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LICENTIATE THESIS

# Already Adaptive?

## *- An investigation of the performance of Swedish moose management organizations*

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## Abstract

The primary aim of this thesis has been to explore the significance of institutions, specifically property rights, on the establishment of adaptive management systems for natural resources. Another goal has been to contribute to how institutional theory and, in particular, theories of institutional change can be utilized to explain the presence or absence of adaptive management systems. In addition, the importance of conflicting interests regarding management of natural resources, and the effects of these conflicts on establishing adaptive management systems is examined.

In Sweden, conflicting interests exist between hunting and the forestry industry. This is because moose cause grazing damage which results in economic losses to the forestry industry, whereas hunters prefer large moose populations to optimize hunting opportunities. Changes in the Swedish official policy have stipulated that formal institutional prerequisites for *local adaptive management systems* are in place regarding moose management, because landowners have gained increased management rights, including the right to decide moose population size.

A quantitative study of Swedish Moose Management Units has revealed that these units are not particularly adaptive. A few hypotheses were stipulated relating to issues such as conflicting interests. The first hypothesis was that the devolution of management rights of moose took place without accompanying restructuring of the public administrative moose management system, and that this has led to isolated MMUs, a hypothesis data support. The second hypothesis was that conflicting interests between hunters and the forestry industry would result in the extent of adaptive management aspects being less when the ownership structure predominantly consists of forestry companies. Empirical analysis showed that there were small statistically-significant differences that could be explained by ownership structure. However, the hypothesis that private ownership would entail more aspects of adaptive management was rejected. The final hypothesis was that neither the forestry industry nor the private landowners would achieve the size of moose population desired, and data findings supported this.

If the Swedish state is going to implement adaptive management of natural resources, the role of the public administration has to be examined. This study indicates that the "traditional role" of the CABs does not seem conducive to implementing adaptive management. In addition, the study also indicates the importance of changed legislation to promote adaptive management and achieve a balance between flexibility and predictability. Further research concerning the effects of conflicting interests on establishing adaptive management is warranted.

**Key-words:** Institutions, institutional change, property rights, natural resource management, wildlife, adaptive management, local resource management.

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## Abbreviations:

| | |
|---|---|
| CAB | County Administrative Board (”Länsstyrelsen”) |
| EPA | Environmental Protection Agency (“Naturvårdsverket”) |
| MMU | Moose Management Unit (”Älgskötselområde”) |
| NBF | National Board of Forestry (”Skogsvårdsstyrelsen”) |
| NFS | EPA Directives (“Naturvårdsverkets föreskrifter”) |
| NHA | Hunters National Association – The Countryside Hunters (”Jägarnas Riksförbund - Landsbygdens Jägare”) |
| SAHWM | Swedish Association for Hunting and Wildlife Management (“Svenska jägareförbundet”) |
| SFS | Swedish Statue book (“Svensk författningssamling”) |
| SOU | The Official Investigations of the Swedish State (“Statens offentliga utredningar”) |
| SÖ | Sweden’s international agreements (Sveriges internationella överenskommelser) |
| RF | Swedish Constitution (“Regeringsformen”) |
| WMA | Wildlife Management Area (”Viltvårdsområde”) |
| WMB | Wildlife Management Board (”Viltvårdsnämnd”) |

# 1. INTRODUCTION

In 1993, Sweden signed the Convention on Biological Diversity, thereby agreeing to three main goals which are: 1) the conservation of biological diversity; 2) the sustainable use of its biological components; and 3) fair and equitable sharing of the benefits from the use of natural resources (SÖ 1993:77). *Sustainability* has been defined as using resources in such a manner as not to risk the ability of future generations to utilize them (Feeny, Berkes et al., 1990:296). One aspect of sustainability is how natural resources, such as species with diverse utilization values, can be managed. For many people, fishing and hunting are recreational sports with strong appeals. However, moose cause grazing damage on forest lands, which decreases the value of the forest. A problem facing many governments, therefore, is how to manage resources in a sustainable way, while ensuring that various parties' interests are taken into consideration. This might be a difficult task, since the interests of diverse actors often conflict.

Both the development of new ecological theories and concepts and the apparent limitations of conventional resource management have contributed to the emergence of the adaptive management approach. In the mid-1970's, an interdisciplinary team of biologists and system analysts defined the adaptive management approach, and their work was published in 1978 by a Canadian ecological theorist, C. S. Holling (Lee, 1993). They emphasized that ecosystems are complex, non-linear systems in which the only certainty is uncertainty, and that management strategies have to accept this as an integral part of the ecological system (Folke, Carpenter et al., 2002). Conversely, conventional resource management is characterized by the concept of command and control over resources, the goal being to maximize sustainable yield. The adaptive management process often requires that scientists and resource managers cooperate, in order to establish ecosystem models, since these models are believed to contribute to problem clarification and the elimination of unproductive options. Perhaps the most important result that model building can accomplish is disclosing gaps in the "state of the art" biological and ecological knowledge. The "missing" information can be obtained by implementing

large-scale experiments on ecosystems that generate new knowledge and, therefore, also improve the future likelihood of selecting appropriate policies (Walters, 1997).

Another aspect of the adaptive management approach is its emphasis on the interconnectedness between ecological and social systems. For example, if economic systems are not taken into account, this may jeopardize "purely" ecological solutions (Walters, 1986). The adaptive management approach has been applied successfully in, for example, the Everglades (Gunderson et al.1995), the Columbia River Basin (Lee, 1999), the ground fishery in Tasmania (Lee, 1999), and waterfowl management in the USA (Johnson, 1999).

However, other investigators have chosen another line of research and have focused on adaptive systems by which communities have succeeded in managing resources in a sustainable way (Berkes, 1998, 2003b; Berkes & Folke, 1998). The difference between these two lines of research has been described in the following way:

> The first [view] involves rethinking resource management science in a world of uncertainty and surprise, using a systems approach and adaptive management (Holling 1978; 1986; Walters 1986; Lee 1993). The second involves rethinking resource management social science by focusing on cultural capital (as an integral part of a triad with economic capital and natural capital), and on a property-rights system (Berkes and Folke 1994a; 1994b) (Holling, Berkes et al., 1998).

The second line of research has been directed at the local level and upon resource users and their ability to manage resources in a sustainable way. One important aspect is whether local resource users have managed to build social-ecological resilience by adapting to ecosystem changes. *Social-ecological resilience* has been defined as:

> 1) the amount of disturbance a system can absorb and still remain within the same state of domain of attraction;
> 2) the degree to which the system is capable of self-organization (versus lack of organization, or organization forced by external factors); and
> 3) the degree to which the system can build and increase the capacity for learning and adaptation (http://www.resalliance.org/ev.php).

Thus, two lines of research have developed that deal with adaptive management and, presumably, these require different institutional frameworks for implementation. Institutions comprise both formal and informal rules in society. Informal rules are conventions and norms, while formal rules consist of written political, legal, and economic rules (North, 1990). Conventional resource management is connected with a top-down management structure. It is likely that fundamental institutional changes are required, so as to replace conventional resource management with adaptive management. In this thesis, the first line of research described is called *centralized adaptive management*, and the other is called *local adaptive management*. While centralized adaptive management can be implemented via a top-down management structure, local adaptive management requires a bottom-up management structure, by which local resource users have increased influence. Adaptive management approaches, especially the centralized approach, have been considered by governments as potential solutions to diverse natural resource management problems. Since governments are planning on implementing adaptive management, it becomes paramount to highlight the institutional prerequisites of these approaches, especially because local adaptive management systems already might be in place.

The Swedish authorities have, in several official reports, proposed an "adaptive management approach" so as to ensure sustainable resource use of oceans and terrestrial waters, and proper management of wildlife (SOU 2003:72; Naturvårdsverket, 2003). An international review of Swedish wildlife research suggested that large-scale adaptive management experiments should be performed so as to improve wildlife management (Naturvårdsverket, 2001). The Swedish Environmental Protection Agency (EPA) recently changed policy direction regarding the management of moose, by declaring its intention to implement adaptive management (Naturvårdsverket, 2003). In this report, *adaptivness* is given the following definition: "[…] the management system should be adaptive; that is, it continuously should transform knowledge (inventory data and science) into practical

applications, and thereafter evaluate these" (Naturvårdsverket, 2003:39, author's translation).

In order to successfully implement any of the two types of adaptive management systems, or to examine whether there already are adaptive management systems in place, it is necessary to describe the current institutional framework. As mentioned previously, formal rules are written rules and property rights are formal rules of great significance regarding the management of natural resources. Research in this field has revealed that property rights are very complex. Centralized adaptive management policies that have been implemented in the USA have been facilitated by the large extent of state property. No consideration has had to be made to private owners, as would be the case in, for example, Sweden, where a sizeable proportion of the natural resources are under private ownership. On the other hand, the local approach requires considerable effort from local resource users, and these users also need to have management rights to manage the natural resources. One prerequisite for resource users establishing institutions is the right to organize and, if local resource users are to establish adaptive management systems, this also would be the minimum requirement (Ostrom, 1990).[1] Other researchers have emphasized the necessity of extensive management rights, for resource users to establish adaptive management systems (Adger, 2002/2003; Olsson, Hahn et al., 2003).

However, devolution of management rights does not automatically mean that local resource systems will be adaptive. Research has disclosed that long-enduring local management systems of common pool resources[2] usually are nested within even larger organizations. Such a polycentric governance system requires that citizens be able to organize multiple governing units. "Each unit exercises considerable independence to make and enforce rules within a circumscribed domain of authority

[1] This is one of Ostrom's eight design principles for long-lasting common pool resources. The others are: clearly defined boundaries; congruence between appropriation and provision rules and local conditions; collective choice arrangements; monitoring; graduated sanctions; conflict resolution mechanism; and nested enterprises (Ostrom, 1990)

[2] Common pool resources are goods with characteristics that make it difficult to exclude potential appropriators. Moreover, where joint use also indicates subtract-ability, that is, when one person deducts units from the resource, these resources adversely affect the ability of others to use the resource.

for a specified geographical area" (Ostrom, 2005:283). Emphasis is placed upon the importance of local resource systems in managing resources; however, not without the support of other organizational levels (Folke, Hahn et al., 2005:449). "…[A]utonomous self-organized resource governance systems may be more effective in learning from experimentation than a single central authority" (Ostrom, 2005:281). One reason is that local appropriators have knowledge of the resource and the surrounding environment, and receive feedback from changes in the environment. Another benefit of local resource systems is that the costs for enforcing rules are low. Perhaps the greatest benefit is that, if a local resource system fails, the consequences will not affect as great an area as if a central agency is unsuccessful with its natural resource management policies (Ostrom, 2005). The importance of polycentric institutions is that governance systems at higher levels than local systems can counteract some of the difficulties that face local resource systems, such as, for example, the lack of scientific information, inability to manage larger common pool resources, and conflicts between appropriators (Ostrom, 2005).

In several policy documents, the Swedish government has declared that resource users and land owners should take on a bigger level of responsibility for the management of fish and moose (Prop. 1980/81: 153 & Prop. 1991/92:.9). Over the last few decades, alterations in formal rules have led to devolution of management rights and deregulation of fish and moose policies. Two arguments behind these modifications are high administrative costs associated with the top-down structure and the belief that increased involvement of resource users can improve resource management (Prop. 1980/81: 153 & Prop. 1991/92:.9). Regarding moose, the change in official policy has entailed increased management rights of property owners. Since 1992, landowners can establish so called *Moose Management Units* (MMU sw, älgskötselområden). These MMUs can decide the number of moose that hunters are permitted to shoot during the hunting season, while County Administrative Boards (CAB) decide moose allocation for other moose management organizations, such as Wildlife Management Areas (WMA sw, viltvårdsområden). In other words, because of this conversion of the former top-down management system to a bottom-up

system, the formal institutional prerequisites for *local adaptive management systems* presumably are in place to deal with moose management. Even though the argument for change in the moose management system was not that these systems were to become adaptive, these changes provide an opportunity to investigate whether this has taken place. Another interesting question is whether the concept of polycentric institutions has been realized or, conversely, whether the devolution of management rights has made MMUs become isolated local resource systems.

When investigating institutional change, it is important to consider the organizational structure of the public administration, because it might inhibit the implementation of new management systems. Another important aspect is the norms existing among local resource users as how to manage natural resources prior to the implementation of a new management system. No matter how much sense a management approach, such as adaptive management, appears to make, the conditions behind it must be analyzed. Even though existing institutions can be made more efficient, new management systems never will be implemented in a vacuum (Dolsak & Ostrom, 2003).

A pilot case study of MMUs, conducted in 2003, indicated that both the property rights structure and conflicts of interest are decisive factors in determining whether a system will be adaptive or not. While property rights determine the maneuverability local resource users have in managing resources, conflicts of interests can reinforce or deter local resource users' attempts to establish adaptive institutions (Wennberg-DiGasper, 2004). However, the literature regarding adaptive management is not explicit in this regard. Together, this implies that institutions and institutional change comprise a critical research field, especially since governments set out to implement adaptive management systems. Institutional change often is fraught with conflict. Nonetheless, even though the adaptive management literature connects social institutions with ecological systems the issue of conflicts over resources often is missing. However, one study of Swedish water management demonstrates that strategic behaviors of resource users negatively affect learning from ecological crisis during times of uncertainty and when institutional change

includes distributive conflicts (Galaz, 2005). Conflicts over natural resources are the norm today, and these often reflect deep seated values. Furthermore, conflicts can be exacerbated by ill-suited institutions and policies that increase uncertainty and polarize interest groups (Nie, 2003).

In this thesis, the issues described above are discussed relative to the institutional performance of the Swedish Moose Management Units.

## 1.1 AIMS OF THE THESIS

The primary aim of this thesis is to clarify to what extent Swedish MMUs can be characterized as adaptive, and whether the ownership structure affects the adaptiveness of the management systems. Initially, the two lines of adaptive management research and their relationship to institutional features, such as property rights, will be discussed.

To clarify to what extent the Swedish MMUs are adaptive, a database has been established. It is based upon the management plans that all MMUs must hand in to the County Administrative Boards, and it consists of variables such as monitoring methods and goals regarding the size of the moose population, which can be operationalized as aspects of adaptive management. Since most research within the adaptive management literature consists of case studies, this study is complementary. The main empirical work in this thesis is a quantitative study of the existence of adaptive management systems regarding moose in an industrialized country. In this setting, one should be less likely to find local adaptive management systems, because resource users are not dependent upon the resource or live in close proximity to the resource system, as opposed to the case with indigenous tribes and resource users in third world countries. In addition, it is an opportunity to test whether adaptive management systems have developed at a national level.

However, as mentioned previously, generally there is a lack of focus on the effects of conflicting interests among resource users regarding adaptive management. Therefore, yet another aim of this thesis is to test explicitly whether or not conflicting

interests influenced the establishment of Swedish MMUs. The process behind the changes in formal rules, specifically property rights, is depicted. Hence, the study also consists of a document analysis that examines bills, official investigations and comments by different interest organizations regarding the establishment of the MMUs. This document analysis will indicate the possible conflict level regarding moose management in Sweden. The document analysis also examines, in detail, changes in property rights that have resulted from establishing the MMU system.

By examining if the management system in MMUs varies with diverse ownership structure, it also will be possible to test whether the presence of conflicting interests inhibits the establishment of adaptive MMUs. Consequently, the study is organized around the following three hypotheses:

**Question:**

To what extent have adaptive management systems developed in the Swedish MMUs?

**Hypothesis I:**

*Because devolution of management rights of moose took place without accompanying restructuring of the public administrative moose management system it has led to isolated MMUs.*

The underlying assumption is that the traditional public administrative organizational structure of Swedish moose management is an example of top-down management. The primary role of the public administration has been to establish, implement, and enforce laws and regulations. However, since MMUs were established, this traditional role has changed, because the only remaining administrative duty for the public administration, basically, is to register MMUs. In order for MMUs to avoid being isolated local resource systems, the role of the public administration has include assisting them regarding new scientific information, ensuring that information exchanges take place, and, through informative efforts, monitoring that the MMUs are functioning well. In other words, their traditional administrative

assignments differ markedly from what their role would be if the system comprised polycentric institutions.

**Hypothesis II:**

*Due to conflicting interests between hunters and the forestry industry, the extent of adaptive management aspects should be less when the ownership structure predominantly consists of forestry companies.*

The underlying assumption is that the presence of conflicting interests regarding natural resource management will inhibit the establishment of adaptive management systems, since activities such as collective learning require trust which is not believed to be prevalent when there are conflicting interests. Effective governance requires trust among the appropriators (Ostrom, 2005:279).

**Hypothesis III:**

*Forestry companies will have larger moose populations than their stated goals, whereas private landowners will have fewer moose than their stated goals.*

The underlying assumption is that forestry companies have greater bargaining power (greater resources, and the "support" of formal rules), but that they still do not reach their preferred equilibrium regarding the size of the moose population. The reason for this is assumed to be the hunters' perceived illegitimacy of the extended management rights landowners enjoy as a result of MMUs. It further is assumed that hunters believe that the responsibility of moose management should be shared by hunters and landowners. The reason for the forestry industry failing to ensure that its rules are complied by is connected with difficulties in monitoring and enforcing rules. If those affected by the rules do not believe that they will be enforced effectively, they have no incentive to follow them. It, therefore, is assumed that MMUs that primarily are comprised of forestry companies will have more moose than they want while MMUs owned primarily by private landowners will have smaller moose populations than they want.

In the next section, the methodology of this study is discussed.

## 1. 2 METHODS

The general criteria for establishing an MMU is that the area is large enough to contain its own moose population. If landowners want to establish an MMU, they have to formulate a management plan that has to be approved by the County Administrative Board (CAB) (1987: 905 §3). The moose management plan should contain the long-term goal of managing the moose population, and describe measures taken to restrict damage by moose to farm land, forests, and traffic. The plan also should contain information about the grazing situation, the size of the moose population (the winter population and a calculation of migratory moose), and the number of animals shot per year. According to the EPA's directives, the CABs should revise the MMU management plans and undertake any necessary measures, such as deregistering MMUs (NFS 2002: 19).

For the purpose of this study, all the MMU plans in Sweden have been collected and the information they contained entered into a database (see Appendix 1 for variables in the database). The database contains 637 MMU plans from twenty counties[3]. Approximately 20 MMU plans are missing. The number of MMUs per county varies from 4 to 89 in Sweden's twenty counties that contain moose populations. The MMUs extend over approximately 10,8 million hectares of land, and the size of the MMUs varies from 1,371 hectares to 247,000 hectares (median size = 10,061 hectares). Since 1992, it has been possible to establish MMUs and, according to the Environmental Protection Agency's (EPA) guidelines, MMU management plans should be revised every third year (NFS:2002:19); however, counties differ in how often this is done. Only one version of moose management plan was collected for each MMU, even though some MMUs had submitted several versions over the years. It is not known whether each MMU plan is the first or a revised version. The Swedish Hunting Association (SAHWM) has formulated a template for moose management plans to be handed in to the CAB at the time that a new MMU is established. However, this template has changed somewhat over the

[3] In Gotland county, there is no moose population

years and, therefore, the MMU plans differ in the type of information available. In addition, some MMUs created their own MMU management plan format.

Information about the ownership structure is not available in the MMU plans. This information has been collected by assuming that each MMU's name corresponds with a certain locality[4]. After this information was collected, the National Board of Forestry (sw, Skogsvårdsstyrelsen) provided data on ownership structure at the municipality level.[5] This information was entered into the database. It includes the following categories: public property,[6] private property, and forest company property.[7] Even though the ownership structure is registered at the municipality level and not at the MMU level, it provides a reliable indication of the importance of the ownership structure on management strategies within MMUs.

It is critical to keep in mind that, even though individual landowners have decided to establish MMUs, there might be several different organizations, such as WMAs, involved and, within these, many individual hunters and landowners. The MMU management plans are the stated goals of these individuals regarding moose management. Thus, the MMU plan is an expression of the goals and actions taken by the landowners and hunters who make up the units.

In survey research, it always is critical to take into consideration the context in which any record or document has been created; in other words, to examine for what purpose and for what audience the record was intended (Yin, 1994). One weakness of MMU plans can be reporting bias introduced by the document authors. However, a factor that might mitigate reporting bias is that the plans were supposed to be presented at local moose forums.[8] (NFS:2002:19) For example, in Norrbotten County, diverse interest organisations have had an opportunity to criticize the information in

[4] This information was available in databases of the Central Office of the National Land Survey.
[5] There were some estates that were assigned to more than one owner category; therefore, "assignments" to new categories were made randomly, according to Lena Ullsäter at the NBF (email 2005-07-09).
[6] The state owned company, Sveaskog, is included in "public property".
[7] It was not possible to determine which municipality to which 70 of the MMUs belonged to due to a variety of factors.
[8] Local forums are voluntary and are compromised of hunter representatives and larger landowners, such as forest companies, who, among other things, leave suggestions on moose hunting quotas to the Wild Care Committees (sw, viltvårdsnämnd) which, in turn, advise the CAB.

the MMU plans. Whether this procedure has been employed by other CABs in Sweden is unknown. The Swedish Hunting Association (SAHWM)[9] in Norrbotten County often has been critical of the establishment of MMUs, because it believed these to be too small or their estimation of the moose population to be incorrect. In contrast, a forestry industry interest organization in Norrbotten County, when commenting upon MMU management plans, was less critical than the SAHWM. It also should be mentioned that the CABs also review MMU management plans and should have some idea about the reliability of the information in the MMU plans.

Even though there are many "numbers" stated in the MMU plans, only some of these should be accepted as "hard facts", such as the size of the area. Other figures cannot be taken at face value, such as the number of moose per thousand hectares, since this is something that is extremely difficult to measure accurately. However, one way to ensure higher reliability of this variable is to only consider those MMUs who have utilized reliable monitoring methods. Unfortunately, there are regional differences regarding the kind of monitoring methods utilized, since a prerequisite for using airplane inventory is snow; consequently, this monitoring method rarely is used in the southern or south central part of Sweden. The question of reliability repeatedly is discussed in the chapter on results.

The question of concept validity will be discussed in Chapter 7, where theoretical concepts are operationalized. Since the data have not been created for this specific investigation, a careful argument for concept validity is made so that operationalization appears transparent. Certain aspects of the adaptive management approach will not have any corresponding variables in the database; however, indications of the presence of local adaptive management aspects can be found among the variables in the database.

As mentioned previously, this thesis also contains a document analysis of official investigations, bills and comments from diverse interest organizations and "parts" of the State, including different central public agencies and the government. The arguments for and against changes in formal rules, such as the establishment of

[9] SAHWM is Sweden's largest interest organization of hunters and was established in 1830.

MMUs, was organized according to the diverse interests commenting upon these suggestions.

In the next section, the disposition of the thesis is presented.

## 1.3 DISPOSITION OF THESIS

This thesis contains two main sections, one theoretical and one empirical. The first three chapters constitute the theoretical section, which contains a description of adaptive management theories and institutional theory. A general introduction to ecological concepts and theories from which the adaptive management approach stems is introduced first. In order to understand different aspects of adaptive management, it is important to have some basic ideas concerning the critical functions of ecosystems. This, in turn, is followed by a description of the two adaptive management approaches. Finally, a comparison between these two approaches, with a focus on their institutional implications, is introduced.

The other theoretical chapter in the first section of the thesis contains *institutional theory* and theories of institutional change. Since institutional theory and especially *institutional change theory* is the basis for the study, this section is a relatively in-depth description of important concepts within these theories. Critical concepts and ideas regarding property rights are depicted in a separate section.

In Chapter 4, a brief introduction to the current Swedish hunting administration and a review of the historical background of the hunting administration are introduced.

In Chapter 5, how MMUs were established is described.

The second part of the thesis consists of empirical findings and analysis. The empirical parts of this thesis consist of two investigations. In Chapter 6, the document analysis of the bargaining processes among interested parties regarding the changes in formal rules, especially the establishment of MMUs is presented. This chapter concludes with a discussion of how the changes in formal rules might have affected landowners and hunters.

The second empirical investigation is based upon investigations of the MMU database and, in Chapter 7 key concepts of local adaptive management are operationalized. In Chapter 8, the question of whether MMUs are adaptive management systems will be answered. In Chapter 9, the hypothesis regarding the significance of diverse ownership structures in the establishment of adaptive MMUs is tested empirically and the results presented.

Conclusions and policy implications are presented in Chapter 10.

