis of age, and animals <1 year of age were not radio-collared. The collared animals comprised three females and two males (Asbo (A2♀), Gera (G1♂), Ketema (K2♀), Ras (R2♀) and Murtina (M1♂).

Each collared animal was radio-tracked on foot regularlay. Once an animal was located, it was kept in sight for as long as possible and recordings were made every 15 minutes, if possible, of the following: location (GPS fix); group size; activity; vegetation height; and, habitat type.

The radio transmitter of one male wolf (M1♂) soon failed (<5 months) and this wolf was excluded from the analysis of home range due to the problem of a small number of fixes (Seaman and Powell, 1996). Home range size of the other four radio-collared wolves was analysed using two methods:

- A minimum convex polygon (MCP) method was used for analysis of individual and pack home ranges based on the GIS package Arc View. This method was selected to allow comparison with another study of Ethiopian wolves in the Bale Mountains National Park (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottille, 1995b). The shape and configuration of individual and pack home ranges were adequately estimated by a 100% minimum convex polygon, as wolves restrict themselves to a well-defined area.

- Stability of home ranges of individual animals was studied by using the fixed kernel method that gave the probability of use area. The analysis was done using a computer package Home Ranger, Version 1.5 (May 1999, Ursus Software, Revelstoke, Canada). The fixed kernel method was used in preference to the adaptive kernel method because recent work by Seaman and Powell (1996) found that the latter method provides a less satisfactory analysis of animal movement in the home range. Bootstrapping of the data was employed for smooth estimates of error, as recommended by Warton (1995).

8.3 Results

8.3.1 Population Estimate

The density of Ethiopian wolves in the Guassa area using DISTANCE analysis was found to be $0.19 \pm 0.05/Km^2$. Based on the total area of the Guassa, the total population estimate of Ethiopian wolves in Guassa was found to be 19 individuals.

8.3.2 Diet and Feeding Behaviour

8.3.3.1 Diet of the Ethiopian Wolf

The 348 faecal samples were collected from the home range areas of packs, often in latrines or on the boundaries of pack home ranges. Of the full sample of faeces, 32.1% were collected from Mima mounds, 30.2% in open areas of short vegetation or on foot paths, 23.9% from dense shrub and grass tussocks, and 13.8% from around swampy bogs and along river or stream courses.

Table 8.1 Prey items from all faecal samples of Ethiopian wolves collected in the Guassa area, shown as frequency of occurrence within the total sample and volume across the whole sample.

Prey Category and Rodent Species	**Frequency of Occurrence**		**Volume**
	n	(%)	(%)
Murinae rodent (bone, teeth and hair)	455	94.5	71.5
A. abyssinicus	207	59.5	32.5
L. flavopunctatus	148	42.5	23.2
O. typus	89	25.6	14.1
S. grisecauda	11	3.1	1.7
Mole rat (bone, teeth and hair)			
T. splendens	106	30.6	16.6
Abyssinisan hare (hair) *L. starcki*	26	7.5	4.1
Sheep wool	37	10.6	5.8
Birds feather	6	1.72	0.9
Vegetable matter (grass)	7	2.01	1.1

Nine categories of prey item or of species were found in the faecal sample of Ethiopian wolves (Table 8.1), comprising seven species of mammals, including five species of rodents, feather from birds and vegetable matter which was grass. There was no seasonal difference (χ^2=0.516, df=8, P>0.05) in the frequency of prey items between the wet and dry seasons. Therefore, all data were combined irrespective of season (Table 8.1).

Rodents occurred in most samples, and were the most important prey in terms of frequency of occurrence and total volume. The *Murinae* rodents were present in 94.5%

of the total sample and accounted for 71.5% by volume. *A. abyssinicus* and *L. flavopunctatus* were the most common diurnal *Murinae* rodent species in the diet, and while the nocturnal *S. grisecauda* was the least common *Murinae* rodent in the diet. The fossorial common mole rat *T. splendens* was present in 30.6% samples and accounted for 16.6% of the total volume. In total, rodents accounted for 88.1% of prey volume in the diet of Ethiopian wolves in the Guassa area. Sheep's wool and hair from Abyssinian hares were present in 7.5% and 10.6% of the samples, and accounted for 4.1% and 5.8% of the prey volume, respectively. Bird feathers and grass were present infrequently.

8.3.3.2 Foraging Behaviour

Ethiopian wolves forage alone. Of a total of 536 behavioural observations, 67.5% were spent on foraging activities, checking rodent burrows and running after rodents. Patches with abundant prey were checked carefully by walking slowly, with ears pointed and frequent pauses to investigate and to locate rodents by sound. Where prey was less abundant, wolves trotted rather than walked. In areas of high vegetation growth, the wolves moved slowly trying to detect movements of rodents in the grass. Wolves sometimes ran in a zig-zag across the field to stimulate the movement of rodents, thereby making hunting easier.

The Ethiopian wolf captures its *Murinae* rodent prey by slowly moving towards it in a crouched position, stopping sometimes with its belly pressed against the ground, and moving forward slowly until it reaches a distance from where it can pounce to grab the prey. Stalking of the prey (n=219) lasted from a few minutes to 20 minutes, with an average of 9.5 minutes. If *Murinae* rodent prey escaped it was followed to its burrow, where the wolf often dug it out by using its forepaws. A tactic commonly followed to take *Murinae* rodent prey out of their burrows was to pounce at the mouth of the hole using its elongated muzzle in a stabbing motion. If the prey was not caught, the wolf would dig into the hole for up to 50cm to 1m. Some 57.1% of staking attempts were successful in catching small *Murinae* rodents. Digging is the also the only favoured way of catching the fossorial *T. splendens*. While looking for *T. splendens*, the wolf digs the entrance of the burrow, and waits on the other side while making a few scratches. When the mole rat came to cover the hole the wolf pounces and grabs the mole rat. Some 21.0% of the digging attempts for mole rat (n=89) were successful, and digging sometimes led to the nests of other *Murinae* rat colony.

While the Ethiopian wolf primarily feeds on live rodents, stalking of Abyssinian hares *L. starki*, and feeding on carrion, was also observed. Hunting for hares and scavenging for road-killed hares accounted for 3.4% (n=9) of the foraging activity of the wolf. On one occasion, a wolf was observed feeding on a young gelada baboon *Theropithecus gelada,* and on another occasion another wolf was observed stalking a baby gelada baboon. On five occasions a wolf was seen in the middle of foraging troops, with no response from the baboons to the presence of the wolf. Scavenging on dead livestock was observed on two occasions. On the first occasion, a group of five wolves belonging to the Gera pack (see section 8.3.3.2) were seen feeding on a dead horse for two days. They were eventually chased away by a spotted hyena *Crocuta crocuta*. On the second occasion, a group of nine wolves belonging to the Ras pack (see section 8.3.2.1) was seen feeding on a sheep that was estimated to be 1-1.3 years old. It was not known whether the sheep was killed by the wolves or if it had died of other causes.

8.3.2.3 Prey Abundance and Preference

The three common species of diurnal rodents (*A. abyssinicus*, *L. flavopunctatus* and *O. typus*) accounted for 69.8% of the prey by volume for the Ethiopian wolf in the Guassa area of Menz (Table 8.1). The density and biomass of these rodents in the three main habitats (*Euryops-Alchemilla*, *Festuca* and Mima mound) was estimated from the live trap data (Chapter 6).

Table 8.2 Biomass (kg/km^2) of the three diurnal rodents in the Guass area major habitat.

Habitat	*A. abyssinicus*	*L. flavopunctatus*	*O. typus*	Total Biomass
Euryops-Alchemilla shrubland	571.4	385.8	117.1	1074.3
Festuca grassland	297.1	227.3	179.9	703.4
Mima mound	169.7	317.6	84.6	571.9
Total	1038.2	930.1	381.6	2349.6

The relative abundance of rodents in the other three minor habitat types of *Erica* moorland, *Helichrysum-Festuca* grassland, and swamp grassland was estimated using a catch index per 50 traps for day and night. This indicated that the swamp grassland held more diurnal rodents than *Helichrysum-Festuca* grassland, and *Erica* moorland, whereas the *Erica* moorland held the most for nocturnal rodent (*S. grisecauda*).

The density of the common mole rat was found to be 785.9kg/km^2 in the Guassa area, based on 360 circular sample plots. The relative abundance of the mole rat was highest in *Euryops-Alchemilla* shrubland (24.7%), Mima mound (20.5%) and *Festuca* grassland (19.7%).

A. abyssinicus and *O. typus* were the most highly preferred prey items, with a Chesson index value of 0.3 each. The common mole rat *T. splendens* and *L. flavopunctatus* were the second preferred prey items, with the a Chesson index value of 0.2 each. The nocturnal *S. grisecauda* was the least preferred species among the rodents with a Chesson index value of 0.02.

8.3.3 Habitat Preference and Spatial Organisation

8.3.2.2 Habitat Preference in Ethiopian wolf

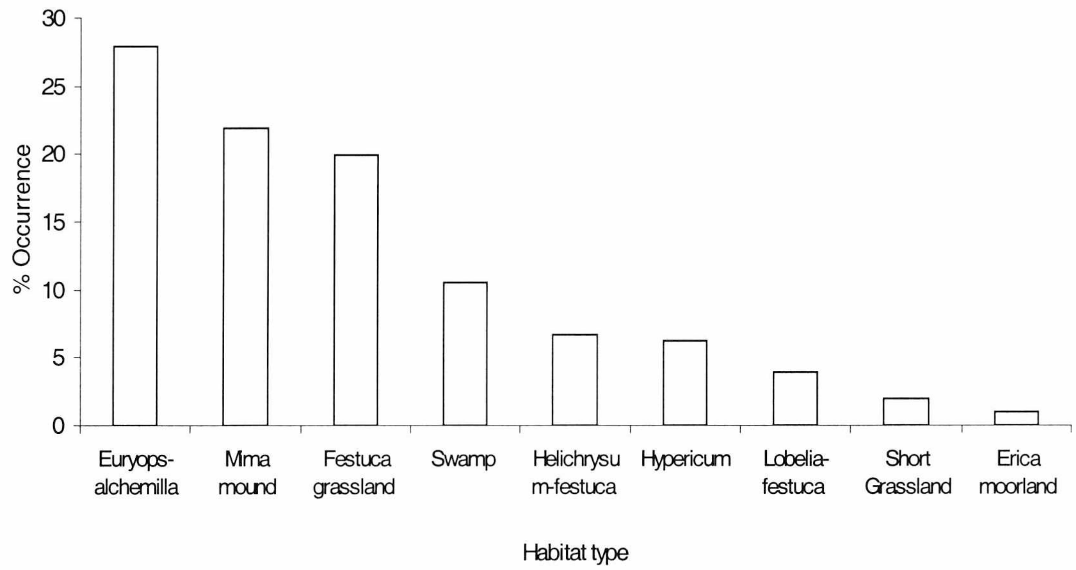

Figure 8.1 Percentage occurrence of Ethiopian wolf in different habitat types.

Wolves were usually seen in the three main habitat types of *Euryops-Alchemilla* shrubland, Mima mound and *Festuca* grassland, which together accounted for 70.2% of wolf sightings (n=536). These three habitats alone accounted for 61.2% of the total area of Guassa and contained the highest densities of rodents (Chapter 6). The four habitat types, swamp grassland, *Helicrysum-Festuca* grassland, *Hypericum* shrubland and *Lobelia-Festuca* grassland accounted for 21.3% of the total wolf sightings, while their total area covered 17.3% of the Guassa area. *Erica* moorland and short grassland areas accounted for 2.8% of the wolf sightings, while the total area of these habitats covered 21.3% of the study site.

There was a positive relationship (r^2=0.63, $F_{1,7}$=11.98, P<0.01) between the proportion of time Ethiopian wolves spent in a particular habitat and the proportion of the Guassa area occurred by each habitat.

Y= -0.005+X1.1

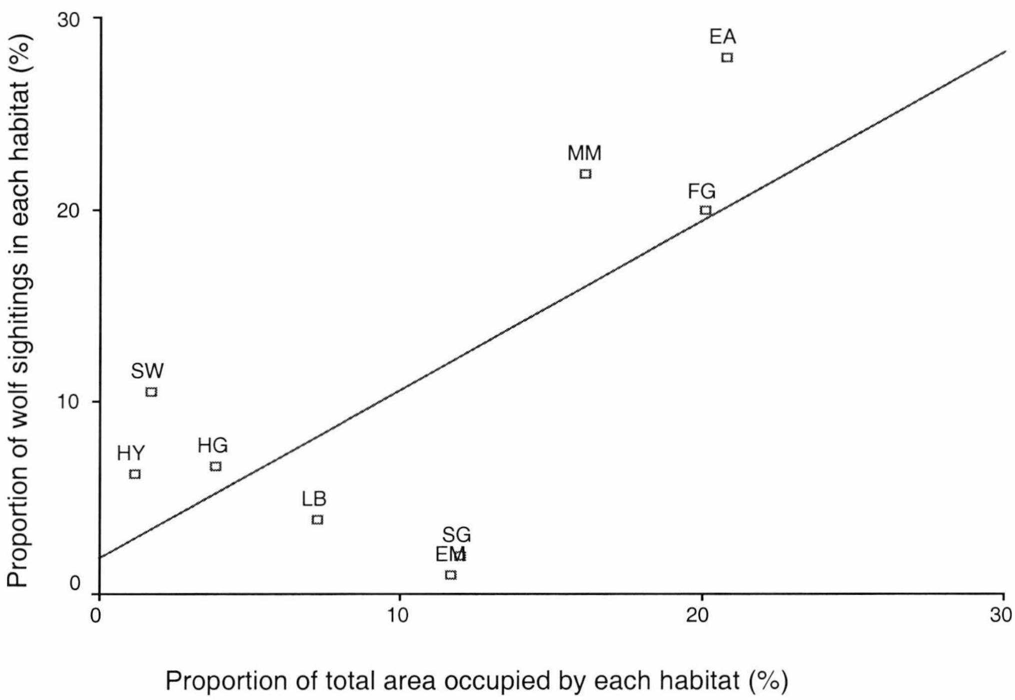

Figure 8.2 The relationship between proportion of time a wolf was found in a particular habitat and the proportion of the total area covered by each habitat.

Habitat key: EA=*Euryops-Alchemilla* shrubland; EM=*Erica* moorland; FG=*Festuca* grassland; HG=*Helichrysum-Festuca* grassland; MM=Mima mound; SW=Swamp grasland; SG=Short grassland; HY=*Hypericum* shrubland; and LB=*Lobielia-Festuca* grassland.

Points above the regression line show that Ethiopian wolves most preferred the swamp grassland (1.5), Mima mound (1.4), *Euryops-Alchemilla* Shrubland (1.3) and *Festuca* grassland (1.1) highly than the rest habitat types. Short grassland (0.2) and *Erica* moorland (0.01) are the least preferred habitat. However, a multiple regression using the proportion of sightings as the dependent variable and the proportional habitat size and rodent density as explanatory variables showed that the only predictor of wolf habitat preference was the density of rodents ($F_{1,4}$=27.49, p<0.01) in a model that explained 87.3% of the variance.

8.3.2.1 Home Range of Individuals and Packs

The annual home ranges of four radio-collared individuals based on the 100% minimum convex polygon (MCP) method ranged from 5.48-7.27 km^2, with Asbo (A2♀) 5.48 km^2; Gera (G1♂) 5.95 km^2; Ras (R2♀) 6.80 km^2, and Ketema (K2♀) 7.27 km^2. Hence, the annual mean home range size for the four radio-collared Ethiopian wolves was 6.37±0.4 km^2. Home ranges differed (χ^2=15.7, df=3, P<0.01) in size between individuals but there was no difference between the seasons.

The stability of home ranges of the four radio-collared individuals using the fixed kernel method gave different probabilities of use of their home range areas (Table 8.3) as illustrated for one individual (Figure 8.3)

Table 8.3 The 25%, 50%, 75%, and 95% probability of finding the study animals.

Individual ID	**25%** (km^2)	**50%** (km^2)	**75%** (km^2)	**95%** (km^2)	100% (km^2)
Asbo (A2♀)	1.00	2.43	4.63	8.34	14.37
Gera (G1♂)	0.34	1.10	2.49	4.80	8.22
Ketema (K2♀)	0.14	0.43	1.01	2.10	3.98
Ras (R2♀)	0.14	0.46	1.16	2.62	4.88

The estimated 100% movement of Asbo (A2♀) was 14.37 km^2. The bootstrap estimate for the exact mean area was 16.41 km^2, with minimum and maximum values for the 100% exact area ranging from 14.22 to 19.74 km^2 (SE±1.16). The 100% movement of Gera (G1♂) was 8.22 km^2. The bootstrap estimate for the exact mean area was 8.62 km^2, with minimum and maximum values for the 100% exact area ranging from 8.25 to 9.07 km^2 (SE ± 0.21). The estimated 100% movement of Ketema (K2♀) was 3.98 km^2. The bootstrap estimated a higher mean area of 4.25 km^2 with minimum and maximum values of 4.02-4.44 km^2 (SE ±0.083). The estimated movement area for Ras

(R2♀) was 4.88 km^2 (Figure 8.3). The bootstrap mean estimate was 5.23 km^2 with minimum and maximum area of 2.71-3.128 km^2 (SE±0.88).

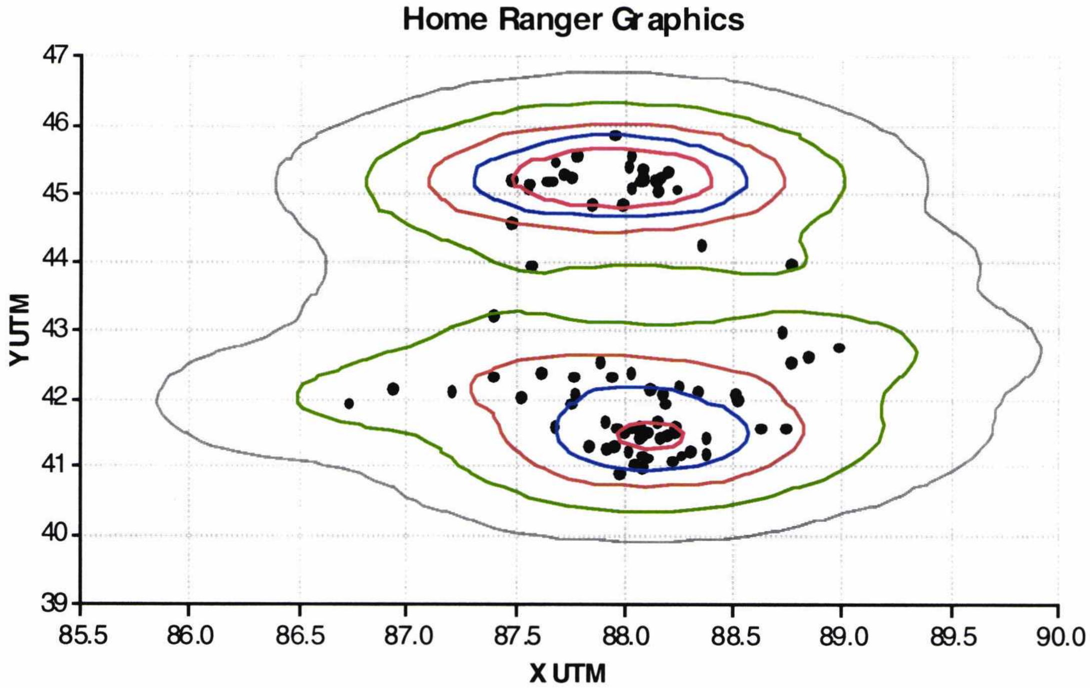

Figure 8.3 Movement of Ras (R2♀), with contour lines showing the 25%, 50%, 75%, 95% and 100% probability of finding the animal.

