

1 The Challenges of Modernity for Reindeer Management in Northernmost Europe

B.C. FORBES

1.1 Introduction: The Research Setting

This book presents the combined results of a research and development project funded by the European Union's 5th Framework Programme of 2001–2004. The full title of the project was “The challenges of modernity for REiNdeer MANagement: integration and sustainable development in Europe's subarctic and boreal regions (RENMAN)”¹. Within this Framework Programme, RENMAN was funded under the Key Action “Quality of Life and Management of Living Resources” (Contract QLK5-CT-2000-0745). This portion of the program mandated that funded research aim toward (1) “the design and negotiation of policies that will have a direct impact on the local conditions and prospects for securing an acceptable level of quality of living”, and (2) “the continuation of appropriate management regimes for the utilization of living resources locally and regionally within the European context”. As such, it called for a direct role for local stakeholders – in this case reindeer herders – in the process of policy-relevant research and for the use of historical trends to facilitate adaptation to future changes. In these aims, RENMAN is quite similar to other EU-funded research projects that focus on particular species in northernmost or Arctic Europe to provide stakeholders and policy makers with a predictive framework of outcome for land use in fragile ecosystems, such as the projects “HIBECO” (Wielgolaski 2005) and “FRAGILE”.

The purpose of RENMAN was therefore to develop new tools and models of participatory research and planning in reindeer management that would foster integrated and sustainable use of reindeer (*Rangifer t. tarandus* L.) and related living resources in northernmost Europe (for the natural history of the reindeer see Preface to Part I). Reindeer management is among the most

¹ The acronym “REN” (“ren” = “reindeer” in German and Scandinavian languages) stands for “reindeer” and “MAN” for “management”.

important mutually competing activities using natural resources and the environment in the Barents Euro-Arctic Region (BEAR). It is also one of the oldest and most resilient forms of livelihood in the region. Reindeer are a living resource central to the culture of many northern circumpolar indigenous peoples, including the Sámi, as well as non-indigenous peoples in some areas, e.g., in Finland and Russia.

RENMAN was conceived as a 36-month project comprised of 12 tightly integrated subprojects or “workpackages” (referred to as WPs in this book) divided among nine partner institutes in five countries.² The project investigated both the human dimensions and natural conditions of reindeer management in order to formulate sustainable future scenarios. To achieve efficient integration of the workpackages, an integrative systems analysis was conducted to assist the whole project in problem distinction, system identification, interdisciplinary understanding, and sustainability evaluation (Chap. 16). The results presented here therefore provide a complex picture of the position and role of reindeer management in both the physical environment and cultural landscape of the research region.

Local study areas were selected in subarctic and boreal Fennoscandia and the adjoining Kola Peninsula (Fig 1.1), with special emphasis on the traditional homeland of the Sámi, Sápmi.³ Multiple research localities allowed for comparisons through the application of standardized research methods. The precise study sites were selected in conjunction with herders during interviews and field excursions at the start of the project in winter/spring 2001 and aimed to represent the variability in management within a representative portion of the reindeer herding area. In fact, during each phase of the project – conceptualization, implementation, and reporting – herders were integral participants as practitioners and researchers alongside external scientists (Fig. 1.2). The project involved herders from northern Finland, Sweden, Nor-

² Arctic Centre, University of Lapland, Finland (coordinator, principal contractor); Department of Geography, University of Oulu, Finland; Finnish Forest Research Institute, Rovaniemi, Finland; Helsinki University of Technology, Espoo, Finland; Christian-Albrecht University, Kiel, Germany; The Norwegian Crop Research Institute, Tromsø, Norway; Dept. of Social Anthropology, University of Tromsø, Norway; Institute for Cultural Anthropology and Ethnology, Uppsala University, Sweden; Institute for Anthropological Field Research, New Bulgarian University, Sofia, Bulgaria.

³ We gratefully acknowledge the active participation and tremendous input of the many reindeer herders, their families, communities and organizations that are not listed in the formal authorship of this book, but who contributed to our collective understanding of reindeer management in many important ways. Without this generous assistance and mutual trust the project would not have been possible. We are pleased that this experiment in participatory research has been deemed a success in the local communities involved and sincerely hope that the new approaches to research tested here, and the resulting management proposals, can lead to further discussion and implementation in the future.