## 2. THE CONCEPT OF ADAPTIVE MANAGEMENT

As mentioned previously, it is critical to distinguish between the two lines of adaptive management research, since these presumably require radically different institutional frameworks for successful implementation. Both of these approaches stem from the same theoretical background and adhere to some basic concepts. The theoretical concepts are *"ecosystem complexity", "resilience"* and *"adaptive renewable cycle"*. A key factor in the adaptive management approach is that the management system should not alter the ecosystem, but rather except the "surprise" element and respond appropriately. In practice, it entails accepting the unpredictable features of ecosystems and accepting the limitations of human intervention in controlling ecosystems (Berkes, 1998).

There is a lack of systematic comparisons between the two lines of research in the literature. These two lines of research should not be seen in an either/or light. Both stem from the same concepts and have major contributions to make with respect to the management of natural resources. Thus, the aim is not to cast judgments on the relative merits of the two lines of research. Nonetheless, it is believed that future research will benefit from this distinction, since it will allow for more focused and productive questions that can better relate the approach to current management practices, be it either in developing or developed countries. Since there is a chance that there already are adaptive moose management systems in place, which have evolved through bottom-up processes, it is crucial both to describe the current institutional framework and institutional prerequisites necessary for implementing these approaches. This chapter begins with a general introduction to some important ecological research findings and concepts, and how these relate to the two approaches. This is followed by a general description of each of the two approaches, and finally a systematic comparison between the institutional implications of each.

***Ecological Concepts:***

In many countries, the management of natural resources largely has been controlled by governments and central agencies. There has been a belief and trust in scientific

solutions to ecosystem problems, not only among scientists, but also amid the general public. World views assuming that people are alienated from ecosystems have been prevalent (Folke, Pritchard et al., 1998). However, major crises in ecosystems are occurring more frequently, and there is increased realization of the global nature of many environmental problems, such as the global warming effect. Even resources, such as fish, are disappearing right in front of us; for example, the near extinction of cod in the Baltic Sea. There is a frantic search for new ways to manage our natural resources in a sustainable manner.

Numerous problems caused by conventional resource management have stemmed from the view of ecosystems are controllable by humans. In this thesis, the following definition of an *ecosystem* will be used: "An ecosystem consists of plants, animals and microorganisms that live in biological communities and which interact with each other and with the physical and chemical environment, with adjacent ecosystems and with the water cycle and the atmosphere" (Odum in Folke, Pritchard et al., 1998:4). In conventional resource management, the environment is believed to consist of separate resource units that can be extracted, according to calculations of maximum sustainable yields, to achieve constant yields, without depleting the resource (Berkes & Folke, 1998). This management concept is based upon the assumption that ecosystems are linear and predictable. However, research has shown that ecosystems are complex systems, which often have attributes such as non-linearity, uncertainty and self-organization (Berkes, 2003b).

***Resilience:***

Conventional resource management often is successful in the short-term, because it usually treats single variable problems, such as fires, pestilences, floods or draughts that can be "solved" by means of scientific methodology. However, natural disturbances are crucial for the development and resilience of an ecosystem (Holling et al. in Folke, Pritchard et al., 1998). Management efforts to control single variables are made to decrease uncertainty and increase investments (Berkes, 2003b:19). This approach has been called *management pathology*, because it entails increasing human

dependence on an ecosystem, while simultaneously undermining that ecological system (Gunderson & Holling, 2002). Conventional resource management practices often have caused ecosystems to flip into a degraded state, due to loss of *resilience* (Holling & Sanderson, 1996:7-8) which can be defined as a system's ability to maintain its basic structure and patterns of behaviour after disturbances (Holling 1986:296). When an ecosystem has low resilience, drastic shifts can change it irreversibly. If so, the ecosystem threshold has been reached, but it is difficult to predict when this is going to occur, especially since thresholds move over time (Folke, Carpenter et al., 2002:8). For example, research on coral reefs and forests have disclosed that ecosystems often respond drastically to gradual changes. Studies on the effects of added nutrient concentrations into lakes, for example, have demonstrated that there seemingly is no effect until a certain threshold is reached, after which clear water turns into turbid, eutrophied water (Folke, Carpenter et al., 2002:28). Sometimes, these equilibrium shifts are permanent, as with desertification; at other times, these shifts are periodic, as with outbreaks of forest pests (Folke, Pritchard et al., 1998:7).

***The Ecosystem Cycle:***

The ecosystem cycle consists of four phases that are active during different time periods. These four phases are the *exploitation phase*, *conservation phase*, *release phase* and *reorganization phase* (Holling & Sanderson, 1996:21). The exploitation and conservation stages are fairly stable conditions (Olsson, Folke et al., 2003:27). In the exploitation phase, new species are established; and, in the conservation phase, nutrients and the biomass are consolidated.

> Exploitation is represented by those ecosystem processes that are responsible for rapid colonization of disturbed ecosystems and during which organisms capture easily accessible resources… Connectedness and stability increase during the slow sequence from exploitation to conservation and a "capital" of biomass is slowly accumulated (Folke, Pritchard et al., 1998:6).

In the climax state, the system is “mature” for environmental disturbances, such as fire, disease, or insect pest outbreaks. The release phase is when natural disturbances, like fires, take place, and it is a very rapid phase (Berkes, 2003b:18). The adaptive renewable cycle discloses the importance of not preventing “natural disturbances” affecting ecosystems. Many traditional societies allow disturbances to occur at a local level, so as to prevent centralized disturbances later on (Folke, Colding et al., 2003:356).

Resilience research has concluded that certain plants, animals and biotic processes are the basis for all other “life” forms, and should be focused on (Gunderson, Holling et al., 1995:26-28). Research also indicates that the stability of an ecosystem dependsupon slowly changing variables, such as soil properties and biomass of long-lived organisms (Carpenter, Scheffer et al., 2001). Diversity is crucial in the ecological system and this refers to the function of a species (for example pollinators and predators) and the diversity of the species. Diversity acts as insurance against drastic changes in the ecological system, and certain organisms or species have critical functions (Folke, Carpenter et al., 2002:25-27). If the resilience of an ecosystem declines, it becomes vulnerable to both human-induced and natural disturbances. The ecosystem cycle shows that disturbances are an important part of the system. However, if the ecosystem’s resilience declines, even natural disturbances become a threat to the ecosystem. Research in this field also has disclosed difficulties in determining thresholds, and this is troublesome, especially since alternative states of ecosystems can be very expensive or even impossible to reverse, and can have far-reaching consequences.

The above-described concepts form the basis of the adaptive management approaches. The importance of diversity, for example, can be dealt with by applying an ecosystem perspective, instead of only focusing on single species or “problems”. The importance of not preventing natural disturbances in an ecosystem also is highlighted by applying an ecosystem perspective. The limitations of traditional biological and ecological science in dealing with complex non-linear systems, such as ecosystems, have resulted in an emphasis on experiments utilizing the adaptive

management approach. In addition, the complexity of ecosystems has resulted in an emphasis on learning in the adaptive management approach. The two lines of research adhere to the above-described concepts and theories. However, the institutional prerequisites for each are significantly different, as will be described in the subsequent sections.

## 2.1 CENTRALIZED ADAPTIVE MANAGEMENT

This section begins with a general introduction to the adaptive management approach, which is followed by a description of the implications of the approach regarding property rights, stakeholders, knowledge, learning and finally implementation problems. An interdisciplinary team of biologists and system analysts defined the approach in the mid-1970s, and the approach and closely-linked concepts have since gained recognition. This, in turn, has led to an increase in related research. Holling, Walters and Gunderson have made substantial contributions to the centralized line of research (Gunderson, Holling et al., 1995; Walters, 1997). Walter's definition of the approach is: "Implementation of experimental management policies that attempt to balance short-term social, ecological, or economic risks with possible longer-benefits due to increased knowledge of system properties" (Walter in Jones, 1998:33). This approach is linked closely with larger scale experiments, which recognize surprise, but it relies heavily on "traditional" biological/ecological science.

***Property rights:***

Most centralized adaptive management implementation has taken place in Canada, Australia and the USA, in geographically-large ecosystems and on state-owned land. Lee claims that " …adaptive management appears to be a "top-down" tool, useful primarily when there is a unitary ruling interest able to choose hypotheses and test them" (Lee, 1999:18). Even though not all efforts in implementing adaptive management have taken place in geographically large ecosystems, such as the

Everglades and the Columbia River Basin, most have. Gunderson has pointed out that it is necessary to have "space" for taking measures in the social and resource systems (Gunderson, Holling et al., 1995:19) and that small-scale experiments are unproductive, since these are neither recorded nor communicated efficiently (Gunderson, 1998:43). One argument for large-scale implementation of the adaptive management approach is that biologically-effective preservation of species and habitats requires larger areas (Lee, 1999). An example where this approach has been implemented in a geographically-smaller ecosystem is in Ontario's inland fisheries. The cost of the adaptive management approach was justified by formulating questions regarding important species from different lakes in the area; in other words, the results would be applicable to other lakes as well. The Ontario fishery managers formulated questions they considered important, such as the affect that open-access fishing would have on the fish population, and how trout would react to the loss of its traditional habitat. These questions were tested by conducting experiments in three different lakes. One of the results was the discovery that trout were capable of finding substitutes for loss of habitat (Fruetel, 1998). However, experiments like this would be difficult to implement in lakes where people have private fishing rights. Most people probably would be reluctant to permit their fishing waters to undergo experimentation for the "greater good". In addition, environmental organizations or societies arguing for the prevention of cruelty to animals might not be pleased with experiments like those described above.

***Stakeholders:***

While there seems to be consensus regarding the importance of close cooperation between resource managers and scientists, this is not the case with respect to the degree of involvement of different stakeholders. Lee points out the importance of some kind of prior agreement with stakeholders, before the adaptive management approach is implemented, since conflict always is present (Lee, 1999). Stakeholder involvement in these processes can reveal diverse views of deeply-held ecological beliefs and values, between various interests such as "development" interests and

environmental interest groups (Walters, 1997). However, scientists have divergent views as to what degree stakeholders should be involved in the process. It seems that most researchers realize that stakeholders are going to become involved if the questions affect them. However, there is a concern regarding stakeholders' lack of scientific knowledge. Currently, stakeholder involvement in natural resource management seems to be the norm, and their importance in the process is highlighted in many political documents and laws. For example, in the European Committee's Watershed Directive, the involvement of communities in the establishment of watershed management plans and in reviewing these is highlighted (Directive 2000/60/EC). Gunderson expresses concerns about replacing uncertainties in ecosystems with institutional processes, such as community-based management systems by which science gets thrown out (Gunderson, 1998). In order words, he issues a warning against institutional structures that end up neglecting important parts of the adaptive management approach.

***Public administration:***

The technical challenge of the approach is to create a framework in which participants will formulate alternative testable hypotheses and then make a choice between these hypotheses (Gunderson & Holling, 2002:414). Thus, it is important that managers are familiar with science and have the capacity to understand new scientific findings (Carpenter, 1998). The resource managers also have to function as leaders, since they have to motivate the involved parties to gather information (Lee, 1999). A significant problem is making public resource managers accept risks and conduct experiments, instead of striving for reliability and the reduction of surprises, as is the practice in conventional resource management (Danter, Griest et al., 2000:539). In addition, the current academic structure discourages team efforts and experiments, because promotions are based upon rapid, numerous publications, a requirement which is not consistent with long-term studies and cross-disciplinary efforts (Carpenter, 1998). Depending on a country's natural resources, public management structure, and the employees' educational background, the

implementation of adaptive management might differ between countries. If the current public administration has a focus on natural science and not on law, this might mitigate difficulties in implementing adaptive management.

***Learning:***

One basic feature of the adaptive management approach is the importance of continuously learning about ecosystems. It has been revealed that conventional resource management exhibits major flaws in this regard. Research has disclosed that no efforts have been made to document the past decades of professional experience of resource managers, and that policy failures were not even noted (Hillborn in Ostrom & Janssen, 2002:9). One of the major challenges is to develop the capacity for learning among resource managers, and this seems to be enhanced when the focus is on understanding in networks, with several individuals collaborating. It also is necessary to facilitate learning among other actors in the process, besides just technical experts. One significant obstacle to encouraging learning is the short political cycle, since it does not promote long-term projects (Carpenter & Gunderson, 2001). However, if learning is to become a key guideline of the public administration in natural resource management, the view of public administrators as experts has to be altered and also gain legitimacy among the public and other concerned interests.

***Implementation problems:***

Some of the problems regarding the implementation of adaptive management relate to high monitoring costs, since experiments usually require monitoring of a wide range of variables, and some of these variables might be quite expensive to monitor; for example, trends in rare and endangered species and primary production. Another problem involves the risks to which sensitive species might be exposed during experiments. Other obstacles impeding implementation of the approach can be attributed to the existing scientific paradigm, to political inaction, and to fundamentally different ecological values between environmental interest groups and "development" interests (Walters, 1997). It is known that, after a significant crisis in

ecosystems, institutions generally are more “open” to implementing changes, such as the adaptive management approach (Danter, Griest et al., 2000; Gunderson, 2001). In other words, it might become a “last resort” approach, when ecosystems experience significant crises that cannot be “handled” in a traditional manner. One institutional change that could improve the potential for the adaptive approach is flexible legislation that explicitly permits experimental management (Jones, 1998:45). This is quite a radical suggestion in many ways. National governments would have to admit the inability of centralized agencies to ensure the sustainable use of natural resources with “state of the art” scientific findings. The basis of traditional top-down management of natural resources is the capacity of the scientific community and central agencies to “solve” emerging problems. Since a crucial part of the adaptive management approach is to learn from mistakes, it becomes necessary to document failures, and this always poses a political risk (Lee, 1993:53).

***Conclusion:***

Centralized adaptive management partly is related to conventional resource management, since both management systems require a top-down structure, in which the role of the local resource users is limited. However, one difference is that centralized adaptive management focuses on learning about ecosystems by conducting experiments, and does not rely only on traditional biological and ecological science in managing natural resources, as is the case with conventional resource management. The significant emphasis on cooperation among scientists and public resource managers requires changes in current academic and administrative structures. Perhaps the greatest obstacles in implementing the adaptive management approach are its long-term view and the fact that it emphasizes learning and not quick-fix solutions, both in which politicians rarely want to invest, due to the short political cycle?

In what respect does the centralized adaptive management approach differ from the “local” version? This is the topic of the next section.

## 2.2 LOCAL ADAPTIVE MANAGEMENT

This section begins with a general introduction to the local adaptive management approach, followed by a description of the implications regarding property rights, stakeholder involvement, knowledge, learning and finally implementation problems. Prominent scholars who advocate the approach - Folke, Berkes and Colding, among others - rely on theories regarding ecosystems as complex systems. Concepts like resilience, thresholds, and so on are integrated with social notions such as institutions, particularly property rights and common property (Folke, Pritchard et al., 1998:14). The realization that ecosystems are inseparable from social systems has led to influences from common pool resource (CPR) studies and institutional theories, since these focus on rules that govern the management of natural resources. Common pool resources are goods with characteristics that make it difficult not only to exclude potential appropriators, but where joint use also indicates *subtractability*; that is, when one person deducts units from the resource, it adversely affects other users' ability to use that resource. "The key fact of life for co-appropriators is that they are tied together in a lattice of interdependence, as long as they continue to share a single CPR" (Ostrom, 1990:38). A general problem with CPRs is that, if everyone is acting in a logical, rational short-term way, this will lead to the destruction of the "commons". Therefore, an important feature of the management of CPRs is to ensure sustainability of the resource units through organized collective action of the resource users (Ostrom, 1990). Major focus has been on traditional societies and how these have managed to build social-ecological resilience.

> Traditional systems parallel adaptive management in their reliance on learning-by-doing, and the use of feedback from the environment to provide corrections for management practice. They differ from science-based systems generally by the absence of testable hypotheses and generalizable theories, and by the integration of moral and religious belief systems with management (Gadgil et al. in Holling, Berkes et al., 1998)

Since many traditional societies have managed to adapt to an ever-changing environment, proponents of the local adaptive management approach argue that it is

possible to gain insight into what contributes to resilience building, in both social and ecological systems. Certain management practices, based on ecological knowledge, have been identified that increase resilience. Some of these management practices are the monitoring of changes in the ecosystem and in resource abundance; total protection of certain species, as well as, the protection of specific habitats; temporal restrictions on harvesting; integrated species management; and resource rotation. Some social mechanisms behind management practices increasing resilience are the accumulation and transmission of ecological knowledge; cross-scale institutions; and mechanisms for cultural internalization (Folke, Pritchard et al., 1998:418).

The most significant institutional prerequisite for local adaptive management is that the local resource users should have an opportunity actually to manage natural resources. "Promoting resilience means changing, in particular the nature of decision-making to recognize the benefits of autonomy and new forms of governance in promoting social goals, self-organization, and the capacity to adapt" (Adger, 2002/2003:2). To facilitate development of local resource systems, it is necessary to have rules that allow for this to take place. One problem with the local approach could be that people are not motivated to engage in natural resource management. Private ownership of property might provide incentives to engaging in the management of natural resources. However, if there is no interest among local resource users in managing ecosystems adaptively, the whole idea collapses. Another important aspect is that the system has to include more than only a few resource users. As Adger states:

> [it] is important to note that, because of its institutional context, social resilience is defined at the community level rather than being a phenomenon pertaining to individuals. Hence, it is related to the social capital of societies and communities" (Adger, 2000:349).

How many people in a community need to be engaged in the management of the ecosystem and have ecological knowledge in order for the *community* to be socially resilient? This issue should be of particular importance in industrialized countries, where resource users often do not depend upon the resources for their livelihood or

live in close proximity to the ecosystems. It, therefore, is reasonable to assume that there often might be too few resource users engaged in the management of natural resources.

***Local Ecological Knowledge:***

"It comes as no surprise that knowledge of ecosystem dynamics and associated management practices exists among people of communities that, on a daily basis and over long periods of time, interact for their benefit and livelihood with ecosystems" (Folke, Hahn et al., 2005:445-446). Advocates for local adaptive management do not turn their back on science, but acknowledge the existence of ecological knowledge among resource users. To have *ecological* knowledge, one must understand the interaction between and among organisms and their environment (Berkes in Olsson & Folke, 2001). Knowledge of natural resources can be divided into three categories. The first is *local ecological knowledge* (LEK) that resource users have gained through observations of the local environment. It may be a mixture of practical and scientific knowledge complementing each other. Local knowledge consists of a series of local observations over time, which is difficult to attain with "traditional" science (Folke, Colding et al., 2003). In Olsson and Folke's study of cray fishing in Lake Racken in Sweden, they identified a mix of scientific knowledge and local knowledge. The local knowledge was obtained by means of monitoring at the local level and complemented by scientific and governmental sources (Olsson & Folke, 2001). The second type of knowledge is *indigenous knowledge* which is understood as the local knowledge of indigenous people. The third type of knowledge is *traditional ecological knowledge*, which is the knowledge derived from historical and cultural continuity (Berkes, 2003b:12). Sacred groves set aside for religious purposes exist in rural areas of India and can constitute everything from a patch of trees to a forest. Religious beliefs have, in these cases, protected animal refuge areas from human utilization (Colding et al. 2003:176).

Local adaptive management calls attention to the existence of local ecological knowledge and how this, in combination with scientific knowledge, can improve

sustainable utilization of natural resources. In addition, local adaptive management highlights problems with knowledge amid the public administration and in association with the implementation of policy.

> "Nor should we presume that officials have all relevant knowledge to manage complex dynamic systems while local appropriators are ignorant. The knowledge base of government officials may not, in reality, be better than that of local appropriators, who have used a particular resource for years and know its characteristics in considerable detail" (Ostrom, 2005:238).

Another problem with a centralized system is that, when policies are implemented, it requires that all common-pool resources under its jurisdiction will be experimented with and, if this fails, the consequences are far-reaching. Conversely, if there are parallel local resource management systems in place, even though some might fail, some also will succeed. In addition, if there are efficient information exchanges among the local resource systems, these systems each can learn from other's mistakes (Ostrom, 2005:284).

International organizations, such as the United Nations, have emphasized strongly the importance of indigenous knowledge, especially with respect to sustainable development (Davis & Wagner, 2003). Also, the Swedish government states that traditional and local knowledge of "nature" can be very valuable for nature conservation. By signing the Convention on Biological Diversity, Sweden has made a commitment to protect, preserve, and maintain knowledge of traditional and local communities (Skr. 2001/02:173:120).

The Centre for Biological Diversity in Sweden currently is documenting efforts made to implement paragraph 8j of the Convention of Biological Diversity (Tunón, 2004).[10] There are no firm definitions concerning what should be classified as traditional and local communities embodying traditional lifestyles, etc. However, the

[10] Convention on Biological Diversity (Article 8 j) "Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices" (http://www.biodiv.org/convention/articles.asp).

Centre for Biological Diversity suggests that the Sámi, tundra farmers and archipelago fishermen should be included in the definition. Few efforts are made to document traditional knowledge, and multidisciplinary efforts at documenting this kind of knowledge experience difficulties receiving research funding in Sweden (Tunón, 2004). Nevertheless, the Swedish government emphasizes the importance of local ecological knowledge in the management of natural resources:

> Local and traditional ecological knowledge should be tied to its role in monitoring changes in the environment, and its role in monitoring the environmental condition. It is important to utilize local resource users' ecological and practical knowledge in the management of natural resources and ecosystems (Skr. 2001/02:173:121, author's translation).

Thus, the Swedish government considers it important to incorporate local ecological knowledge in natural resource management, and to adhere to the above-described ideas. With regards to questions posed by the Centre for Biological Diversity, the SAHWM stated that basic hunting education (obligatory for every person wishing to receive a hunting license) and hunting leader education, both organized by SAHWM, are efforts at educating Swedish hunters, and that the hunters, in general, have good wildlife biological knowledge. In addition, information regarding hunting is provided by the membership magazine "Svensk Jakt", by the youth magazine, "Akila" and by the SAHWM website. SAHWM believes that an active management system, based upon the commitment and knowledge of local populations, is the best guarantee for a diversified landscape and, therefore, extensive biological diversity.

In a project addressing local moose management, the so called LÄS project[11](Wallin, Vikberg et al., 2003), scientists and resource managers found that hunters had altered monitoring methods so that these no longer were reliable. Wildlife biologists have developed several monitoring methods for moose, such as ÄlgObs (for further information regarding monitoring methods, see Appendix 5).

[11] LÄS was a project that was run by the research department at SAHWM and started in 1997. It was an experiment on "local moose management" in 10 different areas. The landowners and hunters set goals as to the development of moose populations and were assisted by a hunting consultant. A variety of inventory methods were utilized as "tools" in managing the moose population. (www.jagareforbundet.se/forsk/viltforvaltning/las.asp.)

They found that hunters did not have adequate knowledge of how to collect and treat data, and believed that one reason for this was the shortage of time hunters had to devote to moose management. The hunters also lacked understanding of basic statistical concepts, such as random sampling; therefore, as an example, they counted droppings outside of marked areas. In addition, the biologists and resource managers concluded that hunters exhibited a lack of competence in the biological management of the moose. The LÄS project indicates that the Swedish hunters not only lack the basic education for understanding monitoring methods, they also do not have the time to acquire these skills. However, it also is important to note that neither the basic hunting education nor hunting leader education contain any information as to monitoring methods or the basic statistical concepts underlying these.[12]

Scientists have, in many instances, regarded local knowledge with contempt. Consequently, before co-operation between scientists and local resource users can take place, trust has to be forged. Local knowledge is acquired by learning-by-doing, and this usually leads to an intuitive feeling for the characteristics of the environment. For example, research on coastal fishing in Iceland has revealed that skippers have a three-dimensional view and can identify patterns on the sea-bottom. One potential problem with cooperation between local resource users and scientists is a "communication problem". In Iceland, where efforts have been made to increase cooperation between fishermen and scientists, it has become apparent that this "translation" problem exists (Pálssson, 1998:48-65).

The utilization of local ecological knowledge is declared important by the Swedish government; however, not without prior scrutiny concerning the reliability of the knowledge.

> At the same time, traditional knowledge has to be evaluated. Traditional knowledge does not automatically have to be "right" knowledge. It is necessary to critically evaluate all kinds of knowledge, including traditional and local knowledge (Skr. 2001/02:173:121, author's translation).

[12] Conversation with Göran Bergqvist (cloven-hoofed animal consultant at SAHWM) 07-10-05.

Davis and Wagner performed a search on the Social Science Citation Index (SSCI), in order to examine the kind of articles published on local ecological knowledge. They found that, out of 65 articles, only 22 contained empirical studies in the form of case studies; and, that out of those, only four articles described study methodology in detail (Davis & Wagner, 2003). In other words, empirical research regarding local ecological knowledge remains fairly limited. Apparently, there is still a lack of consensus regarding many important methodological concerns. As mentioned, there also is a lack of quantitative studies which might increase the generalizability of results. Despite this apparent lack of empirical studies of LEK, policy makers in both the national and international arenas have emphasized its importance regarding the management of natural resources.