The four packs, (Asbo, Dija, Ras and Gera) in the Guassa area comprised 4-9 adults and sub-adults. These four packs had a mean group size of 5.7± 0.25 individuals. The home range size of four packs using minimum convex polygon (MCP) ranged from 5.48 to 9.23 km^2 (Figure 8.4). Pack home range sizes were as follows: Asbo pack, 5.48 km^2; Dija pack, 6.51 km^2; Ras pack, 9.23 km^2; and, Gera pack: 7.41 km^2, with mean pack home range size of 7.16 ±0.8 km^2.

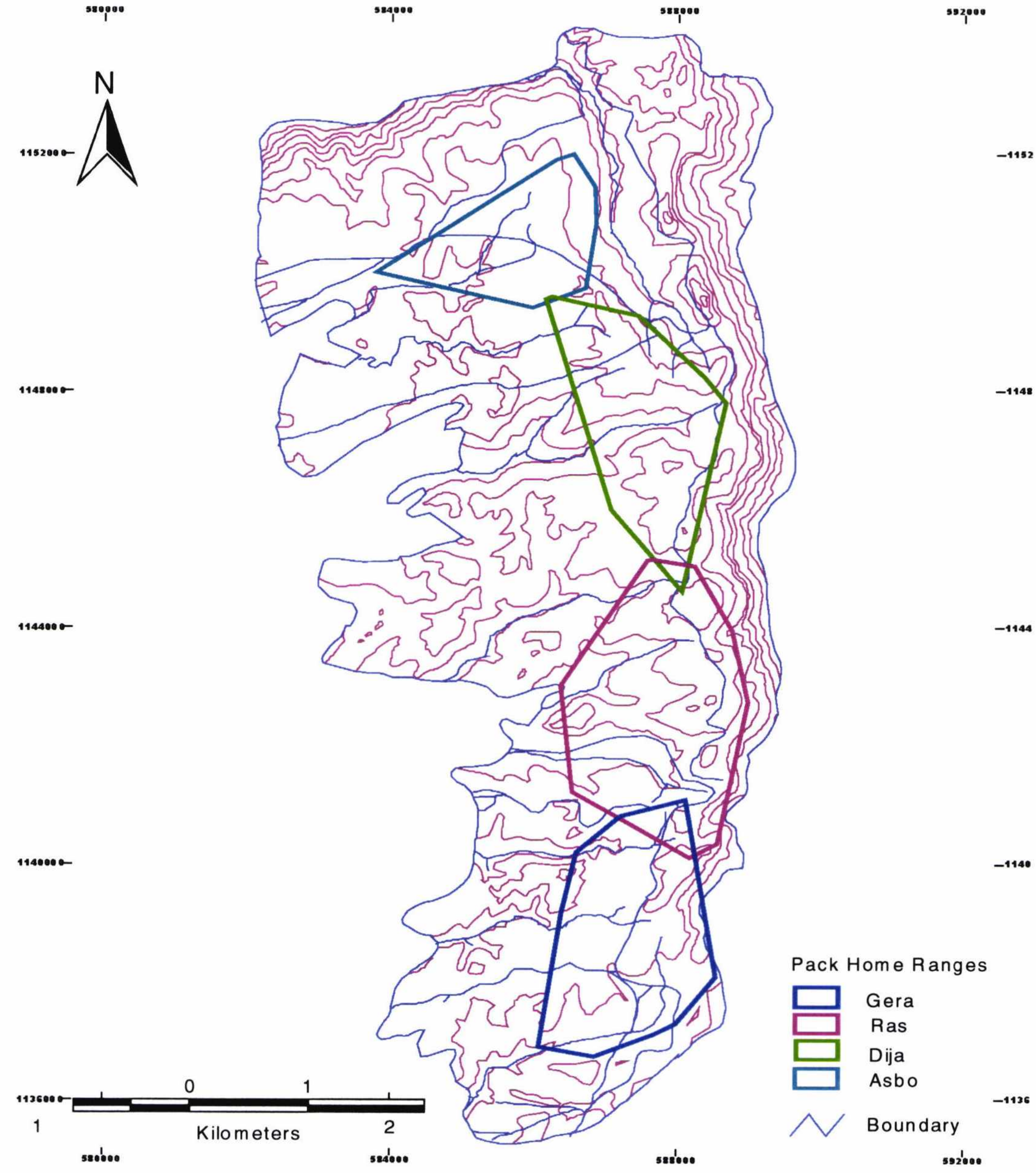

Figure 8.4 Home range size of the four packs in the Guassa area.

The home ranges of adult and sub-adult wolves overlapped almost completely with other pack members. A comparison of home range size to pack size showed a positive relationship between the size of home range and pack size (r^2=0.85), but the relationship was not significant ($F_{1,3}$=4.98, p>0.05) with this small sample size.

The mean home range size of different packs in Guassa was compared with the Bale Mountains National Park packs, living at more or less similar altitudes (3200 to 4000m asl). There was no difference ($F_{2,10}$=0.71, P>0.05) in mean pack home range size of wolves in Guassa and the Web Valley (6.5$\pm$2.1 km^2), and Sanetti (5.5$\pm$ 1.3 km^2), packs in the Bale Mountains (Figure 8.5).

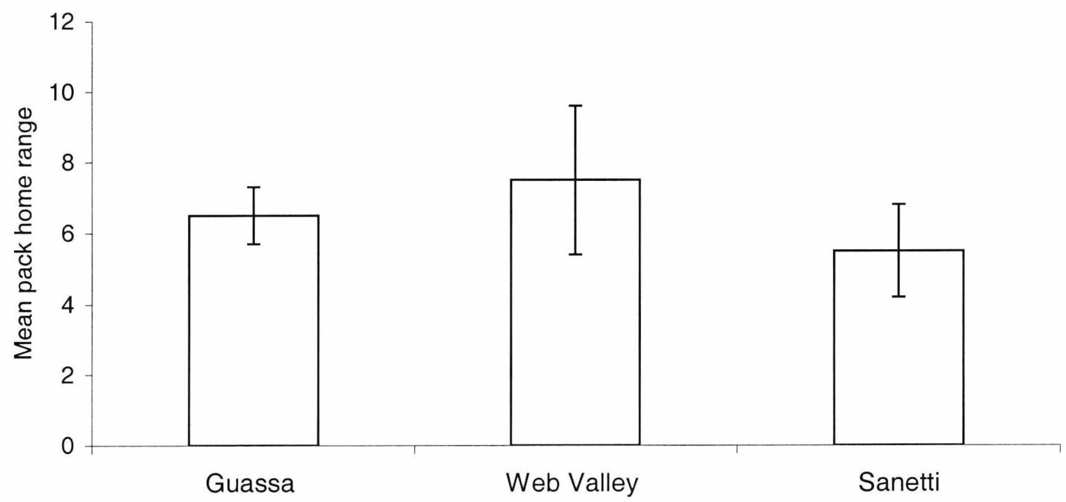

Figure 8.5 Mean pack home range sizes in Guassa and in two areas of Bale Mountains National Park (based on data from Silliero-Zubiri, 1994).

8.4 Discussion

This is the first study of the ecology and social organisation of Ethiopian wolves in human-dominated landscapes in the Central Highlands of Ethiopia. I have shown that the ecology and social organisation of Ethiopian wolves in the Guassa area of Menz is almost entirely similar to that of Ethiopian wolves in the relatively undisturbed Bale Mountains National Park. Despite the absence of giant mole rat in Guassa, Ethiopian wolves remain specialised rodent eaters, depending on *Murinae* rodents and the common mole rat. Their home range and social organisation remains similar to that in Bale Mountains. However, their current density in Guassa is somewhat lower than in Bale Mountains.

8.4.1 Population Estimate

Like the wolf ranges in the Bale Mountains National Park and Simen Mountains National Park, the Guassa area of Menz represents one small area of Afro-alpine habitat containing a continuous single unit of wolf habitat (Gottelli and Sillero-Zubiri, 1992). The density of Ethiopian wolves in the Guassa area was estimated to be 0.19/km^2, which is lower than the recent estimate for the Bale Mountains National Park of 0.5/km^2, but similar to the estimate of 0.18/km^2 Simen Mountains National Park (Marino *et al.*, 1999).

8.4.2 Diet Analysis and Feeding Behaviour

Canids are typically generalist feeders and are thus widely distributed (Macdonald, 1992). Faecal analysis indicated that the Ethiopian wolf feeds primarily on rodents, which accounted for 88.1% by volume of all prey consumed in the Guassa area. Three species of diurnal *Murinae* rodents (*A. abyssinicus, L. flavopunctatus* and *O. typus*) were the main prey accounted for 69.7% by volume, while the common mole rat *T. splendens* accounted for another 16.6% by volume. Although the percentage occurrence of *T. splendens* in the faeces of Ethiopian wolves in Guassa was low, the total biomass contributed to the diet should be high, because its weight is 2-3 times heavier than the weight of a *Murinae* rat. The nocturnal *S. griseicauda* was poorly represented in the diet of the Ethiopian wolf, probably due to the diurnal foraging behaviour of the Ethiopian wolf. Furthermore, food preference trial, the Ethiopian wolf actively rejected *S. griseicauda* and shrews (*Crociduar* sp.) (Sillero-Zubiri and Gottelli, 1995a). Peaks of Ethiopian wolf foraging activity suggest that there is positive relationship with the activity of rodents above ground in daytime (Gottelli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995a). The Chesson index indicated that wolves in the Guassa area mostly prefer *A. abyssinicus* and *O. typus* as their primary prey followed by *T. splendens* and. *L. flavopunctatus*. In contrast, Ethiopian wolf in the Bale Mountains primarily depends on the giant mole rat *Tachyoryctes macrocephalus*, which accounted for 46.6% of total volume consumed (Gottelli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994; Sillero-Zubiri *et al.*, 1995a). Nevertheless, *T. splendens* is still the most important prey item in the lower altitude areas of grassland in the Bale Mountains, where *T. macrocephalus* is absent (Morris and Malcolm, 1977; Malcolm, 1997).

Numerical representation of potential prey species in a carnivore diet rarely corresponds with the proportions in which these species are present, due to factors such as prey availability and anti-predator behaviour, energetic costs of hunting, and size and value of the prey (Krebs, 1972; Macdonald, 1977). Lockie (1959) suggests that the occurrence of prey item in faeces tends to exaggerate the percentage of small prey taken, and tends to underestimate medium and large prey. One way around this problem is to compare the actual biomass that could be contributed by the proportion of each species in the diet. If the total biomass that was consumed by the Ethiopian wolf in the Guassa area was compared by species, *T. splendens* may contribute the highest biomass by volume (Malcolm, 1997).

It was suggested that among canids and felids, all species weighing over 21.5kg are purely vertebrate feeders (Carbone *et al.*, 1999). However, the 14.5kg Ethiopian wolf is less than this predicted weight, yet feeds solely on vertebrates (rodents). Hence, the Ethiopian wolf is a clear outlier in this regard, and this may be explained by the constraint of energy requirements imposed on the wolf by cold Afro-alpine climates. Of all canid species, the Ethiopian wolf is the only one with a specialised year round rodent diet (Sillero-Zubiri 1994; Sillero-Zubiri and Gottelli, 1995a; Sillero-Zubiri *et al.*, 1995b). There is no difference in the type of prey taken by the wolf during the dry and wet seasons, and the wolf feeds exclusively on rodent year round, unlike the varied diet of all other canid species. While arctic and gray foxes feed exclusively upon rodents at some time of the year, their annual diet was more diverse (Simonetti *et al.*, 1984). Other canid species like coyotes, jackals, wolves (*Canis lupus*), and African wild dogs, mainly hunt for larger prey, which has led to the traditional view of the evolution of canid sociality through pack hunting (Macdonald, 1983). However, the occurrence of other prey items in their diet shows that Ethiopian wolves also occasionally hunt for larger prey like Abyssinian hare *L. starcki.* An Abyssinian hare provides a larger meal than any species of rodent in the Guassa area, but the energy involved in chase and their low abundance, makes it a difficult to hunt and kill. However, Ethiopian wolves also feed on road-killed hares, which is the most likely source of hares in their diet.

Serious allegations are made in the Guassa area that the wolf is a nuisance animal feeding on lambs. Among the samples, only few contained livestock hair. Hence, wolves do occasionally feed on lambs, but and there was no direct evidence to indicate any wolf predation on sheep (see Chapter 10). It has been suggested that the wolves feeds on carrion unlike in the Bale Mountains, where feeding on carrion is limited by the presence of other species of carnivores and of domestic dogs (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995a). In the Guassa area wolves feed on a substantial amount of carrion. Dead livestock accounted for much of the carrion diet and wolves are free to collect as much as they can in many cases, as the density of other carnivores in the Guassa area is low. Communal feeding occurs on larger prey whenever the opportunity arises.

8.4.3 Habitat Preference

The distribution and abundance of many species are influenced by the spatial arrangement of suitable habitats across given landscapes. In many studies within-site habitat quality has been mainly used to evaluate habitat suitability. However, spatial pattern among sites is also important in determining the suitability of habitat for a species (Cutler, 1991; Riitters *et al.*, 1997).

The three main habitats in the Guassa area are all major wolf habitats. Habitat preference indices indicate that the Mima mound was the most preferred habitat, followed by *Euryops-Alchemilla* shrubland and *Festuca* grassland. The densities of rodents in different habitats largely explain this habitat preference. Similar results have been observed in the Bale Mountains, where wolf density has been positively correlated with diurnal rodent density and negatively correlated with vegetation height (Sillero-Zubiri and Gottelli, 1995a,b).

The main three habitat types accounted for 60.9% of the total area of Guassa and are considered as optimal habitat. Some 25.3% of the total area is regarded as good habitat, and the short grassland area with its shallow soil and with many pebbles is marginal habitat accounting for 13.5% of the total area. Hence, the Guassa area is an important wolf habitat, second only to the Bale Mountains. Studies conducted on Ethiopian wolf range in different areas of the country have indicated that the Guassa area has a high ratio of optimum to good and marginal habitats, indicating the importance of the area for the future survival of the species. Most of the areas where the wolf is found have lower ratio of optimum habitat than Guassa, including the Simen Mountains and other mountain blocks in the North-western and South-eastern Highlands of the country (Marino *et al.*, 1999).

8.4.4 Spatial Organisation: Home Range Size

Canids are generally territorial, and occupy stable home ranges large enough to ensure a food supply all year round, but their home range sizes differ widely between species and habitats (Macdonald, 1983). Even within broadly similar habitats, there is considerable intraspecific variation in the basic parameters of carnivore social organisation including group size, and home range size. Territoriality is one of the most important behavioural traits affecting the spatial organisation of animal populations (Doncaster and Macdonald, 1991). Ethiopian wolves were organised in discreet groups occupying definite ranges, with members of each pack sharing more or less the same range. Pack members gather for social interactions and border patrols at dawn, noon and dusk.

There was a strong positive correlation between pack size and home range size in the Bale Mountains although the relationship was not significant in Guassa due to small sample size of radio-collared wolves. Home range size of canids tends to negatively correlated with group size (Andelt, 1985). No correlation has been observed between pack size and territory size among other group living, solitary foraging carnivores (e.g. badgers *Meles meles,* red foxes *Vulpes vulpes*, and black-back jackals *Canis mesomelas).* In contrast, a strong correlation is found in co-operative hunters (e.g. grey wolves *Canis lupus*, Coyotes *Canis latrans*, and lions *Panthera leo*). In a competitive scenario, where all available habitats are occupied, pack size determines the outcome of territorial boundary clashes and the maintenance of a high quality range may be the greatest advantage of group living (Macdonald, 1983).

The influence of dominance on individual home range use has been shown with the kernel home range analysis, where dominant female (R2) had a smaller home range than the subordinate female in the pack (K2). Similar results were found from Bale Mountains where dominant females have smaller range areas than the subordinate females, although dominant male home ranges were bigger than those of subordinate males (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995b). In Bale Mountains males did not disperse and were recruited into multi-male philopatric packs, whereas some sub-adult and sometimes adult females dispersed or become "floaters". Theses floaters occupied either large ranges which overlapped two or three pack ranges or narrow ranges between pack territories, until a breeding vacancy become available (Sillero-Zubiri, 1994; Sillero-Zubiri, *et al.*, 1996b). In the Guassa area male sub-adults where seen to have dispersed over a large area. A sub-adult male from the Ras pack moved initially to the Dija pack, and later moved out of the Guassa area to be found killed by farmers in the Gishi area, some 42 km from his natal pack home range. Females also exhibit some shifts in their use of the home range. In the Ras pack the dominant female had two different core areas of utilisation (Figure 8.3).

The home range of Ethiopian wolves in Bale and Guassa is among the smallest reported for all eight species of *Canis* (Ginsberg and Macdonald, 1990; Sillero-Zubiri and Gottelli, 1995b). There is an established relationship between metabolic rate, body weight and size of home range in mammals, with home range increasing as a power of the body weight (McNab, 1963; Harested and Bunnell, 1979). For the 14.5 kg Ethiopian wolf, the model provided by Harested and Bunnell (1979) predicted a home range of 41.8 km^2, nearly six times the mean observed value in the Bale Mountains and in Guassa (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995b). The area that an animal occupies must be large enough to provide an adequate supply of resources, which explains why home range size increases with either body size or metabolic rate. After body size and metabolic rate, diet has been recognised in many studies as the most important factor influencing home range size (Gittleman and Harvey, 1982; Mace *et al.*, 1983). Resources, particularly food dispersion, are fundamental to the spacing and structure of carnivore society in that it may set the limits to the group and territory sizes within which other combinations of selective pressures may operate (Macdonald, 1983). This may explain the smaller than predicted home range of the Ethiopian wolf, which enjoys a high density of available food resources. Hence, the rodent community found in the Guassa area is rich, but varies between optimal, good and marginal habitats.

