THE CHANGING ROLE OF HUNTING IN SWEDEN—FROM SUBSISTENCE TO ECOSYSTEM STEWARDSHIP?

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ABSTRACT: Although hunting served traditionally to supply game meat, and that is still important in Sweden, recreation is the most common reason for hunting moose (*Alces alces*) today. Hunting also serves an important management purpose in regulating moose populations to control crop and forest damage. This study used semi-structured interviews with key stakeholders and officials involved in the recently implemented ecosystem-based, adaptive local moose management system where hunters and landowners become environmental stewards responsible for managing moose in context with forest damage, vehicular collisions, large carnivores, and biodiversity. Our study found that participation and collaboration in reaching management objectives was perceived as positive by stakeholders, although their stewardship is jeopardized if specific management responsibilities are not clarified regarding monitoring. Further, it is important to find long-term funding solutions for monitoring activities that are critical for adequate data collection and to support the stakeholder role as steward. The importance of monitoring must be communicated to individual hunters and landowners to achieve an ecosystem-based moose management system that effectively incorporates both social and ecological values.

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Historically, hunting was primarily associated with human subsistence and livelihood, whereas today it is mostly associated with recreation (Hendee 1974, Barnard 2004), and has gradually developed into a tool to meet sustainable wildlife and ecosystem management objectives (Holsman 2000, Fischer et al. 2012). With this shift, hunters and other stakeholders should be directly or indirectly involved in environmental stewardship; i.e., the responsible use and protection of the natural environment through conservation and sustainable practices (Leopold 1950, Holsman 2000, Chapin et al. 2009).

Moose (*Alces alces*) hunting in Sweden embodies this development where utility and leisure lately have become closely intertwined with management objective such as game population control (Holsman 2000, Council of Europe 2007). A new moose management system was implemented in Sweden in January 2012 that emphasizes the stewardship role of hunters and landowners. It provides a unique opportunity to analyze the extent that stakeholders support this institutional change and whether the new system offers the resources necessary for hunters and landowners to exercise ecological stewardship.

The Swedish moose management system has evolved several times in past decades to balance the interest of hunters (i.e., high moose populations) with other societal

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interests, most notably the commercial forestry sector concerned with browsing on economically valuable tree species. An increasing number of moose-vehicle collisions (MVC), negative effects on agriculture, and biodiversity are also of high concern (e.g., Angelstam et al. 2000, Edenius et al. 2002, Lavsund et al. 2003, Seiler 2003). Because these incremental changes did not resolve these conflicts, the Swedish Parliament decided, in one step, to move from a top-down administrative system consisting of a patchwork of organizational management units, into an ecosystem-based, adaptive local management system incorporating moose biology components like home range size and seasonal migration in combination with stakeholder engagement (Swedish Government 2010; see also Broman 2003, Wennberg-DiGasper 2008).

To avoid repeating previous management failures, the main objective of this reform was to establish a knowledge-based and adaptive moose management system with the capacity to balance different interests (Sandström et al. 2013). In particular, monitoring that was performed irregularly and incoherently across Sweden, is now considered a key focus in the new system to integrate knowledge for establishing and evaluating management objectives. Accordingly, the extent to which the new management system will succeed is dependent on 3 central elements of ecological stewardship: the will among hunters and landowners to 1) support wildlife management program goals designed to balance social and ecological values, 2) support and participate in the development of institutions for defining and implementing stewardship goals, and 3) participate in monitoring activities related to meeting social or ecological objectives (Holsman 2000, Chapin et al. 2009). Our objective was to study the implementation phase to assess stakeholder acceptance and capacity to handle the objectives of ecosystem-based institutions and monitoring as part of knowledge-based management.

BACKGROUND

Compared to previous management systems, the current system has a pronounced national objective for long-term balance of the moose population with forest resources and societal interests (Swedish Official Investigation 2009). To reach this objective, an official investigation identified the need to overcome institutional deficiencies, primarily the lack of collaboration between key stakeholders and an ecosystem-based approach, but also the lack of systematic monitoring of moose and forest resources (Swedish Official Investigation 2009).