Fig. 1.1. Map of the intensive RENMAN study areas in Sweden, Norway, Finland and Russia are as follows: 1. Näkkälän paliskunta; 2. Kautokeino common winter pastures district 30; 3. Lapin paliskunta; 4. Lovozero region; 5. Muonio Sameby; 6. Tuorpon Sameby; 7. Lihittäjä concession Sameby; and 8. Sirkas Sameby. Many other districts within Finland also took part in the project via a series of annual participatory workshops (Chap. 3)



Fig. 1.2. RENMAN project participants in Oteren, Norway, discussing the selection of study sites along the Norway/Finland border in May 2001. In the photo from left are as follows: Johan Mathis Turi, [former] President of the Association of World Reindeer Herders, Kautokeino; Dr. Christian Uhlig, researcher from the Norwegian Crop Research Institute; Heidi Kitti, Ph.D. student from Arctic Centre, University of Lapland; and Timo Kumpula, Ph.D. student from Department of Geography, University of Joensuu. *Photo: B.C. Forbes*

way, and on Kola Peninsula, Russia. We are not aware of previous projects in Europe of this magnitude that have involved local stakeholders to such an extent in all aspects of the research.

1.2 Semantics and Book Structure

The terminology treating livelihoods involving the keeping and use of reindeer has been somewhat variable over time and from country to country. We attempt to differentiate here between reindeer husbandry, herding, and management, all of which are relevant in contemporary northernmost Europe. To be sure, there is a certain degree of conceptual overlap in the terms husbandry, herding, pastoralism, and management as discussed by different authors (Ingold 1980; Krupnik 1993; Paine 1994; Anderson 2005). In general, herding encompasses the day-to-day work with a herd. It concerns the relationship between a herd and its pasture as directed by herders for the welfare of the animals and, if necessary, to the exclusion of the comfort of the herders themselves. Husbandry, on the other hand, has more to do with a herd as the “harvestable” resource of its owners. According to Paine (1994), “herding” is about the control and nurture of reindeer within their terrain and “husbandry” is more related to the growth of capital (“on the hoof”) and profit. In addition, he argues that husbandry includes social mechanisms such as dowry and inheritance. To this we would add that husbandry clearly also deals with reproduction and breeding.

In this book we generally adhere to the terms herding, as defined above, and management. Management is used in the broadest possible sense, and is intended to encompass all practices pertaining to the keeping of reindeer. This term is not perfect. For example, individual herders may not feel they are actually “managers” of their own herds, which are allowed to range freely much of the time. However, in a comprehensive discussion treating ecological, sociocultural, political, and economic issues within four different countries, we are certainly dealing with management at several scales, from local *siida* and landscapes to the wide region of northernmost Europe. Furthermore, the RENMAN project was funded in part to tackle issues of policy relevance within Europe. As such, we adopted a participatory approach in an attempt to address management holistically.

The book is structured in three main parts, reflecting the various research topics and approaches. Part I covers first the geographic and social evolution of reindeer herding as a form of livelihood (Chap. 2), and the development of participatory approaches to management (Chap. 3). The next few chapters address, respectively, the different conceptions of “environmental management” (Chap. 4), the dilemmas of so-called concession reindeer management in modern-day Sweden (Chap. 5), and post-Soviet changes in property

regimes on the Kola Peninsula (Chap. 6). Together, the chapters in this book section outline the main sociocultural and economic conflicts that lie at the heart of contemporary reindeer management within the region.

Turning to the natural and physical sciences in Part II, Chapter 7 provides a suitable transition as it treats a question right at the nexus of the natural and social sciences – what is the best way to characterize pasture “quality”? Assessments of forage quantity and quality derived primarily from satellite surveys have provided the basis for pasture inventories and policies concerning population regulation in recent years (e.g., Kumpula et al. 1997, 1999, 2004). Yet, herders have their own sets of indicators that vary in space and time, combining ecology, geography, and social relations, all of which bear heavily on their patterns of pasture use. Chapters 8 and 9 contrast vegetation cover and structure patterns on either side of the Finnish–Norwegian border, where strongly divergent management systems have been in place for nearly 50 years. Chapter 10 focuses on common forage species in wetlands and reveals their individualistic short-term responses to ultraviolet radiation, an important component of global change. The remaining contributions address questions surrounding: the long term effects of grazing and trampling in mineral (Chap. 11) and organic (Chap. 12) soils, as well as microbial ecology (Chap. 13), and the hygienic status of both soils and surface waters (Chap. 14).

The final section, Part III, provides an integrative overview, beginning with an analysis of the various drivers underlying recent population trends of semi-domestic reindeer in Fennoscandia (Chap. 15). A systems analysis of reindeer management balances some of the different social, economic, and ecological interactions within reindeer management. Such analysis also simulates future scenarios based on trade-offs that develop when certain inputs are altered (Chap. 16). Finally, Chapter 17 provides a multidisciplinary synthesis, drawing conclusions from the combined findings of all the authors.