One recent study regarding LEK of different bird species among Inuit peoples in the Arctic, disclosed that dramatic declines in population would have gone undetected by western science, if not for the reports provided by the local resource users. The study also disclosed that there was a difference in the scope and quality of knowledge of different species and, therefore, the authors called for research specifically exploring the relationship between species and the local community; for example, if a species was non-migratory, this increased knowledge of the species. However, the study indicated that LEK cannot track population changes, except for catastrophic declines; therefore, scientific monitoring is a critical complement (Gilchrist, Mallory et al., 2005). Another important question related to LEK is how many people in a community need to have ecological knowledge for it to be characterized as *local* ecological knowledge? In essence, this discussion is the same as the one regarding the resilience of a community (Davis & Wagner, 2003; Moller, Berkes et al., 2004).

***Ecosystem Management:***

"Management of ecosystem resilience to sustain resources and ecosystem services requires the ability to observe and interpret essential processes and variables in ecosystem dynamics to develop the social capacity to respond to environmental

feedback and change" (Folke, Hahn et al., 2005:445). Contrary to conventional resource management, adaptive management takes into consideration the entire ecosystem and not only single resources. In a similar fashion, *ecosystem management* treats single resources as part of a complex network of processes, and functions on different spatial and temporal scales (Olsson & Folke, 2001). If, for example, there is a change in the predatory population, this might greatly affect the entire food chain and have far-reaching consequences which might be difficult or even impossible to predict. Another aspect of ecosystem management is that both slow and fast processes in the system are monitored and taken into consideration. Therefore, not only fast processes, such as species abundance, but also slow properties, such as changes in soil or pH levels in water, should be monitored (Olsson & Folke, 2001). In other words, a significant difference between ecosystem management and conventional resource management is that the former emphasizes the goal of understanding the ecosystem, and not only detailed information about specific species (Folke, Hahn et al., 2005).

Landowners and hunters jointly are responsible for ecosystem management regarding wildlife in Sweden. However, the paragraphs pertaining to ecosystem management in the Hunting Law are formulated with a focus on the size of wildlife populations relative to public and private interests, and there is no mention of ecosystem management *per se* (SFS 198:259§4)[13]. However, responsibility for ensuring biodiversity is regulated by the Forestry Act, which states that the forest is a national asset that must be taken care of in a sustainable manner, in order to ensure its productivity while simultaneously protecting biological diversity (SFS 1979:429§1). The National Board of Forestry (NBF, sw Skogsstyrelsen) and the County Forestry Agencies (CFA, sw Skogsvårdsstyrelserna) are required to ensure that biological diversity is preserved and the forest protected against animals (SFS1993:1272§3 p.

[13] "The wildlife should be cared for in order to preserve wildlife species that constitute the country's wildlife populations[…]and further an appropriate development of wildlife populations with consideration to public and private interests. Wildlife care, through special measures, ensures that wildlife is protected, and that the hunting pressure is adjusted according to the status of populations. Landowners and persons leasing hunting rights are responsible for taking appropriate measures, and for adjusting to hunting pressure" (SFS 1997:343, author's translation).

2&5). At the establishment of MMUs, no regulations regarding the importance of considering biodiversity or ecosystem management were enforced. The focus remains on wildlife populations and this entails single-species management, instead of ecosystem management.

***Experiments and Monitoring:***

Another important adaptive management feature is for local resource users to *conduct experiments*. When local resource users conduct experiments, they ask questions first and, then, attempt to answer them by testing their ideas in management practices. When managing moose, it is critical to obtain information regarding population sizes. If there are no ways to find out the population size, it becomes impossible to decide how many moose to shoot or how many fish to catch. Hence, *monitoring* of the resource is a crucial aspect to managing animal resources adaptively. Typical, traditional monitoring methods of wildlife are low-cost, rapid and performed in connection with harvesting of the resource. Some traditional monitoring methods are "catch per unit effort" (CPUE), body condition index, breeding success, and collective information gathering while hunting (Moller, Berkes et al., 2004). That traditional methods are used in connection with the harvest requires that the "sampling" is not random, due to factors such as the skill of the hunters, the relative abundance of the resource, the time it takes to slaughter the animals, and so on. It is argued that the strengths of scientific monitoring are that it has higher spatial generality, it is quantitative and objective, and it can be decoupled from harvesting (Moller, Berkes et al., 2004). However, interestingly enough, the most widespread monitoring method of moose in Sweden, ÄlgObs, is conducted during the hunting season. In other words, this method is not decoupled from harvesting, and has proven to be a reliable monitoring method. Wildlife biologists in the LÄS project were trying to implement CPUE by having hunters fill out diaries, albeit with unsatisfactory results (Wallin, Vikberg et al., 2003). Conversely, traditional CPUE often is conducted in such a manner that the hunters keep a mental note on their CPUE relative to expected CPUE based upon previous experience (Moller, Berkes et al.,

2004). The scientific version of CPUE is more time-consuming to perform and, therefore, perhaps less likely to appeal to hunters.

***Learning:***

In the local adaptive management approach, significant emphasis is placed on the importance of social and institutional *learning*, resulting in social memory of the community, which is communicated by different actors. Some of these might be wise men, interpreters (people that explain ecological knowledge to the community), networkers, visionaries, innovators, implementers, followers and reinforcers (Folke, Colding et al., 2003:366-368). In the Lake Racken study, the key steward was a biology teacher who conveyed scientific findings to the other resource users (Olsson & Folke, 2001). "A major challenge concerning the problem of fit is to build institutions that monitor ecosystem change, and that generate, accumulate and transfer ecological knowledge and understanding" (Folke, Pritchard et al., 1998:21). There are certain types of organizational structures that promote learning - for example, decentralized organizations - since these enhance the potential for collective learning (Röling & Jiggins, 1998). Many aspects of adaptive management, such as continuously learning about ecosystems, require time to establish local adaptive management systems. Social conflicts can inhibit the process of learning if individuals employ strategic behaviour and, thus, negatively affect the ability to respond to environmental crises (Galaz, 2005).

***Polycentric Institutions and Cross-scale Linkages:***

As already discussed, polycentric institutions necessitate citizens organizing in units that have a certain degree of independence regarding decision-making over resources. However, it is not sufficient to have units exercising authority over geographical areas without any contact between them. Researchers seem to agree on the importance of *linking local resource systems to other scales* (Berkes, 2002, 2003a; Cash & Moser, 2000; Low, Ostrom et al., 2003; Murphree, 2000). Generally, the specific characteristics of the CPR determine how important it is to have linkages. If

the resource is part of a highly-complex ecosystem and its use results in extensive negative externalities, linkages are critical (Dolsak & Ostrom, 2003). Thus, the presence of larger, overlapping jurisdictions is an important complement to the working of local level systems. Larger units, in general, can handle issues such as natural disasters and corruption/inefficiency; can provide scientific and technical skills to complement local knowledge; and may provide conflict resolution arenas for conflicts among parallel units (Low, Ostrom et al., 2003). Linkages can be either vertical or horizontal. Vertical linkages are connections on a spatial level; horizontal linkages are on an organization level (Berkes, 2002). Some of the arguments for local natural resource management systems are that it is easier to obtain information at lower transaction costs and that local institutions can establish rules appropriate to local conditions (Hanna, 1998; Ostrom & Schlager, 1996). Research in this field has proven that local-level institutions respond faster to changes in the ecosystem than centralized agencies (Davidson-Hunt & Berkes, 2003:67). It is common that local resource users detect changes in the eco-system; for example, when members of a local fishing association in Sweden detected changes in the eco-system by using various indicators (Olsson & Folke, 2001). In addition to having knowledge of the ecosystem, resource users also know people living in the area, and what norms exist. Knowledge of norms pertaining to resource management is crucial, since people might continue to adhere to norms, even if formal rules contradicting these are implemented. Another aspect to take into consideration is that local appropriators are more likely to be able to draft rules that contribute to reciprocity and high levels of trust among the appropriators, than public officials without knowledge of the characteristics of the community and its norms (Ostrom, 2005:281). If local resource management systems cooperate with each other, it perhaps is possible to raise funds in order to increase knowledge of the resource systems; in addition, these systems can learn from each others' experiments and, thereby, improve their resource management strategies (Ostrom, 2005:280). Also, the Swedish government believes it is imperative to tie local ecological knowledge across different scales to promote sustainable development:

> Local ecological knowledge and the organizations that possess it should constitute an essential part of nature conservation. Conservation also must be linked to other levels – municipalities – County Administrative Boards among others – in order to contribute to sustainable management (Skr. 2001/02:173:121, author's translation).

The role of public administration requires certain organizational structures, so as to contribute to sustainable resource management. In the local approach, one responsibility of the resource manager is to provide scientific and technical skills to complement local knowledge. Another important role is to provide arenas for conflict resolution; thus, managers have to take on the role of a mediator or facilitator for conflict resolution (Low, Ostrom et al., 2003:108). Resource managers can enhance cross-scale linkages to ensure that ecosystem scales are in accordance with social/economical scales. "The strength of polycentric governance systems in coping with complex, dynamic biophysical systems is that each of the subunits has considerable autonomy to experiment with diverse rules for using a particular type of resource system, and with different responses to external shock" (Ostrom, 2001:2).

To summarize, contrary to both conventional resource management and centralized adaptive management, the local approach can be characterized as a bottom-up management system. A central prerequisite is that resource users have extensive management rights. The approach entails that local resource users have a significant responsibility in managing natural resources. However, if resource users do not have local ecological knowledge or the time to invest in the management system, it is unlikely that the management system will be adaptive.

## 2.3 CENTRALIZED OR LOCAL ADAPTIVE MANAGEMENT?

*Centralized adaptive management* is similar to conventional resource management, in that it is a top-down management system in which scientists and resource managers decide the kinds of policies that should be implemented. The role of the local resource users is limited to assisting in the management of the resource. In addition, the involvement of stakeholders is complicated, due to the fact that the approach

requires significant scientific knowledge, especially regarding model building. Most stakeholders probably would have difficulties understanding these models or the scientific basis for experiments. Gundersson fears that, if stakeholders have too much influence, this inability will result in a disregard for the importance of science in the process (Gunderson, 1998). Another difficulty might be that conflicts among diverse interests spill over into the adaptive management process to hinder learning, since scientists might be employed by different interest groups to specifically further their interests, inhibiting the impartial process of model building. Thus, real stakeholder influence in centralized adaptive management might be very difficult to achieve.

*Local adaptive management*, on the other hand, can be characterized as a bottom-up system, whereby local resource users are expected to manage the resource quite independently, even though it is considered vital to establish cross-scale linkages so as to benefit from vertical and horizontal coordination. The bottom-up approach requires that the resource user invest significant time and effort in managing the resource. This has been suggested as an explanation for why hunters could not manage moose populations in the previously-mentioned LÄS project. Another problem is the question of whether local resource users have local ecological knowledge and if they truly can understand scientific knowledge. The LÄS project revealed that the hunters lacked an understanding of the basic statistical concepts upon which the monitoring methods were based (Wallin, Vikberg et al., 2003). This throws doubt into the likelihood that hunters really can comprehend scientific knowledge and implement this in the management of natural resources. At Lake Racken, a biology teacher played a key role in “translating” scientific information to the other local resource users (Olsson & Folke, 2001). It is not likely that every MMU will have similar actors at their disposal.

The importance of the property rights structure has to be highlighted, since the centralized approach seems to require state-owned property to be implemented successfully. If there are strongly protected individual or communal property rights in place, it would be difficult to implement the centralized approach, since it is fairly invasive. Perhaps this approach, at least in its “extreme” form, only can be justified

when ecosystems are near collapse. The local approach, on the other hand, requires extensive management rights in order for resource users to be able to apply adaptive management. It is, of course, possible to extend management rights to local resource users on state property, and thereby implement some kind of co-management system. But, in essence, this requires different property rights structures to be successful. As should be obvious, there are many similarities between the two approaches, such as the emphasis on learning collectively and the utilization of experiments.

Perhaps it is too far-fetched to believe that the local approach would function in countries where local resource users are not dependent on the resource for their livelihood, where they do not live in close proximity to the ecosystems, where they have limited time to spend on natural resource management, and where local ecological knowledge is rare. This begs the question of whether this approach is more of a utopia with limited practical use.

However, it is possible to combine the local and centralized adaptive management approaches. For example, if the property rights structure is conducive to local adaptive management, it is possible to utilize certain aspects of centralized adaptive management in order to improve resource management at the national or regional level. Scholars emphasize cross-scale linkages, since local resource systems cannot function in isolation. Consequently, perhaps certain aspects of the centralized adaptive management would contribute to new knowledge that could be utilized in local resource systems.

Independent of the preferred approach of adaptive management, all types of conversion from a conventional resource system to one that is more adaptive require some kind of institutional change. This is the topic of the next chapter.

# 3. FUNDAMENTAL THEORETICAL CONCEPTS

In this chapter, institutional theory and, specifically, institutional change theory are introduced. The first section discusses main concepts and ideas underlying institutional theory and institutional change. Since property rights are critical formal rules regarding the management of natural resources, property rights theory is introduced in a separate section.

## 3.1 INSTITUTIONS AND INSTITUTIONAL CHANGE

*New institutionalism* is a theoretical framework that has become important within many different disciplines, such as political science, economics and sociology. The noble prize laureate, Douglass North, has a well-cited definition of institutions: "*Institutions* are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" (North, 1990:3). There are different theories on what institutions are and how they change over time. However, all theories regarding institutions share some common features. Institutions contain a structural feature which requires that a single individual does not create institutions on their own; instead, they relate to a group of people who have a common understanding (Peters, 1999). Institutions also show some sort of stability, although the question of stability is debated among institutional theorists (Ensminger, 1992; Peters, 1999). In addition, institutions affect individual behaviour, by establishing expectations and incentives that people take into consideration when making decisions (Knight, 1992). In a world without institutions, people would neither know how to act nor how to cooperate. "Social rules ensure predictability through their normative or prescriptive force; they impose obligations and create corresponding entitlements, which are publicly acknowledged and collectively enforced" (Beetham, 1991:65).

***Formal and Informal Rules:***

People choose to follow rules because these are enforced, either by a third-party, such as a state with a violence monopoly, or by social sanctions carried out by a group. Most scholars differentiate between *formal rules*, that are enforced by the state, and *informal rules* that are enforced by other individuals affected by the norm or by the fact that the norm has become internalized (Axelrod, 1986; Coleman, 1994; Knight, 1992; North, 1990). A *norm* is internalized when individuals breaking it sanction themselves by, for example, feelings of guilt. Formal rules form a hierarchy of rules with constitutional law at the top and acts at the bottom. Informal rules are defined as conventions and norms in a society (North, 1990).

> [A] norm concerning a specific action exists when the socially defined right to control the action is held not by the actor but by others[…]there is a consensus in the social system or subsystem that the right to control the action is held by others (Coleman, 1994:243).

In other words, norms exhibit system properties and an action such as smoking no longer is controlled exclusively by the smoker, but by a norm informing him or her where this action might take place. Many times, norms precede the enactment of a law and, if a norm becomes a law, private enforcement mechanisms are supplemented by the law enforcement establishment. Smoking currently is forbidden in workplaces and even in bars, according to formal rules, but all of this was preceded by a norm. Even though formal rules apply to moose management, on many occasions there are strong traditions that, in reality, might take precedence when hunters decide which action to take. In other words, norms governing moose hunting might be difficult to change by implementing a formal rule. A law, in general, clarifies obligations more explicitly than a norm does; in other words, there is less ambiguity when people interpret a law (Axelrod, 1986). There are a few reasons why it is fruitful to distinguish between formal and informal rules. A law-governed society is characterized by an organized production of laws and a hierarchal system for interpreting laws, usually with a supreme court. In democratic societies, a

constitution prescribes the procedures by which parliament may enact laws and how the government and departments can enforce acts.

Another characteristic of formal rules is the existence of a judicial "language" and the legal profession. As mentioned previously, one difference between a norm and a law is that the law usually explicitly expresses the rule - for example, a term such as 'waste' is defined through a judicial process and becomes very exact - which would be almost impossible to accomplish if it was a norm. Lastly, a law-governed society is connected to a state with a violence monopoly (Hyden, 2002). It is analytically productive, when analyzing institutional change, to differentiate between formal and informal rules, because formal rule changes are prescribed by constitutional law and monitoring and enforcement problems differ. "The drawback to custom and convention, particularly with regard to important and potentially contested issues, is that they carry with them no means of adjudicating disputes about their precise reference and scope, and they rely on diffuse means of enforcement applied by society as a whole" (Beetham, 1991:65). Formal rules are applicable on a general level; for example, the formal rule against stealing is applicable to all citizens. Even though there is an informal rule in society, as a whole, against stealing, this might not be the norm in a criminal gang. In addition, there are very few formal rules that regulate our private life; exceptions are formal rules protecting human life and integrity and certain rules regulating family life, such as marriage and inheritance (Hyden, 2002).

> [F]ormal rules, in even the most developed economy, make up a small (although very important) part of the sum of constraints that shape choices; a moment's reflection should suggest to us the pervasiveness of informal constraints. In our daily interaction with others, whether within the family, in external social relations, or in business activities, the governing structure is overwhelmingly defined by codes of conduct, norms of behaviour, and conventions. Underlying these informal constraints are formal rules, but these are seldom the obvious and immediate source of choice in daily interactions (North, 1990:36).

In this thesis, property right rules are of great importance, because these determine whether resource users will possess management rights, which is critical for the

establishment of adaptive management systems. However, even if there are clear property rights regarding moose management, informal rules also influence actions taken by hunters and landowners. The formal rules might contradict the norms to which hunters adhere, for example, regarding the view of who should decide the size of a moose population. Formal rules and informal rules coexist in societies; sometimes they converge, and at other times they are contradictory. For example, regarding theft there are both formal and informal rules constraining peoples' behaviour. If formal and informal rules converge, they are mutually enforcing. However, if there is a conflict, it is costlier for third-party enforcers to ensure that the formal rule is followed (Nee, 2001). Ellickson has shown how cattle ranchers in Shasta County solve cattle trespass problems by informal rules instead of resorting to the traditional court system, because the former was less expensive. Only when a trespass conflict could not be resolved using graduated informal sanctions did people resort to the judicial system (Ellickson, 2001). If a person makes the decision to steal something, that person risks not only social disapproval but also punishment enacted by the state. However, the chance for detection increases if not only third-party enforcers can detect deviation from the rule, but also neighbours. Convergence of formal and informal rules also reduces uncertainty in social interactions (Nee & Ingram, 2001). If there is a conflict between a formal and informal rule, it might be difficult for people to know what rule it is that affects other people's behaviour. This coexistence of formal and informal rules is the reason for the difficulties in changing societies fundamentally by means of revolution, because changes in formal rules do not necessarily translate into changes in informal rules (North, 1990). Informal rules are path-dependent, since conformance to norms is met by reward, and disobedience is met with social disapproval (Nee & Ingram, 2001).

One difficulty is how to distinguish between *regularized behaviour* and norms. The difference between a rule and regularity in behaviour can be determined by the reaction of a community. If it is a rule a person breaks, the transgression will be sanctioned by the community. If a person just alters their behaviour, people might be

surprised, but the change will not be rebuked (Ensminger & Knight, 1997). “Informal norms are rules of a group or community that may or may not be explicitly stated and that rely on informal mechanisms of monitoring, such as social approval and disapproval” (Nee & Ingram, 2001:19). Individuals sanction non-compliance with informal rules dealing with routine manners in everyday interactions; and people who conform to norms have an incentive to ensure that these are followed, because it automatically reinforces their status as conformers. The costs for monitoring informal rules are smaller if the people affected by the norm interact frequently, since this allows for a higher degree of information sharing (Nee & Ingram, 2001).

***Institutions and Organizations:***

North, among other scholars, distinguishes between institutions and organizations. *Institutions* are the rules of the game, while *organizations* are players who are restricted by the rules, but also can change them. Organizations can be political bodies, economic bodies, or social bodies and these are formed to achieve some common purpose (North, 1990). It is analytically fruitful to separate organizations from institutions, since different models are required to analyze their operations and interactions (North, 1995). For example, formal rule change usually is viewed as a bargaining process between actors, such as the State and special interest organizations (Knight, 1992; Libecap, 1993; North, 1990). An organization takes formal rules into consideration, but it also implements its own formal rules within the organization, which are enforced by various sanctioning mechanisms. “When the formal norms of an organization are perceived to be congruous with the preferences and interests of actors in subgroups, the relationship between formal and informal rules will be closely coupled” (Nee & Ingram, 2001:33). An example of this is the “publish or perish” scenario that exists within universities, a scenario that is prescribed by both formal and informal rules. When formal and informal norms in an organization converge, they increase organizational performance; however, if they do not converge, the result often is feelings of alienation and stress among people within the organization (Nee & Ingram, 2001).

The boxes in Figure 1 form a hierarchy, in which the arrows pointing downwards illustrate constraints placed by a higher level on a lower level. The arrows pointing upwards in the figure illustrate that "…hierarchically superior levels are constituted and created by levels below" (Nee & Ingram, 2001:32). The upper box in the figure contains formal rules that constrain organizations in a society through organizational rules. When there are changes in formal rules, organizations will adapt to these, and those who do not adapt will be negatively affected by selection pressure.

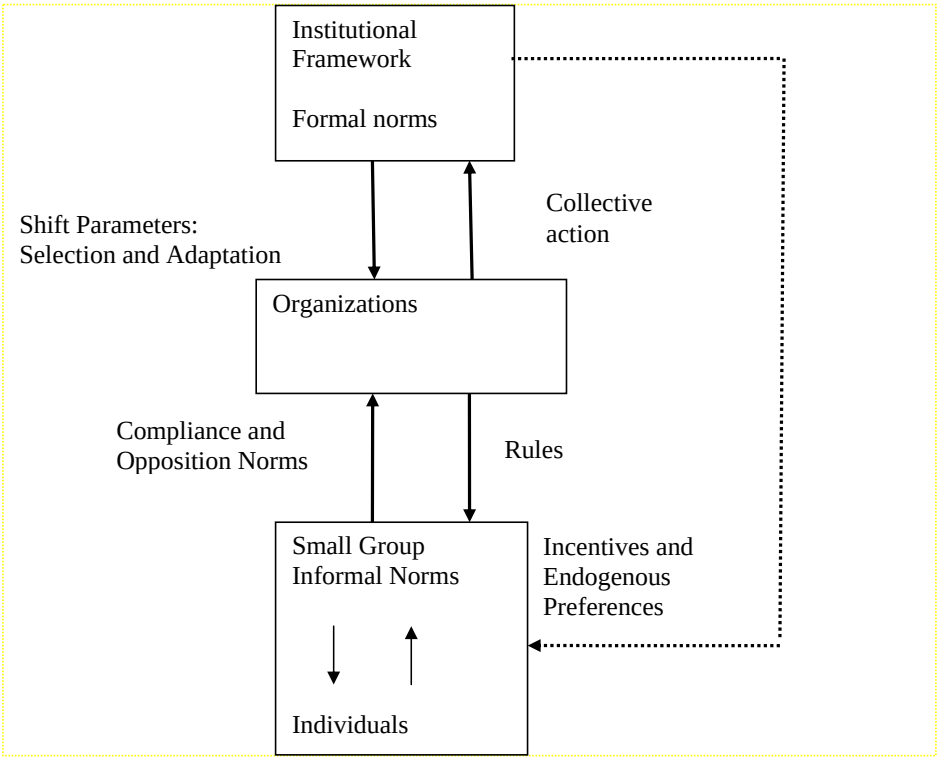



**Figure 1. A Model for the New Institutionalism in Sociology (Source: Nee & Ingram, 2001).**

However, formal rules also directly affect individual action by altering incentives and endogenous preferences (as illustrated by the arrow on the right hand side of the figure). For example, if there is a change in a formal rule regulating property rights, this will change some individuals' incentives and, consequently, probably also their actions.

Organizations have formal rules that are enforced upon its members by sanctions and, therefore, affect subgroups in the organizations (as illustrated by the arrow pointing downwards from the middle box to the lower box). Subgroups in organizations will comply with the formal rules of the organization; however…"informal norms will evolve into "opposition" norms if institutions and organizational sanctions are weak relative to contradicting group interests" (Nee & Ingram, 2001:35). Opposition norms entail that subgroups and individuals in the organization actively resist formal rules. As previously discussed, the efficiency of an organization is dependent upon the congruence of formal and informal rules, since contradictions can result in distress among members, and poor production.