Defensive behaviour may also influence home range size. A model of optimal home range size assumes that the cost of defence increases as territory area increases, because residents of large territories spend more energy patrolling, encountering and expelling more intruders, and travel farther to expel each intruder, than residents of small territories. Hence, all else being equal, a cost of defence argument predicts that undefended home range will be larger than defended home ranges (Schoener, 1983b; Grant *et al.*, 1992).

An average pack size of 5.7 adult and sub-adults in the Guassa area was similar to the group size of 5.9 adult and sub-adults in the Bale Mountains (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995b). The average home range sizes of individual wolves in Guassa (5.43 km^2) and Bale (6.7 km^2) were also similar. Average pack home range sizes in Guassa (7.16 km^2) were also similar to those in the Bale Mountains. The Web Valley (6.5 km^2) and Sanetti (5.5 km^2) are at more or less similar altitudes and have similar vegetation communities to the Guassa area. However, these areas in the Bale Mountains are excluded from any type of human use since they are found in the core areas of the Bale Mountain National Park. Therefore, they can be taken as a good example of wolf pack home range where humans and livestock are excluded. Nevertheless, despite this lack of human disturbance compared with Guassa, there appear no influences of such disturbance on social organisation of Ethiopian wolf in Guassa.

Even though this study has shown no effect of human disturbance upon pack size and home range in Guassa compared with Bale Mountains National Park, I will now examine in more detail the effect of human and livestock presence on the Ethiopian wolf population in the Guassa area of Menz.

Chapter Nine

9 The Effect of Human and Livestock Presence on the Activity of the Ethiopian wolf

9.1 Introduction

Wildlife species in human dominated landscapes have to cope with the various consequences of human presence if they are to survive and reproduce. Indirect interactions between humans and wildlife species have been the subject of many studies (Boyle and Samson, 1985; Duffus and Dearden, 1990; Albert and Bowyer, 1991). Equally, direct human wildlife interactions can have a detrimental effect on the survival of species. For example, tourism interrupts the feeding activity of Asian rhinos *Rhinoceros unicornis* substantially through keeping the rhino alert to the presence of tourists (Lott and McCoy, 1995). Similarly, tourists affect the foraging activity around the nesting sites of ruddy shelducks *Tadorna ferruginea* (Hulbert, 1990). The presence of humans close to breeding bald eagles *Haliaeetus leucocephalus* disrupts perching, nesting and foraging (Grubb and King, 1991). brown pelicans *Pelecanus occidentalis* are disturbed to such an extent that their nesting success has been reduced, causing some populations to become threatened (Anderson, 1988). Increased tourist activity in Grand Canyon National Park, USA has reduced the foraging efficiency of bighorn sheep (*Ovis canadensis*) in winter (Stockwell *et al.*, 1991). Human activity around brown bear *Ursus arctos* fishing sites has a significant effect on non-habituated bears (Olson, *et al.*, 1997).

In the previous chapter, I showed that the ecology and social organisation of Ethiopian wolves differed little in the human-dominated landscapes of the Guassa area compared with the disturbance-free area of Bale Mountains. Nevertheless, given the extensive sanctioned use of the Guassa area by common property resource users for harvesting of grass, firewood, and for grazing livestock (Chapters 5 and 7), it was important to determine the nature and effect of interactions between Ethiopian wolves and humans and livestock. Hence, this chapter aims to compare the behavioural responses of Ethiopian wolves in the presence of human and livestock, by examining the following:

- the presence or absence of alarm calls or other responses related to human presence; and,
- the extent and nature of disturbance to normal behaviour of Ethiopian wolves.

Where possible, I compare these data with responses from other wild animals in human-dominated landscapes.

9.2 Materials and Methods

Radio-collared Ethiopian wolves were located regularly to undertake behavioral studies (see Chapter 8). Animals without radio-collars were also located by scanning from vantage points. Once an animal was located, data were collected using focal watches (Altmann, 1974). Animals were observed for durations of up to 15 minutes, although sometimes animals move quickly from view. Data were collected on the following: on location (GPS fix); activity; presence and absence of humans and livestock; distance from humans and livestock; and, wolf response to presence of humans. Distances from the wolf to humans or to livestock were estimated to the nearest 50m. The response of the wolf to human presence was classified as: alarm call, a high pitched bark followed by trotting or running away from humans; move away, moving slowly away from the area; aware, a vigilant watch on humans from time to time while performing its normal activity; and, ignore, when the wolf is not responding to the presence of humans.

The different types of wolf response to human and livestock presence or absence were compared with total response types recorded while humans or livestock were closeby wolves and when humans or livestock were absent. Data were analysed separately for human and livestock presence, using a chi-square test and a General Liner Models

(GLM) with normal error structure. GLM was used to estimate the effects of human and livestock presence on the length of time a wolf performed a given activity. The length of effective observation time was taken as the dependent variable. Two independent categorical variables, comprising presence and absence of humans or livestock and the different categories of wolf activities (a categorical variable with 5 levels) and their interaction was fitted in the model.

9.3 Results

9.3.1 Effects of Human Activity on the Ethiopian Wolf

A total of 214 observations were recorded of the presence of Ethiopian wolves close to humans. Most observation were of humans at distances >50m and <150m wolves (Figure 9.1). In most cases, wolves moved away slowly from humans, but they also frequently ignored humans presence. Wolves less frequently remained aware of humans or made an alarm call (Figure 9.2). As the distance between the wolf and people increased, the proportion of each activity changed systematically (χ^2=88.29, df=9, P<0.001). The proportion of encounters resulting in alarm calls decreased from 55.0% at a distance of <50m to 2.4% at a distance of <150m. In contrast, the proportion of wolves ignoring people increased from 10.1% to 43.4% over the same range of distance (Figure 9.3).

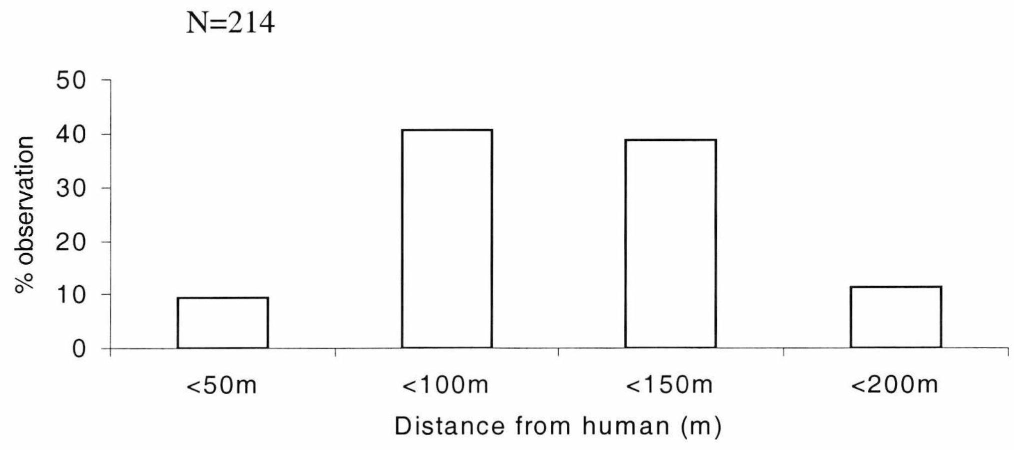

Figure 9.1 Distances at which Ethiopian wolves were observed close to humans.

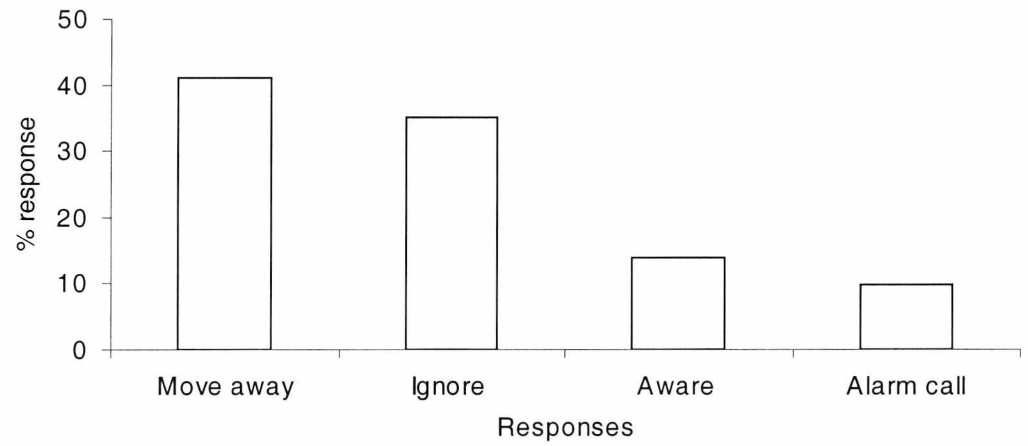

Figure 9.2 Responses of Ethiopian wolves to human presence.

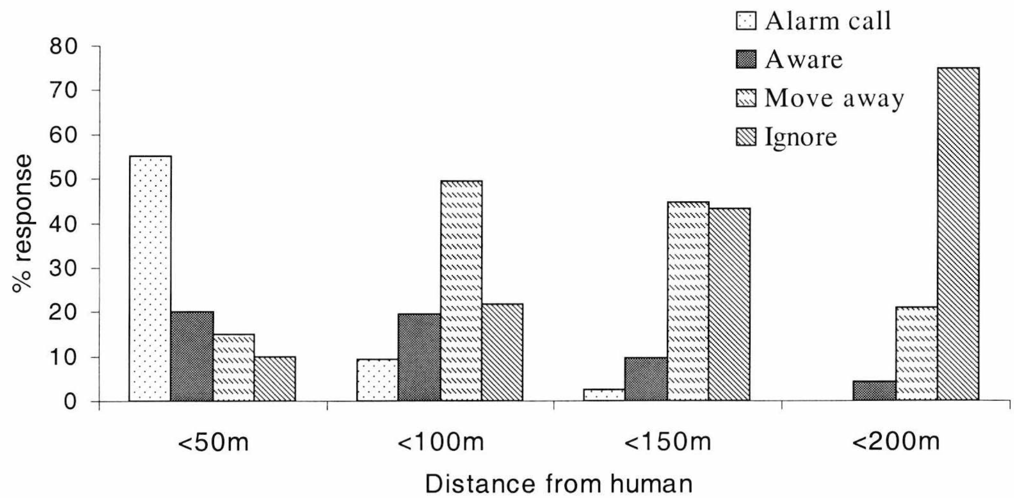

Figure 9.3 Proportions of different responses by the Ethiopian wolf in relation to distance from humans.

There was no difference (χ^2=2.45 df=1, p>0.5) between the proportion of time spent foraging in the presence and absence of humans (Figure 9.4). However, wolves tended to lie down more when there was no human in the area (χ^2=21.62, df=1, p<0.001). In contrast, running activity took place when humans were in the vicinity (χ^2=12.2, df=1, p<0.001). In the majority of cases where walking was recorded (55.5%), the wolf was already walking when humans came around.

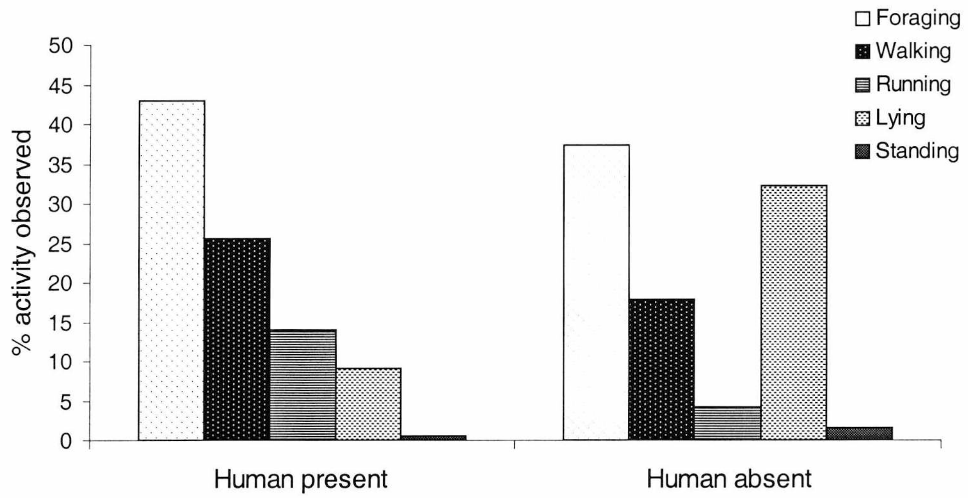

Figure 9.4 Proportion of time spent on different activities by Ethiopian wolves in relation to the human presence and absence.

There was no clear relationship (χ^2=11.48, df=12, p>0.5) between different activities of the wolf in relation to distance from humans. However, the proportion of activities such as foraging and walking tended to increase as distance from humans increased, while running away from humans tended to decrease as distance increased (Figure 9.5).

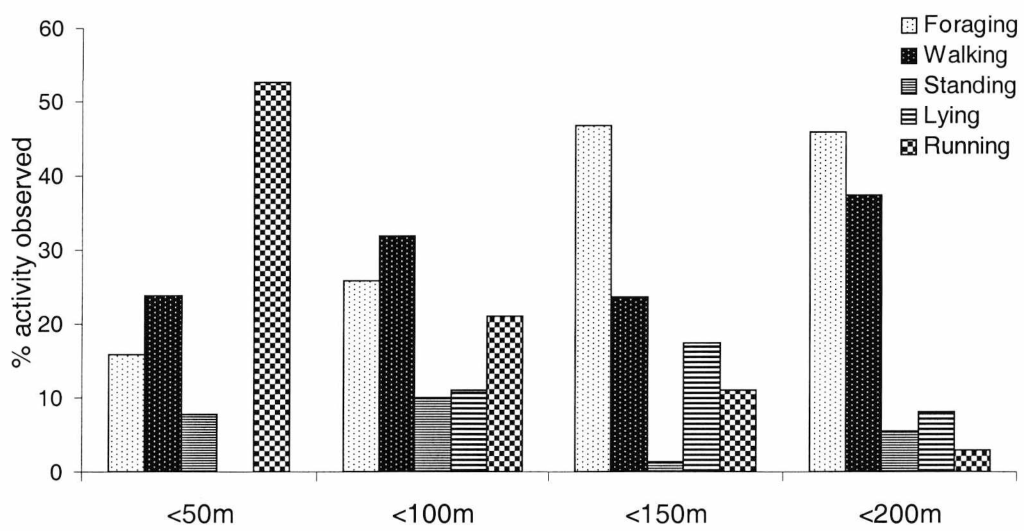

Figure 9.5 Proportion of time spent on different activities in relation to distance from humans.

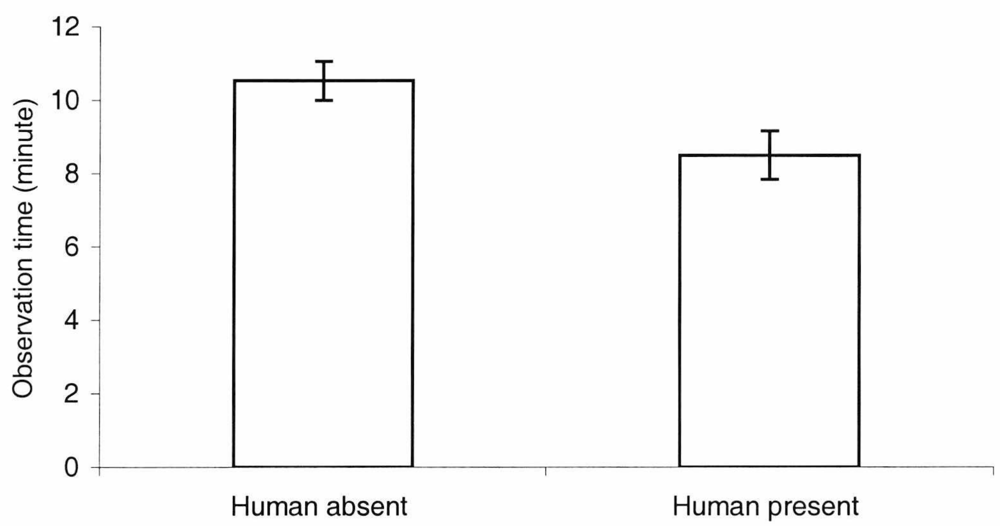

Figure 9.6 Mean length of time each wolf was observed in the presence and absence of humans.

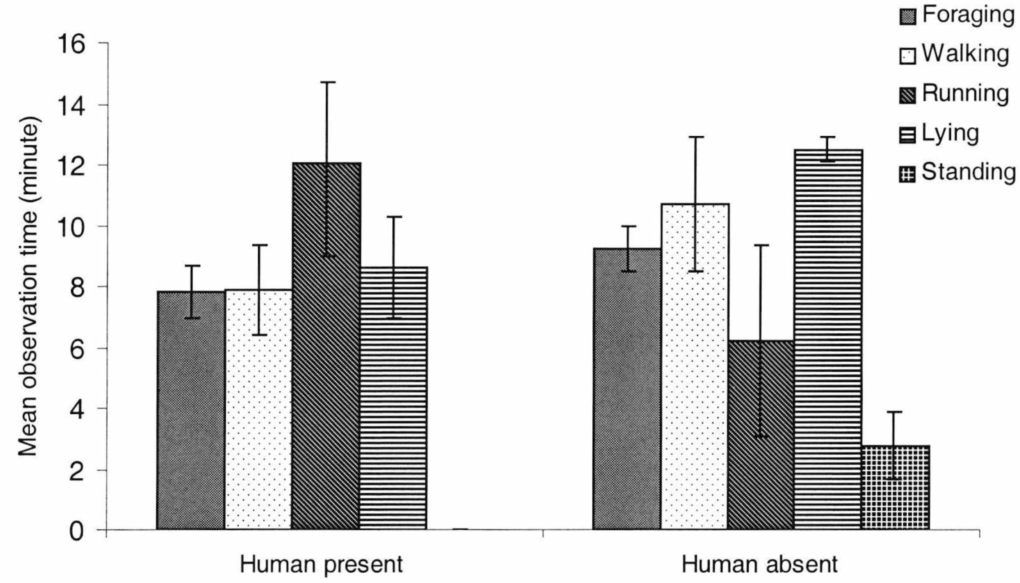

Figure 9.7 Mean observation time for each activity type in presence and absence of humans.

In general, the time that wolves were observed in presence of humans was shorter than in the absence of humans ($F_{1,441}$=5.77, p<0.05) (Figure 9.6). However, a Tukey analysis indicated that there was no significant difference between mean time spent foraging (p>0.5), walking (p>0.0.5) and running (p>0.0.5) in the presence or absence of humans. However, a difference was evident between standing and lying activity during presence and absence humans (p<0.05) (Figure 9.7).

There was no interaction ($F_{4,403=}$1.68, p>0.05) between the length of time an activity was performed in the presence or absence of human in a model that explained 61.0% of the variance (Figure 9.8). This suggests that there was little or no influence of human presence or absence on different activities of the wolf.