The institutional change included some redistribution of tasks between the management levels, but also adding a new management body at the ecosystem level (i.e., moose management areas) that covers the equivalent of a moose population (at least 50,000 ha in the south and 100,000 ha in the north). This approach should bridge the regional level with moose management units and license areas at the local level (Table 1). The moose management areas are governed by a moose management group consisting of 3 landowners and 3 hunters. This group is responsible for 1) making an ecosystem-based and adaptive moose management plan for their respective area (stretching over maximum 3 years), 2) advising hunters and landowners in creating local management plans within the moose management units, and 3) coordinating and evaluating monitoring activities (Swedish Official Investigation 2009). The institutional amendment of the moose management system resulted in redistribution of funding as well, from primary administration use by the County Administrative Boards to include all monitoring of moose and forest resources (Swedish Government 2010).

Table 1. The institutional framework of the old and new Swedish moose management systems. The Swedish Environmental Protection Agency has the ultimate responsibility at the National level with the Swedish Forest Agency functioning primarily as an advisory and supporting authority. At the regional level the County Administrative Boards have authoritative responsibility for moose management. At the regional level in the new system, wildlife management delegations with members from all interest groups are included. At the ecosystem level in the new system are moose management areas consisting of moose management groups with stakeholder representatives (3 hunters and 3 landowners). The different categories of license areas in the old system are removed, and license areas or moose management units exist only at the local level in the new system. Moose management units also include stakeholders at the local level.

	Old system	New System
National level	Swedish Environmental Protection Agency /Swedish Forest Agency	
Regional level	County Administrative Boards	County Administrative Boards including Wildlife Management Delegations
Ecosystem level (50,000–100,000 ha)		Moose management areas led by a moose management group with 3 landowners and 3 hunters
Local level (10,000–15,000 ha)	License areas (A, B, C, and E) Wildlife management units Moose management units (hunters and landowners)	Moose management units (hunters and landowners) License areas (in exceptional cases)

The lack of systematic monitoring is addressed by science-based recommendation to focus on 4 accepted monitoring methods to provide annual information about the moose population including harvest statistics, hunter observation rates, pellet-group counts, and calf weights (Bergström et al. 2011, Danell et al. 2011, Ericsson and Kindberg 2011, Kindberg et al. 2011). Jointly, these methods require long-term, standardized implementation to function as reliable indices either singly or in combination (Bergström et al. 2011, Månsson et al. 2011).

To further meet the broader goals of the ecosystem-based system, information about large carnivore populations and MVCs will be evaluated, and assessment of forage and browsing damage are also necessary to address the primary management objective (Swedish Government 2010). Moose damage survey methods and forage forecasts are suggested as the basis of monitoring and are preferably conducted every 3rd and 5th year, respectively (Kalén and Bergquist 2011, Rolander et al. 2011). The damage survey methods estimate the proportion of old and fresh stem damage within a given height interval and area (Rolander et al. 2011), and the forage forecasts estimate the availability and quality of food resources through combination of satellite mapping of clearcuts and field sampling (Kalén and Bergquist 2011).

STUDY AREA

We conducted our study in 5 counties (Västerbotten, Dalarna, Södermanland, Västra Götaland, and Kronoberg) distributed across Sweden: 62°00′N, 15°00′E (Fig. 1). These counties were selected because of their differences in ecology, landownership, and use patterns that present varied challenges to fully implement the new ecosystem-based, adaptive local management system. The counties cover all Swedish vegetation types including alpine, boreal, boreonemoral, and nemoral zones. Forests are dominated by commercially valuable Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*), and by deciduous tree

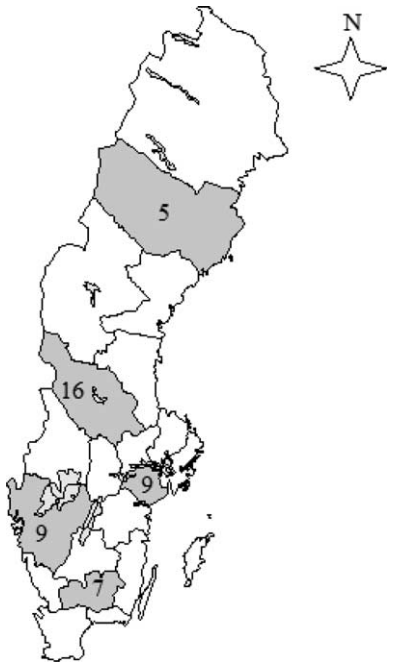

Fig. 1. The 5 counties that served as the study area; from the north, Västerbotten, Dalarna, Södermanland, Västra Götaland and Kronoberg Counties. The figure in each county represents the number of moose management areas in that county.

species such as birch (*Betula* spp.), aspen (*Populus tremula*), and rowan (*Sorbus aucuparia*), as well as broadleaved trees like oak (*Quercus* spp.) in the south.