Organizations also affect formal rules through collective action (as is illustrated by the arrow pointing upwards from the middle box to the top box). Organizations will try and alter formal rules that would benefit their organizational aim, for example, through lobbying or participating in referral systems, in order to exert influence over political decisions.

The lowest box in the figure illustrates that individuals create and are affected by informal norms simultaneously, and that these norms relate to small groups. The differences between the establishment, changes and enforcement of informal norms and formal rules have been discussed at length in the previous sections.

Figure 1 will be utilized to examine changes in the Swedish Hunting Administration in Chapter 6.

***Rationality concept:***

In this thesis, the individual actors that are engaged in moose management through MMUs are believed to be "rational". The *rationality* concept rests on three basic assumptions: 1) an individual always wants more 'utility'; 2) an individual has set preferences; and 3) an individual makes consistent choices (Hultkrantz & Nilsson, 2004). The rational individual is strategic and goal-oriented. One critique of the rationality concept is the assumption that individuals have complete information and the ability to process it; this, in reality, hardly ever is the case. Simon's concept of

bounded rationality takes this into consideration, as he claims that individuals use their personal selection criteria when there is incomplete information (Simon in Ostrom, Schroeder et al., 1993). In addition, economic and psychological experiments in game theory have disclosed a variety of behaviours besides the self-interested actor. For example, many people seem to be conditional cooperators and are willing to contribute, as long as other people do this as well. People also are willing to punish people who do not contribute, even when it involves a cost for them to do so (Ostrom, 2000b). The "rational egoist" is very useful in predicting behaviour in competitive market situations. In these settings, the actors are relatively autonomous and the time horizon is short for making decisions. However, in most situations, a mixture of actors will be found. Even though actors like the "rational egoist" exist in many settings, often there are actors with strong norms of reciprocity; and, when communication is possible, this facilitates trust building (Ostrom, 2005:235).

The most significant criticism of the concept of the rational individual is against the assumption that preferences are stable, and this assumption is particularly ill-suited for explaining changes in norms and values (Alston, Eggertsson et al., 1996; Knight, 1992). However, Knight and Ensminger use a rational choice perspective when examining norm changes, due to conflict between different ideological preferences. Not all norms in a society govern economic behaviour, for the reason that some norms are motivated by nonmaterial preferences and ideological values (Ensminger & Knight, 2001).

In this thesis, the bargaining theory is utilized, which rests on the view of individuals as rational; therefore, this view also is assumed. In addition, the main empirical analysis will focus on aggregate individual rationality, since it is assumed that there are two main interests in conflict, i.e., between hunting and the forestry industry. Each individual landowner and hunter is assumed to be rational, to want more utility and to have preferences regarding the management of the moose population. The large landowner's primary interest is forest production, which entails a preference for a smaller moose population; whereas the hunter's primary interest is

to ensure hunting opportunities, which results in a preference for a larger moose population. In order to answer the questions posed in this thesis, a "simplified" view of individuals as rational actors is more productive.

***Methodological individualism*:**

The question of how to explain social phenomenon, by a structural or individual perspective, constantly is discussed within the social sciences. The arguments for individual methodology are based on ontological, epistemological and methodological considerations. The ontological view is that social phenomena are created by individuals and made up of individuals. The epistemological thesis is that, because only individuals can be observed directly in society, all social knowledge has to be formulated from an individualistic perspective. Methodological individualism is a normative stance that claims that social phenomena should be defined, explained and reduced to laws about individuals (Udehn, 2002); or, as North states:

> Institutions are the creation of human beings. They evolve and are altered by human beings; hence our theory must begin with the individual. At the same time, the constraints that institutions impose on individual choices are pervasive (North, 1990:5).

North's statement includes all three arguments. However, he emphasizes the affect of institutions (a social concept), so that his is not an "orthodox" view of methodological individualism, because social phenomena have some kind of explanatory force. In their interpretation of institutions, March and Olsen emphasize structure over individuals, because they consider routines to be the most important aspect of institutions (Peters 1999). Significant problems with viewing people as norm-driven are that 1) this perception fails to take into account the problem of conflicting roles; 2) it removes human decision making; and 3) it inhibits explanations for change (Knight, 1992; Peters, 1999). However, even in mainstream empirical sociology, it is common to use some form of methodological individualism (Nee, 2001). Coleman argues that, even though the emergence of norms must be explained on the basis of individual actions, once a norm is established, it is a system-

level property which affects individuals (Coleman, 1994). Most scholars within institutional analysis rely on methodological individualism, with a view of individuals as rational actors.

Methodological individualism is employed in this thesis; however, as depicted in Figure 1, it is assumed that institutions affect individuals and, therefore, structure also has an explanatory value. For example, property rights are believed to affect managers (see section 3.2).

***Institutional change:***

The main objective for scholars within the rational choice institutional paradigm has been to understand the collective action problem (Knight, 1992; Peters, 1999).

> Unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interest.* In other words, even if all of the individuals in a large group are rational and self-interested, and would gain if, as a group, they acted to achieve their common interest or objective, they will still not voluntarily act to achieve that common or group interest (Olson, 1965:2).

In other words, the focus has been on how to achieve outcomes that are socially efficient, when there is a conflict between individual rationality and group rationality (Knight, 1992). "Social dilemmas occur whenever individuals in interdependent situations face choices in which the maximization of short-term self-interest yields outcomes leaving all participants worse off than a feasible alternative" (Ostrom, 2000a:473). This problem has been called the *public-good problem*, the *free-rider problem*, the *tragedy of the commons*, and the *prisoner's dilemma* (Ostrom, 2000a).

Research in the field of social dilemmas has identified many exceptions to the *zero-contribution thesis* of Mancur Olsson, and scholars also have been able to identify what types of collective action problems are associated with different types of goods, such as common-pool resources and public goods. Additionally, modifications to behavioural assumptions have been highlighted as important in furthering the research in this field (Ostrom, 1990, 2000a, 2000b).

The problem of avoiding *free-riding* (receiving benefits without paying costs) has been labelled a *first-order collective action problem*, and concerns how institutions are established. The problem of establishing a rule that induces contributions is called a *second-order collective action problem* and is a question of institutional design, such as Ostrom's famous design principles. The *third-order social dilemma* is the problem of rule enforcement, since sanctioning entails a cost to the person carrying out the sanctions, while everyone else receives benefits, even free-riders (Ostrom, 2000b). However, this problem is mitigated when there is a second norm rewarding the sanctioner's sanctions. This second norm necessitates other people expressing gratitude towards people carrying out the sanctions (Coleman, 1994).

Criticisms of the theories of collective action are 1) that they fail to explain mechanisms behind institutional change; and 2) the explanation for the establishment of institutions is that the benefits received from an institution must outweigh the costs for its establishment, monitoring and enforcement (Knight, 1992; Knight & Sened, 1995; Peters, 1999).

***Theories of institutional change:***

How, then, do institutions develop and change? Three theories of institutional change have been proposed: social convention theory, market based theory, and the bargaining theory.

> Most rational-choice theories of institutional emergence and change employ some model involving a game with multiple equilibriums. Related to each equilibrium is an institution (rule of action) that would, if selected, resolve the strategic problem inherent in a situation in which there are a number of ways of doing something and the task is to establish a common way of doing it (Knight, 1995:96).

*The social convention theory* assumes that institutions evolve arbitrarily and that the only institutional changes that are made are the ones that are Pareto improving (at least a few will increase their utility and no one's utility will decrease). The institutional change will gravitate towards some salient resolution (Knight,

1992). Basically, anything in the context that can provide a focal point will be chosen to achieve coordination. This theory of institutional change, therefore, is most fruitful when there are no distributional consequences of the different equilibrium rules; for example, when deciding whether to drive on the left or right side of the road (Ensminger & Knight, 1997).

*The market based theory* also assumes only Pareto-improving institutional change regarding decentralized institutional change. However, formal institutions are not created to be socially efficient, but to serve the interests of actors with the greatest power, and may very well be socially inefficient (North, 1990). In other words, formal rule change might be Pareto-improving, but this depends upon what the interests of the actors are, and their relative bargaining strength. The market based theory employs two mechanisms for explaining institutional change. One is the voluntary contract and the other is competition. The basis of the market based theory is a market with competing actors trying to contract with each other. The choice of contracts will be affected by the relative transaction costs (the costs for establishing a contract *ex ante* and *ex post*) related to each alternative (Knight, 1995:107). Actors will choose what is best for them, but the pressure of competition is the mechanism ensuring Pareto-improving institutional change. A high degree of competition will ensure that the bargaining power of individual actors will not determine the outcome, since competition acts as an equalizer (Knight, 1995). However, when transaction costs are high, Pareto-improving changes may not take place (Knight & North, 1997). Regarding centralized institutional change, North and Libecap have asserted that competitive situations often are thwarted, due to differences in the strength of different organized interests. According to Knight, this aspect of the affect of distributional consequences on decentralized change has not been pursued, despite the fact that many informal rules, such as gender, produce asymmetries (Knight, 1992).

***The Bargaining Theory:***

The *Bargaining theory* assumes that " …social institutions are the by-product of strategic conflict over substantive social outcomes" (Knight, 1995). In other words, the difference between the bargaining theory and the other two theories is that the mechanism for change is strategic conflict among actors, and resolution of the bargaining often is achieved due to asymmetries in resource ownership.

> The people of the institution-free Hobbesian world have equality of bargaining power, but no social order. In a world endowed with institutions that resolve societal conflicts, there is social order but unequal bargaining power and unequal access to coercive resources (Levi, 1990:402).

The stability of institutions, therefore, is explained by their ability to provide benefits to the most powerful actors (Knight & Sened, 1995). Coleman distinguishes among beneficiaries and targets of norms, which entails that a certain class of actors whose actions are being controlled are targets, and beneficiaries are those actors who benefit from the norm (usually the potential sanctioners). *Disjoint norms* are norms by which the beneficiaries and the targets are two different sets of actors; conversely, for *conjoint norms* each actor simultaneously is the beneficiary and target of the norm. The reason that disjoint norms can be enacted by beneficiaries is that they have power over the targets. In addition, not only do powerful actors have the potential to establish disjoint norms, they also more easily can avoid sanctions regarding conjoint norms. This is because these sanctions are costly for the person carrying out the sanctions and, therefore, less likely to be enacted if the transgressor is powerful (Coleman, 1994).

Actors are self-interested individuals who want to increase their utility. Even if all actors suffer when they cannot establish institutions to solve coordination problems, some can better afford not to solve coordination problems due to greater resources. If some actors have power over other actors, due to, for example, greater resources, they will opt for a rule that will ensure that their share is as large as possible, and they also will have the bargaining power to establish their preferred institution. *Power* can be defined as the ability of individuals with greater resources

to affect other individuals' alternatives. Depending on the context, different resources, such as knowledge, resources and status, among other things, can increase an actor's power (Knight, 1992). The relative distribution of rights and resources in a given context affects the level of power different actors have. Moreover, when there are great differences, this facilitates groups with more power establishing norms that control the actions of those with less power. The powerful group also will have the tools to ensure that the norms are enforced (Coleman, 1994). However, there also is another aspect of power relations in society and its affect on the establishment of norms in a society. This aspect deals with the fact that the establishment of formal versus informal rules is dependent upon who wants to ensure that their interests are met.

> Throughout history, in fact, the limitations on power which the subordinate have been able to secure, and which they understand as constituting rights for themselves, have usually been conventional rather than legal in form, in contrast to the rules securing the power of the dominant (Beetham, 1991:67).

Greater resources permit an actor to better afford extended bargaining and perhaps threaten other actors. Consequently, their influence in the bargaining situation will be stronger than that of actors with more limited resources (Knight, 1992). The bargaining theory does not presuppose that an institutional change will be Pareto-improving; however, this very well may be the case (Knight, 1992). The focus is on the eventual distributional consequences of choosing among rules that all ensure coordination. When rules generate unequal distribution, the primary mechanism for change is bargaining among actors (Knight, 1992). Sometimes, it is clear that different rules produce unequal distributions. At other times, it may be harder to judge what consequences a new rule will generate.

The bargaining theory can be utilized to analyze MMUs, for the reason that a diverse landowner structure might affect the choice of rules regarding moose management. For example, MMUs owned entirely by forestry companies are likely to have an interest in ensuring a small moose population, while hunters leasing hunting rights do not have any incentives to establish a small moose population. Their interest

is hunting and, contrary to forestry companies, they do not have to pay the costs for a large moose population that causes grazing damages. Both the hunters and the forestry industry need to achieve some kind of cooperation, but presumably there are several equilibriums with clearly distributional effects. The size of the moose population can be at several equilibriums, but still within the biological carrying capacity. Therefore, it is important for the groups to establish institutional rules that ensure their goals. According to the bargaining theory, the actors with the greatest resources have the power to ensure that the rule that most benefits them will be implemented.

Knight points out that, when choosing between theories of decentralized change, the bargaining theory is most suitable when there are distributional consequences of the rules. When an MMU is established by private landowners, the conflicts between forest production and hunting interests should not be as great as when a forestry company is the single owner of the MMU. An earlier investigation has revealed that 59% of private landowners (in three counties with grazing damage deemed unacceptably high by the forestry sector) considered the moose populations to be of appropriate size and only 7% considered the moose populations too large (Fällman, Ligné et al., 2005).

Under what conditions does decentralized or centralized institutional change occur, according to the bargaining theory? Changes in informal rules can take place if the relative bargaining power of the actors changes, or if the distributional consequences of rules changes. External effects (changes in technology, demographics and so on) or unanticipated effects of rules can generate change (Knight, 1992). When striving to achieve institutional change, if the relative bargaining power of actors changes, the problem of solving the collective action problem within the group remains. Changes in formal institutions have to be viewed as a bargaining process between the State and powerful interest groups. The State actors either are politicians or administrative officials, and their interests are direct (administrative costs of enforcing formal rules) or indirect. The indirect interest of State is to ensure revenues, but also to stay in power. Whether or not the State will

implement more socially-efficient rules depends upon what groups of actors ensure the interests of the State, either materially or by electoral support (Knight, 1992).

Informal rules, as mentioned previously, show remarkable stability, despite efforts to replace informal rules with formal rules. This difficulty can be explained by the fact that changing an institution necessitates changing existing social expectations.

> To be successful, the new rule must cause social actors to shift their probability estimates to the strategies associated with that equilibrium. But unless an actor is confident that the new rule will be recognized and applied by those with whom he interacts, there is no reason for him to change his probability estimates (Knight, 1992:185).

There are many reasons why an actor might not believe that the new rule will be recognized and followed. People who have followed a certain rule all their lives might be unwilling to change their actions, despite the fact that this refusal to follow a new rule might incur a cost to them. In addition, ideological views might compel people not to follow new rules, despite the cost. However, one other difficulty in establishing new formal rules is that the new rule might be subject to different interpretations and, therefore, might fail to provide the same critical information to all who are subject to the rule. Yet another reason is the risk that sanctions under the new rule will not be effectively implemented (Knight, 1992: 185-189). The monitoring problem is great regarding formal rules; for example, in smaller communities it is easier to monitor and sanction non-compliance with informal rules, because the social interactions are extensive, intensive and long-lasting. Another problem might be that sanctions are not appropriate for deviation of rules. One of Ostrom's design principles emphasizes the importance of graduated sanctions, which indicate that the severity of sanctions gradually should increase (Ostrom, 1990).

The bargaining theory will be utilized to analyze changes in the Swedish moose management systems. However, as mentioned previously, property rights are very important formal rules regarding the management of natural resources. This also

applies to MMUs, since these entail changes in property rights. Therefore, property rights theories will be presented in the next section.

## 3.2 PROPERTY RIGHTS

This thesis explicitly tests the assumption that the property rights structure affects the potential to establish local adaptive management systems. Since the publication of Hardin's article, "The Tragedy of the Commons", considerable research has been conducted on the effects of diverse property right regimes over natural resources (Hardin, 1968; Libecap, 1993; Ostrom, 1990; Ostrom & Schlager, 1996). Hardin mistook the commons for open access, but he highlighted the difficulties in achieving collective rationality among a group of rational resource users without any rules (Hardin, 1968). Later research has proven that commons have rules restricting access and usage of the resource (Ostrom, 1990). When analyzing common-pool resources, four ideal and analytic categories frequently are used: *open access* (unrestricted usage), *state property* (held by a government that decides on access and use limitations), *communal property* (property held by a community, whose members have equal rights of access and use) and *private property*. Private property entails that individuals have the right to exclude other users and regulate the use of resources, and these rights generally are recognized and enforced by the state. Ownership also usually is transferable and exclusive (Feeny, Berkes et al., 1990). All types of regimes are restricted in the use of the resource, except for open access. In Table 1, a comparison of the four ideal categories regarding specific owner rights and duties is depicted.

**Table 1. Types of Property-Rights Regimes with Owners, Rights and Duties (Source: Hanna, Folke et al., 1996:5).**

| ***Regime type*** | ***Owner*** | ***Owner rights*** | ***Owner duties*** |
|---|---|---|---|
| Private property | Individual | Socially acceptable uses, control of access | Avoidance of socially unacceptable uses |
| Common property | Collective | Exclusion of nonowners | Maintenance; constrain rates of use |
| State property | Citizens | Determine rules | Maintain social objectives |
| Open access (nonproperty) | None | Capture | None |

Research has revealed that none of these are better than others at ensuring sustainability, besides the fact that open access often leads to resource degradation (Berkes, 1996:88). However, these categories are too "general" to really be of help when analyzing specific property rights, since these are much more complex. For example, property right regimes affecting the Sámi in Sweden are all of the above, in some form or other. The Sámi village territory functions as communal property. With regards to reindeer grazing, the village implements rules; however, these rules cannot be socially unacceptable, such as overgrazing resulting in degradation of the sensitive tundra. The State owns the land, while the Sámi have user-rights that include not only grazing rights, but also hunting and fishing rights. In addition, individuals own the reindeers (Wennberg-DiGasper, 2003). Similar complexity applies to the Swedish MMUs.

The "ideal" relationship between property-holders and the State is a fundamental societal question, as well as the question of how much legitimate control the State should be able to exert over property holders (Reeves, 1991:112). The Swedish Constitution states that private property is protected against expropriation by the State, unless it is needed for the public good. If this is the case, the property owner is compensated. Lane & Skogh argue that there is an asymmetry between individual property owners and public authorities, since profits and losses are connected to the individual, while authorities make many decisions on usage of land.

“During present circumstances, the costs for environmental protection is randomly distributed over individual property owners with, in part, confiscatory methods” (Skogh & Lane, 1993). One example is when the Swedish State allowed the general public to fish with “manual” fishing gear in the archipelagos on the East Coast. Prior to this change, sports fishermen either had to purchase fishing permits or make agreements with the individual fishing rights holder. Minimal financial compensation was paid out to the fishing rights holders (Skogh & Lane, 1993: 167 - 171). However, when Sweden signed the European Convention (SFS 1994:1219) on Basic Human Rights and Freedoms, a stronger protection of private property was enacted. The Swedish Public Administration Supreme Court (regeringsrätten) has tried a number of cases, and praxis has developed the *proportional principal*. This implies that the individual landowner’s interest should be balanced against the public interest, when judging whether infringement of property rights are justified (Prop. 1999/2000:73:29). The practical implications of the proportionality principle, with respect to the moose management system, are described in Chapter 5.

In Table 2, a breakdown of what property rights contain is depicted.

**Table 2. Bundles of Rights Associated with Position (Source: Ostrom, 2003)**.

| | Full owner | Proprietor | Authorized claimant | Authorized user | Authorized entrant |
|---|---|---|---|---|---|
| **Access, i.e.,** [The right to enter property] | X | X | X | X | X |
| **Withdrawal, i.e.,** [The right hunt] | X | X | X | X | |
| **Management, i.e.,** [The right to regulate usage patterns] | X | X | X | | |
| **Exclusion, i.e.,** [The right to decide – access and how to transfer the right] | X | X | | | |
| **Alienation, i.e.,** [The right to sell or lease Management rights and/or exclusion rights] | X | | | | |

Property rights refer to the relationship between people with regards to some object. This implies that one person's right includes another person's obligation to respect that right (Ostrom & Schlager, 1996). The most basic rights are rights to *access* and *withdrawal* of resources. *Management* rights are defined as the right to organize usage patterns; this includes where, how and when appropriation of a resource can take place. To have management rights also means that it is possible to make decisions regarding improvements of the resource. *Exclusion* implies that the person holding the right can decide who will have access, while *alienation* is defined as the right to sell or lease out the management rights and/or exclusion rights (Ostrom, 2003). These rights either can be held individually or by collectives. The significant difference between access and withdrawal rights versus management rights, exclusion rights, and alienation rights is that the last three entail that the property rights holder can make decisions about future rights. In other words, in order to provide incentives for resource users to invest in resource management, it is critical that they have, at least, management and exclusion rights (Ostrom & Schlager, 1996).

As mentioned previously, researchers have emphasized the necessity of extensive management rights, in order for resource users to implement adaptive management systems. Therefore, the above discussion regarding property rights also is applicable to MMUs. As will be discussed, the potential to establish MMUs has entailed management rights for landowners, something that is critical regarding management of the moose. “Systems of property rights and rules defined, implemented and monitored, and enforced by resource users are likely to perform better than systems of property rights and rules defined, implemented and enforced by an external authority” (Ostrom & Schlager, 1996:146). Reasons as to why resource users should be more successful than external authorities in defining, implementing, monitoring and enforcing rules are 1) their knowledge of the physical environment due to daily harvesting activities; 2) the rules match the social and cultural environment; and 3) the costs of monitoring and enforcing rules being lower (Ostrom & Schlager, 1996).

In the next chapter, the Swedish moose hunting administration is described briefly. This is followed by a review of the historical background of the Swedish hunting administration system.

## 4. THE SWEDISH HUNTING ADMINISTRATION

At the national level, the *Environmental Protection Agency* (EPA) is the supervising public authority for the management of wildlife. With respect to this function, the EPA issues directives and general advice. It also formulates plans to protect endangered species and manage wild animals that cause damage. The *County Administrative Board* (CAB) plays a significant role in implementing wildlife policy. The CAB grants permission for many activities concerning hunting and wild care. They decide on the establishment of Wildlife Management Areas (WMA, sw viltvårdsområden) and MMUs, and grant hunting permits (Prop. 2000/01:73:73). There is a consultative administrative unit, called the *Wildlife Management Board* (WMB, sw viltvårdsnämnden) in each county, where diverse interests are given an opportunity to offer their views and add expert knowledge, prior to major decisions by the CAB (Fransson, 2003:27). The WMBs are regulated by law, by which their primary responsibilities and organizational structure are stipulated. The WMBs are made up of hunting, forestry, agricultural and nature interest organizations (SFS 1987:905 46§) and they address issues of overreaching and principal nature (NFS 2002:19 29§ p.2). *Local forums*, that are voluntary, are compromised of hunter representatives and larger landowners, such as forestry companies who, among other things, leave suggestions on moose hunting quotas to the WMB which, in turn, advises the CAB. However, the establishment of local forums are not mandated, but purely voluntary, and SAHWM organizes these local forums (Fransson, 2003).

***Moose Management Organizations:***

In principle, all moose hunting requires licensing, which means that moose quotas are allocated to persons with hunting rights. The CABs decide what areas can be registered as licensed areas, under the condition that the area is large enough to shoot one mature moose per year and still ensure the existence of the species. However, one moose calf per year can be shot if the area is of at least 20 hectares (SFS 1987:259 §33). There are two main organizations for coordinating moose hunting among landowners in Sweden. One is the WMA and the other is the MMU. Landowners also

cooperate in other ways, but the WMA and MMU are the only formal organizations that facilitate cooperation between landowners. Two or several properties in the same area can be united to form a WMA, in order to coordinate hunting and the management of wild animals (SFS 2000: 592 1 & 3§§).

During the last twenty years, landowners increasingly have cooperated, which has called for groups of hunting teams that previously hunted separately joining together and receiving a common quota from the CAB. For example, part of or an entire *Krets*[15] can receive a quota from the CAB which, in turn, is divided among the different hunting organizations, such as hunting clubs and WMAs. It also has become more common for "multiple year licenses" (sw, flerårslicenser) to be issued, which means that the CAB decides the largest number of moose that can be shot during a three year period (Prop. 1991/92: 9; SOU 1990:60).