1.3 Research Problems, Questions, and Regions and Sites

Changes in reindeer systems that adversely impact small and dispersed communities involved with herding include, among others, reductions in grazing land and forage resources. Such losses may occur as a result of large-scale exploitation by the expanding forestry and hydroelectric power industries, mining, and competition with tourism or crop-based agriculture, as well as of future habitat alteration due to global warming. Reindeer themselves have long been critical constituents of the northern portions of the BEAR, with marked capacities for affecting ecosystem structure and function (Oksanen 1978; Helle and Aspi 1983; Fox 1998; Helle 2001; Moen and Danell 2003). Large areas in northern Norway, Sweden, and Finland and portions of the adjoining Kola Peninsula have been grazed for millennia (Staal and Nieminen 1993;

Forbes 2005; Chap. 2). As the aforementioned competition over space and resources has increased and its effects have become visible, in particular over the past 20 years or so, there have been recurrent and widespread reports of depletion of plant resources that some scientists have termed “overgrazing” and calling for significant reductions in the number of reindeer in the Nordic countries (Torp 1999; Riseth 2000; Tahkolahti 2000; Tuomi–Nikula 2001). The combined effect of these various trends is that political discussion about reindeer management policy and its relationship with other uses of the environment continues to intensify (Jernsletten and Klokov 2002). Relevant recommendations regarding land management and human rights have already been promulgated in the context of World Heritage Sites (Agenda 21), of the EU’s Northern Dimension (in particular Protocol No. 3 on the Sámi people attached to the EU accession treaties of Finland and Sweden), and of the EU General Secretariat’s “Resolution on Indigenous Peoples”.

Intended in part as a response to this trend, the International Arctic Science Committee (IASC) workshop on the Human Role in Reindeer Systems was held at the Arctic Centre in Rovaniemi, Finland, in 1999 (Forbes and Kofinas 2000). This was a firm step toward the integration of international, multidisciplinary research pertaining to both semi-domestic and wild reindeer. The workshop brought together biologists, social scientists, and indigenous practitioners to discuss priorities in reindeer-related research for the first decade of the new millennium. As such, it was a watershed event in terms of bringing reindeer herders into the research process in a meaningful way. During the workshop it was noted that Sámi herders perceive that there has been inordinate emphasis on meat production and the ostensibly poor condition of lichen-dominated winter pastures. According to some Sámi, much of the research addressing these issues has been conducted without acknowledgment of the importance of practitioners’ knowledge and the sociocultural context of reindeer management.

The IASC workshop built upon a theme earlier put into action via a more circumscribed participatory planning workshop held in Inari, Finnish Lapland, in 1997. That workshop was organized as a concerted action of the “Human Environmental Interactions” theme of the European Commission’s Arctic–Alpine Terrestrial Ecosystems Research Initiative (ARTERI). The mandate of ARTERI was to develop research themes and encourage their implementation in a way that would allow for discussions among local residents, natural and social scientists, and policy makers concerned with environmental protection and management in arctic and alpine regions of Europe. Although the participants at the ARTERI workshop identified concerns in diverse fields of human environmental interactions in upper Finnish Lapland, their future scenarios shared common topics. Reindeer management, forestry, and tourism were the dominant livelihoods that discussed (Burgess 1999; Müller-Wille and Hukkinen 1999). Subsequently, a successful application for management improvement was submitted to the Academy of

Finland by J. Hukkinen “Reindeer Management as Environmental Management in Finland”, which brought together a large number of scientists with the express purpose of integrating herders. The project was not implemented at that time for administrative reasons. However, ensuing discussions among scientists and herders contributed greatly to the RENMAN project proposal to the EU, which then developed over a two or three year period and finally came into focus during the 1999 Rovaniemi workshop.

The critical research questions for RENMAN included:

- Is “overgrazing” the only problem and reducing the number of reindeer the only solution in reindeer management?
- What are the key issues in reindeer management for the local reindeer herding communities?
- What is the future of reindeer management in northern Fennoscandia and adjacent northwest Russia?
- Much is known about winter pastures, but what about the quality of summer pastures?
- Can herders participate meaningfully in the research process?
- How can reindeer management be best integrated with other uses of the northern environment, such as tourism, forestry, and hydropower?

From the beginning, herders urged us to pay special attention to summer pastures because they felt that the emphasis on winter pastures in recent years had been at the expense of an appreciation and understanding of summer pastures. Summer pastures are important for calf growth and overall herd production (Kumpula et al. 1999). Other key reasons for selecting the chosen study areas were: (1) the demonstrated willingness of the herders and their representative organizations⁴ to participate; (2) the existence of previous studies that provided necessary background biological data; and (3) the various investigators’ familiarity with these regions, several through long term studies. For reasons of broader interpretations in anthropological and socio-economic terms, the general reference region has been all of northernmost Fennoscandia. The overall objectives of the social science workpackages within RENMAN were to: (1) establish a novel and thoroughly participatory mode of analyses for human environmental interactions in Europe; (2) develop future scenarios of reindeer management in northern Fennoscandia; and (3) create a framework for interactive reindeer management planning that is grounded in the knowledge base of reindeer herders and supported with scientific studies (Chaps. 3 to 6). The results presented here provide a

⁴ Svenska Samernas Riksförbund; Suoma Boazosámit (Sámi Reindeer Herders of Finland); Paliskuntain Yhdistys (Association of Finnish Reindeer Herding Districts); and the Association of World Reindeer Herders, based in Norway.

complex picture of the position and role of reindeer management in both the physical environment and cultural landscapes of the research region.