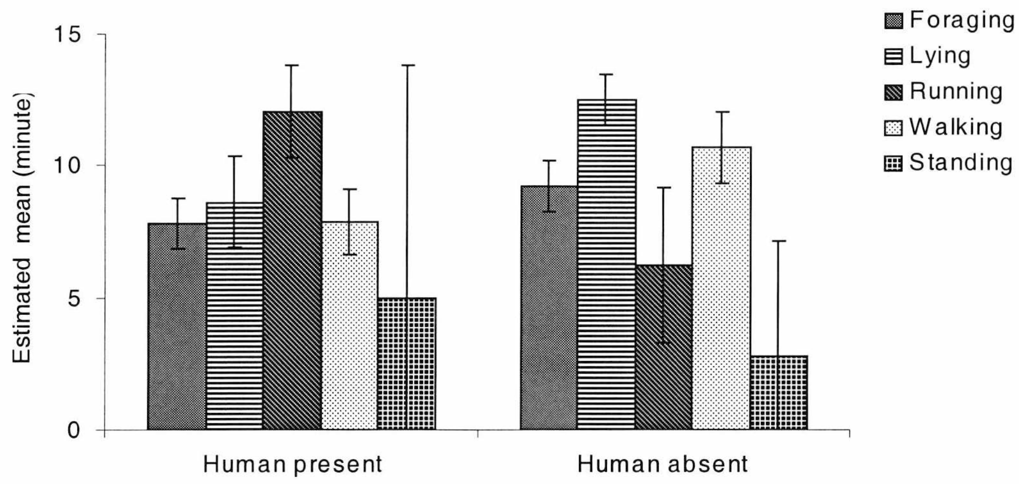

Figure 9.8 Estimated mean length of time for each activity type from the GLM

9.3.2 Effect of Livestock Presence on the Ethiopian Wolf

A total of 267 observations were recorded of Ethiopian wolves close to livestock, primarily cattle. Most observations were of livestock at a distance of <200m and >50m from wolves (Figure 9.9). Ethiopian wolves did not make similar responses to livestock as they did to humans (Figure 9.2), but largely continued with their activities.

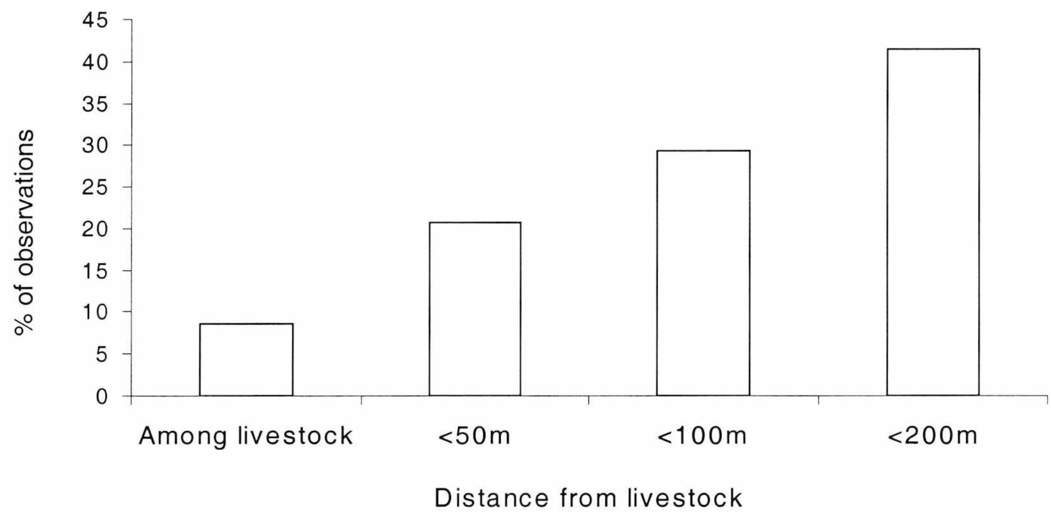

Figure 9.9 Proportion of wolves observed close to livestock.

There was a difference (χ^2=14.53, df=4, $p<0.05$) in the activity of the Ethiopian wolves in the presence and absence of livestock. More foraging activity took place while livestock was around. More time was spent on other activities while wolves were close to livestock, except for running and lying (Figure 9.10).

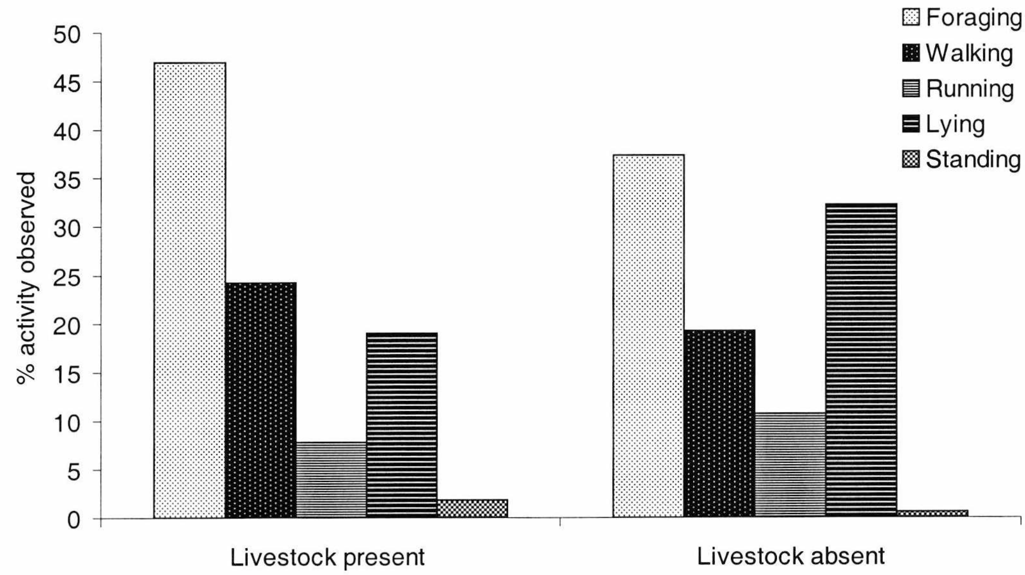

Figure 9.10 Proportion of different activities observed during presence and absence of livestock.

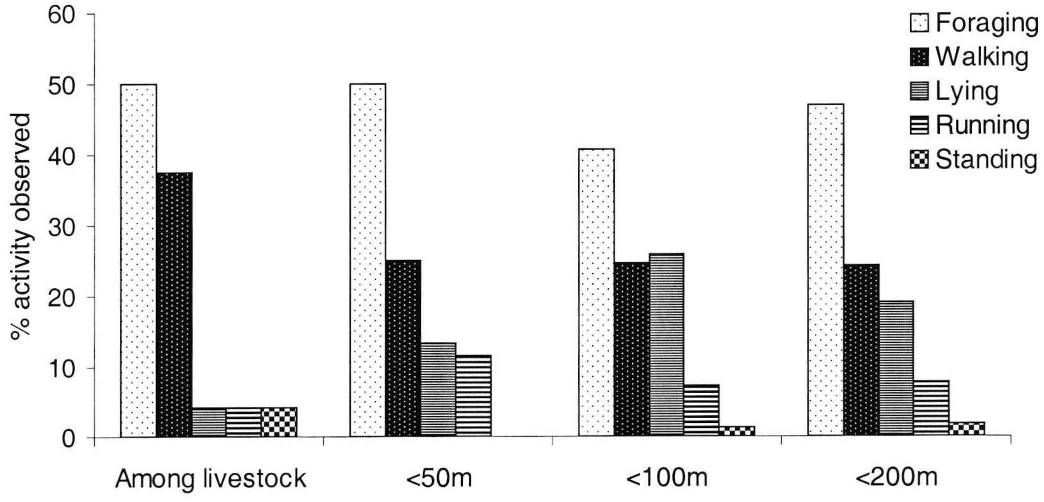

Figure 9.11 Proportion of different activities in relation to distance from livestock.

No association (χ^2=12.6, df=12, p>0.05) was observed between time spent on different activities of the wolf in relation to distance from livestock. However,time spent on foraging was higher than any other activity while livestock were closeby wolves (Figure 9.11).

There was no difference in the time that wolves were observed in the presence and absence of livestock ($F_{7,415}$=1.51, P>0.05). There was also no interaction ($F_{5,419}$, p>0.05) between the length of time an activity was performed in the presence or absence of livestock, in a model that explained only 31.0% of the deviation (Figure 9.12). This suggested that there was little or no influence of livestock presence on different activities of the Ethiopian wolves.

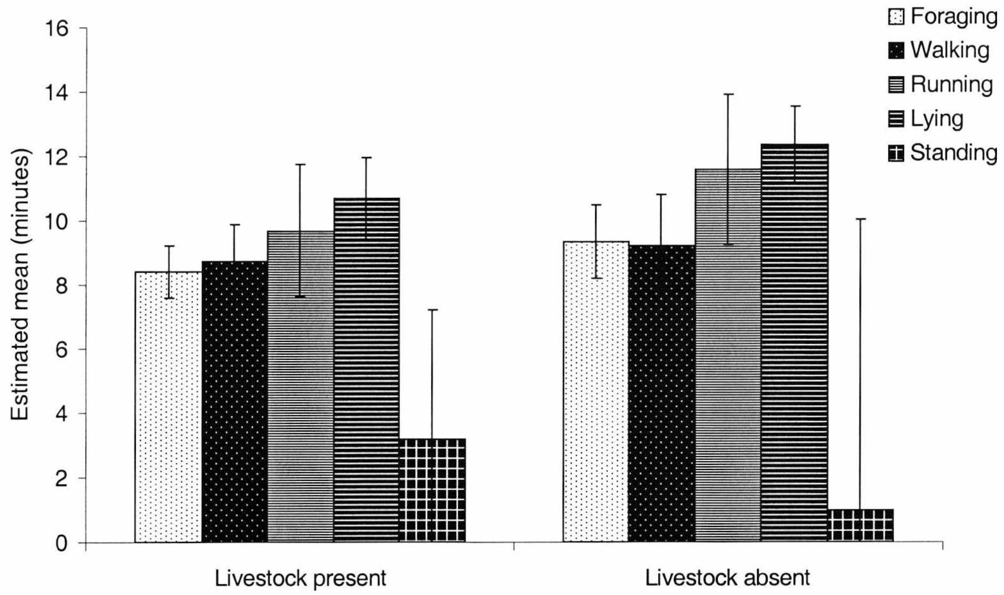

Figure 9.12 Estimated mean time during livestock present and absent.

9.4 Discussion

Studies on the effects of disturbance on wild canids through sanctioned use by humans and their livestock of an area are uncommon. It is important for future management of endangered species to understand the relationship between the cause and effects of disturbance (Anderson, 1988). It has been documented that populations of wolves *Canis lupus* in Minnesota recover in areas of higher human activity (Mech, 1999). Nevertheless, resource managers are faced with decisions whether or not to place land use restrictions in areas where wolves are recovering. However, land-use restrictions are highly controversial, particularly when the human population obtains resources from the wolf range and where many local residents oppose wolves. Thus, it is important to document the degree of adaptability of wolves in human-dominated landscape. This is the first such study for Ethiopian wolves, and it has shown that wolves do show alarm responses to humans at close distances, but not to livestock. The proportion of different wolf activities changed very little in the presence of humans or livestock, and it has been observed that the wolves benefited from the presence of livestock by providing a mobile hide during hunting for rodents amongst grazing livestock.

9.4.1 Effect of Human Activity on the Ethiopian wolf

Ethiopian wolves responded differently in relation to the different distances that they find themselves from humans. (Figure 9.2, 9.3 and 9.5). When the distance was less than 50m, a wolf was likely to make an alarm call, followed by moving away. At a greater distances the likelihood of a wolf making an alarm call was substantially reduced, and no alarm calls were made at distances of greater than 150m. At increasing distances the proportions of other responses also increased, while the proportion of running decreased. At a distance of greater than 150m, the Ethiopian wolves largely ignored human presence.

The proportion of time spent foraging was not influenced by the presence of humans. Time spent foraging by wolves did not differ in the presence of humans (Figures 9.7and 9.8). Any reduction in time available for foraging would reduce time for digging out rodents. For example, digging out the fossorial common mole rat requires longer than digging out other species, since burrows can be up to 1.7m deep (Kingdon, 1974). If the presence of humans prevents the wolf from digging, this may reduce the likelihood of catching mole rats, and as a result forcing the wolf to concentrate on smaller *Murinae* rodents that are active above ground level. Certainly, the Ethiopian wolf in the Guassa area feeds (see Chapter 8) mostly on smaller rodents. In contrast, wolves in Bale Mountains National Park live in a less human-dominated landscape and can spend more time digging for mole rats, which in turn make up a greater proportion of their diet (Morris and Malcolm, 1977; Sillero-Zubiri and Gottelli, 1995a; Sillero-Zubiri *et al.*, 1995a,b) Malcolm, 1997). When wolves *Canis lupus* lived in wilderness, they were thought to have a low tolerance for human disturbance near their den and pups. However, it was found that wolves tolerate human presence and high vehicle traffic even when they have pups (Mech, 1999).

8.4.2 Effect of Livestock Presence on the Ethiopian wolf

Wolves associate with livestock as long as livestock herders do not chase them. Most observed associations are with cattle, but on a few occasions wolves were observed with equines. Hence, sheep flocks are closely guarded and the wolves are chased away. Wolves spent more time standing, foraging and walking in the presence of livestock. When wolves were less than 50m from livestock, mostly foraged and walked, but time spent on these activities changed very little as distance from livestock increased (Figure 9.11). This indicates that there is no effect of livestock grazing on the behavioural activity of the wolf.

The Ethiopian wolf has been observed to follow cattle while hunting for rodents, using the cattle to hide from rodents that are disturbed by the cattle. The local name for the Ethiopian wolf among Oromiffa speaking people of the Bale Region probably originated from this (Sillero-Zubiri, 1994; Sillero-Zubiri and Gottelli, 1995a). In the Guassa area of Menz, people give another explanation as to why wolves follow cattle during grazing. Wolves may hunt close to cattle in the hope of capturing new-born calves. It is a very common belief in Menz that if a wolf approaches a pregnant cow, it is a sign that the cow will soon deliver, but I have no evidence to support or refute this. However, as in Bale Mountains I often saw wolves following cows, and likewise the wolf is making use of the cattle as a mobile hide to hunt for rodents that run following the disturbance by cattle grazing close to rodent burrows.

A study conducted on brown bears indicated that the habituation to people allowed many bears to fish near people (Olsen, *et al.*, 1997). Ethiopian wolves have been seen to tolerate a human and livestock presence and to forage close to humans and livestock. Such tolerance may have evolved through habituation as a survival strategy in human-dominated landscapes. However, some wolves continue to avoid humans presence, apparently unable to habituate to the presence of humans or livestock.

If Ethiopian wolves do not habituate to humans or to livestock presence, the impact will be cumulative, as the frequency of disturbance increases in the highest months of human and livestock use in the area. Animals may compensate for an energy loss due to disturbance if time is not limiting (Stockwell *et al.*, 1991). However, a species like the Ethiopian wolf, that subsists on small rodents to meet its daily metabolic requirement, may face serious constraints from disturbance and may have to use an effective strategy to cope with human and livestock disturbance. Additional compensatory activity may have an important influence on the total time budget of the Ethiopian wolf in human-dominated landscapes, and this could include foraging at night or increased feeding on carrion. However, there is no any indication of wolves in Guassa hunting at night, but an increase in scavenging had been observed (see Chapter 8).

The availability of food can affect the intensity and pattern of human disturbance on various colonies of birds (Van der Zande and Verstrael, 1985; Anderson *et al.*, 1982). There is little evidence to suggest that human and livestock presence affects the different activities of the Ethiopian wolf in the Guassa area. The Ethiopian wolf in the Guassa area lives in a suitable habitat that is under the protection of the community. Therefore, the effect of human disturbance may be minimal due to availability of abundant prey (see Chapter 6), the abundance of which is promoted by different human activities in the Guassa area (see Chapter 7).

An important assumptions, however, is that the relationship between disturbance level and responses, whether negative or positive, is a matter of degree. In other words, that a range of disturbance levels exist where there is a graded effect (Anderson, 1988). A minimum effective level of disturbance is a reality in human-dominated landscapes. It follows then, that some kind of safe level of disturbance should be estimated. It is important in the management and conservation of endangered species to quantify the level and effect of disturbance, so that causes of disturbance can be identified and their negative impact can be eliminated or mitigated.

Nevertheless, while it appears encouraging for the future of Ethiopian wolf in the Guassa that they are little disturbed by human and livestock use of the area, I will next examine the attitudes of the Menz community to wildlife of the area in general, and to the Ethiopian wolf in particular.

Chapter Ten

10 Attitude of the Menz Community towards Wildlife and the Ethiopian Wolf

10.1 Introduction

The decline of all species of wolf are driven by habitat loss, excessive hunting, disease and negative attitudes towards wolves. Two species of wolves, the Ethiopian wolf and the red wolf, are already listed as critically endangered species by IUCN (Webber and Rabinowitz, 1995; Fuller, 1995; Baillie and Groombridge, 1996).

In many societies wolves are symbols of power within an intricately woven cultural fabric (Boitani, 1995). Wolves have long been viewed as harbingers of death and a direct threat to human life. Hence, fear and persecution of wolves dates back many centuries in some societies. European mythology illustrates the deep-rooted nature of this fear. It can be argued that the Euro-American historical and cultural bias towards eliminating wolves has resulted in their present day status. Negative attitudes in recent years have been compounded by the threats that wolves potentially pose to economically important livestock, to huntable wildlife and to other forms of land use (Kellert, 1985a; Kellert *et al.*, 1996). Declines of wolves can also be attributed to how the different species are valued by society. Values attributed to wolves vary greatly among different geographic, cultural, socio-economic and demographic groups, depending on their knowledge and perception of the species, and to associated conservation issues (Kellert *et al.*, 1996; Clark *et al.*, 1995; Boitani, 1995).

Historically, attitudes towards wolves have been largely negative. Wolves became extinct in Great Britain around 1684. Wolf extermination was not fully accomplished in Central and Northern Europe until the beginning of this century (Boitani, 1992;

1995). The history of wolf extermination in North America was associated with the arrival of the first domestic animal in 1609. Pioneers, mindful of the recent final victory over wolves back in England, were determined in their efforts to eliminate wolves from their homeland. In the second half of the 19^{th} century, the battle against the wolf become more intense as killing methods improved. When the frontier moved west, the fur trade became another reason to kill wolves. In the first decade of the 20^{th} century, most of the 48 states were cleared of wolves and this process was complete over most of North America by 1915 (Boitani, 1992; Clark *et al.*, 1995; Boitani, 1995; Kellert *et al.*, 1996).