The most significant difference is that MMUs can decide how many moose to shoot during a hunting season, while the CAB decides moose allocation for other licensed areas. The MMU is an entirely voluntary organization, in contrast to WMAs that might subject landowners to enforced enrolment. The arguments for establishing MMUs were to decrease detailed regulation and to transfer the responsibility of managing moose populations to landowners and hunters (Prop 91/92:9:16). Since 1992, when the first MMUs came into being, these management systems have proliferated, so that now they oversee approximately 10,8 million hectares (MMU database). This can be compared to the Wildlife Management Areas that were established in 1938, and which, in 1996, oversaw approximately 7,3 million hectares (SOU 1997:91:110-126). However, some WMAs might have been large enough to form an MMU and, in other instances, a WMA might have joined with other license areas to establish a MMU. The WMA is regulated by a special law whereby there are stipulations as to its rights and obligations. The WMA association is, for example, entitled to make decisions regarding the organization of hunting, as in whether

[15] The Krets is an organizational unit of the SAHWM and it usually corresponds with a municipality

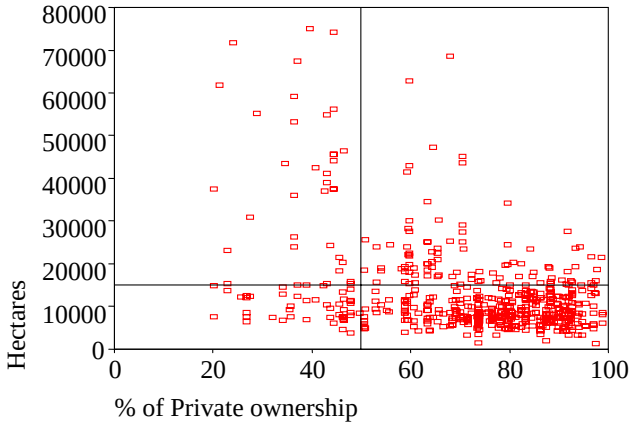
everyone has to hunt together or not[16]. The association also has the right to make decisions as to the minimum number of hectares that is required for each hunting certificate. Decisions made by the association can be appealed at the CABs (Prop. 1999/2000:73). Conversely, MMUs are very loosely regulated and the only sanction mechanism available for the CABs is to deregister the MMU.

***Ownership Structure:***

There are about 22,7 million hectares of forestland in Sweden (about 5,8 million hectares of land with no assigned value). The State owns 18%, private stock companies 24%, individual private owners 51%, other private owners 6%, and other public owners 1% (www.svo.se/minskog/templates/Page.asp?id=16226). In order to hunt, one must either own property or lease hunting rights from the State, forestry companies or private landowners. The most common scenarios by which individuals gain the right to hunt are when families own hunting grounds and hunt on their own land (55%) or when a hunter leases hunting rights, either on their own or together with others (49%) (Prop. 1999/2000: 73:84-87). Only 1% of all private properties are larger than 400 hectares in area (Fällman, Ligné et al., 2005). Figure 3 show that a higher percentage of private ownership involves smaller MMUs.

[16] At Luleå University of Technology, a project investigating these issues currently is being conducted by Terence Fell.

**Figure 2. Private ownership correlated with the size of MMUs in Sweden.**




This is consistent with the fact that most private properties are smaller than 400 hectares. Consequently, it is reasonable to assume that private owners have a smaller forest production interest than large property holders.

In the next section, a review of the Swedish hunting administration's historical background is presented.

***Historical background of the Swedish hunting administration:***

In 1789, hunting privileges were abolished and the right to hunt once again was transferred to the landowner, which had been the case prior to 1351. Unregulated hunting resulted in almost total extinction of the moose population by the middle of the 19$^{th}$ century (SOU 1983: 21:90-101). During the early 20$^{th}$ century, the moose population steadily grew, due to factors such as the establishment of a restricted hunting season, decline of moose predators such as wolf and bear, and less cattle grazing in forested areas (SOU 1990:60:26). Until the end of the 1930´s, moose hunting primarily was regulated by the hunting season, which was decided according to the observed state of the moose population. During the hunting season, landowners were permitted to shoot as many moose as they could (SOU 1983: 21:90-101).

Since the 1930´s, two major changes have taken place regarding the moose hunting administration in Sweden. The *first* change has been increasing cooperation between landowners regarding moose hunting. Already in the 1912 Hunting Law, there is a paragraph addressing the importance of voluntary cooperation between landowners in order to achieve some kind of agreement regarding moose hunting. However, this paragraph pertained to agreements reached voluntarily between landowners. The reasoning was that, to be able to sustain the moose population, restrictions on rational self-interested actors had to be in place, so as to achieve collective rationality. It was assumed that a small property owner would shoot more moose than his land could support; moreover, because moose are migratory, it was considered difficult to achieve collective rationality to sustain a viable moose population, without cooperation between landowners. The rationale for deciding not to legislate in this matter was that it would not be in agreement with norms and conventions that existed at the time. The legislators recognized the "power" of informal rules, and how futile formal rules can be if these are contradictory to informal rules. However, in the 1938 Hunting Law, the potential to force cooperation between landowners was established. If 4/5 of the property owners agreed to the establishment of a Game Keeping Area,[17] the minority of landowners were forced to join this organization. The reason behind this change was that voluntary cooperation often stalled due to a few landowners resisting the establishment of Game Keeping Areas. Justifications for the restriction in property rights were 1) the fear of extinction of the moose population, and 2) the belief that the landowner, in principle, could continue to hunt in the same manner as before (SOU 1997:91).

The *second* significant change has been the establishment of licensed hunting, which requires that the County Administrative Boards (CAB) register areas of a certain size, and decide, prior to the start of each hunting period, how many moose can be shot, a number determined by various factors including the size of the moose population and the productivity of the land (SOU 1990: 60-101). Since the 1930's,

[17] Game Keeping Areas changed their name in 2000 to Wildlife Management Areas (sw, viltvårdsområden) (SFS:2000:592).

the Swedish hunting administration has been characterized by increased regulation and centralization. According to the current Hunting Law, all hunting must be licensed hunting. This means that certain land areas have been registered by the CAB and the CAB allocates moose quotas to these areas (SFS 1987:259). Licensed hunting was conducted on approximately 95% of moose land by the beginning of 1990 (Prop. 1991/92: 9:41).

Until the early 1980's, the Swedish moose management system had been characterized by growing cooperation among landowners and efforts to increase the historically weak moose population. However, by the late 1970's and early 1980's, Sweden experienced historically large moose populations, the largest on record. Despite increased hunting, the moose population continued to grow. The shooting numbers increased from 50,000 in 1975 to over 150,000 by the early 1980's (SOU 1990:60:26-28).

***Problems with the Swedish Hunting Administration:***

The main reason for the unprecedented increase in the moose population was the changes in the moose management system, such as licensed hunting. In some counties, hunting practices contributed to rapid growth in the moose population. For example, the percentage of calves shot had increased, in order to save productive cows and thereby raise the productivity of the moose population. The increase in calf shooting also contributed to a higher average age of the moose population and, in turn, its growth (SOU 1990:60:26). Another reason for the increase in the moose population was changes in forest production. Since the 1950's, changes in Swedish forest production has included extended clear-cutting of forests, introduction of new forest plants, and a proportionately larger share of plant and young forests. All these changes in forestry production have contributed to larger moose populations, because moose prefer grazing on new plants, and large clear-cut forest areas provide more food than old forests do (SOU 1990:60:26).

There also have been unanticipated consequences of formal rules relating to the moose administration system. It was not until 1987 that the forestry industry could

appoint a representative to the Wildlife Management Boards (WMB) that advice CAB prior to important decisions (Prop. 1986/87: 58:65). A problem has been that hunting interests have dominated the WMB and the same general attitude that exists among hunters, not to "overtax" the moose population, has been in majority in the WMBs. The reason is that forestry industry representatives often hunt themselves and, therefore, represent the hunting interests to a higher degree than that of the forestry industry. This problem has been highlighted by forestry interest and agricultural interest organizations. Even though the composition of WMBs is regulated by law, the unanticipated consequence has been overrepresentation of hunting interests, and this is believed to have exacerbated the problem of moose grazing damage (SOU 1990: 60:46; Prop. 1991/92:20).

Another problem with the centralized and detailed regulated moose administration system is the problem of high costs (Prop. 1986/87:58.41). Consequently, the government decided that the Environmental Protection Agency (EPA) should suggest ways to change routines and decision-making procedures at CABs with respect to moose management (Prop. 1991/92: 9). Another cost has been reimbursement to the forest and agricultural sector for grazing damages. Hunters pay a fee to the CAB for each moose they shoot. Part of this fee is intended to cover the costs of grazing damage by wildlife, and another part is to be utilized for wildlife care efforts. The fee has been raised over the years, as grazing damage has increased, so that an increasing proportion has been directed towards reimbursement for grazing damage. There also have been significant differences between different parts of the country with respect to these reimbursement costs. Hunting interests in the northern part of the country have criticized this system, because their fees have been transferred to areas in southern Sweden with more extensive grazing damage (SOU 1990: 60: 57). It was argued that the grazing reimbursement system lacked incentives for active preventative actions, in particular, for increased shooting (SOU 1990: 60:40). However, this problem also is connected to the limitations of a highly-centralized, top-down system management system. One reason for decentralization of the moose management system was that it was considered critical to adjust the moose

population to local conditions, such as the productivity of the land and the extent of grazing damage. Also, according to the government, the goals concerning the density of the moose population at the local level had to become more flexible (Prop. 1991:92: 9:16).

In the next chapter, the discussion centers on the changes in property rights that have occurred since the establishment of MMUs.

## 5. THE ESTABLISHMENT OF SWEDISH MMUs

Due to problems caused by the excessively large moose populations, two measures were suggested in a government bill passed in the early 1990's. One was abolishing the grazing damage reimbursement system. This change accentuated the importance of keeping moose populations down (Prop. 1991/92: 9). However, the most important change was establishing Moose Management Units (MMU; älgskötselområde) in 1992. It was emphasized strongly that landowners in the current system had a difficult time ensuring that their interests were taken into account.

> It cannot be overlooked that local imbalances in the moose populations reflect a real conflict of interest between hunting and forestry interests. There is a risk that the problems are transferred to the local level without any direction as to how to solve them; therefore, it is critical that agricultural and forestry interests have actual influence. The problem does not only concern the issue of reaching a common goal as to the size of the moose population, this goal also has to be realized (Prop. 1991/2: 9:23, author's translation).

Inadequate knowledge regarding the moose population, irresponsibility, and poor cooperation between landowners and hunters also were identified as reasons for the surplus moose population (Prop. 1991/2: 9:1-24).

Obviously, the establishment of MMUs has changed property rights. In Table 2 (see Chapter 3), a breakdown of what property rights contain was depicted. In other words what changes in property rights has taken place due to the possibility for landowners to establish MMUs?

Also, without MMUs, private property rights are restricted through "*allemansrätten*" (everyman's right), which permits public access to private property, a right that also includes the right to pick berries and mushrooms.[18] Consequently, every person is an *authorized entrant* on private property in Sweden. The "everyman's right" causes conflict between the hunting and the outdoor life interests. The Outdoor Life interest organization stated that hunting interests had been

[18] Allemansrätten is regulated in Swedish constitutional law and it entails the public the right to access private property (RF 2:18).

disproportionately prioritized, and that outdoor life interests primarily were considered to be a nuisance and less important than hunting (Prop. 1986/87: 58:136).

Hunters who lease hunting rights can be characterized as *authorized users*, because their withdrawal rights are specified, they cannot make decisions with respect to management issues, and they have no exclusion or alienation rights. Hunters who lease hunting rights are like everyone else who hunts, are restricted by a number of formal rules, such as the hunting period, the hunting license requirement, and so on.

The potential to establish MMUs has resulted in increased management rights for landowners, since they now can decide how many moose to shoot. The importance of deciding the number of moose to shoot is related to the significant impact that hunting has on the moose population; approximately one third of the moose population is decimated during the hunting season. It is impossible to control a small-game population in this same manner, because the impact of hunting is much smaller (SOU 1990:60:27).

Until 1938, landowners could be considered full owners with all the rights described in Table 2. However, in 1938 the State passed legislation to promote cooperation between landowners, and the latest law regarding cooperation between landowners was enacted in 2000 (Lag (2002:259) om viltvårdsområden). As discussed previously, since Sweden signed the European Convention for Basic Human Freedoms and Rights, private property rights have been strengthened. The argument in the bill preceding the WMA law was that the public interest of coordinating moose hunting justified infringement on private property rights, due to the significant impact that hunting has on the moose population (Prop. 1999/2000: 73:29-31). However, in line with these strengthened property rights, the new WMA law includes more stringent rules regarding the degree of forced enrolment of landowners, and concerning the right of the association to make binding decisions for its members (Prop. 1999/2000: 73). The management rights of each WMA are restricted, because the CAB decides the number of moose that can be shot. However, the WMA still can choose to shoot fewer moose than its allotted quota (SOU 1997:

91:336). The landowner has alienation rights, as they can sell their property or lease out hunting rights. However, the WMA association can regulate landowner's exclusion rights, because it can decide the minimum number of hectares required for a hunting certificate. Each landowner receives hunting certificates proportional to the size of their piece of property. However, landowners with fewer hectares than specified by the association cannot lease out their hunting rights. Many decisions in WMAs are made collectively, such as the decision to hunt on all land in the WMA (Prop. 1999/2000:73).

In other words, when analyzing management rights, it is important to realize that there is a qualitative aspect that depends upon resource characteristics. Since hunting affects the moose population to a great extent, the right to decide the size of the moose population is a critical management right relative to, for example, small-game hunting which is barely affected by hunting. Therefore, the importance of management rights is, in part, dependent upon the impact that harvesting of the resource has on the population. Since a large part of the Swedish hunting area is covered by MMUs, landowners in Sweden appear to consider it important to have management rights over moose. In the next chapter, the bargaining theory will be applied to the above changes.

## 6. BARGAINING THEORY APPLIED TO THE SWEDISH MOOSE MANAGEMENT SYSTEM

The bargaining theory is applicable to the MMU system, because there clearly are distributional consequences from diverse formal rules and diverse interests. In the early 1980's, the average annual number of moose killed by hunters was 170, 000. Thereafter, due to increased hunting, the moose population declined and the number killed by hunters fell to approximately 130, 000 in 1985/86. Despite this decline in the overall moose population, local differences in sizes of moose populations remained (Prop. 1986/87: 58:38). Growth of the moose population had increased the costs for landowners, especially in terms of grazing damage. This led to stronger opinions among landowners as to who should decide the size of the moose population (Prop 1991/92:9). The following analysis primarily is based upon proposition 1991/92:9 [19] and the preceding official investigation[20] that suggested changes in the moose management system, so as to alleviate the problem of excessive grazing damage. The two most important changes were 1) the abolishment of the grazing damage reimbursement system, and 2) the establishment of MMUs.

***Bargaining Partners:***

The main bargaining partners concerning the Swedish moose administration, besides the Swedish state, are the hunting interest organizations, and the forestry and agricultural interest organizations. The largest hunting interest organization is the *Swedish Hunting Association* (SAHWM), established in 1830[21] (Fransson 2003:8). An official investigation revealed that there is no clear division between the responsibilities of the SAHWM and public authorities (Prop. 2000/01:57: 73-75). Due to its semi-official position, the SAHWM has power to influence wildlife policy. However, it is extremely difficult to judge the relative power of the forest industry

[19] Prop. 1991/92:9 om jakt och viltvård
[20] SOU 1990: 60 Skada av vilt – Betänkande av utredningen om ersättning vid vissa viltskador
[21] The SAHWM were delegated the authority to manage wildlife care in Sweden through parliamentary decisions in 1938 and 1951 (Fransson 2003:8).

versus hunting interests. The forest industry is an important export sector in Sweden, and has a powerful economic influence. Besides the SAHWM, there is another hunting interest organization, called the *National Hunters' Association* (NHA), which has fewer members and a focus on landowners. The Swedish State cannot be viewed as a unitary actor, since certain specific government organizations, such as the *National Board of Forestry* (NBF), have different views about the question of moose management than the Swedish government or other state agencies.

All bodies to which the proposed measure of changes in the moose management system was referred for consideration, agreed on the existence of large-scale grazing damage. However, opinions on the extent of this damage, and which measures to use to evaluate it differed between state agencies, the CABs and different interest organizations. It also seems that the concerned parties had different expectations concerning the outcomes of certain changes in the moose management system. The Swedish Environmental Protection Agency (EPA), the NBF, the State Forestry Agency (sw, Domänverket), and the CABs all commented on the bill. The hunting interest organizations - SAHWM and HNA -and several different interest organizations representing the forest and agricultural sectors also commented on the bill.

***Grazing Damage:***

There were differing opinions about the seriousness of grazing damage and which ways to alleviate this. The NBF and *Domänverket* considered the grazing damage significant, and felt that the primary measure taken had to be a severe reduction of the moose population at the national level. The EPA were of the same opinion as the NBF and Domänverket; however, contrary to other two state agencies, they emphasized the difference between the biological-carrying capacity of the forest to feed wildlife, and its economic-carrying capacity with respect to grazing damage to the forest and agricultural sector, and to traffic. The EPA stated that the biological-carrying capacity was two to three times higher than the economic-carrying capacity, and that actors at the local and regional levels had to decide what definition they

utilized when deciding the size of the moose population. This demonstrates that the NBF and Domänverket primarily represented forestry interests, while the EPA seemed to take a somewhat "neutral" stance. The NBF stated that the forest industry is an important export sector, while hunting is a hobby, even though of great significance. The view of the government, as expressed in the bill, was that a shooting range of 150, 000 –200, 000 moose per year, to span a three year period as suggested by the official investigation, was too general, and that consideration had to be taken of local conditions. One of the reasons for this failure of keeping the moose population at acceptable levels was inadequate knowledge of the size of the moose population, resulting in excessively general local quotas not appropriate to the actual situation (Prop. 1991/92: 9:16).

Even though the hunting interest organizations agreed that grazing damages were significant, they also emphasized that, in many areas of the country, the moose population was weak, and countrywide hunting policies, as suggested by the official investigation, were inappropriate. The SAHWM also emphasized that measures had to be taken, by the forest and agricultural sector, to alleviate grazing damage by adjusting forest production and choices of agricultural production. They also argued that hunters should build wildlife fences and establish wildlife feeding areas to alleviate grazing damage.

The forest industry has made it quite clear that the industry's raw material interests should be the guiding principle for wildlife policy (Prop. 1986/87:58:137). Forestry and agricultural interest organizations were of the opinion that actual grazing damage was higher than what had been reported by the official investigation, and that a rapid reduction in the moose population was the answer to the problem. The NBF stated that only limited measures could be taken by the forestry sector in increasing wildlife feed, and that this only made sense when the moose population was in a state of balance. All the state agencies, and the forestry and agricultural interest organizations, were of the opinion that the grazing damage reimbursement system did not provide incentives to keep moose populations in check. However, the SAHWM believed that continuation of grazing damage reimbursement should be considered

for landowners of smaller properties. The agricultural and forestry interest organizations emphasized that removal of the grazing reimbursement system had to be accompanied by real influence for landowners to decide an appropriate size of the moose population.

***Moose Management Units:***

All the interest organizations supported the establishment of MMUs, but those promoting agricultural and forestry interests indicated how important it was that the landowner actually would achieve the level of influence suggested by the official investigation. The SAHWM stated that they supported the MMU model. However, they also pointed out that it was necessary to have some form of binding agreements for members of an MMU, and some form of regulations or norms regarding the actions of the MMU, and offered to write standard agreements and stipulations. The SAHWM claimed that it was very important to ensure that the already-established cooperation among landowners would not fall apart. In contrast to the EPA, the SAHWM also was concerned that smaller hunting areas would have a negative impact on moose populations.

The NBF approved of the establishment of MMUs and stated that well-established hunting areas should be able to decide the number of moose shot. The NBF also claimed that the moose management plan could be utilized to systematically evaluate the moose population and grazing pressure. The NBF pointed out that an administrative system that involves prolonged proceedings and time-consuming discussions among landowners, public authorities, and hunting interest organizations had to be avoided, and that the landowners' influence had to be strengthened to a higher degree than what was apparent from the bill.

Some of the CABs were against the establishment of MMUs, since they believed that the purpose of the MMU was met by "extended licenses" already in place. Another argument against the establishment of MMUs was the view that the current system, with state-regulated quotas that had been decided after consultation with diverse interest organizations, was the best system to ensure a balanced moose

population. One CAB pointed out the importance of the public retaining the power to steer the moose population, based upon wildlife traffic accidents and grazing damage. In addition, one CAB stated that, if a few single large landowners could hunt without some external control, this likely would be offensive to people. Some CABs pointed out that, due to the fragmented ownership structure in their respective counties, the MMU as an organizational form would not become significant. The majority of the CABs stated that the establishment of MMUs was something for which hunters already were prepared, as evidenced by the "extended licenses". They also considered this step a natural development and a responsibility that hunters could handle.

***Landowners and Hunters:***

Views of the roles of hunters and landowners differed somewhat. The NBF reacted towards EPA's description and the ambiguity regarding hunters and landowners, because these often are not the same persons. This unclear distinction obscures the fact that these two actors usually have conflicting interests. The NBF stated that, for natural reasons, hunters usually are more tolerant of grazing damage to young pine forests than landowners are. Due to the significant economic affect of grazing damage, it should be the landowner who has the right to decide the number of moose shot, according to the NBF. All the agricultural and forestry interest organizations stated that it must be landowners who decide the size of the moose population, and that the hunters should be obligated to shoot the set quota. One forestry interest organization stated that, considering the significant economic impact of hunting, there is no room for a "special" hunting interest and, consequently, hunting interest organizations should not be permitted to represent hunting interests before the authorities. The SAHWM were upset over the EPA's deprecatory description of hunters in general, claiming that they had a difficult time handling documents and maps. The SAHWM also pointed out the importance of establishing rules that hunters found meaningful, and stated that, in their experience, it was difficult to achieve a system to which all hunters could agree. Nonetheless, the group also emphasized that most hunters are loyal, but expect a moose hunting administration to be fair.

In Figure 3, the interconnectedness between formal and informal rules is depicted, and also the role of organizations in affecting changes in formal rules through collective action, with respect to the changes in the Swedish Moose Management System.

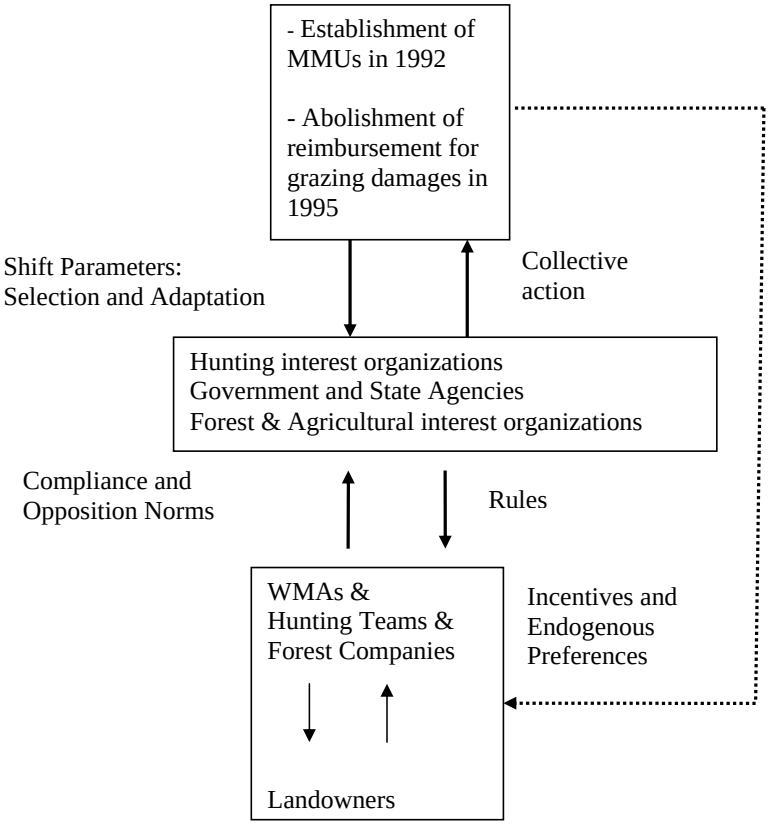



**Figure 3. Changes in the Swedish Moose Management System (Based on Nee & Ingram, 2001).**

The most significant changes in formal rules have been the establishment of MMUs and the abolishment of the grazing damage reimbursement system (as is illustrated by the upper box in Figure 3). Changes in formal rules directly affect the incentives of individuals and small groups (as is illustrated by the arrow on the right hand side). As discussed previously, due to the significant impact hunting has on the moose population, this change in management rights is likely to affect the incentives of

hunters and landowners. Landowners can, by establishing MMUs, decide how many moose to shoot and, thus, their incentives have changed drastically.