Our starting point in the project was that ecology itself is subject to cultural perceptions (of both indigenous and dominant society) and that reindeer management policies therefore have cultural implications. An explanatory model that is based on range biology alone without consideration for ethnic and cultural sustainability as well is destined to fail. Further investigations are therefore needed of the relationship between indigenous and non-indigenous reindeer herding practices and external factors influencing these applications. Central to a better understanding of this relationship is a systematic comparison between practitioners' experience-based knowledge and science-based knowledge concerning, for example, the quality of pastures. Adding to the sense of urgency has been the critical state of reindeer herding in the Kola Peninsula of northwest Russia. In the context of recent food crises in that region, there has been strong interest in enhancing the role of reindeer herding in the local economy, thereby increasing regional food production and improving living standards for the herders and their families (Chap. 6).

1.4 Issues and Concerns

In general, northernmost Fennoscandia is subject to extensive and often intensive land use and ecosystem fragmentation in contrast to much of the boreal zone in Russia and North America (Forbes et al. 2004). For Norway, Sweden, and Finland, boreal forests and forestry are an important source of economic wealth and, relative to neighboring portions of Russia, highly managed for pulp and timber. There is concern that the sustainability of ecosystem resources is already threatened by this intensive use and that future policy changes may turn out to be ineffective to protect resilience (Kankaanpää et al. 2002).

Part of the problem is the lack of an agreed structure to monitor the effectiveness of management strategies, beyond matters pertaining to forest and pulp production, and questions about the efficacy of current monitoring protocols. One example comes from the availability of arboreal lichens, an important source of winter food for reindeer. Such lichens are plentiful within the canopies of older coniferous forests but are typically scarce or even absent in clear-cuts and the young and medium-aged regenerating stands, which characterize large portions of Lapland. In a recent inventory of arboreal lichens, a detailed ground survey conducted by one of the region's reindeer herding cooperatives (Sipilä et al. 2000) found significantly fewer lichen resources than those reported for the same areas by satellite survey (Korkalo et al. 1997). This is not surprising, given the scales of resolution of the different methods, but the fact that the lichen resources tend to be overestimated by satellite sur-

veys, which form the foundation for the government's reindeer management policy, results in distrust of official statistics at the local level.

In northern Finland ground lichens have also been greatly reduced in reindeer herding districts in recent decades (Helle and Aspi 1983; Kumpula et al. 1997; Kumpula 2001). This has occurred through a combination of factors, including generally more intensive reindeer management and "double" grazing use (summer and winter) in some areas, resulting in both winter consumption and summer trampling of lichens. This has been coupled with incremental spatial, economic, and administrative encroachment on reindeer "pasture" resources by diverse land uses such as forestry, hydropower, mining, tourism, and increased off-road vehicle traffic by the herders themselves (Olli 1995; Jernsletten and Klokov 2002; Kankaanpää et al. 2002). Here again, disagreement over the root causes of the problem, invariably characterized as "overgrazing" with most of the blame attributed to the practices of the reindeer herders, means that long term solutions are delayed or avoided while ecosystems continue to degrade under the synergistic effects of multiple and overlapping land uses (Torp 1999; Jernsletten and Klokov 2002; Kankaanpää et al. 2002).

To characterize this trend as overgrazing is to oversimplify a complex suite of issues driven by political imperatives, socioeconomic and demographic changes, and agricultural norms. Already in the 1970s it was clear that summer trampling was having an impact as significant as that of winter consumption of lichens alone, if not more so (Oksanen 1978). The problem is especially acute in Finland, where fences have truncated former migration routes. Summer and winter pastures in some areas are thus tightly interspersed in a patchwork mosaic, whereas formerly they would have been in distinct, widely separated areas (Chap. 7). The result is that unattended animals are able to move back and forth across winter lichen grounds during summer to reach preferred habitats such as riparian zones and wetlands. When dry, the brittle lichens are crushed into small pieces that are then readily blown or washed away. Through this process, large areas can become denuded of lichens even when animals are subsisting mainly on deciduous shrubs, graminoids and other summer forage (Chap. 9). This simple but important concept is rarely encompassed in the discussion and recommendations concerning "overgrazing".