In Africa, the attitudes and perceptions of local communities towards wildlife and areas of important wildlife habitat has been positive historically (Lewis *et al.,* 1990; Newmank *et al.*, 1993; Siachoono, 1995). A positive attitudes among local communities is essential for successful wildlife conservation programmes, since wildlife provides physical, emotional, intellectual, economic and spiritual benefit to human development and well being (Kellert, 1985b). However, these attitudes started to change with the introduction of the American model of protected area conservation in Africa (Ghimire and Pimbert, 1997). The change in attitude and increased killing of animals, their shrinking habitats and the economic decline of many African countries, have led to a growing consensus among conservationists and international conservation organisations that the American national park model, commonly referred as "fences-and fines" approach, has failed to protect wildlife in the continent (Lewis *et al.*, 1990; Matzke and Nabane, 1996). As a result, conservationists have been searching for viable and sustainable alternatives or a lasting solution since the late 1970's and early 1980's (Lewis *et al.,* 1990; Western and Wright, 1994; Siachoono, 1995). The most appealing alternative approach for the conservationists was to establish agreements between communities living adjacent to wildlife areas and the conservation authority that promised co-operation, partnership and the equitable distribution of wildlife costs and benefits (IIED, 1994; Western and Wright, 1994; Leader-Williams *et al.*, 1996). However, before any alternative strategies can be implemented the relationship between the wildlife and the local people must be clearly understood.

In many parts of Africa, the conflict between local people and wildlife is probably the major conservation issue at the present. Conservation attitudes of local people living adjacent to wildlife habitats are strongly influenced by problems associated with wildlife (Newmark *et al.* 1993; Newmark, *et al.* 1994), which has been a source of long standing conflict with the local community (Matzke and Nabane, 1996). Local communities who are unable to control the losses and damage that may be caused by wildlife, are more likely to develop a negative attitude towards the wildlife and to the rules and regulations of wildlife conservation (Newmark *et al.*, 1993).

A number of studies have indicated that people who perceived benefits and enjoy unrestricted access to natural resources, usually support wildlife conservation efforts and protected areas (Kellert, 1985b; McNeelly, 1988; Hartup, 1994). For the conservation of natural resources to be effective, the attitudes of the local communities towards the conservation programme and, above all, their perceptions towards the resource to be protected must be studied so that the communities' perceived needs and aspirations can be taken into account (Infield, 1988; Fiallo and Jacobson, 1995).

In the previous chapters, I have shown that the people of Menz generally value the resources of the Guassa upon which they depend, and which they have traditionally managed through common property institutions (Chapter 3). Furthermore, I have shown that current levels of human use enhance the abundance of rodents that are a prey species to the Ethiopian wolf in many habitats (Chapter 7). Indeed, the ecology and social organisation of wolves in the human-dominated landscape of Guassa differs little from a disturbance-free area (Chapter 8), and Ethiopian wolves are generally little disturbed during interactions with humans and livestock (Chapter 9). Nevertheless, I have shown that current densities of Ethiopian wolf in Guassa are lower than in Bale Mountains (Chapter 8). Without any available data on trends in the Ethiopian wolf population of Guassa, we must recognise that this could be due to wide variety of as yet undetermined factors, including ecological or carrying capacity issues at one extreme, or persecution at another. Hence, this chapter aims to examine the attitudes of the Guassa user community to its wildlife in general, and to the Ethiopian wolf in particular, with the following aims:

- determining levels of support for, and hostility towards conservation of wildlife in general, and the Ethiopian wolf in particular; and,
- establishing factors that might determine such support and hostility, particularly in relation to different peasant associations, to distance from Guassa and to previous management experience of Guassa resource.

10.2 Materials and Methods

A structured and semi-structured questionnaire interview was as conducted among a sample of household heads from the Guassa user community (see Chapters 2 and 4). Questions were specially designed, and analysed separately to provide information on the attitude of the community towards the wildlife of Guassa in general and to the Ethiopian wolf in particular. The specific information sought included: knowledge about the wildlife species in the area; their present population status; whether wildlife in the area posed any problem to the community; and, what species were considered good and bad. Further specific information was also sought related to the Ethiopian wolf population in the area, including its population trend and the reason for any conflict (see Appendix II).

Data were analysed using descriptive statistics and responses were compared using Chi-square test. Logistic regression was used to model responses, as it provided a convenient way to undertake categorical data analysis. In practice the analysis and interpretation are quite similar to the well-known procedure of multiple regression (Freeman, 1987).

To find out how the community perceives the wildlife of the area, a dummy of the respondent's attitude, with 0 if the response was negative and 1 if the response was positive, was taken as dependent variable. The explanatory variables for the analysis included: peasant association; age; sex; length of residence in the area; education level; family size; distance of village from the Guassa area; total number of livestock owned; household capital; and, related responses to wildlife of the area. The likelihood ratio goodness of fit test of the model was described using the chi-square goodness of fit statistics (see Chapters 2, 4 and Appendix II).

10.3 Results

10.3.1 Attitude of the Menz Community towards Wildlife

10.3.1.1 Knowledge of Wildlife Species

Most of the common property resource users in Menz knew at least some of the wildlife species in their area (Table 10.1). A few respondents named only one to three species of wildlife, most named from four to six species of wildlife, while fewer named more than seven species. Knowledge of wildlife in the area differed (χ^2=67.37 df=14, p<0.001) between peasant associations. Residents of Dargegne and Gragne knew more species than respondents from other peasant associations (Table 10.1).

Table 10.1 Number of species named by the respondents in eight peasant associations.

Peasant Association	n	**1-3 Species** (%)	**4-6 Species** (%)	**>7 Species** (%)
Chare	50	32.0	40.0	28.0
Dargegne	80	5.0	65.0	30.0
Gedenbo	48	33.3	33.3	33.3
Gragne	52	11.5	75.0	13.5
Kewula	58	37.9	51.7	10.3
Kuledeha	56	46.4	35.7	17.9
Qwangue	92	23.9	46.7	29.3
Tesfomentier	44	45.5	40.9	13.6
Total	480	27.5	49.6	22.9

The age of respondents was important in determining knowledge of wildlife (χ^2=53.34, df=12, p<0.001). Younger respondents between the age of 15 – 20 years knew fewer species than older (>20 years) respondents. Male and female respondents knew different numbers of species (χ^2=9.59, df=2 p<0.001). Most (67.1%) male respondents named more species than female (42.9%) respondents. Those who had lived in the area for more than 50 years named more (χ^2=37.41, df=10, p<0.001) species than those who had lived there for shorter periods. Those who had attained secondary levels of education named more (χ^2=21.62, df=4, p<0.001) species than those who had attended only primary schools or had no education.

The distance from respondents' villages from the Guassa was associated with knowledge of wildlife species in the area (χ^2=40.40, df=3, p<0.001). Most respondents from nearby areas (<5 km) named more species than those respondents living far from the Guassa area (Table 10.2).

Table 10.2 Number of species named by respondents in relation to distance from Guassa.

Distance (km)	**n**	**1-3 Species (%)**	**4-6 Species (%)**	**>7 Species (%)**
≤5	194	15.5	54.1	30.4
6-10	110	27.3	53.6	19.1
11-15	76	34.2	39.5	26.3
>15	100	46.0	44.0	10.0

10.3.1.2 Trends in Wildlife Populations

Many (42.5%) respondents thought the wildlife of the Guassa area was increasing, while some (24.3%) respondents suggested that wildlife was decreasing, and a few (10.5%) respondents believed that the wildlife numbers were the same. However, 22.7% had no idea about the present status of the wildlife in the Guassa (Table 10.3). There was a marked difference (χ^2=115.54, df=21, p<0.001) in views between peasant associations. Most respondents from Gragne (69.2%) and Dargegne (62.5%) suggested the wildlife of the Guassa area was increasing. In contrast, few (4.2%) respondents from Gedenbo thought that wildlife was increasing and many (45.8%) thought that wildlife was decreasing (Table 10.3).

Table 10.3 Views on trends of wildlife populations among eight peasant associations.

Peasant Association	**n**	**Increasing (%)**	**Decreasing (%)**	**The same (%)**	**No idea (%)**
Chare	50	20.0	36.0	24.0	20.0
Dargegne	80	62.5	25.0	10.0	2.5
Gedenbo	48	4.2	45.8	20.8	29.2
Gragne	52	69.2	17.3	9.6	3.8
Kewula	66	33.3	21.2	42.4	3.0
Kuledeha	62	48.4	12.9	32.3	6.5
Qwangue	92	45.7	18.5	22.8	13.0
Tesfomentier	44	40.9	27.3	18.2	13.6
Total	494	42.5	24.3	10.5	22.7

The sexes held different views (χ^2=35.87, df=3, p<0.001) on the wildlife populations of the area. Most males (42.9%) thought that wildlife was increasing, while of the area indicating increasing, while few (19.6%) females thought so. However, there was no difference between different categories of age (χ^2=22.51, df=18, p>0.05), lengths of residence (χ^2=16.00, df=15, p>0.05) or education levels (χ^2=1.53, df=6, p>0.05).

The distance of the respondents' villages from Guassa was associated with different views on trends in the wildlife population (χ^2=29.79, df=9, p<0.001). Most respondents from nearby (<5 km) areas thought wildlife populations were increasing. However, as the distance from the Guassa increased, the proportion of respondents with no idea about the wildlife increased (Table 10.4).

Table 10.4 Views on trends of wildlife population in relation to distance from Guassa.

Distance (km)	**n**	**Increasing (%)**	**Decreasing (%)**	**The same (%)**	**No idea (%)**
≤5	194	50.5	21.1	11.3	17.0
6-10	110	40.0	33.6	9.1	17.3
11-15	84	26.2	31.0	11.9	31.0
>15	106	43.4	15.1	9.4	32.1

10.3.1.3 Problems with Wildlife

Most respondents (66.4%) had no problem with wildlife, but some 33.6% of respondents believed it to be problematic, and had a negative attitude towards the wildlife (Table 10.5). However, views on the problems with wildlife differed (χ^2=43.94 df=7, p<0.001) among peasant associations. Most (92.0%) people from Chare saw no problem with wildlife, whilst most (61.5%) people from Gragne saw problems (Table 10.5).

Table 10.5 Views on whether or not wildlife brings problems among the eight peasant associations.

Peasant Association	**n**	**No problem (%)**	**Wildlife brings problem (%)**
Chare	50	92.0	8.0
Dargegne	80	71.3	28.8
Gedenbo	49	53.1	46.9
Gragne	52	38.5	61.5
Kewula	62	71.0	29.0
Kuledeha	60	73.3	26.7
Qwangue	78	57.7	42.3
Tesfomentier	42	76.2	23.8
Total	473	66.4	33.6

The age of respondents was important in determining views on problems caused by wildlife (χ^2 =14.35, df=6, p<0.05). Young respondents (<20 years of age) had a more positive attitude towards wildlife than the older ones. The sex of respondents was also an important determinant of views (χ^2=22.34, df=1, p<0.001), with more males (74.3%) having a more positive attitude than females (53.1%). However, there was no difference in views on whether wildlife was problematic related to length of residence (χ^2=9.75 df=5, p>0.05) or education levels (χ^2=3.19, df=2, p>0.05).

The distance of the respondents' villages from the Guassa was associated with their views on whether or not wildlife was a problem (χ^2=12.65, df=3, p<0.05). Respondents living far (>15km) from the Guassa area generally had no problem with the wildlife (78.0%) compared with those people living nearest the Guassa area (Table 10.6).

Table 10.6 Views on whether or not wildlife brings problems in relation to distance from Guassa.

Distance (km)	n	No problem (%)	Wildlife brings problem (%)
≤5	180	67.8	32.2
6-10	109	55.0	45.0
11-15	84	64.3	35.7
>15	100	78.0	22.0

Various reasons were given as to why the wildlife is problematic: 37.1% said carnivores like jackals, wolves, and hyenas attack their livestock; 29.6% respondents said porcupines, baboons and rodents breeding in the Guassa area affects their crop; 20.1% considered that wildlife brings disease to humans and to livestock; and, 13.2% blamed wildlife species, especially rodents and baboons, for competing for grazing land.

10.3.1.4 Support for Wildlife Conservation

Views on support for wildlife conservation were evenly divided amongst the community (Table 10.7). However, there was a difference in support for conservation between peasant associations (χ^2 =30.47, df=7, p<0.001). Most respondents from Tesfomentir (77.3%) and Kuledeha (67.7%) supported wildlife conservation. However, most of the respondents from the other peasant associations did not support wildlife conservation (Table 10.7).

Table 10.7 Views of participants on whether or not wildlife is a useful resource to be conserved in the eight peasant associations.

Peasant Association	n	Not conserve (%)	Conserve (%)
Chare	50	56.0	44.0
Dargegne	80	52.5	47.5
Gedenbo	50	56.0	44.0
Gragne	52	65.4	34.6
Kewula	64	56.3	43.8
Kuledeha	62	32.3	67.7
Qwangue	92	57.6	42.4
Tesfomentier	44	22.7	77.3
Total	494	50.8	49.2

Views on support for wildlife conservation also differed between the sexes (χ^2=26.96, df=1, p<0.001), and most (58.3%) male respondents supported wildlife protection, while few (34.2%) female respondents did so. However, age of respondents (χ^2=3.12, df=6, p>0.05), length of residence in Menz (χ^2=4.32, df=5, p>0.05) and education level (χ^2=2.75, df=2, p>0.05) were not associated with support towards wildlife conservation.

The distance of respondents' villages was important in determining support for conservation (χ^2=19.94, df=3, p<0.001). People living >10km from the Guassa area showed more support for wildlife conservation, whereas most respondents living <10km from the Guassa area did not support wildlife conservation (Table 10.8).

Table 10.8 Views of respondents on wheather or not to support wildlife conservation in relation to distance.

Distance (km)	n	Not conserve (%)	Conserve (%)
≤5	194	55.2	44.8
6-10	110	63.6	36.4
11-15	86	41.9	58.1
>15	104	36.5	63.5

Various reasons were given as to why wildlife conservation was important (Figure 10.1). For most respondents, the economic value of wildlife to generate income from tourism was the main reason for supporting wildlife conservation. Other important reasons for conserving wildlife in the area were: the provision of wildlife meat; avoiding breaking government protection laws; and, job opportunities arising from wildlife conservation; Ethical and aesthetical values of wildlife were also mentioned in the form of: wildlife has a right to live; it reduces evil; provides opportunities for prestigious hunting; and, they are nice to see (Figure 10.1).

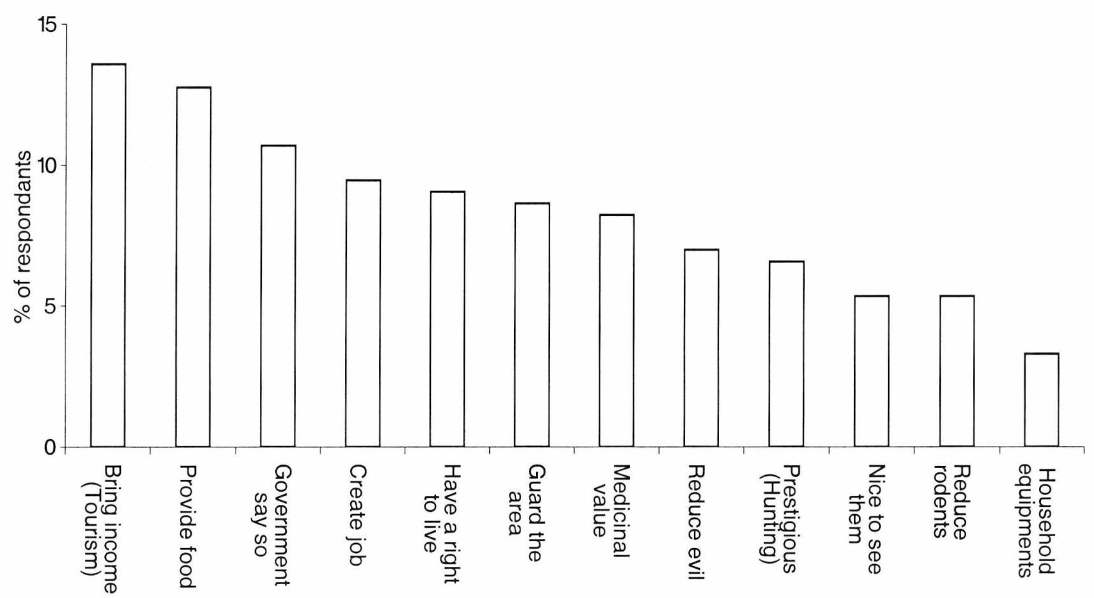

Figure 10.1 Reasons for supporting wildlife conservation in the Guassa area.

Few of the respondents (32.0%) had participated in wildlife conservation seminars or workshops at the district or peasant association level. Of those people who have attended a seminars or workshops the majority (83.5%) had a positive attitude towards wildlife conservation in the area.

10.3.2 Attitude of the Menz Community towards the Ethiopian Wolf

10.3.2.1 Trends in Ethiopian Wolf Population

Most (64.0%) of the respondents thought the Ethiopian wolf population was decreasing in the Guassa area, while only 36.0% thought the population of the wolf was increasing. The residents of the eight peasant associations did not show a significant difference (χ^2=9.58, df=7, p>0.05) in their views of the status of Ethiopian wolf (Table 10.9). No significant difference was observed among different age groups (χ^2=9.29, df=6, p>0.05), sexes (χ^2=0.21, df=1 p>0.05), length of residence in the area (χ^2=10.13 df=5 P>0.05) education level (χ^2=1.16, df=2, p>0.05), and distance from Guassa (χ^2= 6.4, df=3, p>0.05) Table 10.10)

Table 10.9 View on trends in Ethiopian wolf population among the eight peasant associations.

Peasant Association	n	Decreasing (%)	Increasing (%)
Chare	34	70.6	29.4
Dargegne	67	56.7	43.3
Gedenbo	25	84.0	16.0
Gragne	39	69.2	30.8
Kewula	56	60.7	39.3
Kuledeha	45	66.7	33.3
Qwangue	67	55.2	44.8
Tesfomentier	32	68.8	31.3
Total	364	64.0	36.0

Respondents thought various factors were responsible for the decline of the wolf population in the Guassa area (Figure 10.2). The majority of respondents who considered that the wolf population had declined attributed this to: habitat destruction; the civil war that was going on in the area; drought; and, disease. Poisoning and direct killing were also considered as important factors. A few respondents thought predators were responsible for the decline and some had no idea (Figure 10.2).