Organizations (described in the middle box) affected the changes in formal rules by participating in the referral system (which is illustrated by the arrow pointing upwards from the middle box to the top box). The actors who ’bargained’ over the changes in the formal rules were the state agencies, hunting interest organizations and agricultural and forestry interest organizations. However, it is extremely difficult to judge the influence of interest groups over these processes, especially since none of the interest groups clearly were opposed to the suggested changes. It became clear that there were divergent opinions about the size of the moose population and what measures to take in order to decrease grazing damage.

The Swedish State cannot be considered to be a single actor, as revealed by comments made by different state agencies and the government. “Thus, the State consists of numerous authorities and agencies that might be associated with different groups and functions of the resource system” (Carlsson & Berkes, 2005). For example, the NBF primarily represented the forestry industry, while the EPA seemed more “neutral” on the issues. The importance of decreasing grazing damage was emphasized in the bill, and decisions to abolish the grazing reimbursement system and to establish MMUs were made, both to alleviate grazing damage and to transfer responsibility for the size of the moose population primarily to landowners.

Forestry industry interest organizations highlighted the problem of increasing grazing damages and also problems with the existing institutional framework, such as overrepresentation of hunting interests in the Wildlife Management Boards. There was a clear difference in their view of the forest, and in agricultural versus hunting interests. Even though there was no greater conflict between the hunting and forestry interests with respect to the changes in the formal rules, it was clear that views differed as to who should decide the size of the moose population. The reason for this low level of conflict probably, in part, was due to different interpretations about the importance of the changes and also, in part, due to the stance taken by the

government. Those promoting forestry interests strongly expressed the view that the landowner had to have the final say over the size of the moose population.

Changes in the formal rules have affected the incentives of landowners (as is illustrated by the arrow on the right hand side of Figure 3). Since establishing MMUs has become possible, landowners have increased their management rights and, as discussed previously, the right to decide moose quotas is an effective tool to manage the moose population, since hunting decimates a large part of the moose population. The question then becomes: what effect does this have on the norms and relationships between the various interest groups (depicted in the lowest box in the figure)? Who should decide the size of the moose population? The different groups differ in who they think should carry this right. If hunters believe that they have a right to participate in decisions concerning the size of the moose population, an organizational form such as the MMU results in contradictions between formal rules and norms, because this implies that landowners have the right to decide the number of moose shot.

For example, one CAB stated that it might be offensive to many if a few large landowners decide the size of the moose population. Another issue directly related to the question of legitimacy, and also frequently raised, is that of the hunters actually shooting their quota of moose. Hunters ultimately can affect the size of the moose population by not shooting their assigned quotas, irrespective of who generated these numbers. One of the advantages of local resource users defining, implementing, monitoring, and enforcing rules is that it is easier to detect deviations from rules (Ostrom & Schlager, 1996). This, on the other hand, is more difficult for a forestry company. As Knight states, difficulties in establishing new rules relate to changing expectations; in other words, people have to be convinced that other people also will follow the new rules (Knight, 1992). Regarding natural resources, this is a question of who has the right to decide the level of use and state of natural resources, a question which often uncovers deep-seated beliefs and values. As is apparent from Table 1 (Chapter 3), the responsibility of private landowners is to avoid unacceptable use of resources; however, what is deemed ‘unacceptable’ constantly changes.

The interest groups and many of the CABs did not seem to believe that being able to establish MMUs would lead to any drastic changes. Because it is voluntary to join an MMU, and a management plan has to be handed in to the CAB, obviously landowners find this management system attractive. Today, the system covers approximately 10,8 million hectares. The reason for this support must be the opportunity it gives various individuals to have a say in deciding the number of moose to be shot in their local area. In the pilot study conducted in 2003, both an interviewed forestry manager at a large forestry company and the chairman of an MMU comprised of three WMAs considered this management system excellent. The chairman stated that the greatest benefit of the MMU was that decisions were made by hunters, and not by the CAB. He also believed that hunters, in general, had become much more active since they could make their own management decisions, and therefore influence the moose population to a greater degree than was possible when the CAB decided the number of moose they could shoot (interview 2). The forestry manager stated that MMUs were the best management system for moose. He also said that they could blame no one for the situation, since it was their responsibility to determine the size of the moose population (interview 1). It appears that all the bargaining partners underestimated how widespread this management system would become, and how important landowners believe it is to possess management rights with regards to moose management.

A prerequisite for adaptive management being established is extensive management rights, and this requirement is fulfilled by the MMUs. MMU management plans contain information, like the utilization of monitoring methods and the amount of grazing damage. This information can be operationalized as aspects of adaptive management. Thus, moose management plans provide an opportunity to examine whether adaptive management systems are in place. Given the previous analysis of the establishment of MMUs, it is interesting to determine to what extent actors have utilized their new bargaining power; i.e., if this has changed the moose management system and, if so, in what direction? The main questions to be answered are 1) if actors have established local adaptive management systems;

and 2) if there are differences in the moose management system due to diverse ownership structures. In the next chapter, the concepts of local adaptive management will be operationalized, so as to clarify this.

## 7. CAN SWEDISH MMUs BE CHARACTERIZED AS LOCAL, ADAPTIVE MANAGEMENT SYSTEMS?

In this chapter, the concept of local adaptive management will be operationalized, so as to examine to what extent adaptive management aspects are prevalent in MMUs. Generally, adaptive management results in the management system being able to respond to changes in ecosystems independently, whether these changes are caused by people or due to non-anthropogenic causes. In order for a management system to be adaptive, managers must accept the unpredictability of ecosystems and apply an experimental approach to learn more about the system. One important aspect, therefore, is whether managers accept the philosophy of unpredictability and establish management systems that deal with this intrinsic component of ecosystems. In this chapter, aspects of adaptive management will be outlined. Subsequently, how these aspects can be addressed by the variables in the database will be explained. Five different criteria will be utilized to evaluate whether MMUs can be considered to be adaptive management systems. These are 1) the degree of success; 2) ecosystem management; 3) monitoring; 4) activities; and 5) polycentric institutions. These different measurements have been developed from concepts derived from the adaptive management literature.

***Degree of Success:***

Adaptive management is grounded in the realization of the interconnectedness between ecological and social systems, and emphasises how essential it is to take social and economic factors into consideration when establishing natural resource management systems. In other words, adaptive management *does not promote conservation per se*, but rather the utilization of natural resources in a sustainable way, ensuring that no loss of resilience takes place. A management system of natural resources can be considered adaptive if the actors' desired goals regarding resources are met (such as the size of the moose population). To avoid the loss of resilience, it

is essential to ensure the biological diversity of tree species, such as aspen, ash and sallow, and not only the preservation of economically-valuable tree species.

Consequently, one indicator of whether the moose management system is adaptive is if resource users have been successful in reaching their goals for the size and composition of the moose population, within acceptable biological limits. This will be measured by examining goal fulfilment relative to the reported composition of the moose population and the amount of grazing damage. One often-set goal is that the moose population contains enough bulls. Since it is very popular to shoot mature bulls, this is not always an easy goal to reach. Bull population estimates will provide an answer regarding the extent to which MMUs have been successful achieving their preferred moose population composition (for further details on calculations, see Appendix 3).

***Ecosystem management:***

Ecosystem management involves a holistic view of the environment and, thus, it is critical that the resource users not only monitor the moose population, but also other ecosystem properties. For example, do resource users actually perform a local grazing damage inventory? This would be an indication of whether they also pay attention to other aspects of the ecosystem. Another aspect that will be measured is whether they have made notes in the MMU plan about grazing damage involving different tree species. If they have noted the degree of grazing damage to various tree species, this would indicate that they pay attention to other variables in the ecosystem, besides the moose population. However, one also can respond to ecosystem feedback by wildlife care efforts, such as improving grazing conditions by forest clearing, feeding of wildlife, and establishing wetlands. To summarize, the indicator of ecosystem management contains the following variables: utilization of a local grazing damage inventory method; observations of grazing damage to different tree species; and performed wildlife care efforts (see Appendix 4 for further details).

***Monitoring:***

As mentioned previously, one important aspect of natural resource management is the monitoring of wildlife populations. Therefore, it is important to examine to what extent MMUs have utilized monitoring methods and what kind of methods they use. All monitoring methods have their strengths and weaknesses, and it is likely that reliability increases if local resource users utilize more than one monitoring method. Hence, not only if they use monitoring methods will be examined, but also whether they combine different methods (see Appendix 5 for more detailed information on different monitoring methods).

***Activities:***

Another way to measure the "adaptivness" of a management system is to combine different criteria. To decide whether the moose management system is adaptive, the presence of the following aspects should be determined: 1) ecosystem management; 2) local ecological knowledge; 3) learning; 4) experiments; 5) monitoring; 6) responses to environmental feedback; and 7) cross-scale linkages. These features have been defined as critical adaptive management aspects by established researchers in this field (Berkes, 2002, 2003a; Berkes & Folke, 1998; Folke, Colding et al., 2003; Olsson & Folke, 2001).

Thus, one indicator is to estimate the level of activity within MMUs. For example, do resource users perform several monitoring methods, or have a goal concerning the size of the moose population, etc.? Even though this is not an exact indicator of 'adaptivness', this measure will give an indication of the activity level and, therefore, also whether the MMUs perform central activities related to adaptive management. Consequently, an activity index has been created (see Appendix 2 for further information).

***Polycentric Institutions and Cross-Scale linkages:***

It is critical that local resource management systems are not isolated from parallel units or from the public administration. In this thesis, this cannot be measured in the

database. However, it is possible to gain indirect indications of these by, for example, investigating differences between different regions and counties. Therefore, differences in activities between the three regions - Norrland, Svealand, and Götaland - and also differences between counties will be examined.

Not all aspects of the adaptive management approach can be tested using the database, since it lacks some of the information needed; for example, it is not possible to find out the extent of local ecological knowledge, since none of the variables in the database can be used as an indicator. However, the information that is available makes it possible to indicate to what extent there are adaptive aspects in place in MMUs in Sweden.

In the next chapter, the question - to what extent are MMUs adaptive systems? - is answered.

# 8. TO WHAT EXTENT ARE SWEDISH MMUs ADAPTIVE?

In this chapter, the question - to what extent are Swedish MMUs adaptive? - will be answered empirically. This will be accomplished by measuring adaptivness with respect to the five criteria (degree of success, ecosystem management, monitoring, activities, and polycentric institutions and cross-scale linkages) described in the previous chapter.

## 8.1 DEGREE OF SUCCESS

The first criterion is called *degree of success* and contains three variables: the goal fulfilment of number of moose per 1000 hectares; the percentage of bulls in the moose population; and the amount of grazing damage. First, each separate variable will be introduced and discussed.

In Table 3, the numbers of MMUs that have reached their aim regarding the size of the winter moose population are described. If MMUs have succeeded in reaching their goal within the range of 85%-115% (100% equals exact goal fulfilment) they are considered adaptive. However, if MMUs are outside this range they are not considered adaptive. Approximately 15% of all the MMUs fell below 85% and approximately 33% were above 115%. In other words, most MMUs that were unsuccessful in reaching their aim had more moose per 1000 hectares than they desired. It should be noted that some MMUs have not had time to reach their goal, because they only recently have been established. If the first version of the plan was collected for study, the MMUs would not have had time to reach their goals. However, most MMUs will have been established several years ago and, therefore, have had time to adjust their moose population. It is essential to keep in mind that the feeding capacity of the land differs significantly, and also that, in certain areas, there are other animals, such as deer, competing for food. Therefore, there is no “correct” number of moose per 1000 hectares, and this means that it is difficult to control whether MMUs have “realistic” aims. However, due to the review of MMU

management plans by interest organizations and the CABs, it is likely that the goals concerning are not entirely unrealistic.

**Table 3. Goal fulfilment of MMUs regarding number of moose/1000 hectares.**

| Monitoring Method | Goal fulfilment | Percentage |
|---|---|---|
| All MMUs<br><br>N = 417 | MMUs that have not reached their goal as to the number of moose/ 1000 hectares* | 47 % |
| | MMUs that have reached their goal as to the number of moose/1000 hectares** | 53 % |
| MMUs that have utilized both airplane inventory and ÄlgObs<br><br>N = 94 | MMUs that have not reached their goal as to the number of moose/ 1000 hectares* | 70 % |
| | MMUs that have reached their goal as to the number of moose/1000 hectares ** | 30 % |
| MMUs that have utilized either airplane inventory or ÄlgObs<br><br>N = 311 | MMUs that have not reached their goal as to the number of moose/ 1000 hectares* | 49 % |
| | MMUs that have reached their goal as to the number of moose per 1000 hectares ** | 51 % |

*outside the range 85%-115% (100% is exact goal fulfilment)
**within the range 85%-115% (100% is exact goal fulfilment)

The overall level of success in reaching targeted moose populations has been 53%. To ensure reliability of population numbers, it is critical that MMUs have utilized reliable monitoring methods.[22] In total, 94 MMUs have utilized both airplane inventory and ÄlgObs. If an MMU has utilized both versus only one method, the accuracy of the population estimates of moose per 1000 hectares should be relatively high. Only 30% of the MMUs that have utilized both ÄlgObs and airplane inventory reached their goal.

The second variable that is part of the degree of success measure is the composition of the moose population. If the percentage of bulls in the moose

[22] The wildlife biologist, Göran Ericsson, claims that for the information on the number of moose per 1000 hectares to have any reliability, MMUs should have utilized both ÄlgObs and airplane inventory, Umeå 15-09-05.

population is within the range of 31-71%, this is considered to be an indication of adaptivness. However, if the figure is outside that range, the system would not be considered adaptive. In Table 4, the percentage of bulls in the moose population is presented (for further details on calculations, see Appendix 3).

**Table 4. Percentage of bulls in moose populations.**

| Monitoring Method | Bulls in the moose population | Percentages |
|---|---|---|
| All MMUs<br><br>N = 404 | MMUs with too few bulls in the population | 86 % |
| | MMUs with acceptable percentage of bulls in the population | 14 % |
| MMUs that have utilized both airplane inventory and ÄlgObs<br><br>N = 100 | MMUs with too few bulls in the population | 83 % |
| | MMUs with acceptable percentage of bulls in the population | 17 % |
| MMUs that have utilized either airplane inventory or ÄlgObs<br><br>N = 313 | MMUs with too few bulls in the population | 86 % |
| | MMUs with acceptable percentage of bulls in the population | 14 % |

Many hunters want to shoot the older bulls with large horns. Table 4 shows that 86% of MMUs have less than 30% bulls in the moose population. This result seems to indicate that it is difficult for MMUs actually to reach their aim. One possible explanation is that MMU members have not had enough time to adjust their shooting tactics, since the establishment of the MMU. It is likely that it takes time to establish resource management systems that are adaptive, since adaptive management requires that resource users conduct experiments and continuously increase their knowledge of ecosystems. In many of the MMU management plans, one goal relative to moose populations was to increase the percentage of bulls. A probable explanation is that, in MMUs of approximately 60,000 hectares, 30% of the bulls will be shared with

neighbouring areas.[23] (Ericsson & Wallin, 1995) Only 28 MMUs are larger than 60,000 hectares (MMU database); therefore, the majority of MMUs share bulls to a great extent. The median-sized MMU is about 10,000 hectares (MMU database) and this means that median-sized MMUs share about 40-60% of the bulls with their neighbours, depending upon where in the country the MMU is situated (Ericsson & Wallin, 1995). In this case, irrespective of monitoring methods used, there is no significant difference in the figures.

The third variable that is part of the degree of success is the amount of grazing damage. In the MMU management plans, resource managers could note whether they considered the grazing damage to be "insignificant", "acceptable" or "significant".

**Table 5. The amount of grazing damage in MMUs.**

| | |
|---|---|
| MMUs with significant grazing damages | 28 % |
| MMUs with insignificant or acceptable grazing damages | 72 % |

N = 546

Table 5 indicates that a majority of the MMUs consider the amount of grazing damage to be insignificant or acceptable, but still 28% of MMUs are of the opinion that grazing damage is significant. This is a problematic result, considering the negative effects it has on both the value of the forest and on biological diversity.

To estimate the general degree of success of MMUs regarding their goal fulfilment, the reports concerning bulls in the moose population and the amount of grazing damage have been added.

[23] In an MMU of 60,000 hectares, it was found that about 30% of the bulls will be shared with neighbors under the presumption that the moose "habitat" is, on average, 1500 hectares. The habitat of moose varies from 500 hectares to 3000 hectares, depending on the sex of the animal (bulls have habitats twice the size of cows) and what part of the country it is. In northern Sweden, the moose migrate between summer and winter feeding grounds (Ericsson & Wallin, 1995).

**Table 6. Degree of Success.**

| | |
|---|---|
| No success<br>Score=0 | 22 % |
| Low degree of success<br>Score=1 | 45 % |
| Some degree of success<br>Score=2 | 31 % |
| High degree of success<br>Score=3 | 2 % |

N = 589

Table 6 indicates that 33% of the MMUs have some or a high degree of success in reaching their goals, while 67% of the MMUs had no or a low degree of success.

Overall, the above figures indicate that half of Sweden's MMUs have a difficult time reaching their target moose population. As many as 28% of all MMUs considered their grazing damage as significant and this, perhaps, is related to the fact that they are unable to reach their goals. The majority of MMUs that could not reach their aim believed that they had too many moose, and this result is in agreement with the fact that a fair number of MMUs also consider their grazing damage to be significant.

In the next section, the results of the analysis of ecosystem management in Swedish MMUs are presented.

## 8.2 ECOSYSTEM MANAGEMENT

As discussed, one major difference between adaptive management and conventional resource management is that single species management is replaced by ecosystem management. Ecological research has disclosed the importance of monitoring slow variables in ecosystems, because these are principal in the function of ecosystems. In order to estimate the degree of ecosystem management, an ecosystem index composed of three variables has been created. The variables are: utilization of a local grazing damage inventory method; wildlife care efforts; and estimation of grazing damage on different tree species. First, each of the variables will be presented singly,

to be followed by a broader perspective in the form of an ecosystem management index. In Table 7, the percentage of MMUs that utilize a local grazing inventory method is noted.

**Table 7. The percentage of MMUs that utilize a local grazing damage inventory method.**

| | |
|---|---|
| MMUs using a local grazing damage inventory method | 23 % |
| MMUs not using a local grazing inventory method | 77 % |

N = 618

One efficient way both to ensure biological diversity and to control the extent of grazing damage on various tree species is for local resource users to employ a local grazing damage inventory method. There are national surveys conducted on the amount of grazing damage by the National Board of Forestry (NBF), called *Äbin* (see Appendix 5 for further information); however, these surveys only cover larger geographical areas and are not detailed enough to use on the relatively small MMUs. Biologists have developed different versions of local grazing damage inventory methods, and the latest version is called *Local Äbin*. Detailed instructions on how to use this method are available on the NBF website. The scientist who developed the method said it was easy to use[24]. In a pilot study, the interviewed Chairman of an MMU comprised of three WMAs claimed that he had tried to use the index, but found it difficult (interview 2). This might be an example of difficulties in transferring inventory methods to local resource users.

The second variable that is believed to reflect ecosystem management is wildlife care efforts conducted by local resource users. In Table 9, wildlife care efforts performed by MMUs are presented.

[24] Conversation with wildlife biologist, Roger Bergström, Umeå, 15-09-05.

**Table 8. Wildlife care efforts performed by MMUs.**

| | |
|---|---|
| Clearing of forest | 16 % |
| Wildlife feeding | 7 % |
| Other wildlife care efforts | 16 % |

N = 557

Table 8 demonstrates that it is not very common for MMUs to perform wildlife care efforts. A survey of Swedish hunter attitudes disclosed that 73% believe that their wildlife care efforts are meaningful. Approximately 15% of the hunters did not perform any because of long distances to the hunting grounds, and approximately 10% of the hunters did not conduct any because they were dissatisfied with the short hunting leases granted for their hunting grounds (SOU 1997: 91:237).

A third variable that is believed to reflect ecosystem management is whether grazing damage on more than just economically-valuable tree species is noted in MMU management plans. If there are estimates of grazing damage on more than three tree species, this would indicate that ecosystem management is being applied. If resource users utilize a local grazing damage inventory method and identify damage on different tree species, this represents a holistic view of the ecosystems, and perhaps also represents efforts taken to maintain biodiversity.

**Table 9. Estimates of grazing damage on different tree species.**

| | |
|---|---|
| No notes on grazing damages in MMU plans | 31 % |
| Notes on grazing damages on one to two tree species in MMU plans | 37 % |
| Notes on grazing damages on three or more tree species in MMU plans | 32 % |

N = 637

Table 9 shows that 32% of the MMUs actually report grazing damage on more than three tree species. Conversely, 31% made no notes at all regarding grazing damage

on specific tree species. However, this result might, in part, be explained by the different MMU templates established by the SAHWM; not all MMU management plan versions have specific places for writing down grazing damage on more than pine and birch.

In Table 10, the three variables have been summarized to indicate the overall degree of ecosystem management utilized in Swedish MMUs. The index is comprised of the three variables just reviewed. However, the scoring range is 0-5, because MMU members can perform three different kinds of wildlife care efforts (for further details on calculations, see Appendix 4).

**Table 10. Degree of Ecosystem Management in Swedish MMUs.**

| **Score** | **%** |
|---|---|
| 0 | 51 % |
| 1-2 | 42 % |
| 3-5 | 7 % |

N = 637

Table 10 indicates that half of the Swedish MMUs do not apply an ecosystem perspective on the management of the moose population, because 51 % of MMUs scored 0. 42% have some kind of ecosystem management, while only 7% have a high degree of ecosystem management. The degree of ecosystem management is fairly low, especially considering how adaptive management theories emphasize the importance of local resource users actually considering the entire ecosystem and not only single species.

## 8.3 MONITORING

As mentioned previously, one important aspect of adaptive management is monitoring resource abundance. Monitoring of a resource is essential in making management decisions, such as how many moose to shoot. Since all monitoring

methods have their strengths and weaknesses, the reliability increases if MMUs utilize more than one method. Consequently, how many monitoring methods utilized by MMUs will be examined (for further details on the different monitoring methods, see Appendix 5). The utilization of monitoring methods within Swedish MMUs is described in Table 11.

**Table 11. Monitoring methods utilized by the MMUs.**

| | |
|---|---|
| ÄlgObs inventory | 54 % |
| Airplane inventory | 26 % |
| Winter inventory | 2 % |
| Dropping inventory | 5 % |

N = 637

The most commonly utilized monitoring method is ÄlgObs, which is not surprising because this method is coordinated nationally by SAHWM and has existed since 1985 (Ericsson & Wallin, 1998). However, somewhat surprising is that as many as 26% of the MMUs actually have, at some point, utilized airplane inventory, a method that is fairly expensive. Due to attained management rights, perhaps landowners now consider it worth spending the money for this monitoring method? However, it is likely that larger forestry companies are more willing to invest in more costly monitoring methods. When asked about this, one forestry manager stated that his company had utilized airplane inventory methods when it first established their MMUs, so that it could obtain reliable estimates on the size of the moose population (interview 1). As can be seen in Table 11, the winter inventory method and the droppings method rarely are utilized.

In Table 12, the number of moose monitoring methods utilized by the MMUs is presented.

**Table 12. The number of moose monitoring methods utilized by MMUs.**

| | |
|---|---|
| No monitoring methods | 26 % |
| One monitoring method | 49 % |
| Two monitoring methods | 23 % |
| Three monitoring methods | 2 % |

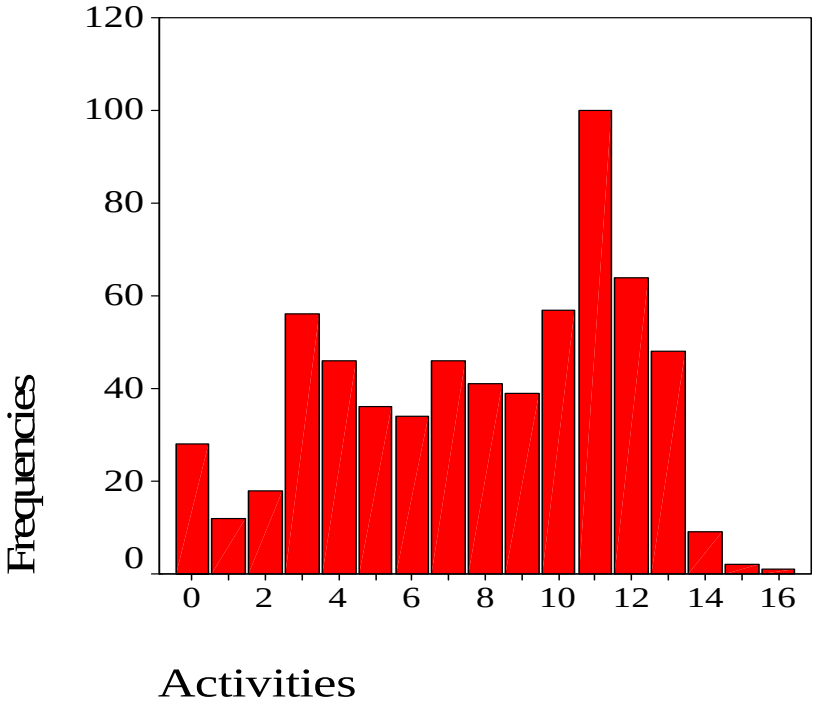
N = 543

A relatively large number of MMUs do not utilize any monitoring methods; although, admittedly, some MMU management plans lack adequate information. However, 49% of the MMUs use at least one monitoring method and 23% utilize two monitoring methods.