In Russia, renewable and non-renewable resource management has been somewhat chaotic at least since the break-up of the Soviet Union, and arguably long before that. Fennoscandia presents a relatively benign situation by comparison, due to its economic and political stability since World War II, as well as a strong regulatory framework for environmental management (Forbes et al. 2004). However, this can create a false perception that the major problems are now behind us, thus threatening adaptive management. The aforementioned example of "overgrazing" as an overriding concern in contemporary reindeer management points to the lack of cooperative manage-

ment of natural resources in northernmost Europe. Co-management is defined as a shared decision-making process, formal or informal, between a government authority and a user group for managing a species of fish, wildlife, or other resources. Ideally, co-management serves to incorporate elements of scientific and local or practitioners' knowledge to sustain viable pools of resources that may, in turn, secure the livelihoods that depend on them. In practice, there are great difficulties in actually integrating the two types of knowledge (Kendrick 2003), although there are instances in North America of different user groups and scientists each benefiting by using information derived from the other source (Klein et al. 1999). According to Kendrick (2003: ii), "...[W]ithout venues where biologists and caribou hunters and elders can share their knowledge in direct and regular interactions, the social learning involved in linking knowledge systems is not likely". A similar recommendation is warranted in the context of European reindeer management with semi-domestic animals and, in fact, was included among the management proposals made by the RENMAN project (Chap. 3).

1.5 Challenges in Modern Reindeer Management

This is a time of great change for reindeer management in northernmost Europe. Serious challenges threaten the future of reindeer management, and the transition from relatively low-tech management prior to the "snowmobile revolution" (Pelto 1973) has often been difficult. To begin with, since World War II, and long before that in the Soviet Union, nation states have appropriated important aspects of decision making. The international borders with their fences separating the Nordic countries, and restricting large cross-border migrations of herds, are just one example of this. During the 1980s heavy grazing by relatively unsupervised herds during summer left many winter ranges in poor condition. The discussion has focused on the absence of favored forage species of lichens and the establishment of less palatable ruderal or "weedy" species. This is in part because of the dramatic disappearance of once-thick lichen mats coupled with the exposure and, in some places, erosion of organic and mineral substrates (Väre et al. 1996; Olofsson 2001). However, even less apparent changes in soils and surface waters may also be critical for long-term ecosystem dynamics (Stark 2002; Chaps. 13–15). At the same time, global change has raised concerns about pasture accessibility (icing events, heavier winter snow accumulations with corresponding longer spring snowmelt), quality, and animal population dynamics (Turi 2000; Helle and Timonen 2001; Nuttall et al. 2005; Chaps. 11, 12). As well, there are economic factors that are largely beyond herders' control. For example, in autumn 2003 the price of reindeer meat plummeted as, among other factors, local supermarkets throughout Fennoscandia became flooded with comparatively inex-

pensive deer and ostrich meat imported from central Europe and New Zealand (Chap. 3; Valtavaara 2003). As one herder noted during the course of the project, “it is not enough to simply be a good herder anymore. Now we have to be experts in a number of other things as well, like marketing, in which we don’t really have much experience”.

Yet it is necessary to point out that there are also excellent opportunities (Turi 2002). One pertinent for a wide spectrum of disciplines and applications is the advent of participatory models of policy-relevant research in Europe. The RENMAN project has been a test case in participatory research and in valuing the local knowledge of herders (Chaps. 3, 7). Participatory studies, and the cooperative management of renewable resources, have been underway for several decades in North America (Treseder 1999). These are relatively new and innovative tools in terms of ecosystem management in Europe (Sandström et al. 2003; Chaps. 3–5). Another promising, if costly, tool is high-resolution satellite imagery (Allard 2003; Chap. 8), which we have found useful for developing timelines of visible patterns and changes in the land at scales meaningful for herders.

Traditionally, Nordic and Russian reindeer-related research has been of high quality yet functionally isolated within the various disciplines, e.g., zoology, agronomy, cultural anthropology, and human geography. Also, funding has tended to derive from national sources so that international comparisons have been difficult to achieve. There is a need to broaden the scope of the discussion and the range of research topics to better address herders’ own needs concerning their future, rather than focusing narrowly on agronomic indicators like meat production and “carrying capacity” within individual nations. One example is the definition of “pasture quality”, which herders in different countries themselves define much more comprehensively than is possible employing standard western scientific indicators such as vegetation composition, cover, biomass, nutrition, digestibility, etc. (Chaps. 7, 9). As it is, the bounds of debate are inherently limited by rather strict adherence to the prevailing agricultural norms (Laakso 2002). As a result, herders are often marginalized as players within the regional and national dialogue on reindeer management policy, even more so when other forms of land use are under discussion. At a minimum, this decoupling of interconnected social–ecological systems (*sensu* Berkes and Folke 1998) effectively excludes herders from the dialogue and inevitably leads to conflict (Laakso 2002; Sandström et al. 2003). In the worst case scenarios, herders are vilified in the media as irresponsible stewards of the land and, therefore, considered incapable as managers in the contemporary milieu of modern commercialized and industrialized land uses within which reindeer management must function (Torp 1999; Aikio 2002). In such a strained atmosphere, concepts of “sustainability” are limited in their applicability and the adoption of new measures to embrace a more holistic form of ecosystem management is difficult at best.