The 5 counties also differ in several other ways that could affect local and regional moose management, including moose population density (Hörnberg 2001) and health; for example, moose tend to be larger in the north (Sand et al. 1995). Predation by brown bears (*Ursus arctos*) is mostly in Västerbotten and Dalarna, whereas wolves (*Canis lupus*) occur in Dalarna and Västra Götaland. The effect of predation on a local moose population varies among and within these counties depending on the composition and number of predators (Sand et al. 2011). While roe (*Capreolus capreolus*) and red deer (*Cervus elaphus*) exist in all 5 counties, some of Sweden's densest fallow deer (*Dama dama*) populations exist in Västra Götaland and Södermanland; Södermanland also has a small population of mouflon sheep (*Ovis aries orientalis)*. Only these 2 counties were considered with potential for interspecific competition between moose and other ungulates.

Land ownership among the counties also differ with more commercial forest companies in the north, and more private land in the south; forest ownership in Sweden is ~51% private and 42% commercial (Bergman and Åkerberg 2006).

METHODS

Representative officials and stakeholders within moose management areas were interviewed in each county. In total, 29 semi-structured, qualitative interviews were conducted in October–December 2012. Phone interviews, except 2 face-to-face, were used to ensure a high response rate. An interview manual with a vast spectrum of qualitative questions regarding the moose management system guided the interviews, and all respondents were asked identical questions. The recorded interviews lasted 45–120 min and were transcribed in full. Respondents were given the opportunity to read their transcribed interview, and to clarify and/or alter any content to ensure the information was as valid as possible.

The first interview in each county was with the wildlife manager of the County Administrative Board, which is the regional authority responsible for wildlife management issues, including moose management. Given their local knowledge, each was asked to suggest a typical management area that was neither more collaborative, nor more conflicted and turbulent, than any other management area in the county. The stakeholders (3 landowner and 3 hunters) in this management area were contacted for further

interviews. In addition, the Swedish Forest Agency (SFA) forest manager who was responsible for wildlife issues in each county was interviewed, since the SFA is an important advisory authority for the stakeholders. There were 40 potential interviews in the study: 5 wildlife managers, 5 forest managers, and 6 stakeholders per county (n = 30) of which 19 were interviewed (9 landowners and 10 hunters) with 1–2 non-respondents (unreachable or unwilling) in each county. Interviews were conducted with at least one hunter and one landowner in each management group; therefore, the data were regarded as reasonably balanced and useful to analyze the new adaptive moose management system.

The interviews were thoroughly read and all information regarding or related to monitoring was extracted from the material. Specific quotes that strengthen, clarify, or illustrate general (or divergent) responses are provided in the results. To ensure integrity, respondents are anonymous and we only describe their stakeholder group or agency and county. The interviews were conducted in Swedish and we present interview quotes based upon our translation to English.

RESULTS

Willingness and capacity to support nationwide objectives

We asked respondents about their attitudes towards the overarching objective of the new moose management system, the need for collaboration, and the ecosystem-based approach. The management of moose in larger geographical areas, as opposed to smaller management units, and the comprehensive ecosystem approach were considered positive in all counties. All but one hunter and landowner felt they would be more able to actively influence the management process. The single hunter from Västerbotten claimed that "local decisions have been moved even further away".

Hunters and landowners also emphasized the increased collaboration between them as important in fostering management legitimacy and trust among all participants. There was a strong conviction among officials and stakeholders that the new system would enable fact-based rather than assumption-based management, and that information derived from moose monitoring, forage forecasts, and browsing pressure estimates would allow more local, detailed, and nuanced management decisions. Two example quotes were: "An advantage is that we will be able to get a clear view of the moose population, and that we, with determined effort, will achieve a high-quality moose population" (hunter from Dalarna), and "We will have a moose population that is adjusted to the forage production—that's what's important, that we do not have too many moose, but we use the resources we have in our forests" (landowner in Kronoberg).

The stakeholders were developing moose management area plans in all counties. The plan was considered an important tool towards realizing management objectives and was regarded as a living document which could be altered if conditions changed. The perceptions of system resilience and how quickly management might respond to change differed among respondents; some believed that a yearly revision was reasonable, while others thought it possible to make immediate amendments during a hunting season. Rapid changes in the moose population would primarily be based on hunter observations, and to some degree on harvest statistics, but this assumes that reporting is relatively fast and that management groups meet frequently to assess the situation. How such reports would be used differed among respondents; some claimed that if hunter observations differed from specified sex-ratios (e.g., equal male:female ratio), then restrictions might be implemented. Others

observed that reporting is generally quite slow, and that the hunting season would likely be over before information could reach the moose management groups and subsequently to hunting teams.