## 8.4. ACTIVITIES

As mentioned previously, the number of activities can be regarded as an indication of adaptive management. The total number of variables in the activity index is 20 (for further details on the variables in the activity index, see Appendix 2). Diagram 1 shows the frequencies of activities among the MMUs.

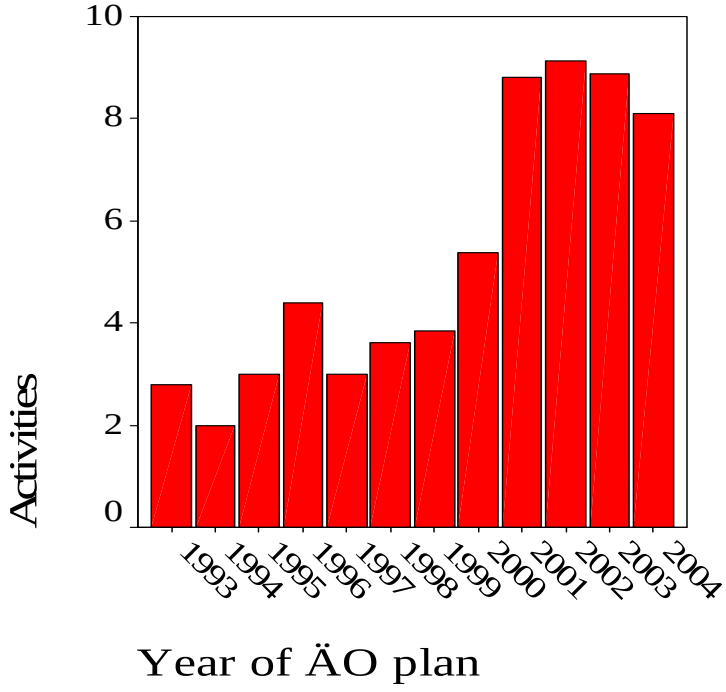
**Diagram 1. Frequencies of Activities in MMUs.**




N = 637

None of the members within the MMUs performed more than sixteen activities. However, this was not unexpected, since it is unreasonable, for example, to expect any MMU to utilize all monitoring methods. In 100 of the MMU plans, it can be noted that the local resource users perform eleven activities. However, many of the MMU plans lack adequate information; therefore, the number of activities performed by local resource users in Swedish MMUs probably is somewhat higher. In Diagram 2, the mean activity index scores in different MMU management plan years are illustrated.

**Diagram 2. Number of activities in different MMU management plan years.**




N = 592

As can be noted, the amount of activities within the MMUs increased in later years. However, it is critical to keep in mind is that it is unknown whether each year represents the first or a revised version of the MMU management plan. As mentioned earlier, it takes time to establish adaptive management systems, since resource users have to conduct experiments and learn about the ecosystem. Perhaps the fact that the activities are higher in later years can be an indication that the local resource users do make an effort to adjust their management strategies. Presumably, it has taken some time for the MMUs to coordinate their activities and to apply appropriate management strategies? In order to clarify this, more investigations must be conducted.

## 8.5 POLYCENTRIC INSTITUTIONS AND CROSS-SCALE LINKAGES

It is critical that local resource systems are nested within a broader context. Cross-scale linkages cannot be measured using the database. However, examining differences between regions and counties can indicate the presence of linkages. Consequently, it is important to examine the role of the CABs and other vertical organizations relative to MMUs. In Chapter 1, it was conjectured that, because the devolution of management rights over moose took place without accompanying restructuring of the public administrative moose management system, MMUs now often exist in isolation. In this section, this hypothesis will be tested. The assumption behind the hypothesis is that MMUs are likely to be isolated local systems and that polycentric institutions do not exist.

At first, regional differences will be examined in order to determine whether there seem to be significant differences between the three regions: Norrland, Svealand and Götaland (a map of the regions is available in Appendix 6).

**Diagram 3. Activities performed by MMUs in regions in Sweden.**

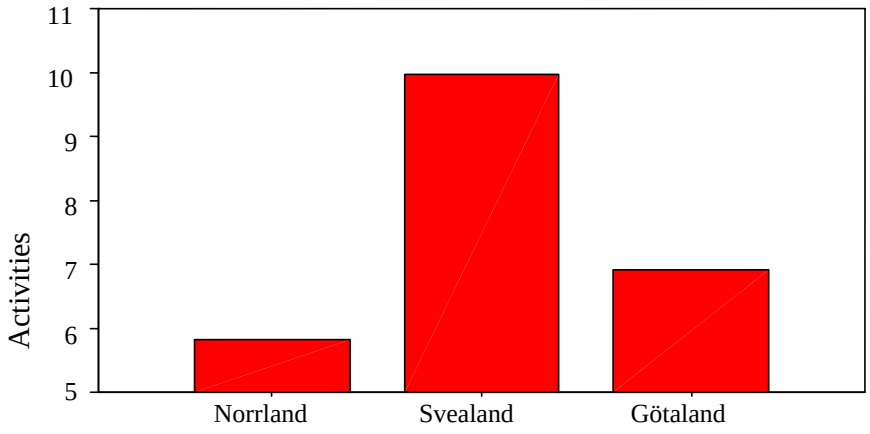
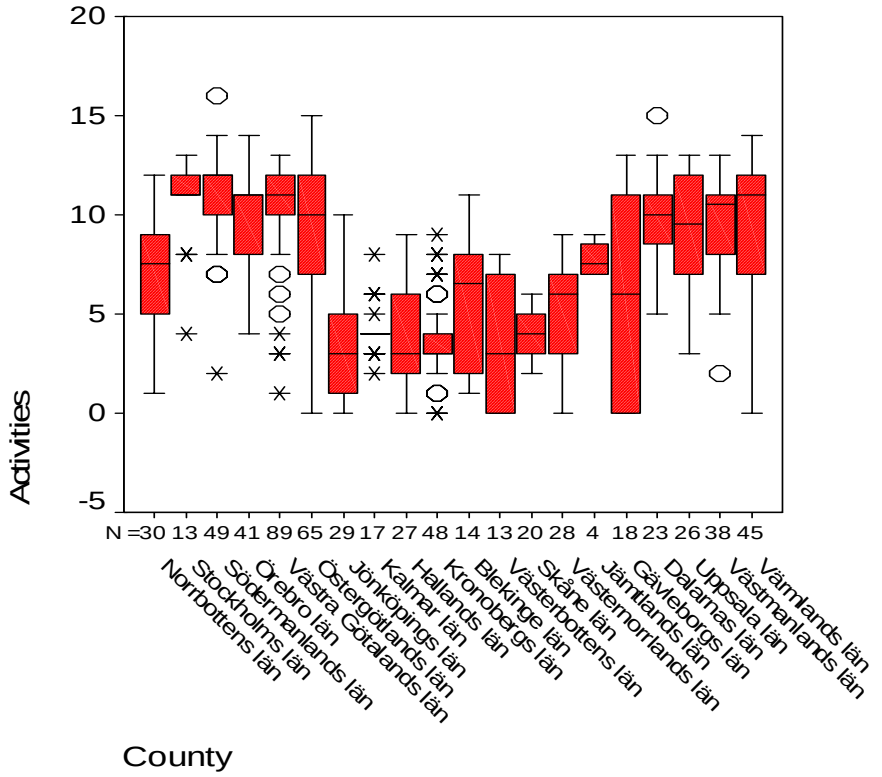


Diagram 3 shows that there are differences in the number of activities conducted by MMUs in the different regions. In Norrland, the average number of activities performed by MMUs is about 5, making this the region in which MMUs conduct the fewest activities. Svealand is the region where the MMUs are most active. Perhaps the latter result can be explained by Svealand's long history of organized hunting. Recall that Wildlife Management Areas have existed since 1938, and these have organized hunting. If these are widespread in a region, it is reasonable to assume that the hunters are used to cooperating in hunting and wildlife care efforts.

Despite this, note that Norrland has 972 WMAs, Götaland 280, and Svealand 625. Consequently, it is difficult to justify activity levels based upon the number of WMAs. It certainly is reasonable to assume that there are other explanations for the inter-county differences in MMU activity levels besides the number of WMAs.

It also is critical to investigate whether there are differences between counties within regions. In addition, this allows for a more detailed examination. One issue is whether the number of activities differs between counties; if this is the case, the procedures of the CABs should, perhaps, be examined. In addition, CABs have an important role to play, since they can provide essential horizontal linkages which are important according to adaptive management theories. In Figure 4, the number of activities in different counties is illustrated on a box plot[25].

[25] The box illustrates a variable's interquartile range and contains 50 % of the cases. The line across the box indicates the median value. The whiskers protruding from the box go out to the variable's smallest and largest value. Outliers are indicated by circles. These are variables with scores much higher or lower than the remainder of the sample.




N = 637

**Figure 4. The number of activities in counties.**

Figure 4 shows that, not only are there differences in the number of activities performed by MMUs in different counties, there also are significant differences between MMUs in the same county. The significant differences among counties perhaps could be explained by CAB administrative routines regarding MMU management plans; for example, how often CABs revise MMU management plans and whether these are reviewed by special interest organizations. If MMU management plans are revised regularly and critiqued, perhaps there is a greater effort by resource users to conduct monitoring, record grazing damage on different tree species, and so forth? Another issue is whether CABs have the personnel capacity to "develop" strategies to improve management strategies within MMUs. Document

analysis revealed that some CABs believed that the function of MMUs already had been met by licensing procedures, and this perhaps led some to be unwilling to spend resources on a new moose management organization. None of the CABs has computerized MMU management plans, and this makes it extremely difficult to access an overview of the activities performed by MMUs, or how management strategies could be improved upon at the county level.

The lack of any systematic treatment of MMU management plans might be due to the legal power of the CABs. There are no other forms of sanction that CABs can take against MMUs, other than to deregister the MMU if it is not working well and this, of course, is a drastic solution. In addition, if a CAB decides to deregister an MMU, the affected landowners once again might apply to establish a new MMU, or the CAB would have to register the area into other licensing units. In addition, there are no formal rules regarding the content of MMU management plans, only the previously-mentioned EPA "advice" (NFS 2002:19).

Figure 4 shows that, in certain counties such as Stockholm, Södermanland, and Västra Götaland, the median number of activities is high, and most MMUs within these counties perform about the same number of activities (as is illustrated by the small boxes). In contrast, the MMUs in Gävleborg County have a fairly low level of median activity, while the distribution is large (indicated by the large box in Figure 4). It would be of special interest to investigate what role the CABs versus local forums have played in determining the number of activities in MMUs.

***Local forums:***

Another aspect of adaptive management is whether there are vertical linkages between local resource systems. An example of a vertical linkage is MMUs participating in local forums. The interviewed forestry manager stated that his MMU had not been invited to local forums by the SAHWM district in Norrbotten County. However, he believed that it is necessary to participate in local forums to coordinate moose hunting over larger geographical areas (interview 1). The SAHWM organizes these local forums, and this is another example of the problems that can arise when a

special interest organization has a central role in public administration. The forestry manager did claim that the central SAHWM had welcomed everyone to the local forums (interview 1). Active participation in the local forums might lead to a "spill-over effect" of management strategies within counties, but no national evaluation of local forums has been conducted. Landowners and hunting interest organizations have conducted an overview of local forums and conclude that these lack formal procedures, including meeting summons, adequate documentation and appropriate representation. In addition, the increase in the number of MMUs was believed to have undermined the local forums. Despite EPA directives that the Wildlife Management Boards should follow up on local forums, they have not reacted to the declining importance of local forums (Fransson, 2003).

In the next section, an analysis of compiled results is presented.

## 8.6. ARE MMUs ADAPTIVE MANAGEMENT SYSTEMS?

In this section, results from the previous sections will be analyzed and discussed. 'To what extent can Swedish MMUs be considered adaptive management systems?' - was the question posed at the beginning of this thesis. How adaptivness is measured in this thesis indicates that the degree of adaptivness in MMUs is low due to, among other things, the low levels of success, both in meeting moose population goals and in ecosystem management. In Table 13, the degree of adaptive management is illustrated, by means of the previously-discussed indicators.

**Table 13. Degree of Adaptive Management**

| *Adaptive Management Criteria* | *Comment* |
|---|---|
| Degree of Success | 67% of MMUs has low or no degree of success in reaching their goal regarding the size of the moose population within acceptable biological and ecological levels |
| Ecosystem Management | 51% of MMUs do not apply ecosystem management |
| Monitoring | 26 % of MMUs do not utilize any monitoring methods |
| Activities | The most common number of activities taken by the local actors within MMUs was eleven (i.e., about half of the theoretically possible activities).<br>The number of activities was higher in later MMU management plan years. |
| Polycentric Institutions | The MMUs are fairly isolated local resource systems with a limited contact both with the CABs and the local forums. |

The degree of success appears to be fairly low, and a serious problem is that many MMUs consider the moose populations too large; this further explains why 28% of the MMUs consider grazing damage to be significant. In other words, the major problem seems to be to address how to decrease the excess moose population. What would hamper such a development? As discussed in Chapter Three, institutional features, such as property rights, influence behaviour. In the next chapter, goal fulfilment regarding the number of moose per 1000 hectares is correlated with ownership, so as to determine whether this can explain the degree of goal fulfilment. Approximately 15% of the MMUs had more than 30% bulls in the moose population. The low percentage of bulls probably can best be explained by the fact that MMUs are geographically small, leading to a sharing of bulls to a large extent. However, a decisive aspect of an adaptive management system is the existence of cross-scale linkages, in particular regarding natural resource management of mobile resources, of which harvesting results in significant externalities. Perhaps the problem of low bull percentages could be alleviated by greater cooperation between MMUs and other hunting organizations through local forums; however, these other organizations have been undermined by the establishment of MMUs.

Fifty-one percent of all the MMUs did not apply ecosystem management. The focus is still on single-species management, which is apparent from the fact that very few MMUs had any form of ecosystem management. In other words, they did not pay much attention to other variables in the ecosystem, and this is a major difference between adaptive management and conventional resource management. For example, one way to ensure that biodiversity is not threatened by moose grazing damage would be for resource users to utilize local grazing inventory methods; however, only 23% of all MMUs did this. It is very likely that this result, in part, can be explained by the single-minded focus both forestry representatives and hunters exhibit. Presumably, neither has a truly holistic view of ecosystems, since their primary interests are economically-valuable tree species or ensuring hunting opportunities, respectively. In addition, there are no formal rules that compel landowners to apply a holistic view to ecosystems regarding moose management strategies. At the same time, there are laws regulating forestry that require that consideration is taken towards ecosystem variables, such as biodiversity. Perhaps it is unrealistic to assume that local resource users will utilize time-consuming and complicated monitoring methods, and perhaps scientists could take this into account and develop monitoring methods that resemble "rules of thumb", something commonly utilized in traditional societies (Gadgil, Berkes et al., 1993). Measurement reliability might be lower, but it still would increase awareness of the state of the ecosystem.

One aspect of adaptive management is fairly extensive monitoring of moose populations. Twenty-six percent of the MMUs do not utilize any moose monitoring methods; albeit, since many of the MMU plans lack adequate data, this figure is believed to be somewhat lower. ÄlgObs seems to be a success, because it is conducted during harvesting and many of the MMUs utilize this method. As discussed previously, traditional monitoring methods usually are low-cost, rapid and performed in connection with harvesting (Moller, Berkes et al., 2004). ÄlgObs is conducted during harvesting and is easy to utilize, since hunters only record the number of moose they spot. In contrast, monitoring methods like counting droppings entail much more effort, because resource users need to mark areas on a map and,

thereafter, count droppings only in these areas. This is time-consuming and; thus, it is unlikely that this method is going to be widespread, even though it is inexpensive.

MMUs seem to be fairly isolated local resource systems. This study indicates that there is no guarantee that the public administration automatically will change its routines to adjust to changes in official policy. The lack of “right tools”, such as efficient sanctioning systems, might lead to inaction on the part of the public administration.

The results indicate that there are rather few aspects of adaptive management present in Swedish MMUs. In the case of Swedish MMUs, it seems like aspects of conventional resource management such as monitoring and focussing on single species management still are prevalent. However, what remains to be investigated is whether the ownership structure can explain the extent of adaptivness in MMUs.

In the next chapter, the question of whether ownership affects the degree of adaptivness within Swedish MMUs is addressed.

## 9. OWNERSHIP AND ADAPTIVE MANAGEMENT

One of the questions raised at the beginning of the thesis was whether MMUs can be characterized as adaptive management systems. The results indicate that MMUs are not particularly adaptive. The second research question posed was if ownership structure influences the establishment of adaptive management systems. In the adaptive management literature, the aspect of conflict seldom is highlighted, even though natural resource management is fraught with conflicts. In other words, it is relevant to determine whether the presence of conflicting interests affects the establishment of adaptive MMUs. The ownership structure's possible significance in the establishment of adaptive management systems will be tested, by examining its affect on different adaptive management criteria. In this section, the following hypotheses will be tested:

**Hypothesis II:**

*Due to conflicting interests between hunters and the forestry industry, the extent of adaptive management aspects should be less when the ownership structure predominantly consists of forestry companies.*

The underlying assumption behind this hypothesis is that adaptive management implementation requires cooperation and trust between parties in the local resource system. Aspects of adaptive management, such as learning collectively, monitoring, conducting experiments and so on, all entail that a certain level of trust exists between actors, so as to facilitate cooperation. If there are conflicting interests, and it is assumed that this conflict predominantly is between hunters and forestry representatives, this should inhibit the development of adaptive management processes since these two parties should not exhibit high levels of trust.

**Hypothesis III:**

*Forestry companies will have larger moose populations than their stated goals, whereas private landowners will have fewer moose than their stated goals.*

This hypothesis is based on the assumption that, due to the conflicting interests between hunters and foresters, forestry companies will not be able to reach their moose population goals. As explained previously in accordance with the bargaining theory, the party with the greatest resources has the greater ability to implement rules. In this case, forestry companies have greater resources, especially financial. They also are supported by formal rules that state that landowners should decide the size of the moose population. The forest companies have "power" over hunters who lease hunting rights, because they can terminate leases and raise fees. However, a rule might not be implemented if it contradicts the ideology of those affected or if there are difficulties in monitoring and enforcing rules (Knight, 1992). As discussed previously, the Hunting Law states that wildlife management is a joint responsibility of hunters and landowners, and it seems reasonable to assume that hunters, in general, believe they also should have some influence in deciding the size of the moose population, especially since their interests are contradictory to those of forestry companies. In addition, the problems of monitoring and enforcing rules should pose difficulties for forestry companies, because forestry property usually is large. Only 1% of private landowners own properties larger than 400 hectares, so it is reasonable to assume that forest interests will not be as prominent for private property owners as for forestry companies (Fällman, Ligné et al., 2005). The forestry companies bear the entire cost for grazing damage on forest land, so they prefer fewer moose. Conversely, hunters are likely to prefer more moose to enhance hunting opportunities. Therefore, it is likely that private landowners will be less likely to perceive that the moose populations are too large.

In the next section, the first hypotheses will be tested. There was only one aspect of adaptive management that did not correlate with the ownership structure, and that was the amount of activities performed by the MMUs.

**Table 14. Correlation between ownership and activities**

| Ownership | Correlations | Activities |
|---|---|---|
| Private | Pearson Correlation<br>Sig. (2-tailed)<br>N | ,002<br>,970<br>560 |
| Public | Pearson Correlation<br>Sig. (2-tailed)<br>N | ,019<br>,662<br>560 |
| Company | Pearson Correlation<br>Sig. (2-tailed)<br>N | -,017<br>,690<br>560 |

As can be seen in Table 14, there is no statistically-significant correlation between ownership structure and the number of activities performed by resource users. Whether the ownership structure at the municipality level is predominantly public, private or company obviously does not affect the number of activities taken by resource users. According to theories of local adaptive management, one prerequisite for local resource users establishing institutions conducive for adaptive management is that they have extensive management rights. This prerequisite is fulfilled relative to MMUs, but private ownership does not automatically ensure that more activities are performed. Is this an indication that, despite the fact that ownership includes extensive management rights, there simply is not enough interest among local resource users to invest time in the management of moose populations?

Another factor that might explain differences in activities is the size of the MMUs, since it is reasonable to assume that smaller MMUs have fewer hunters and, therefore, fewer people available to spend time on activities than in MMUs with more hunters. In addition, a larger MMU should have more resources.

However, there is a very small, negative, statistically-significant correlation between the area of MMUs and the number of activities[26]. Larger MMUs tend to enact fewer activities. In other words, when MMU area increases, the number of activities decreases.

[26] Pearson Correlation is -,115** (Sig (2-tailed) ,004) ( N = 625,).

In Table 15, all the statistically-significant correlations between ownership and adaptive management are presented.

**Table 15. Correlations between ownership and adaptive management.**

| Owner | Correlations | Grazing[27] damages | % of Bulls | Wild[28] Care Efforts | Eco-system Mgm[29] | Monitor[30] | Goal fulfil-ment |
|---|---|---|---|---|---|---|---|
| Private | Pearson Correlation<br>Sig. (2-tailed)<br>N | ,230**<br>,000<br>511 | -,248*<br>,000<br>355 | ,114*<br>,012<br>488 | -,059<br>,172<br>544 | -,216*<br>,000<br>475 | -,300**<br>,000<br>375 |
| Public | Pearson Correlation<br>Sig. (2-tailed)<br>N | ,016<br>,710<br>511 | ,057<br>,284<br>355 | ,032<br>,484<br>488 | -,058<br>,177<br>544 | ,055<br>,236<br>475 | -,041<br>,433<br>375 |
| Company | Pearson Correlation<br>Sig. (2-tailed)<br>N | -,255**<br>,001<br>511 | ,228*<br>,000<br>355 | -,159**<br>,000<br>488 | ,112**<br>,009<br>544 | ,197**<br>,000<br>475 | ,369**<br>,000<br>375 |

**. Correlation is significant at the 0.01 level
*. Correlation is significant at the 0.05 level (2-tailed).

One aim of this thesis has been to test whether the ownership structure affects the adaptivness of the system. The underlying assumption is that conflicting interests between hunting and the forestry industry inhibit the establishment of adaptive management systems. On the other hand, if the ownership structure predominantly is comprised of private landowners, the forestry interest is not as great, since properties are smaller. Therefore, private ownership should be conducive to the establishment of adaptive management systems regarding moose. However, the hypothesis is rejected by the empirical findings. Private ownership does not induce more adaptive management aspects than forestry ownership does. However, one can find

[27] Grazing damage is defined as follows; small or acceptable grazing damage=1, and large grazing damage=0.
[28] Wild care efforts consists of three variables; clearing of forests, wildlife feeding, and other wild care efforts, no activities gives a score of 0 and if all three wild care efforts are undertaken, the score is 3.
[29] Ecosystem management is constituted by the following variables: utilization of a local grazing inventory method=1, no notes on grazing damage=0, notes on up to two different tree species=1, notes on more than two tree species=2. The score range is 0-3.
[30] The monitoring index is composed of four moose monitoring methods: ÄlgObs, airplane inventory, winter inventory, and dropping inventory. The score range is 0-4.

statistically-significant correlations between all aspects of adaptive management and type of ownership.

***Grazing damage:***

There is a small negative correlation between private ownership and perceived grazing damage, such that the higher the degree of private ownership, the lower the grazing damage. The opposite holds true when the ownership structure increasingly is dominated by forestry companies. An investigation regarding the attitude of private landowners regarding the size of the moose population (in three counties with grazing damage deemed unacceptably high by the forest sector) revealed that 59% of the private landowners considered moose populations to be of appropriate size and only 7% considered them too large. However, the investigation also disclosed that private landowners with properties of 400 hectares or larger considered the moose populations too large. Only 1 % of all private properties are larger than 400 hectares. No difference in attitude (regarding the size of the moose population) was found among private property owners, irrespective of whether or not they lived on their properties or had significant knowledge of forestry practices (Fällman, Ligné et al., 2005). This seems to indicate that what is acceptable to property owners is not dependent upon their knowledge of grazing damage, but rather that they are more tolerant towards grazing damage than the forestry industry.