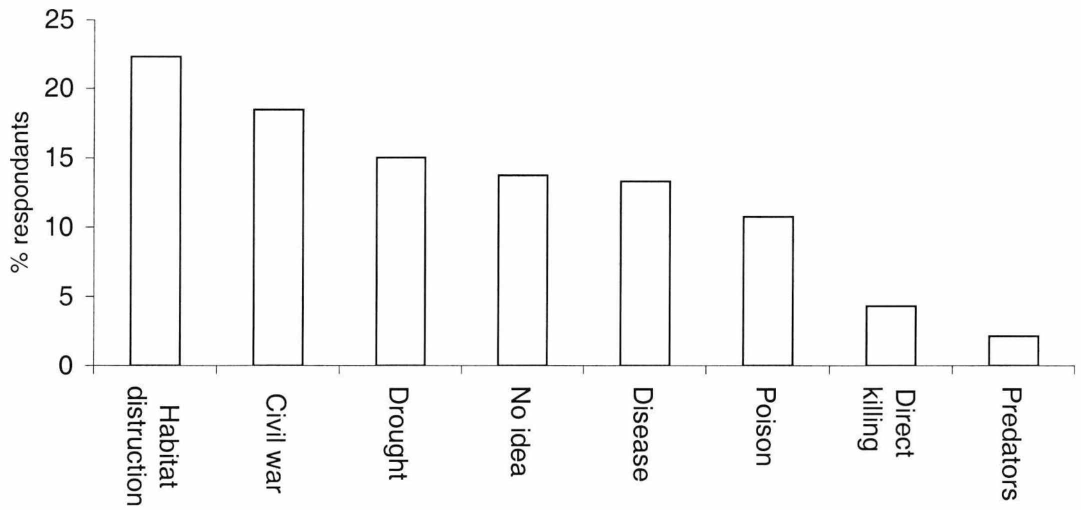

Figure 10.2 Factors identified by respondents as responsible for the decline of the Ethiopian wolf population in the Guassa area.

Among the participants who thought the wolf population was increasing, a few (7.6%) attributed this to the lack of any enemy for the wolf in the Guassa, and a few (3.0%) attributed the increase to the protection of the Guassa area by the community. However, most (87.7%) had no idea as to why the population of Ethiopian wolf is increased.

10.3.2.2 Support for Ethiopian Wolves

Support for Ethiopian wolves was fairly evenly divided among the community, with a slight majority (55.8%) supporting the wolf as a good species. However, attitudes between residents of the eight peasant associations towards to the wolf showed a significant difference (χ^2=34.54, df=7, P<0.001). Most residents from Gedenbo (84.0%), Tesfomentir (69.6%), Gragne (59.3%), Kuledeha (56.3%) and Dargegne (56.1%) considered the Ethiopian wolf a good species (Table 10.10).

Table 10.10 Attitude of respondents from different peasant associations towards the Ethiopian wolf.

Peasant Association	n	Good species (%)	Nuisance species (Bad) (%)
Chare	52	44.0	56.0
Dargegne	82	56.1	43.9
Gedenbo	50	84.0	16.0
Gragne	54	59.3	40.7
Kewula	66	54.5	45.5
Kuledeha	64	56.3	43.8
Qwangue	92	38.0	62.0
Tesfomentier	46	69.6	30.4
Total	504	55.8	44.2

There was a difference (χ^2=3.94, df=6, P<0.05) among different age categories, as to whether the Ethiopian wolf was considered a good or nuisance species. Most (78.6%) respondents >70 years of age considered the Ethiopian wolf a nuisance species, while most (69.8%) respondents of 15-20 years of age considered the Ethiopian wolf a good species. There was also a difference (χ^2=10.55, df=1, p<0.001) between the sexes, with most (61.4%) male considered the wolf a good species. People with different levels of education also held different views (χ^2=8.30, df=2, p<0.05). More respondents with no education (59.7%) or with secondary levels of education (54.5%) supported Ethiopian wolf as good species than those who had attended only primary level of education (44.8%). However, length of residence in Menz was not associated with different views (χ^2=8.94, df=5, P>0.05) about the wolf.

The distance from respondents' villages from the Guassa was also associated with different levels of support for the Ethiopian wolf (χ^2=11.864, df=3, p<0.01). As the distance from the Guassa area increased, more respondents regarded the Ethiopian wolf as a good species (Table 10.11).

Table 10.11 Respondents considering Ethiopian wolf as good and nuisance species in relation to distance from the Guassa area.

Distance (km)	**n**	**Good species (%)**	**Nuisance species (Bad) (%)**
≤5	196	46.4	53.6
6-10	112	58.9	41.1
11-15	86	62.8	37.2
>15	100	63.6	36.4

Various reasons were put forward by respondents as to why the Ethiopian wolf was good species (Figure 10.3). These included its potential for tourism, its endemic and heritage value and its utilitarian value in controlling rodents. Among the people who thought that the Ethiopian wolf was a bad species, most (84.8%) gave sheep predation by the wolf as their main reason. However, 15.2% responded that the Ethiopian wolf has no value whatsoever and did not think it is worth conserving.

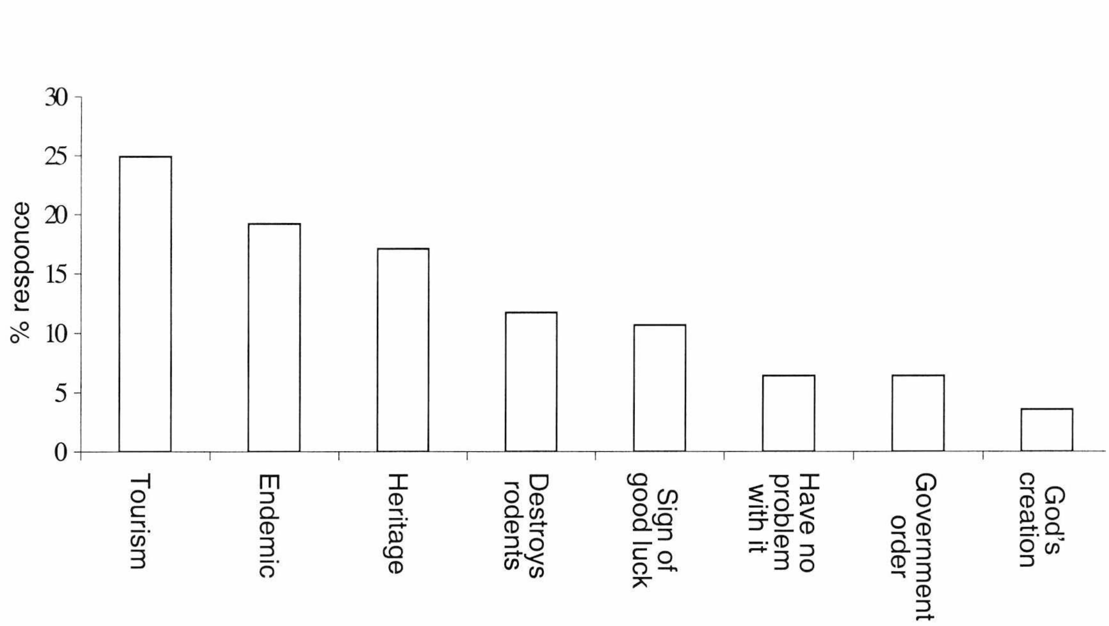

Figure 10.3 Reasons why the Ethiopian wolf is a good species.

10.3.2.3 Sheep loss to Ethiopian Wolves

Few (14.5%) households had lost sheep to the Ethiopian wolf in the last 10 years. Of these, 8.1% (n=86) of households said they had lost sheep in the last year, 26.7% within the last five years, and 65.1% in the last 10 years. Most (83.6%) reports were of one lost sheep, and the rest (16.4%) were of two lost sheep. Sheep loss per household was estimated to be 0.01% per year or 0.2% over the total reported period (10 years). However, peasant associations reported different levels (χ^2=31.84, df=7, p<0.001) of sheep loss over the last 10 years. More sheep loss over the last 10 years was reported in Chare (28.0%), Dargegne (22.0%) and Qwangue (20.7%), while no loss was reported in Tesfomentir (Table 10.12).

Table 10.12 Proportion of respondents who reported lost sheep to the Ethiopian wolf from eight peasant associations.

Peasant Association	**n**	**Yes (%)**	**No (%)**
Chare	50	28.0	72.0
Dargegne	82	22.0	78.0
Gedenbo	50	16.0	84.0
Gragne	54	14.8	85.2
Kewula	62	6.3	93.8
Kuledeha	64	3.1	96.9
Qwangue	92	20.7	79.3
Tesfomentier	46	0.0	100.0
Total	502	14.5	85.5

The distance of respondents' village from the Guassa area was associated (χ^2=20.08, df=3, p<0.001) with reported loss of sheep. As distance from Guassa increased the proportion sheep of reported lost to Ethiopian wolves decreased (Table 10.13).

Table 10.13 Proportion of respondents who reported lost sheep to the Ethiopian wolf in relation of distance form the Guassa area.

Distance (km)	**n**	**Lost sheep (%)**	**Not lost sheep (%)**
≤5	196	22.4	77.6
6-10	112	20.5	79.5
11-15	86	4.7	95.3
>15	108	1.9	98.1

Among the respondents, 41.9% reported lost livestock to other species of wildlife in the area over the last 10 years. The species listed as being most problematic were: common jackals *Canis aureus* accounting for 40.3% of reports; spotted hyena *Crocuta crocuta* accounting for 36.0%; both common jackals and spotted hyena 19.0%;

Egyptian mongoose 1.0%; and, unknown 3.8%. Jackals have attacked sheep, and hyena attacks any form of livestock.

10.3.2 Factors Determining Attitudes towards Wildlife and Ethiopian wolf in Menz

The model for factors that might have played a role in determining whether or not wildlife bring problems explained 69.3% of the variance, and the likelihood ratio goodness of fit test showed good fit for the model (P<0.001). The peasant associations in which the respondents reside the sex and family size of the respondents were important in determining their views on problems (Table 10.14). Respondents from Chare were least likely to consider that wildlife brought problems, while respondents from Gedenbo and Gragne were most likely to believe it did bring problem. Furthermore, males were more likely to believe that wildlife brings problem than females.

Table 10.14 Factors determining views of respondents on whether or not wildlife brings problem, based on a logistic regression.

Variable	B	SE	df	Significance
Peasant Association			7	0.000***
Chare	-1.51	0.65	1	0.021*
Daregegne	0.11	0.46	1	0.812
Gedenbo	0.99	0.48	1	0.040*
Gragene	1.58	0.48	1	0.001**
Kewula	0.39	0.47	1	0.415
Kuledeha	0.35	0.48	1	0.477
Qwangue	0.63	0.44	1	0.158
Tesfometer	0	-	0	-
Sex (Male)	1.08	0.23	1	0.000***
Family size	-0.09	0.05	1	0.115
Constant	-0.35	0.56	1	0.533

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

The model for factors might have played a role in determining whether or not wildlife conservation should be supported (Table10.15) explained 76.3% of variance, and the likelihood ratio goodness of fit test shows a good fit to the model (P<0.001). The peasant association in which the respondents reside was important in determining support, which was lacking across all peasant associations (Table10.15). Older people supported wildlife conservation, as did those who had attended a workshop or seminar on wildlife conservation.

Table 10.15 Factors determining views of respondents on whether or not conserving wildlife is worthwhile, based on a logistic regression.

Variable	B	SE	df	Significance
Peasant Association			7	0.000***
Chare	-1.88	0.54	1	0.005**
Daregegne	-1.75	0.49	1	0.004**
Gedenbo	-2.13	0.55	1	0.001***
Gragene	-2.46	0.53	1	0.000***
Kewula	-2.24	0.56	1	0.000***
Kuledeha	-1.40	0.50	1	0.029*
Qwangue	-1.95	0.01	1	0.001***
Tesfometir	0	-	-	0
Age	0.02	0.01	1	0.025*
Workshop or Seminar attended (yes)	2.44	0.28	1	0.000***
Constant	3.08	0.67	1	0.000***

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

The model for factors that might have played a role in determining knowledge of the Ethiopian wolf's population trend in the Guassa area (Table 10.16) explained 64.2% of the variance, and the likelihood ratio goodness of fit test shows a good fit to the model (P<0.01). Attending a workshop or seminar about wildlife conservation and past experience of losing sheep to Ethiopian wolf were important in determining knowledge of population trends for the Ethiopian wolf (Table 10.16). Hence, those who had attended a workshop or seminar and those who had lost sheep to Ethiopian wolf were more likely to say the Ethiopian wolf population is decreasing in the Guassa area.

Table 10.16 Factors determining knowledge of Ethiopian wolf population trend, based on logistic regression.

Variables	**B**	**SE**	**df**	**Significance**
Workshop or seminar attended (yes)	-0.53	0.24	1	0.024*
Lost sheep to Ethiopian wolf (yes)	-0.64	0.30	1	0.036*
Constant	0.26	0.31	1	0.406

Level of significance shown with *= P<0.05.

The model for determining view of respondents on whether Ethiopian wolf is a good or bad species explained 72.1% of the variance and the likelihood ratio goodness of fit test showed a good fit to the model (P<0.0001). The peasant associations in which respondents reside, level of education, attending a workshop or seminar on wildlife conservation, support for wildlife conservation and losing sheep to Ethiopian wolf where important to determine attitude of respondents towards the Ethiopian wolf (Table 10.17). Respondents from Gedenbo are more likely to say Ethiopian wolf is a good species, while respondents from Kuledeha and Qwangue are more likely to say Ethiopian wolf is a bad species. Likewise, respondents who attended workshop or seminar on wildlife conservation and those who supported wildlife conservation are more likely to say the Ethiopian wolf is a good species, while respondents who reported lost sheep are more likely to say Ethiopian wolf is a bad species.

Table 10.17 Factors determining views of respondents on whether the Ethiopian wolf is good or bad species, based on logistic regression analysis.

Variables	B	SE	df	Significance
Peasant Association			7	0.000***
Chare	-0.28	0.51	1	0.591
Dargegne	0.19	0.47	1	0.672
Gedenbo	1.55	0.58	1	0.075*
Gragene	0.38	0.52	1	0.455
Kewula	-0.17	0.50	1	0.726
Kuledeha	-1.01	0.50	1	0.040*
Qwangue	-1.27	0.48	1	0.007**
Tesfomenter	0.0	-	0.0	-
Education			2	0.003**
No Education	-0.1725	0.59	1	0.757
Primary level of education	-1.1417	0.62	1	0.079
Secondary or above education	0.0	-	-	-
Workshop or seminar attended (yes)	1.4522	0.28	1	0.000***
Support wildlife conservation (yes)	1.04912.	0.26	1	0.001***
Lost sheep to Ethiopian wolf (yes)	-1.3974	0.35	1	0.000***
Constant	1.7082	0.39	1	0.000***

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

The model for factors that might have determined reports of sheep loss by households (Table 10.18) explained 85.4% of the variance, and the likelihood ratio goodness of fit test showed a good fit to the model (P<0.001). Distances from the Guassa area and previous livestock loss to other wildlife were important in determining reports of sheep loss to the Ethiopian wolf (Table 10.18). Hence, those households found near to Guassa are more likely to report sheep loss than households found further away from

Guassa, and those households who have lost livestock to other wildlife, are more likely to lose livestock to Ethiopian wolves as well.

Table 10.18 Factors determining sheep loss to households, based on logistic regression.

Variables	B	SE	df	Significance
Distance form Guassa	-0.11	0.02	1	0.000***
Lost livestock to other wildlife (yes)	1.38	0.29	1	0.000***
Constant	-1.75	0.28	1	0.000***

Level of significance shown with *= P<0.05, ** =P<0.01, ***=P<0.001.

10.4 Discussion

Studies of attitudes to wildlife are increasingly common, but studies of attitudes of common property resources users to the demise of their regimes in the face of modernising forces (Chapter 3) and of humans conducting their activity of resource harvesting (Chapter 5) among population of the Ethiopian wolf, have not been conducted previously. The results of this study have shown clearly that the community around the Guassa area knows about the wildlife of the area and does not have many problems with it, yet they do not they support wildlife conservation for various reasons. The Menz community considered that the Ethiopian wolf population in the Guassa area is decreasing. However, most respondents have a positive attitude towards the wolf, but attitudes are determined by: the peasant association from which they came; education level; attending a workshop or a seminar on wildlife; their support to wildlife conservation; and, past experience of losing sheep to the Ethiopian wolf.

10.4.1 Attitude of the Menz Community towards the Wildlife

Most of the residents knew the wildlife of the area, but of the peasant associations, residents of the near by Quangwe and Dargegne knew most species found in the Guassa area (Table 10.1). These two peasant associations live very close to the Guassa area (see Table 3.1) and they are more likely to spend more time in the Guassa area than those living further away. Therefore, the distance from the village to the Guassa area is also important in determining their knowledge (Table 10.2). Furthermore, the young respondents knew fewer species than the older generation, possibly be due to the accumulated knowledge of the older people.

Most respondents did not think that wildlife brought problems and had a positive attitude towards the wildlife of the area (Table 10.5). The logistic model predicted that residents of Chare Peasant Association residents are most likely to have a positive attitude towards the wildlife. In contrast, residents of Gedenbo and Gragene peasant associations are more likely to consider wildlife as problematic (Table 10.14) Male residents of Menz are more likely to consider that wildlife is problematic than females. Hence males are more likely to have a negative attitude towards wildlife. Family size was important to determining views on wildlife. As larger families will have extra labour to look after crops or livestock, they are not likely to suffer crop and livestock loss as much as smaller families.

Only 49.2% of respondents supported wildlife conservation in the area and the logistic model showed that all peasant associations had a negative attitude towards wildlife conservation (Table 10.15). In similar way, in Natal, South Africa, 68% of the 182 people surveyed felt wildlife conservation was an unimportant initiative (Infield, 1988). The negative attitude of the Menz community towards wildlife conservation may have emanated from a fear of losing the area to wildlife conservation interests. The common practise in the country is for areas of wildlife conservation to exclude any type of community resource use. The community adjacent to Guassa already has previous experience of being excluded from resources in the name of conservation. For example, the state forest, close to the Guassa area does not allow the community any type of resource appropriation at present. The negative attitudes towards conservation could also be as a result of experience of the being forced to pay fines by the district forest department if cattle were found grazing or if people collected fallen branches. In other situations, a considerable area has been kept aside as natural enclosure following severe erosion in the 1980s in Menz. After a few years of complete protection, these natural enclosures started to grow high quality grass. Therefore, the community requested to use the grass but the conservation authorities declined to grant permission. When the civil war irrupted in the area from 1989 to 1991, the community went back and destroyed the natural enclosures through overgrazing in a few weeks. Hence, the community has developed a fear and mistrust of conservation practises in the locality. The community is strongly opposed to any exclusion from the resource and this has been repeatedly mentioned in group discussions with the community.

Restricted access to natural resources in protected areas by outsiders has frequently resulted in negative attitudes towards conservation by communities. Fear of exclusion from the resource has developed to shape their attitude towards wildlife conservation (Fiallo and Jacobson, 1995). Three important situations have been described for communities not to be interested in conservation. First, if the communities' raised expectations are not met; second, if it involves more costs than benefits; and, third, if they do not clearly understand the programme (Songorwa, 1999). Whatever the objective of the conservation endeavour may be, local people have little incentive to support conservation unless they gain out of the conservation effort or, at least, are not deprived of benefits they already enjoy (Tisdell, 1995; Badola 1998).