Willingness and capacity to implement stewardship goals

We asked respondents to describe the ongoing implementation process to understand the degree of support and willingness to participate in the development of institutions for defining and implementing stewardship goals. Despite pervasive belief in the new moose management system and a willingness among stakeholders and officials to participate in the implementation process, several obstacles were identified in fully implementing the system.

The first obstacle was the short time period between the political decision in April 2011 and when the moose management groups would initiate their work (January 2012); both officials and stakeholders claimed they had inadequate time. Specifically, more time was needed to acquire monitoring information, to fully understand the function and implementation of the new moose management system, and to adjust work arrangements before the first 3-year plan was due. A landowner in Kronoberg summarized this with: "The process has been too fast, we do not have enough knowledge, we have too little knowledge regarding our game populations, we have no monitoring methods we all agree on applying, we have poor knowledge of browsing damage, we have no good overview of forage forecasts either, we rule and believe that we can manage the moose population, and we almost become overconfident and imagine we can calculate, down to nearest decimal, how many moose we can harvest."

The second obstacle was the lack of available and sufficient knowledge from monitoring to define management plans and objectives. The need for better data and the desire to develop a better overview of resource status was apparent in all counties. A new database (algdata.se) providing easy access to monitoring information and statistics important for developing their management plans was an identified need. Certain regional county data requirements differed. Västra Götaland respondents stressed the lack of resolution in forage forecasts, moose damage surveys, predator densities, and MVCs. They also preferred that numbers and data be available for each management unit or even each hunting team, rather than an average number at the county or management area level. In Södermanland, the importance of including other ungulate species was highlighted with regard to species-specific browsing damage surveys.

The third obstacle was the vagueness of management responsibilities regarding data collection, statistics, and monitoring. Despite the high degree of awareness of the need for monitoring, the responsibilities for such activities were especially perceived as confusing among the respondents. The main emphasis of responsibility for implementation, interpretation, and evaluation of monitoring lies with the moose management groups in their respective areas; the moose management units are obliged by regulations to participate in monitoring (Environmental Protection Agency 2011). Yet, there was confusion concerning role and authority among both officials and stakeholders. A forest manager in Västerbotten stated: "We should have a locally based management. And what does it mean? Does it mean that the management unit or maybe even the level below [hunting team] holds the steering capacity? Or does it mean that if the moose management group does not approve the unit's management plan then you have to do it all over again?". The County Administrative Board, the agency with actual decision-making power to demand participation

in monitoring (Swedish Official Investigation 2009), referred to the management groups and claimed the task was theirs to solve. They in turn claimed a lack of instruments and authority of decision-making and cannot demand monitoring participation from the management units. It is unclear if the management unit participation refers to all specified monitoring activities or if they can choose among suggested actions. Stakeholders also claimed that hunters had the actual capability for control.

License areas that cover parts of many moose management areas in all counties were another issue because they are not obligated by law to follow any management plan or participate in monitoring activities; consequently, they risk counteracting or interfering with plans in management units or management areas. Respondents were apprehensive that the vagueness about management responsibility might undermine the purpose and role of management areas and the crucial monitoring required for ecosystem-based management.

There were also uncertainties in all counties regarding high costs associated with decisions, prioritization, and the interval of monitoring activities to provide management with sufficient information.

The lack of financial resources to support the moose management system was the fourth obstacle. Originally, the moose management system was intended to be economically self-sufficient through harvest fees, including the cost of monitoring programs (Environmental Protection Agency 2011). Both officials and stakeholders found it unrealistic that, in accordance with the decision made by the Swedish parliament, the entire moose management system (administration, management group members, and monitoring) should be funded by harvest fees alone; cost of monitoring was of greatest concern. Most funding during the implementation phase was used for administrative work with little left for monitoring. Most monitoring methods listed here are relatively inexpensive and require minimal effort of hunters, with pellet-group counts the exception as field work should occur twice annually (Bergström et al. 2011). To save money, an official and a stakeholder suggested that monitoring be conducted in 4–5 year intervals rather than annually. However, this approach would reduce the ability to detect trends in data and recent information would not be unavailable during a 3-year plan undermining the adaptive advantage of the management plan. Neither wildlife or forest managers could financially support monitoring activities and higher harvest fees were not considered a viable solution; in Södermanland and Västra Götaland, this might have a contrary effect where hunters would refocus efforts on other game. One perception was that monitoring expenditures should be shared among stakeholders, versus exclusively funded by hunters, by having landowners responsible for forest resources and hunters responsible for moose. Stakeholders also indicated that the SFA should be responsible for funding and providing forage forecasts and moose damage surveys.