***Percentage of bulls:***

There also is a small statistically-significant correlation between the percentage of bulls in the moose population and ownership structure. A greater share of private ownership is associated with fewer bulls in the moose population. This, in part, can be explained by the fact that forestry company MMUs generally are larger and, hence, share a smaller percentage of bulls with neighbouring areas. With the current organizational structure of MMUs, increasing cooperation between MMUs and other hunting organizations might alleviate this problem. However, as discussed, it seems

that local forums engage fewer landowners, since the establishment of MMUs (Fransson, 2003).

Hence, another possible explanation for the percentage of bulls might be the size of MMUs. There is a small, positive statistically-significant correlation between the percentage of bulls and the size of the MMU area[31]. As the area increases in size, so does the percentages of bulls. This seems to confirm the idea that larger areas have their "own" moose population and this makes it possible to control the population to a higher degree. Another explanation might be that it is more difficult to restrict the shooting of bulls when there are many private landowners involved. It might be "easier" for a forestry company to establish rules prohibiting the shooting of bulls, because they, for example, can charge higher fees if hunters shoot bulls instead of cows or calves. In Figure 5, the correlation between private ownership and percentage of bulls is illustrated by means of a scatter plot.

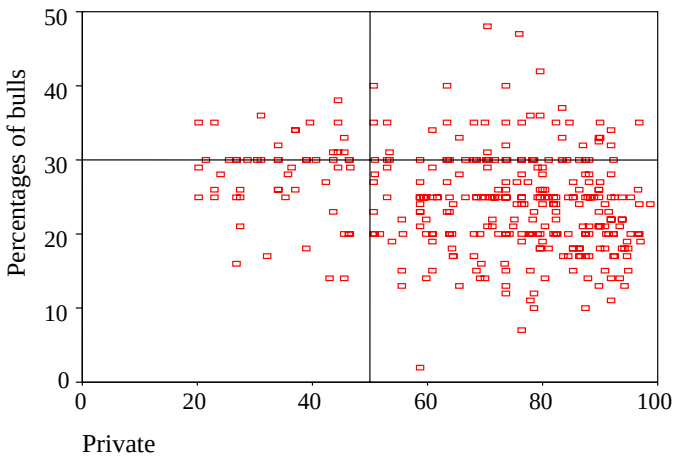



**Figure 5. Correlation between private ownership and percentage of bulls.**

As can be seen in the scatter plot, many MMUs have fewer than 20% bulls, and this may jeopardize the reproductive capabilities of the moose population, in the long

[31] Pearson Correlation ,151** (Sig. (2-tailed, ,003) (N = 399). However this statistically-significant correlation is lower than the one between percentage of bulls and ownership (see Table 16).

run. However, it is critical to keep in mind that the scatter plot includes all MMUs, irrespective of what monitoring methods they use.

***Wild care efforts:***

There is a statistically-significant, albeit weak correlation between ownership structure and wildlife care efforts. More wildlife care efforts are associated with MMUs with a higher share of private ownership, while there is a negative relationship with a higher share of forestry company ownership. Private landowners believe moose populations to be too small. Wildlife care efforts, such as clearing of forests and wildlife feeding, are beneficial to them because they contribute to enhanced feeding capabilities for moose, and thus growth of the populations. These results are consistent with the official investigation into Swedish hunter attitudes towards performing wildlife care activities. According to this investigation, 10% were unwilling to perform wildlife care efforts because they were dissatisfied with their leasing arrangements (SOU 1997: 91:237).

***Ecosystem Management:***

As forestry company ownership increases, so does ecosystem management, although the correlation is weak. This small correlation might be explained by the fact that forest production is regulated through the Forestry Act, which is explicit as to the importance of maintaining biological diversity. Forestry companies probably have routines for dealing with these issues to a larger degree than small property holders.

***Monitoring:***

There is a weak, statistically-significant correlation between the ownership structure and the amount of monitoring methods that MMUs utilize. In municipalities with predominantly private ownership, MMUs utilize fewer monitoring methods and the opposite holds true when the ownership structure primarily is comprised of forestry companies. In other words, forestry companies tend to utilize more monitoring methods than private landowners do. Forestry companies probably can better afford

to utilize airplane inventory than private landowners. In addition, most large forest company land is situated in the northern part of the country, which means that airplane inventory can be utilized, in contrast to the southern parts of Sweden that often lack snow.

***Goal fulfilment:***

The strongest correlation is between ownership and goal fulfilment, and this result strengthens the third hypotheses; *Forestry companies will have larger moose populations than their stated goals, whereas private landowners will have fewer moose than their stated goals.* Neither forest companies nor private landowners are successful in reaching their aim. While the forestry companies are not succeeding in decreasing their moose populations to meet targets, private landowners do not seem to be able to increase them. Forestry companies utilize more monitoring methods than do private landowners and, therefore, should at least have the tools to reach their aim; however, they continue to believe that they have too many moose on their land. How can this result be explained?

Document analysis revealed that there is a conflict between hunting organizations and agricultural and forestry interest organizations regarding the size of moose populations and the amount of grazing damage. There also are divergent views on who legitimately should decide this. For example, the agricultural and forestry interest organizations emphasize that landowners should decide the size and that hunters must shoot their allotted quota. It even was emphasized in a bill that hunters had an obligation to shoot the moose, whereas SAHWM points out that it is important that hunters find the moose management system fair. Due to changes in formal rules, such as the establishment of MMUs and the abolishment of the grazing damage reimbursement system, the incentives facing hunters and forestry companies have changed, as depicted in Figure 3. Formal rules might not be implemented if they contradict informal rules and norms. Hunters might find that the landowners' increased management right, specifically the right to decide the number of moose to be shot, is unfair. Perhaps this could explain why forestry companies are unsuccessful

in decreasing the moose population, while private landowners perceive their moose populations as too small? However, another probable explanation might be that hunters on forestry company land are not able to shoot their allotted quotas during the hunting season. Sparsely populated areas, in Sweden, might not have enough hunters to shoot as many moose as landowners want. However, this question cannot be answered at this time.

## 10. CONCLUSIONS and POLICY IMPLICATIONS

A literature review of the centralized versus local adaptive management approaches revealed that centralized adaptive management requires that a top-down management system be implemented, meaning that resource users do not have any significant role to play. The centralized adaptive management approach still differs markedly from conventional resource management, because it emphasizes experiments in ecosystems to fill the knowledge gap of biology and ecology. Centralized adaptive management has a long-term focus, and requires multidisciplinary efforts to be implemented successfully.

The local adaptive management approach requires that resource users have extensive management rights and they also are regarded as the key actors in this bottom-up approach. However, it is essential to remember that such a management system also needs to be linked, both vertically and horizontally. Linkages are critical when resource extraction has negative externalities and the resource is mobile. This is the case with moose, because they are both mobile and greatly affected by harvesting, contrary to small game. In addition, horizontal linkages allow other agencies, like the State, to offer new knowledge and assist in conflict resolution.

Document analysis revealed that external changes, specifically significant increases in the moose population that result in unacceptable grazing damage, led to changes in formal rules. The conflict level in moose management seems to have intensified. The government, public agencies, CABs, hunting interest organizations, and forestry and agricultural interest organizations have had different views of who legitimately should decide the size of moose populations. Document analysis also demonstrated that the *bargaining theory* has explanatory value, since it takes into consideration not only the relative power positions of bargaining actors, but also how different equilibriums have distributional consequences. Rules regarding who is to decide the size of the moose population are of great significance, since there clearly are distributional consequences. For landowners, a large moose population entails

economic losses, whereas a small moose population means fewer hunting opportunities for hunters.

The potential of establishing MMUs allows landowners to decide moose population size by adjusting the scale of harvesting. The current ownership structure in Sweden is believed to be conducive to local adaptive management. Landowners have found the MMU management system attractive, so that MMUs now cover approximately 10,8 million hectares of Swedish land. The landowners obviously want to manage the moose population. However, whether they truly are equipped to do so is another question. Sweden's signing of the European Convention on Basic Human Rights and Freedoms has strengthened property rights, so that the State no longer has the mandate to control natural resources, as previously. For example, public interests versus private rights were discussed relative to the new WMA law (SFS: 2000:592) and the conclusion was that infringement on private property rights was justified by the need to achieve coordination in hunting. Since so many landowners have established MMUs, a decision to abolish this moose management organization might be very controversial, and the question about what alternative organizational structures there are also has to be addressed by the authorities. As discussed, there also have been high administrative costs for conventional resource management regarding moose; hence, alternatives for the government appear to be few.

A new moose management organization recently was proposed by SAHWM, and by forestry and agricultural interest organizations, which would require that all existing moose management organizations be abolished and replaced by one moose management organization, overseeing at least 50,000 hectares. In charge of this management organization would be the existing local forums. However, contrary to their current role, they would be able to make binding decisions on moose quotas. The new role of the CABs would be to coordinate, evaluate, and provide conflict resolution platforms for local forums. The CABs no longer would register licensed areas or decide moose quotas (www.jagareforbundet.se/fran_sjf/skrivelserochre/algforvaltnings.asp.). However,

how this kind of management organization can be justified, in view of the current property rights structure is difficult to conceive. Is the public interest regarding hunting so significant to justify this considerable infringement of property rights? The main argument behind the suggestion is that the organizational structure should be decided on biological grounds and on available monitoring methods for moose and grazing damage. Should only landowners and hunting interest organizations decide what is in the public's best interest? Another serious problem concerns the rights of a non-public entity making binding decisions without there being any recourse for appeal, a circumstance that would contradict the principles of a constitutional state.

To what extent have adaptive management systems developed in Swedish MMUs? This question was posed at the beginning of this thesis. The answer to this question, based upon the current analysis of data, is that MMUs cannot be characterized as adaptive. For example, ecosystem management principles are not applied by the majority of MMUs. There is a strong tradition of single-species management, and the only interests truly represented in the management of moose are hunters and the forestry industry. As discussed previously, ecosystem management is an important aspect of adaptive management, and a major alternative to conventional resource management. Overall, the MMUs seem to lack an ecosystem perspective and the focus is on single-species management. With the decentralization and deregulation of the moose management system, it is vital that public interests are taken into account when management decisions are made. Landowners have an obligation to ensure that natural resources are not used in socially unacceptable ways. Therefore, increased management rights also should entail responsibility to other aspects of the ecosystem, besides the moose population; for example, by ensuring that biodiversity is not threatened due to significant grazing damage on different tree species. However, in the current system, there are no guarantees that landowners apply a holistic view of ecosystems, particularly with respect to decisions on moose populations; though this might be improved by informative efforts regarding the importance of maintaining biodiversity or by implementing formal rules. The EPA claims that the grazing damage caused by cloven-hooved animals poses a threat to

certain tree species that, in turn, many bird species depend upon (Naturvårdsverket, 2003). This study shows that there is a lack of attention to variables in the ecosystem that are not of immediate interest. This lack of an ecosystem perspective is serious, both with respect to maintaining biodiversity and ecosystem resilience. A focus upon only commercially-valuable tree species and moose cannot be deemed using natural resources in a sustainable way and, consequently, cannot be socially acceptable. There is minimal participation of stakeholders, such as environmental organizations, that would highlight these different vital aspects of ecosystems.

The first hypothesis posed was: *Because devolution of management rights of moose took place without accompanying restructuring of the public administrative moose management system it has led to isolated MMUs.*

This hypothesis is strengthened by the empirical findings.

***The role of CAB:***

As discussed, the public administration has a paramount role to play, because it can provide knowledge, share advice, and promote learning. If adaptive management is to be implemented regarding moose management, as the EPA advises (Naturvårdsverket, 2003), it is critical that the role of the CABs are examined and these organizations, perhaps, reorganized. The traditional roles of CABs regarding moose management are those of enforcing and monitoring rules; however, since the evolution of MMUs, this role has been undermined. It seems that CABs are inflexible and that the current organizational structure inhibits the establishment of adaptive management. The study indicates that the administrative routines at CABs differ regarding their treatment of MMU plans. However, it also is important to note that it was not possible for CABs to anticipate how widespread MMUs would become, and therefore not realistic that administrative routines would be altered at the start of MMUs. In addition, the concept of implementing adaptive management systems is fairly new and, thus, knowledge of this particular management system might not be held by the personnel within CABs in Sweden. The number of activities performed

by resource users in MMUs varies between and within counties. Consequently, it would be of interest to further examine the role of CABs and local forums.

***SAHWM, CABs, and Local Forums:***

The wildlife management organizational structure perhaps also can explain the apparent lack of administrative routines and management strategies regarding MMUs. For example, the SAHWM provides MMU plan templates, organizes local forums, and is in charge of hunting education and the treatment of ÄlgObs. In other words, the fragmentation of the organizational structure inhibits any broad overview as to what actions to take to improve moose management in MMUs. This division of wildlife administrative assignments between the CABs and the SAHWM dictate extensive cooperation, if adaptive management is to be implemented.

There are many measures that could be taken to promote polycentric institutions. For example, the role of local forums could be strengthened to promote information exchange within MMUs, and this could be achieved by making participation in forums obligatory. The CABs could ensure that MMU plans are administered, so as to promote adaptive management aspects. Another measure that might be taken could be to ensure that CABs have a graduated sanctioning system towards MMUs that are not taking appropriate measures. Greater cooperation between CABs and SAHWM regarding issues such as MMU plans, local forums and so on could perhaps improve moose management overall.

The second hypothesis was: *Due to conflicting interests between hunters and the forestry industry, the extent of adaptive management aspects should be less when the ownership structure predominantly consists of forestry companies.*

It was assumed that different ownership structures would result in diverse management systems within MMUs. Empirical analysis showed that there were small statistically-significant differences that could be explained by ownership structure. The hypothesis that private ownership would entail more aspects of adaptive management was rejected, however. In other words, adaptive management aspects,

as measured in this thesis, are not more prevalent under private ownership. However, certain aspects of adaptive management, such as local ecological knowledge and learning processes, have not been investigated in this thesis. It is likely that these aspects, in contrast to monitoring methods, are more sensitive to conflicting interests. For example, the previously-mentioned study of Swedish water management disclosed that learning was affected by strategic actions, when there were conflicting interests (Galaz, 2005). This study indicates that the property rights structure does affect the kind of management strategies that are employed by MMUs, and that this should be taken into account regarding decisions of devolution of management rights over natural resources.

The third hypothesis was: *Forestry companies will have larger moose populations than their stated goals, whereas private landowners will have fewer moose than their stated goals.*

The strongest statistical correlation was between ownership and goal fulfilment, since forest companies consider the moose population too large and the opposite holds true with private landowners.

One of the arguments for establishing MMUs was that the size of the moose populations had to be adjusted to local conditions and that, because the forest's biological-carrying capacity was two to three times larger than the economic-carrying capacity, different goals could be set (Prop. 1991/92:9). Despite the fact that MMUs can set their own goals concerning the moose population, forestry companies still believe there are too many moose. Whether this can be explained by their failure to achieve shooting numbers (due to difficulties with hunters shooting that many moose) or whether the conflicting interests have been transferred to the local level and still are not solved, cannot, at this point, be answered empirically. Private landowners, on the other hand, are not able to increase moose populations to meet their objectives either.

In many international forums and, in particular, the UN, the importance of traditional ecological knowledge is highlighted in order to ensure sustainable

resource management. By signing the Convention of Biological Diversity, the Swedish government also has committed to further its utilization of traditional ecological knowledge regarding natural resource management. In addition, the Swedish government has declared the importance of using local ecological knowledge; however, not without prior scrutiny regarding the reliability of such knowledge. Despite this, research has revealed that there are few efforts to actually utilize local ecological knowledge. Consequently, investigating the extent of local ecological knowledge among Swedish hunters seems warranted.

This study indicates that extensive management rights are not a guarantee that local resource users will invest time in the management of natural resources, or apply a holistic view of the ecosystem. The conversion of a top-down system characterized by single species management and monitoring methods developed by scientists will not automatically turn into adaptive management systems, even though resource users have gained management rights. Still, there are going to be different management strategies, depending upon ownership structure. Thus, to implement adaptive management, consideration must be made as to what resources, time and expertise are available, and how these factors relate to different ownership structures.

***Future Research:***

If the Swedish State is going to implement adaptive management of natural resources, the role of the public administration has to be examined. This study indicates that the ’traditional role’ of the CABs does not seem conducive to implementing adaptive management. In addition, the study also identifies the importance of changes in law that promote adaptive management; this is a question of balancing between flexibility and predictability.

Further research concerning the effects of conflicting interests on the potential of establishing of adaptive management should highlight problems that need to be addressed prior to implementing this approach. It also would be of interest to further examine the significance of the ownership structure, by collecting data on ownership structure at the MMU level, in order to find out whether the statistically-significant differences identified are greater.

To clarify what promotes and inhibits successful MMUs, case studies could be performed to contribute new knowledge as to the importance of informal rules in establishing adaptive management systems.

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1. Interview with a forestry company's forest manager 06-10-03
2. Interview with a chairman of a MCA 09-10-03

**APPENDIX 1**

Variables in the MMU database

1. Name of MMU
2. Year of establishment
3. MMU year - year the plan was submitted
4. County
5. Area of MMU
6. Cultivated area
7. Number of hunting teams
8. Private ownership, municipality level
9. Public ownership, municipality level
10. Forest company ownership, municipality level
11. Yearly shooting number of moose and moose calves
12. Number of moose/1000 hectares – winter population
13. Percentage of bulls in the moose population
14. Percentage of cows in the moose population
15. Percentage of calves in the moose population
16. Goal as to the number of moose/1000 hectares – winter population
17. Change in the moose population – increase or decreased
18. Moose migration
19. Grazing damages
20. Amount of feed available
21. Local grazing inventory
22. Clearing of forest
23. Support feed of wildlife
24. Other wild care effort
25. Monitoring 1 Älgobs
26. Monitoring 2 Helicopter inventory
27. Monitoring 3 Winter inventory
28. Monitoring 4 Calf inventory
29. Monitoring 5 Dropping inventory
30. Grazing damage on pine
31. Grazing damage on birch
32. Grazing damage on sallow
33. Grazing damage on aspen
34. Grazing damage on ash

## APPENDIX 2

### Activity Index

The following variables make up the activity index. Each "activity" can be assigned a score of 0-1. The score range of the activity index is 0-20.

1. ÄlgObs (is used 1/is not used 0)
2. Helicopter (is used 1/is not used 0)
3. Winter inventory (is used 1/is not used 0)
4. Calf inventory (is used 1/is not used 0)
5. Dropping inventory (is used 1/is not used 0)
6. Local grazing damage inventory (is used 1/is not used 0)
7. Goal, number of moose per 1000 hectares (information exists 1/does not exists 0)
8. Number of Moose per 1000 hectares (information exists 1/does not exist 0)
9. The composition of the moose population (information exists 1/does not exist 0)
10. Changes in the moose population (information exists 1/does not exist 0)
11. Amount of grazing damages (information exists 1/does not exist 0)
12. Clearing of forest (is used 1/is not used 0)
13. Support feed of wildlife (is used 1/is not used 0)
14. Other wild care efforts (is used 1/is not used 0)
15. Grazing damage on pine (information exists 1/does not exist 0)
16. Grazing damage on birch (information exists 1/does not exist 0)
17. Grazing damage on sallow (information exists 1/does not exist 0)
18. Grazing damage on aspen (information exists 1/does not exist 0)
19. Grazing damage on ash (information exists 1/does not exist 0)
20. Amount of feed available (information exists 1/does not exist 0)

## APPENDIX 3

### Database Calculations Adaptive Management:

### Degree of Success

The degree of success is comprised of three different factors: goal fulfilment of the number of moose per 1000 hectares; the percentage of bulls in the moose population; and the degree of grazing damage.

***Goal fulfilment:***
If goal fulfilment is within the range of 85-115% (where 100% is exact goal fulfilment) = adaptive (1)
If goal fulfilment is outside the range 85-115% (where 100% is exact goal fulfilment) = not adaptive (0)

***Percentage of bulls in the moose population:***
If the percentage of bulls in the moose population is within the range of 31-70% = adaptive (1)
If the percentage of bulls in the moose population is outside the range of 31-70% = not adaptive (0)

***Grazing damage:***
Grazing damage = small or acceptable = adaptive (1)
Grazing damage = large = not adaptive (0)

**This measurement can give an adaptive score of zero to three, because when individual item scores are added together, the highest possible sum is three.**

**APPENDIX 4**

**Ecosystem Management:**
*Utilization of a local grazing inventory method:*
Yes, is used = adaptive (1)
No, is not used = not adaptive (0)

*Estimation of grazing damage on different tree species:*
Grazing damage on three or more tree species recorded in the MMU plans = adaptive (1)
Grazing damage on less than three tree species recorded in the MMU plans = not adaptive (0)

*Wild Care efforts:*
Wildlife feeding - Yes = adaptive (1), No = not adaptive (0)
Clearing of forest - Yes = adaptive (1), No = not adaptive (0)
Other wildlife care efforts - Yes = adaptive (1), No = not adaptive (0)

**This measurement can give an adaptive score of zero to five, because when individual items are added together, the highest possible sum is five.**

## APPENDIX 5

## Moose Inventory Methods utilized in Sweden

### ÄlgObs

This inventory method is used across all of Sweden. It requires that hunters, during seven days of the hunting season, note down the number of moose they have spotted and the time this has taken. At least 5000 hours is necessary for it to be accurate and, therefore, usually areas of 50,000 ha or larger are required due to the fact that larger areas have more hunters. During the LÄS project, it was revealed that local variants of the ÄlgObs had developed and that this, if not corrected, might lead to lower information value from this monitoring method (Wallin, Vikberg et al., 2003). The method is efficient at a regional level but not at a national level. It is not possible to compare different regions, since the likelihood of spotting moose differ due to differences in vegetation, topography and method of hunting. ÄlgObs provides information as to changes in the moose population by comparing the number of moose observations/man hour between years. The method also has proven to be a good measure of moose productivity, which is calculated by the number of calves divided by the number of cows. The probability that a change in the population, as measured by Älgobs, is a real change is 81% (Ericsson sammanfattning avhandling 1999/ Svensk jakt).

**Airplane inventory**
Airplane inventory is done by airplane or helicopter. The method is reliable regarding moose density and measures absolute densities. The disadvantage is that it is expensive and requires snow. This method usually is more reliable for larger areas as well. In the LÄS project, it was discovered that the fact that moose is migratory several times per year can lead to erroneous estimates of the moose population within areas (Wallin, Vikberg et al., 2003).

**Dropping method**
The dropping method gives a measure of moose density during a certain time period, for example, winter. It provides absolute data. The first step is to establish test areas where the number of droppings, in turn, are translated into the number of moose per 24-hour time period (the moose leave 14-17 droppings/24-hours). This measurement reveals moose density. The method can be inexpensive, but is labour intensive and demands many hours (SAHWM). When this method was encouraged in the LÄS project, it was discovered that the hunters had a tendency to overestimate moose density. The researchers suspected that this result stems from the fact that it is tempting for a hunter to report droppings, even if they are discovered outside the measured area, and that this inventory method is relatively sensitive to a single reporter's mistakes (Wallin, Vikberg et al., 2003). The forestry manager at the forest

company in Norrbotten County said that this method is not appropriate for the northern part of Sweden, due to its geographically large areas (interview 1).

**Shooting statistics**

Since 1939, the SAHWM has collected shooting statistics for moose. The system of shooting statistics is organized, based upon reports collected from geographically-defined hunting areas. It functions well as a trend measurement, especially in areas where the same units report shooting statistics. Shooting statistics can be combined with other geographical information. The disadvantage is that there seldom is any information as to how representative the units are. The reports come from an area of approximately 33% of the total hunting area (Kindberg, 2002). All MMUs reported shooting statistics in the MMU management plans. Sometimes, the shooting statistics are unrefined, since many times it is a result of strategies by landowners to prevent increases in the moose population or actually to reduce the population (Lindroth, 2000).

**Äbin**

Äbin is an inventory method that measures grazing damage caused by cloven-hoofed animals. It is conducted by the National Board of Forestry (sw, skogsvårdsstyrelsen). The inventory method is used in areas of approximately 60,000 ha which are divided into squares that are measured for grazing damage (www.svo.se/minskog/templates/grundbok.asp?id=10453). Local Äbin has been developed to measure grazing damage of moose on young forests, and has been developed to be utilized in areas of about 20,000 ha (www.svo.se/minskog/templates/grundbok.asp?id).

**APPENDIX 6**

Map of regions in Sweden