10.4.2 Attitude of the Menz Community towards the Ethiopian Wolf

The Menz community generally believes that the Ethiopian wolf population in the Guassa area is decreasing. This understanding of the Ethiopian wolf's population trend was common across all groups in community (Tables 10.9).

The logistic model showed that those people who had attended workshops or seminars at various levels, and those who had lost sheep to Ethiopian wolf were more likely to think the population of the Ethiopian wolves in the Guassa area is decreasing (Table 16). Attending a workshop or seminar or any informal discussion with the community helps comparisons between what they used to know and what is there now, and to initiate discussion among the community about the status of the wolf. Those people who have lost sheep are more likely to notice any decrease in incidents of sheep loss, and take this as an indicator that the wolf population in the area has decreased.

Various factors were thought to have caused the decline of the wolf population in the Guassa area. Habitat destruction, particularly as a result of the increased number of livestock just after the decline of the *Qero* system, and the recurrence of drought, has been mentioned as important for the decline of the wolf population. Persecution of the Ethiopian wolf during the civil war of 1989 to 1991 in the area has also been mentioned as important factor. A military force was stationed in the Guassa area from 1989 to 1991. They reportedly killed lots of wildlife, mostly wolves, gelada baboons and spotted hyenas, for fun and, although illegal, nobody stopped this activity. The military stationed in the Guassa area at that time also used anti-personnel mines that have since killed much wildlife. Respondents indicated that many hyenas have been killed by these mines. Although some areas are still thought to have mines, no human or wildlife incidents were reported during this study. Possession of modern firearms since end of the civil war may also account for some past killing of wolves. However, direct persecution of wolves at the moment does not seem to be an important factor as far as the population of Ethiopian wolf in the Guassa area is concerned.

A substantial number of the respondents indicated disease as an important factor for the decline of the wolf population in the area. Among known canid diseases, rabies has been noted by most respondents as the most common disease in the area. Rabid dogs are usually killed by the owner or by any member of the community. However, in some cases, the rabid dog may not be identified soon enough and will remain with the livestock in the Guassa area and then transmit diseases to the wolf. Many of our key informants and group discussion participants indicated seeing domestic dogs fighting with wolves and described this situation as a possible way of transmitting the disease. No participants mentioned seeing sick wolves in the area.

An epidemiological study of domestic dog disease in Menz indicated that, among the 179 sampled dogs, 11.7% were positive for Canine Distemper Virus (CDV), 23.8% for Canine Adenovirus (CAV), and 81.0% for Canine Parvovirus (CPV). Rabies incidence has been low, and among 78 dogs sampled only 2.6% were found positive. The reported pattern of rabies cases has been lower in Menz than in Bale Mountains, where rabies appears to be endemic and occurs frequently. The higher dog density in the Bale Mountains may explain this difference (Sillero-Zubiri *et al.*, 1996a; Laurenson *et al.*, 1998; Marino *et al.*, 1999).

Poisoning of wolves has been mentioned by respondents as a reason for the decline of the wolf population in the Guassa area. The community has identified two forms of poisoning. Poison may be used to control the rodent population in areas adjacent to Guassa and may be used to directly to kill wolves. Poison is extensively used by the community to control rodents in agricultural fields. This may kill birds of prey and Ethiopian wolves. Birds die after eating poisoned rodents, and wolves will pick up the carrion of birds. Direct application of poison was mentioned, and the experience was cited of a farmer who lost sheep and poisoned the carcass of the sheep with Malathion

(Organo chlorophosphate compound), a chemical commonly used to control rodents, in order to kill two wolves he thought had killed his sheep.

Predation of wolf pups by birds of prey has also been mentioned as important in the decline of Ethiopian wolves population in the Guassa area. Wolf pups come out of their den from the age of 4 weeks and they are usually guarded at least by one parent. However, when the parents leaves to forage, the pups may be exposed to predators. With an abundant rodent density, there is an exceptionally high density of avian predators in the area. Eagles are mentioned as the prominent predator of wolf pups in the area, and there is a high density of greater-spotted eagle *Aquila clanga,* and tawny eagle *Aquila rapax.* Imperial eagle, *Aquila heliaca,* Verreaux's eagle, *Aquila verreauxii* and Wahlberg's eagle, *Aquila wahlbergi,* are also found in less numbers in Guassa. However, no sightings were made of eagles or of other predator attacking wolf pups in this study.

Respondents who considered that the wolf population in Guassa was increasing, generally thought that the absence of an enemy was the main reason for the increased population. The traditional management system that has prevailed in the area was also mentioned as an important reason. It is encouraging that the Ethiopian wolf is generally considered a good species among the Menz community. However, opinions differ greatly among peasant associations (Table 10.10). Modelling the responses of participants using the logistic regression model indicated that participants from Kuledeha and Qwangue had a negative attitude towards the wolf. Those who have lost sheep to the wolf are more likely to consider the wolf a nuisance. Participants who considered that the wildlife conservation was important in the area were also more likely to consider the Ethiopian wolf as good species. Also, those who had attended workshops or seminars were more likely to say the Ethiopian wolf is a good species. In contrast, those who had lost sheep are more likely to consider the wolf a nuisance (Table 10.17).

Future anticipated development of tourism, which it is assumed will bring income to the area, is the most important reason mentioned by respondents for considering the wolf as a good species. At the moment, there is no tourist activity in the Guassa area. However, the community expects this to develop and to attract tourists from the nearby urban centres and from outside the country. Likewise, students in Tanzania and farmers in Rwanda believe the main value for wildlife conservation is development of tourism (Harcourt *et al.*, 1986).

A reasonable number of the respondents knew that the Ethiopian wolf is an endemic species and considered it a natural heritage to be protected. Others see its importance from the point view of destroying rodents, and suggested that, had it not been for the wolf, it would have been very difficult for them to grow any crops and or to find any grazing land in Guassa area, which would have been devoid of any grass.

The Ethiopian wolf plays an important role in the culture of the Menz community. If a wolf is seen on farmland it is considered as sign of good harvest. Due to this belief people usually refrain from attacking wolves around farmland and homesteads. However, it is rarely found close to human habitation. Another important belief about the wolf is that if a wolf crosses your way while travelling it is considered a sign of a good luck and indicates the fulfilment of your journey. This belief is unique to Menz, since if a wolf or jackal crosses someone's path in the southern part of the country is a sign of bad luck. For example, in Bale Mountains lorry drivers crossing have been reported to kill wolves to avoid being crossed on the road by wolves (Hillman, 1986).

The Ethiopian wolf is important species in Menz folklore. It is frequently mentioned in many of the traditional folksongs and parables, and is depicted as a beautiful and tricky animal. An old informant informed us that the skin is used to make the parchment in witchcraft. A few key informants said that a small piece of wolf or jackal liver can be used to treat rabies. However, people who described this said they have not killed wolf for such a purpose. Similarly, the use of wolf liver medicament has been mentioned in the Simen Mountains (Stäehli, 1975).

Sheep predation is the most important reason for the community to consider the Ethiopian wolf as a nuisance species. However, only a small proportion of the respondents (14.5%) reported having lost sheep to the Ethiopian wolf (Table 10.12), while 41.9% reported having lost livestock to other wildlife species. Common jackals and spotted hyenas are the species that are implicated as being the major nuisance species in the area. The negative attitude towards wolves is a sentiment generally motivated by fear of economic loss. Despite this perception, the wolf constitutes a minor problem compared to other predators in the area. Those people who have lost livestock are more likely to have negative attitude towards the conservation of wildlife and specifically of predators in the area. In communities with a subsistence economy even small losses can be of economic importance and can generate negative attitudes towards wildlife and conservation in general. (Mishra, 1982; Oli *et al.*, 1994).

Reports of losing livestock to wolves negatively correlated with distance from the Guassa (Table 10.13, and 10.18). Those people who have lost sheep are more likely to have lost livestock to other predators as well. Hence, peasant associations close to the Guassa area were likely to describe the wolf as a nuisance species. With increasing distance from wolf range, there is a more positive attitude towards the species. A study in Yellowstone National Park also showed that distance was a significant predictor of willingness to support restoration of wolves (Bath and Buchanan, 1989).

Education level was the most important predictor found in other studies of attitudes to conservation (Kellert, 1985b). In this study, education has not significantly shaped attitudes towards the wolf. This is not very surprising, since most of the households in the survey were illiterate and the number of educated people in the area was too low to make any significant impact. However, education and age seem to be positively associated with a recognition of the wolf as a conservation problem. Increased diffusion of information about the conservation of wildlife had a significant effect on the perception of the community.

The total amount of livestock lost to Ethiopian wolf in Menz (0.01/year/ household) is very small compared to livestock losses to other predators. Predation by snow leopard *Panthera uncia* in the Himalayan Highlands takes 0.7 animals per household, as a result of which more than 60% of the community has a negative attitude towards the snow leopard (Oli, *et al.*, 1994). Annual predation rates of up to 7.6% of sheep and goats per household in China have a significant effect on attitudes and on the economies of households (Schaller *et al.*, 1987). Obtaining an objective assessment of the numerical and economic loss of livestock to predators has always presented a problem. It is particularly difficult to separate predation as a proximate cause of loss from ultimate causes such as disease, nutrition, weather, or accident. Many predators may take injured or sick individuals or scavenge (Kruuk, 1972; Oli *et al.*, 1994). Also in an area dominated by different species of predator, it can be very difficult in some instances to find out which species is responsible. The direct quantification of predator impact is rarely possible and rates of loss reported may be deliberately inflated or fail to distinguish between proximate and ultimate causes. In this study, for example, we requested the community to report any loss of livestock to Ethiopian wolf. However, over two years no wolf predation was reported.

Chapter Eleven

11 Research Findings and Conclusions

The Ethiopian Highlands provide an example of a severely degraded environment. Vegetation cover has been reduced to 2.7% of its original surface area, some 50-60% of rainfall is wasted as run-off, carrying an estimated 2-3 billion tonnes of topsoil annually, which has resulted in unprecedented decline in agricultural productivity (Wolde-Mariam, 1991; Hurni, 1987). In future, this poses important implications for food security and famine in the country. The Ethiopian Highlands are also unique in terms of the biodiversity they support. Much of the unique Afro-alpine habitat is under threat as a result of expanding human activities and a change in the land management system, with some estimates suggesting that within 20 years, 65% of the remaining Afro-alpine habitat will be lost (Hurni, 1987). However, people and the biodiversity have co-existed in some areas for many millennia, and people in these areas have been managing their resources in a wise and responsible way through traditional practices. People following such practices are despairing as a result of social, economical and political changes imposed from outside. However, some areas still maintain some of the practices under tremendous pressure from outside modernising forces. It is one such area, the Guassa area of Menz, in which this study was based, and where a common property management regime is operating.

11.1 Common Property Resource Management

This study has documented the presence of, and the subsequent changes that have affected, a common property resource regime in the Guassa area of Menz that was managed under an indigenous institution known as the *Qero* system (Chapter 3). The *Qero* system allowed equitable use and distribution of highly sought natural resources that were, and still are, important for the livelihood security of the community. This was achieved by a set of rules and regulations for resource appropriation based around the prevailing traditional land tenure and property rights regime. The rules were simple and provided for protection with controlled utilisation, as well as for their enforcement, and there were essential aspects of the traditional management system for common property resources.

Following the 1974 revolution in Ethiopia, the Agrarian Reform of 1975 brought a change in the land tenure system of the country that abolished communal ownership of land, as well as the associated common property resource management institutions. Using land reform as means to promote equality, the government over-stepped its bound and meddled with the right of communities to land and other resources. The state disregarded individual and communal holdings, at the same time undermining the legitimacy of traditional systems and institutions. To the same degree that such measures failed to protect individual and communal property, state property also suffered from lack of social sanction and suffered ultimate destruction. Hence, the state brought about the destruction of the livelihoods of the people and this lead to an unprecedented environmental crisis, particularly in the highlands.

When it became apparent that the resources on which the communities in the Guassa area depended were under threat, the communities, rather than contributing to the demise of the resource, confronted the state to demand proper management. Indeed, the community put into effect their own emergency management regime and formed the Guassa Committee. The community reaction to destruction of the management of their life support system follows previous descriptions of well-functioning common property resource regimes. These indicate an ability to accommodate surprise or sudden shocks, which increase the resilience and stability of the system caused by modernising forces (Gibbs and Bromley, 1989).

The majority of the communities adjacent to the Guassa area believe that the *Qero* system was more effective than the present day management (Chapter 4). However they have also noted the difficulty of returning to the *Qero* system with its particular institutional base and bye-laws. Nevertheless, the communities still prefer full community control over the management of the Guassa area, that in turn requires intensive community re-empowerment to enable decision-making, implementation and enforcement.

11.2 Common Property Resource Use Pattern

The livelihood of the Menz community is heavily associated with the resources found in the Guassa area. These include: grass for roof thatching, household materials and farm implements; fuelwood; and, grazing grounds (Chapter 5). The entire community of Menz obtains its grass, with which nearly all the houses in Menz are thatched, from the Guassa area. Hence, the community frequently refers to the *Festuca* grass as "*our cloth bread and butter* ". As the prices for other alternative roofing materials are very expensive, the community will continue to depend on the Guassa area grass for thatching for the foreseeable future. Nevertheless, cutting grass for thatching and sale at market does not seem to result in over exploitation of the resource at present (Chapter 7).

The Menz community also depends on the Guassa area as a source of fuel. However the type of vegetation collected is low quality fuel, so many households have to supplement this low quality fuel with livestock dung. A few households have a private wood-lot and such households do not depend on the Guassa area for fuel. There was once no incentive to plant trees in homestead areas as they lacked any clear ownership. In turn, this has increased the degree of dependence on the shrubby vegetation of the Guassa area for fuel. However, households have now started planting trees for fuel and other purposes, since trees planted around homesteads now belong to the person who planted them.

Finally, the Guassa area is an important refuge and grazing ground for the livestock of the adjacent communities. With repeated redistributions of land to allow for the increasing human population, the land available for grazing and farming has decreased in the past few decades, which in turn has increased the importance of the Guassa area. Grazing in the Guassa area follows a seasonal pattern (Chapter 5). Most grazing occurs at the height of the dry season and early wet season, when private grazing land and other sources of fodder run out. Recurring of droughts in the region also exert pressure on the length of time that livestock can stay in the Guassa, as well as on the opening date of the Guassa area for grazing. The present stocking density of livestock in the Guassa area seems to be at equilibrium with the expected livestock stocking density of similar areas (Chapter 7). The seasonal movement of livestock in and out of Guassa has helped to regulate the extent of grazing.

Rural populations in many parts of Africa have met their survival requirements from their surrounding area, by precisely managing off-take and allowing time for the regeneration of the resources. Without such traditional management systems, many communities would have suffered declines in their livelihood. In recent years, government-sponsored changes have disrupted traditional management systems by alienating communities from the natural resources that they once traditionally managed and from which they benefited. This has often resulted in the decline of a sense of ownership of the natural resources on which their livelihood security depended. The development of state-owned projects, such as the state forest and the increased interest in investing for sheep farming threaten the future sustainable use of the natural resource by the community in the Guassa area.

11.3 The Ethiopian wolf in the Guassa area of Menz

The Ethiopian wolf population in Guassa represents a relict population of this critically endangered species. Most Ethiopian wolf populations are now found on remnants of Afro-alpine vegetation communities in high altitude areas. Only in Simen Mountains National Park and in the Bale Mountains National Parks are populations of Ethiopian wolf formally protected. However, wolf populations remaining on unprotected areas account for nearly half of the world population. Therefore, this study of the Ethiopian wolf population in Guassa will help the future conservation of the species in human-dominated landscapes.

The size of the Ethiopian wolf population in the Guassa area of Menz is small compared to the population remaining in the Bale Mountains (Chapter 8), but there are no detailed population estimate from other areas. The wolf population in Menz was once assumed to be the second largest population of the species, but populations in Arsi and North Wollo highlands may be higher or similar in size to the Menz population (Marino *et al.,* 1999). Nevertheless, the population of wolves in Bale appears to have declined in recent years due to disease, direct persecution and habitat distraction. Therefore, the conservation of populations outside the protected area system increases the chance of future survival.

The Ethiopian wolf predominantly feeds on rodents. In Guassa, wolves feed primarily on three species (*Arvicanthis abyssinicus*, *Lophuromys flavopunctatus Otomys typus)* of diurnal rodents that accounted for 70% of their diet, as well as on common mole rat *Tachyoryctes splendens* which account for 17% of their diet. The estimate of the prey species available to wolves in the Guassa area suggests that prey biomass was abundant (Chapter 6). Nevertheless, the total biomass of prey in the Guassa area was slightly lower than the total prey biomass available for wolves in Bale, which predominantly feed on Giant mole rats *Tachyoryctes macrocephalus.* Furthermore, scavenging and predation on sheep was higher in Guassa than in Bale, and this could be due to the low density of other carnivores and as well as to the sanctioned presence of livestock in the Guassa area.

Ethiopian wolves are distributed in most of the habitat types in the Guassa area. However, *Euryops-Alchemilla* shrubland, *Festuca* grassland, Mima mound and the swamp grassland are the most preferred habitat types, due to their high densities of rodents.

Ethiopian wolves in Guassa occur in discrete social groups occupying a defined home range. Members of each pack share similar home ranges and gather at dawn and dusk for various social activities and feed alone in the day. The mean group size was 5.7 adult and sub-adult individuals, and the mean home range size of individual wolves was 5.4km^2. There was no difference between group size and individual or pack home ranges, between the Guassa and Bale Mountains wolf populations. Ethiopian wolf home ranges are amongst the smallest recorded for most species of canid (Ginsberg and Macdonald, 1990), which probably reflects good habitat quality, as a result of abundant rodents in the Afro-alpine habitat.

The Ethiopian wolf lives in a human dominated-landscape in the Guassa area. Communities living around the Guassa area have utilised the resources which are very important for their household economy (Chapter 5). Nevertheless, resource utilisation did not adversely affected the total biomass and population structure of the rodent community (Chapter 7). However, the proportion of each species of rodent differs between the types of human use. *Arivcanthis abyssinicus* was the most common prey item in the diet of the Ethiopian wolf but its abundance was not affected by grass cutting and grazing. However, its abundance decreased where fuelwood collection occurred as elsewhere in the East African highlands (Kingdon, 1974) and in the Simen Mountain National Park (Güttinger *et al.*, 1996). In contrast, the abundance of *Lophuromys falvopunctatus* was reduced by grass cutting and grazing, but was greatest where fuelwood collection had occurred. In further contrast, *Otomys typus* was absent in areas where grazing had taken place. The nocturnal *Stenocephalemys griseseicauda* was not affected by any type of human use.