1.6 Conclusions: Outlook for Resolutions to Conflicts in Reindeer Management

Even if the direct transfer of North American-style co-management as a model to alleviate conflicts between aboriginal peoples and western-based governments does not seem practical for northernmost Europe, in the short term it is necessary to acknowledge at least that we are dealing with complex systems that transcend simple agricultural paradigms and models of “carrying capacity”. Reindeer management functions now, as it always has, at the nexus of diverse social and ecological systems (Folke et al. 2002; Berkes et al. 2003). In Fennoscandia, the overlaying of national and international borders and the extensions of post-World War II political and economic agendas on the region have invariably complicated the study of holistic solutions to what are simultaneously local and regional issues and concerns. Across the border in Russia, the situation has rightly been characterized as a “crisis” since the collapse of the Soviet Union (Krupnik 2000). While the problems are often quite different from those faced by herders in the Nordic countries, for example, widespread poaching of privately owned herds (Konstantinov 2002), there are still lessons to be learned by comparisons between the two regions (Chap. 6).

To weigh all of these different factors properly in a manner that allows us to develop possible scenarios for the future is a daunting task. Models based solely on “ecological” criteria are clearly insufficient. Other methods can include integrative systems analysis (Chap. 16), in which the ramifications of different choices are balanced against the entire suite of socioeconomic and ecological interactions that characterize modern reindeer management. In general, the RENMAN project scientists felt it was important to return a measure of power in decision making to herders. Already there have been further developments in this direction in Finland, where the Ministry of Agriculture and Forestry has held participatory workshops, using the RENMAN template, expanding the discussion beyond matters of ecology in envisioning different future scenarios for reindeer management (Saijets 2004; Talvitie 2004). At the same time, there needs to be more balance in power relations with other players in terms of regional land use: forestry, hydropower, mining, and tourism (Chap. 2). Internationally, as practitioners of reindeer management, herders themselves are increasingly well represented by the Association of World Reindeer Herders (WRH; Fig. 1.1). WRH not only seeks to advance the sustainability of reindeer management as a viable livelihood, but also makes great efforts to coordinate and integrate their own activities with those of researchers in both natural and social sciences (Kankaanpää 2002). It is in this spirit of shared interest in the future of reindeer management that the RENMAN study has functioned (Chap. 17). We hope that the findings presented here are of broad interest to scientists, administrators, and herders, and that

the participatory model of research can gain newfound traction in the European North to better link practical and scientific knowledge.

References

- Aikio P (2002) The prospects of Sámi reindeer herding in Finland. In: Kankaanpää S (ed) *The 2nd World Reindeer Herders' Congress Anár 2001*. Arctic Centre Rep 36:36-40
- Allard A (2003) Detection of vegetation degradation on Swedish mountainous heaths at an early stage by image interpretation. *Ambio* 32:510-519
- Anderson DG (2005) Reindeer pastoralism. In: Nuttall M (ed) *Encyclopedia of the Arctic*, vol 3. Routledge, New York, pp 1752-1754
- Baskin L (2000) Reindeer husbandry/hunting in Russia in the past, present and future. *Polar Research* 19:23-29
- Berkes F, Folke C (eds) (1998) *Linking social and ecological systems*. Cambridge Univ Press, Cambridge, 459 pp
- Berkes F, Mathias J, Kislalioglu M, Fast H (2001) The Canadian Arctic and the Oceans Act: the development of participatory environmental research and management. *Ocean Coastal Manage* 44:451-469
- Berkes F, Colding J, Folke C (eds) (2003) *Navigating social-ecological systems*. Cambridge Univ Press, Cambridge, 393 pp
- Burgess P (1999) Human environmental interactions in Upper Lapland, Finland. *Arctic Centre Rep* 27:1-80
- Colpaert A, Kumpula J, Nieminen M (2003) Reindeer pasture biomass assessment using satellite remote sensing. *Arctic* 56:147-158
- Finstad GL, Bader H, Prichard AK (2002) Conflicts between reindeer herding and an expanding caribou herd in Alaska. *Rangifer* 13:33-37
- Folke C, Carpenter S, Elmqvist T et al (2002) *Resilience and sustainable development: building adaptive capacity in a world of transformations*. Ministry of the Environment, Stockholm, 74 pp
- Forbes BC (2005) Reindeer. In: Nuttall M (ed) *Encyclopedia of the arctic*, vol 3. Routledge, New York, pp 1750-1752
- Forbes BC, Kofinas G (eds) (2000) The human role in reindeer and caribou grazing systems. *Polar Research* 19(1):1-142
- Forbes BC, Fresco N, Shvidenko A, Danell K, Chapin FS III (2004) Geographic variations in anthropogenic drivers that influence the vulnerability and resilience of high latitude social-ecological systems. *Ambio* 33:377-382
- Fox J (1998) Finnmarksvidda: reindeer carrying capacity and exploitation in a changing pastoral ecosystem - a range ecology perspective on the reindeer ecosystem in Finnmark. In: Jentoft S (ed) *Commons in cold climate: coastal fisheries and reindeer pastoralism in north Norway*. Parthenon Publ, Paris, pp 17-39
- FRAGILE (2003-2006) Fragility of Arctic Goose habitat: Impacts of Land use, conservation, and Elevated temperature. <http://www.fragile-eu.net/index.php> (accessed 2 March 2005)
- Helle T (2001) Mountain birch forests and reindeer husbandry. In: Wiegolaski FE (ed) *Nordic mountain birch ecosystems*. UNESCO/The Parthenon Publishing Group, Paris, France, pp 279-291
- Helle T, Aspi J (1983) Effects of winter grazing by reindeer on vegetation. *Oikos* 40:337-343