In all counties but Västerbotten, another problem was how to fairly subdivide monitoring costs among many small landowners in the fragmented ownership common in Sweden. One solution was that all monitoring be conducted by volunteers; however, certain deficiencies were identified relative to voluntary monitoring including lack of trust among some stakeholders regarding the credibility of monitoring data, and the time that stakeholders were willing to spend on voluntary activities. Circumventing such concerns requires hiring professionals for monitoring which would increase costs substantially. The money available from harvest fees in each specific county differs because of variable harvest fees, but more

importantly, on the annual moose harvest in each county; for example, harvest is about ~1,000 moose in Södermanland versus 6,000 in Dalarna. Raising harvest fees to increase management finances was not considered as an option, especially in Södermanland and Västra Götaland where increasing costs for hunters might have an unintended effect. Rather than investing money and efforts in moose hunting, officials and hunters suggested that other game species might instead become increasingly important to the hunters.

Willingness and capacity to participate in monitoring activities

We asked respondents to describe monitoring methods used previously, new methods to be implemented in the adaptive system (Fig. 2), and their general knowledge about different monitoring methods. Information about local moose populations during implementation of the new system was mostly obtained from harvest statistics and hunter observations, but data from all base-monitoring methods were used to some extent when moose management areas defined their initial plans. Throughout Sweden in 2012, ~50% of management areas used hunter observation rates of moose during the first week of moose hunting. Rates within our management areas were higher than the national average (unpublished data, Swedish Hunting Association), although none of the 5 counties considered this sufficient information to manage their moose population. Pellet-group counts were conducted in all counties; however, they did not provide complete data for any county or moose management area due to their fragmented application. Only Södermanland collected data on calf weight but it was regarded as a monitoring method for future use. Hunters still recorded calf weights and future use of these data might be facilitated by a fully developed database (algdata.se). This

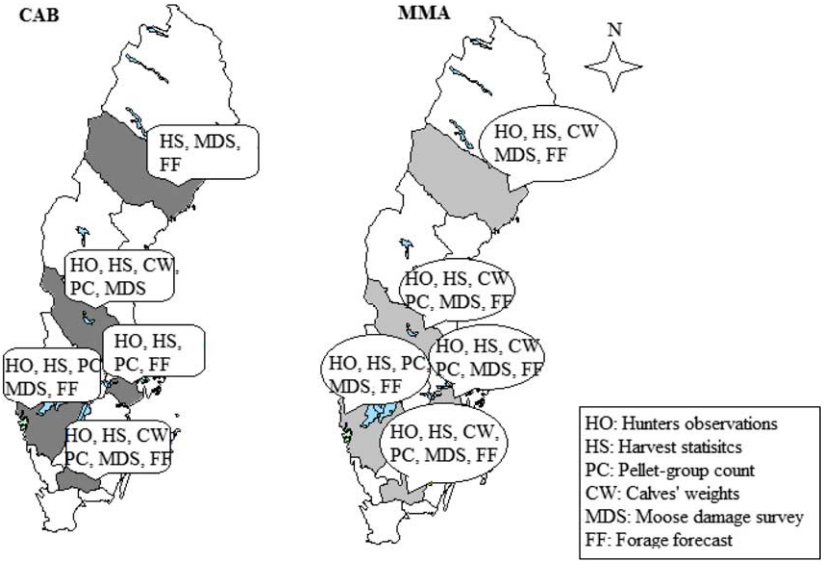

Fig. 2. The monitoring methods planned to be used in each county (CAB) and selected moose management areas (MMA). Additional monitoring will be conducted in MMAs than at the county level in Västerbotten, Dalarna and Södermanland.

database will gather data from all monitoring effort and other areas of interest, and will presumably serve as an important management tool in facilitating stewardship.

Forage forecasts were provided by the SFA in all counties but a comprehensive forage forecast should include both satellite mapping and field visits; only satellite images were available in Kronoberg and Södermanland. The quality of forecasts in other counties could not be ascertained from responses. A countywide moose damage survey was conducted only in Västerbotten, the only county with a long-term tradition of monitoring browsing damage. Browsing was monitored on a smaller scale in Dalarna.