Ethiopian wolves responded to nearby humans, by making alarm calls and moving away (Chapter 10). As the distance from humans increases, wolves less frequently use alarm calls, while wolves largely ignored human presence at a distances >150m. Wolves spent a similar time foraging in the presence or absence of humans. Wolves were also frequently observed close to livestock and responded in varied ways to the presence of livestock. More foraging and walking occurred close to livestock, supporting the assumption that wolves use livestock as a mobile hide while hunting for rodents. Activities were similar at whatever distances the wolves were from livestock. Therefore, livestock presence had little or no quantifiable effect on the activity of the Ethiopian wolves.

11.4 Attitudes of the Menz Community towards Wildlife and the Ethiopian wolf

In general, the community feels the wildlife of the area is increasing, and experiences no problems with wildlife. Attitudes towards Guassa's wildlife was strongly associated with the peasant association from which the respondents came. Most respondents did not support formal wildlife conservation activities in the area. However, those people who supported conservation gave various economic and ethical reasons for their support (Chapter 10).

Communities in Menz generally felt that the Ethiopian wolf population in Guassa area had decreased over the last few years. Habitat destruction, civil war, drought, disease and poisoning were mentioned as reasons for the decline of the Ethiopian wolf population. Most respondents considered the Ethiopian wolf as a good species. However, different peasant associations held different views. Respondents with no or basic education, and those who had lost sheep to the Ethiopian wolf, considered the Ethiopian wolf as a nuisance species. Respondents who considered conservation of wildlife as an important activity, and those who had attended relevant seminars and workshops had a more positive attitude towards the wolf. Most respondents who considered the Ethiopian wolf a nuisance species gave sheep predation as a major reason. However, reported sheep loss per household per year was found to be very small (0.01%), and the distance from Guassa to the respondent's village was negatively correlated to sheep losses. Other predators accounted for more livestock loss in the Guassa area than the Ethiopian wolf.

11.5 Conservation Implications

The Ethiopian highlands are an important refuge for a variety of endemic and endangered species of fauna and flora. The highlands have a long history of environmental crisis and food insecurity, and rural poverty is a major concern. Therefore, integrated conservation and development activities should be justified on the grounds of increased community involvement and sustainable use of natural resources.

The Guassa area represents one of the highest areas in the Central Highlands. The previous strong indigenous management of the area's natural resource has helped the survival of various species of endemic fauna and flora that are locally extinct in many other similar parts of the country. For example, the Ethiopian wolf has recently become locally extinct from the Kundi and Goshe Meda areas of Central Highlands. This is mainly due to habitat destruction, as a result of increased demand for farmland, and the expansion of plantation forestry.

The future of many endangered and threatened species in the Ethiopian highlands greatly depends on protection that is provided by the local communities. Less than 0.4% of the total highland biome in the country is protected within national parks or other protected areas. The protected areas in many cases have failed to protect the resources they were established to protect, due to increased hostility developed between the protected areas and the adjacent communities. Much of the highlands are under threat from subsistence farming. Therefore, areas like the Guassa offer great potential for protection of highland biome.

The empowerment of the community to practise sustainable use of natural resources has been beneficial for wildlife. Community entitlement to the land should be recognised in the land tenure system of the country, particularly for areas set aside for sustainable use. Such a policy change would help the survival of biodiversity, and should be given priority to efficiently increase the size and representation of areas for conservation of threatened species.

Communities have a vested interest in protecting an area as long as they accrue a benefit from the protection. Rural livelihoods depend on access to the resource necessary to meet their basic needs. For conservation activities to be successful and sustainable, they must have the dual objectives of protecting the resources and improving local livelihoods. The traditional communal management regime in the Guassa area followed the basic principles of equitable distribution of the resource to the community. It has also helped the survival of endemic fauna and flora, and it also maintained the water catchment capability of the mountain block to provid a year round flow of water to the adjacent communities living in lower lying areas.

In countries like Ethiopia, where conservation activities are given low priority, large conservation areas and sizeable populations of endemic and threatened species can probably only be maintained by a radical change in approach to conservation. The small budget allocated by the government to conservation, and the contribution of international conservation agencies to conservation in developing countries have been largely concentrated in problem-ridden protected areas (Leader-Williams and Albon, 1988). The conservation value associated with human exclusion, with which those populations have a long standing and close integration, is now recognised as inappropriate, even in biological terms (Homewood and Rodgers, 1987; Ghimire and Pimbert, 1997). A pragmatic approach would be to increase the protection of areas where there is a viable wildlife population under the communal management of local communities. These type of areas experience less conflict in resource appropriation and, above all, they are free from conflicts inherent between protected areas and adjacent communities. There is an important lesson to be learned from the case of wildlife conservation in Ethiopia, where many decades of conservation effort were destroyed over a few weeks, when a total power vacuum was created in the country (Tedla, 1997; Admassie, 2000). Communally owned and managed areas are more stable and capable of absorbing a sudden shock in the management of the system. This can provide important lessons for wildlife conservation in other areas of Africa, where civil strife and political instability are common phenomena.

At present the Ethiopian highlands are under serious threat from expanding human populations that are striving to survive in the midst of environmental and social crisis. Setting aside areas for complete protection as envisaged by the proponents of a "fence and fine" system is impossible, and may result in further exacerbating the existing environmental and social problem in the area. A more pragmatic approach would be to work towards allowing for more involvement of local people in the management and use of their natural resources. In recent years, protected areas have been established as multiple-use areas (IUCN Category VIII), and this trend is especially important where the use of natural rather than modern manufactured products still plays an important role in the livelihood of the communities (Leader-Williams *et al.*, 1990).

The acute need for agricultural land and for access to natural resources on which the livelihoods of many rural communities depends, as well as the indirect political and social costs of establishing strictly protected areas, makes it likely that an integrated approach to land management will provide the most practical option for future conservation and development. Thus, small patches of important habitat for endemic and threatened species that are not included in the protected area system of the country, could be incorporated into multiple use areas offering wider options for integrated rural development and conservation of biodiversity.

11.6 Management Recommendations

The indigenous resource management system in Menz has allowed the community to utilise their natural resources in a sustainable way until it was challenged by the change of land tenure system in the country during the 1975 Agrarian Reform The question of land tenure in Ethiopia is a critical issue in the protection of the remaining natural resources, particularly for resources found outside the protected area systems of the country. Lack of ownership on the land has resulted in increased soil erosion, forest destruction, decreased interest in land management and overgrazing in many parts of the country. The government should address the existing land tenure issue of the country in an acceptable manner. Otherwise, this in combination with other factors, will lead to the complete destruction of the resource base, a decline in the livelihood of many rural communities, and in the extinction of many species of conservation importance.

Communities in Guassa have shown a preference for community management over state control and attributed the present problem of law enforcement to a lack of ownership. Therefore, the community should be empowered to protect and sustainably use their resources. Communities around the Guassa area prefer an indigenous resource management system based on existing indigenous institutions. In this case, the *Idir* system is an indigenous institution formed to help members of a community during difficult times and has strong bye-laws, such that anyone excluded from *Idir* system is regarded as a social outcast. Local communities have a strong belief that this institution is capable of controlling the appropriation and exclusion of illegal users from common property resources. The effectiveness of the *Idir* system at managing the common property resourc as well as fulfilling its other duties, should be investigated in detail by researchers interested in the development of local institutions for sustainable common property resource management.

The Guassa area resource is vital for the livelihood of the Menz community, and the communities should be allowed to continue utilising its resources. However, its protection should not be left solely to the communities living adjacent to the Guassa area. All the user communities should participate in protecting the resource as they all participate in appropriating the resources. Blaming one community (in this case the peasant associations close to Guassa) without participating in the protection will prove unacceptable and will never stop the problem. Rural communities should decide the way in which their resource should be used, as any dissatisfaction among the community on resource appropriation leads to conflict, usually resulting in the destruction of the resource base.

Communities around the Guassa area should be encouraged to be self-sufficient in their energy requirements. The use of dung and shrubs with a low calorific value will never allow households to be energy sufficient. As a way of promoting energy sufficiency in the community, the development of community-based tree nurseries and privately owned tree plantation projects should be encouraged, since such schemes may provide economically viable and self-sufficient energy sources. Selection of species that are environmentally friendly and multi-purpose should be given priority, since they provide fodder, fruit, fuel, and construction material, and also improve soil fertility and wildlife habitat.

Grazing in the Guassa can continue at present level, as there is little evidence to support overgrazing and overstocking. Wildlife conservation and livestock development are mutually compatible, at least in the Guassa area. The value of grazing in maintaining low vegetation cover has resulted in an increase in abundance of important prey species for the Ethiopian wolf and is a positive effect of the grazing system in Guassa. Subsistence agriculture practised as a mixture of farming and livestock keeping forms the basis of the rural economy. At this particular juncture, any increase in livestock numbers is very unlikely, as households are usually reluctant to increase the size of their stock unless there is clear benefit to be gained. The prevailing land shortage for cultivation and grazing in the area, coupled with the recurrence of drought, means that households are forced to sell more livestock than they acquire at present. Despite strongly held beliefs, there is now real concern for the environmental, economic and social dangers of many conservation projects, that in turn are leading to a growing understanding of the appropriate nature of many traditional forms of wildlife protection, cultivation and livestock rearing. The real danger associated with this type of resource management is when communities dependant on the resource for their livelihood lose interest due to modernising forces that increase the use of substitute resources. In the case of Guassa, the future replacement of *Festuca* grass by corrugated iron sheet rooves may prove the downfall of this regime. At the moment, this is not a major problem in Menz, since the price of this material is unaffordable by standards of the rural economy, and a change in living standards does not always presuppose environmental destruction.

The Ethiopian wolves in the Guassa area of Menz represent an important population in the country. The existing relict populations in a few Afro-alpine localities are small and isolated, making them increasingly exposed to extrinsic factors like human persecution and contact with domestic dogs, in turn resulting in disease and hybridisation. Due to their small size, they may also have been exposed to environmental and demographic stochasticity, genetic drift, and inbreeding depression (Caughley, 1994).

In order to halt the dramatic decline and to reduce the probability of extinction of the species, serious conservation measures are needed. A recent study on the epidimology of canid disease in Menz has indicated that the Guassa wolf population is less affected than other populations studied to date (Marino *et al.*, 1999). This may be attributed to infrequent visits paid by domestic dogs to the Guassa area, in turn as a result of few dogs being owned by households in the area. Continuous surveillance of canid disease in the Menz, and monitoring of dog movements in the Guassa area, should continue.

There is a positive attitude among the community towards the Ethiopian wolf. However, most local people do not see the critical situation in which the Ethiopian wolf finds itself in globally or the need for protection. An effective educational programme could be mounted to educate the public about the danger of extinction and how to stop it.

The Ethiopian wolf can serve as a flagship species for the conservation of the unique highland ecosystem, which is an important hotspot for biodiversity. Flagship species have been used to convey issues of conservation importance, which presupposes the conservation of unique habitat as well as a large array of species, which are endemic and threatened. Many flagship species have been the subject of major public awareness campaigns, and have promoted conservation on a general or regional basis (Simberloff, 1998; Leader-Williams and Dublin, 2000). The Ethiopian wolf is a flagship species for the conservation of the Afro-alpine areas of Ethiopia, and can help to save co-existing organisms and their habitats, and to raise conservation interest, because it has been managed to capture public interest and sympathy in the last few years.

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Appendices

Appendix I

Check List of Questions for Key Informants interview

1. Background information (Address of the interviewee)

1.1 Name of kebele ____________________

1.2 Name of Gote ____________________

1.4 Age of the respondent ________________________

1.5 Number of Attendants ________________________

2. Traditional Resource management

2.1.What do you know about the past management of the Guassa area?

2.2 Could you tell us about the extent of the Guassa area in the past and at the present?

2.3 What is the management system of the Guassa area at the present?

2.4 If the management is changed at present what brought the change?

2.5 Do you believe that the former management system was effective compared to the present one? If yes, why?

2.6 How effective is the present management system?

2.7 What problems exist to enforce effective management of the Guassa area?(Inside and outside factors)?

2.8 What is the role of the local administrative council (i.e. elders, PA, Woreda, Zonal and Regional) in the traditional management of the Guassa area?

2.9 In your opinion how should the Guassa area be protected?

3. Resource utilisation

3.1What are the reason for protecting the Guassa area?

3.2 How important is access to the Guassa resource to the community?

3.3 When does the Guassa area close and open for use? What is the time interval? Who

decides on this interval?

3.4 What is the seasonal pattern of resource use?

3.5 Who collects what (fauna and flora), what is frequency of collection, (No. of days/month), what quantity is collected

3.6 Which social group is more dependent on the Guassa resource? Why?

3.7 How is utilisation regulated (Elders, PA, Woreda, Zone, Region)?

3.8 What are the pressures leading to encroachment of the Guassa area?

4. Wildlife /Conservation

4.1 What wildlife species are found in the Guassa area (past and present - changes in number, species)?

4.2 Are any species believed to have been there in the past and now extinct in the Guassa area?

4.3 Do you know any species, which was not previously found in the Guassa but is found there now?

4.4 What is the view of the community towards wildlife (competition with domestic stock, grass cutting, disease, predation etc.)?

4.5 Is any group (cattle owners, grass cutters, farmers, firewood collectors) really interested in wildlife conservation?

4.6 Are any species regarded as nuisances and which species are regarded as important in terms of local belief and use?

4.7 What do you know about the Ethiopian wolf population of the Guassa area?

4.8 What is the general trend of the Ethiopian wolf population?

4.9 If the wolf population is decreasing or increasing, what do you think the reason may be?

4.10 What is the largest group of Ethiopian wolf you have seen?

4.12 Have you seen Ethiopian wolves out side the Guassa area? If yes, when and where?

4.13 What time of the day you are more likely to see a wolf?

4.14 Have you ever seen wolf mating?

4.15 Have you ever seen wolf pups? If yes how many and were?

4.16 What do you think the wolf is eating (list /rank if possible)?

4.17 Have you ever seen a sick wolf in this area?

4.18 Have you ever found dead wolf in this area?

4.19 What do you think the reason for wolf mortality?

4.20 Have you ever seen Ethiopian wolves and domestic dogs together? What were they doing?

4.21 How do you see the attitude of the community towards the Ethiopian wolf (in the past and at present)?

4.22 Have you ever seen wolves taking any livestock? If yes what type? How many in the Last 12 months?

4.23 Do you feel the presence of Ethiopian wolf in the area is bad for the people?

4.24 Do you believe Ethiopian wolf and people can live harmoniously in the Guassa area?

2.25 What types of animal diseases are common in this area (list/rank according to importance)?

5. Agriculture and economy

5.1 What are the different social structures (farmer, labourer, merchant; poor, rich) in your community? Rank according to size in the community.

5.2 What economic activities are predominant in the area? List/Rank

5.3 Have these activities changed in the past years?

5.4 How many times per year do you harvest crops, and in what period/season?

5.5 What are the main products (agricultural and off-farm) of your area? Name/List/Rank

5.6 What is the survival strategy during hard times such as drought?

5.7 How do hard times affect the Guassa area?

6. Do you know any sayings and songs about the Guassa area, the Ethiopian wolf and any other wildlife?

Thank you very much for your co-operation

Appendix II

Individual Interview

1. Introductory questions

1.1 Peasant Association (Kebele)

1.2 Village (Gote)

1.3 Distance from Guassa

1.4 Age

1.5 Sex

1.6 Residence in Menz

1.7 Marital status

1.8 Family size

1.9 Education level

2. Household Economy

2.1 What do you work for a living?

2.2 What it the size of your farm land?

2.3 What type of crops do you grow?

2.4 How much did you harvested form these crops (kg) last year?

2.5 How much did you sold in the last 12 months.

2.6 Do you have livestock?

2.7 How many Cattle?

2.8 How many Sheep ?

2.9 How many Transport animal?

2.10 What livestock did you sell last year?

2.11 How many of them?

2.12 What other off-farm activity do you have?

3. How do you value the Guassa area in terms of resources?

3.1 What resource do you get from the Guassa area?

N	Resource	Not Important (1)	Less important (2)	Important (3)	Highly Important (4)	Very Important (5)
3.2	As Grazing area					
3.3	Area to collect grass					
3.4	Marketable resource					
3.5	Firewood collection					
3.6	Source of food resource					
3.7	As a source of water					
3.8	As a source of rain					
3.9	Household Implements					
3.10	Farm implements					
3.11	Area for Medicinal Plant					
3.12	Habitat for wildlife					
3.13	Aesthetic Value					
3.14	As Natural Heritage					

4. The Guassa area and the Common Property Resource Management?

4.1 Could you tell us a bout the present day management of Guassa?

4.2 When does the protection loosened?

4.3 Who is responsible for the management of the Guassa area at present?

4.5 Is the size of Guassa decreasing?

4.6 If yes, Why?

4.7 What are the problems in the protection of the Guassa?

4.8 Is there a penalty now to protect the Guassa area?

4.9 How do you rate the following management problem in the Guassa area.

N	Problem	Not a Problem	Less Problem	Problem	Big Problem	Very big problem
4.9.1	Lack of ownership					
4.9.2	Weak enforcement					
4.9.3	Population increase					
4.9.4	Drought					
4.9.5	Market demand					
4.9.6	Over exploitation					
4.9.7	Neighboring Woreda					

4. 10 In your opinion, do you think the present protection/ management of Guassa is effective?

4.11 Why?

4.12 How do you want the Guassa area to be managed?

4.13.Who should be responsible for the management of the Guassa area?

5. Resource use in the Guassa area

5.1 Do your livestock graze in the Guassa area

5.2 How many months do you graze your livestock in the Guassa area?

5.3 What is the size of your grazing land?

5.4 How many months do you use your grazing land?

5.5 Where do you get your firewood?

5.6 What do you collect as firewood?

5.7 How many times do you collect firewood in one month?

5.8 Who collects firewood in the household?

5.9 Do you have wood lot (private trees?

5.10 If yes, what trees do you grow?

5.11 Do you make charcoal?

6. Wildlife and Ethiopian wolf

6.1 What wildlife do you know in the Guassa area?

6.2 Is the wildlife population in the Guassa area decreasing or increasing?

6.3 If yes/no why

6.4 Do you think wildlife brings problem?

6.4 If yes, what problem?

6.5 Do you believe wildlife is a useful resource to be conserved?

6.6 If yes/no, why

6.7 Is the number of Ethiopian wolf in the Guassa area increasing or decreasing?

6.8 If yes/no, why?

6.9 Is the Ethiopian wolf good or bad species?

6.9 If yes/no, why?

6.10 Have you lost sheep to Ethiopian wolf?

6.11 If yes how many in the last 12 months?

6.12 How many in the last 5 year?

6.13 How many in the last 10 years?

6.14 Have you lost livestock to other wildlife in the Guassa area?

6.15 If yes, to what species of wildlife?