- Helle T, Timonen M (2001) The North Atlantic Oscillation and reindeer husbandry. In: Kankaanpää P et al (eds) Arctic Flora and Fauna: Status and Conservation, Edita, Helsinki, p. 25
- Ingold T (1980) Hunters, pastoralists and ranchers. Cambridge Univ Press, Cambridge, Cambridge, 336 pp
- Jernsletten J-L, Klokov K (2002) Sustainable reindeer husbandry. Arctic Council/Centre for Saami Studies, Tromsø, 157 pp
- Kankaanpää S (ed) (2002) The 2nd World Reindeer Herders' Congress Anár 2001. Arctic Centre Rep 36:1-182
- Kankaanpää S, Müller-Wille L, Susiluoto P, Sutinen M-L (eds) (2002) Northern timberline forests: environmental and socio-economic issues and concerns. Finnish Forest Research Institute, Jyväskylä, 289 pp
- Kendrick A (2003) Caribou co-management and cross-cultural knowledge sharing. PhD thesis, University of Manitoba, Winnipeg, 266 pp
- Klein DR, Moorehead L, Kruse J, Braund SR (1999) Contrasts in use and perceptions of biological data for caribou management. Wildlife Society Bulletin 27:488-498
- Konstantinov Y (2002) Soviet and post-Soviet reindeer-herding collectives: transitional slogans in Murmansk Region. In: Kasten E (ed) People and the land: pathways to reform in post-Soviet Siberia. Reimer, Berlin, pp 171-188
- Korkalo M, Pouta T, Valle P, Kokkonen P, Korpivuoma J, Itkonen P, Ollila T (1997) Peurakaira's ecological-area plan (in Finnish). National Board of Forestry Forest Economy Publication 9, 79 pp
- Krupnik I (1993) Arctic adaptations: native whalers and reindeer herders of northern Eurasia. University Press of New England, Hanover, 355 pp
- Krupnik I (2000) Reindeer pastoralism in modern Siberia: research and survival in the time of crash. Polar Research 19:49-56
- Kumpula J (2001) Productivity of the semi-domesticated reindeer (*Rangifer t. tarandus* L.) stock and carrying capacity of pastures in Finland during 1960-1990's. PhD Thesis, University of Oulu, Oulu, 44 pp
- Kumpula J, Colpaert A, Kumpula T, Nieminen M (1997) Winter pasture resources of the Finnish reindeer management area (in Finnish w/English summary). Finnish Game and Fisheries Research Institute, Kaamanen, 42 pp
- Kumpula J, Colpaert A, Nieminen M (1999) Summer pasture resources of the Finnish reindeer management area (in Finnish w/English summary). Finnish Game and Fisheries Research Institute, Kaamanen, 54 pp
- Kumpula J, Colpaert A, Anttonen M, Nieminen M (2004) The repeated reindeer pasture inventory in the northernmost part (13 districts) of the reindeer management area during 1999-2003 (in Finnish w/English summary). Finnish Game and Fisheries Research Institute, Helsinki, 39 pp
- Laakso AM (2002) The anomalies of contemporary reindeer herding management and supporting reindeer research: the need for a new paradigm. Pro gradu (Masters) thesis, University of Lapland, Rovaniemi, 127 pp
- Moen J, Danell Ö (2003) Reindeer in the Swedish mountains: an assessment of grazing impacts. Ambio 32:397-402
- Müller-Wille L, Hukkinen J (1999) Human environmental interactions in Upper Lapland, Finland: development of participatory research strategies. Acta Borealia 16(2):43-61
- Nuttall M, Berkes F, Forbes BC, Kofinas G, Vlassova T, Wenzel GW (2005) Hunting, herding, fishing and gathering. In: Arctic Climate Impact Assessment. Cambridge Univ Press, Cambridge, pp. 649-690

- Oksanen L (1978) Lichen grounds of Finnmarksvidda, northern Norway, in relation to summer and winter grazing by reindeer. Rep Kevo Subarctic Res Station 14:64-71
- Olli A (1995) Off-road vehicle traffic and possibilities to control it in the Pöyrisjärvi wilderness. In: Sippola A-L, Alaraudanjoki P, Forbes BC, Hallikainen V (eds) Northern wilderness areas: ecology, sustainability, values. Arctic Centre Publ 7:354-364
- Olofsson J (2001) Long term effects of herbivory on tundra ecosystems. PhD Thesis, Department of Ecology and Environmental Science, Umeå University, Umeå, 49 pp
- Paine R (1994) Herds of the tundra: a portrait of Saami reindeer pastoralism. Smithsonian Institution Press, Washington, DC, 242 pp
- Pelto PJ (1973) The snowmobile revolution: technology and social change in the Arctic. Cummings Publishing Company, Menlo Park, CA, 225 pp (revised Waveland Press, Prospect Heights, IL 1987, 234 pp)
- Riseth JÅ (2000) Sámi reindeer management under technological change 1960-1990: implications for common-pool resource use under various natural and institutional conditions. PhD Thesis, Department of Economics and Social Sciences, Agricultural University of Norway, Ås, 237 pp
- Saijets J (2004) Reindeer economy should not be like a museum (in Finnish). Lapin Kansa, 7 Oct 2004, p 5
- Sandström P, Granqvist Pahlen T, Edenius L et al (2003) Conflict resolution by participatory management: remote sensing and GIS as tools for communicating land-use needs for reindeer herding in northern Sverige. *Ambio* 32:557-567
- Sipilä P, Magga H, Aikio P (2000) Looking for arboreal lichen: Lapland Cooperative area's arboreal lichen inventory 1999-2000 (in Finnish w/English summary). Lapland Reindeer Cooperative, Vuotso, 24 pp
- Staaland H, Nieminen M (1993) World reindeer herding: origin, history, distribution, economy. Proceedings World Conference on Animal Production, Edmonton, pp 161-203
- Stark S (2002) Reindeer grazing and soil nutrient cycling in boreal and tundra ecosystems. PhD Thesis, University of Oulu, Oulu, 31 pp
- Tahkolahti J (2000) Researcher would reduce reindeer by one third (in Finnish). *Helsingin Sanomat*, 14 Nov 2000, p A11
- Talvitie M (2004) Reindeer economy could move into two camps (in Finnish). Lapin Kansa, 16 Sept 2004, p 21
- Torp E (1999) Reindeer herding and the call for sustainability in the Swedish mountain region. *Acta Borealia* 16(1):83-95
- Treseder L (1999) The evolution and status of wildlife co-management in Canada. In: Treseder L, Honda-McNeil J (eds) Northern Eden: community based wildlife management in Canada. University of Alberta, Edmonton, pp 7-18
- Tuomi-Nikula H (2001) Overgrazing threatens reindeer management (in Finnish). Lapin Kansa 30 Dec 2001, p 4
- Turi JM (2000) Native reindeer herders' priorities for research. *Polar Res* 19:131-133
- Turi JM (2002) The world reindeer livelihood - current situation: threats and possibilities. In: Kankaanpää S, Müller-Wille L, Susiluoto P, Sutinen M-L (eds) Northern timberline forests: Environmental and socio-economic issues and concerns. Finnish Forest Research Institute, Jyväskylä, pp 70-75
- Valtavaara M (2003) Reindeer breeders look to southern Finland for help as producer-prices fall (in Finnish). *Helsingin Sanomat* 6 Oct 2003, p A7
- Väre H, Ohtonen R, Mikkola K (1996) The effect and extent of heavy grazing by reindeer in oligotrophic pine heaths in northeastern Fennoscandia. *Ecography* 19:245-253
- Wielgolaski FE (ed) (2005) Plant ecology, herbivory and human impact in Nordic mountain birch forest. *Ecological studies* 180. Springer, Berlin Heidelberg New York, 365 pp