The need and desire to collect more detailed and comprehensive information was evident in the planned monitoring activities identified by officials and stakeholders in all counties. The necessity for more information and data about forest resources was specifically highlighted by a landowner in Västerbotten: "in order to achieve a functioning adaptive management based on more facts and local knowledge that consider both the quality of the moose population, but also take moose damages into account". There was confusion and opinions were divided about the applicability of monitoring methods and related validity of derived estimates. Respondents in Västra Götaland desired estimates at the management unit level or lower, believing estimates at the management area level were too coarse.

Officials and stakeholders indicated their intention to address MVCs in management plans. They generally believed that MVCs were not only of societal importance, but reflected the relative size and trend of the moose population. Stakeholders in Västra Götaland claimed that moose impacts on crops must be assessed, since moose damage, especially to oat (*Avena sativa*) fields, is a recurring issue within their area.

All respondents identified the need to include prominent county-specific conditions such as other ungulate species, moose migration patterns and predation, and habitat changes in the moose management system. In the 3 counties with established populations of large carnivores (i.e., brown bears in Västerbotten and Dalarna, wolves in Dalarna and Västra Götaland), information about predator populations and predation rates was considered an important component of moose management plans. Respondents in Södermanland stressed the importance of co-managing other deer and ungulate species, rather than focus on moose singly, arguing that moose and deer interact and share several resources (e.g., habitat and food). They also questioned why deer and wild boar (*Sus scrofa*) were not already considered in the ecosystem-based management system. In Västerbotten, seasonal migration patterns of moose were reflected in the management plan. In Kronoberg, habitat changes resulting from the 2005 hurricane Gudrun received special attention, as it felled 75 million cubic meters of forest in southern Sweden (Swedish Hydrological and Meteorological Institute 2013), creating beneficial habitat for moose and roe deer.

DISCUSSION

The respondents generally perceived the increased participation and collaboration between hunters and landowners as positive. Despite some concern that the new management approach might remove decision-making from the local to ecosystem level and lose legitimacy with individual hunters and landowners, the majority of officials and stakeholders supported the program goals and believed the opposite. Most envisioned a decentralized influence from the county to ecosystem level or down to the local level, and believed that enhanced

stakeholder stewardship would consolidate management legitimacy. Despite the positive spirit and increased collaboration, most respondents found the specific management responsibilities to be unclear. The term "local" seemed to create confusion about division of power, at what scale, and where power resided to influence decision-making.

Lack of funding and the actual time provided for implementation of the new system were other obstacles identified by respondents. While time constraints would gradually be remedied, the funding issue risks undermining the entire management system since it reduces the possibilities for stakeholders to contribute to ecosystem stewardship.

Stakeholders were aware of the need to maximize information to successfully balance moose and forest resources. All acknowledged the need for reliable monitoring and appropriate sampling as part of adaptive management, and that the purpose of monitoring might be lost without using appropriate techniques. However, stakeholder expectations and scientific recommendations regarding data acquisition and monitoring differed. The suggested monitoring methods were most useful for moose management areas, and less so for smaller local units where the goal is to use accurate estimates (Ericsson 2011). Pellet-group counts are an exception, but using this method in a smaller management unit would not be as useful when managing a large population, a primary goal for achieving ecosystem-based management (Swedish Official Investigation 2009). Understanding the limitations of monitoring techniques is crucial to achieve transition from an assumption-based to a knowledge-based management system.

The forest monitoring methods are applicable at both the management area and local scales (Kalén and Bergquist 2011, Rolander et al. 2011). However, local damage surveys are often only roughly correlated with population density (Rolander et al. 2011), and applying such data with moose population estimates at larger scale risks error in interpretation within the larger management area. Further, data collected at different resolutions probably poses risk to the overall assessment that includes various monitoring techniques, potentially complicating stakeholder stewardship further.

The ability to modify the management plan was perceived as a core and essential feature of the moose management system; however, perceptions varied as to whether it was possible to alter management decisions during an ongoing hunting season. Indeed, invoking change given new information is essential in adaptive management (Allen et al. 2011). The question remains as to the extent of adaptability in the new moose management system. The regulations (Environmental Protection Agency 2011) provide for changes during a hunting season, yet this would require continual monitoring and rapid response by stakeholders. Unless reporting efforts improve, it will be difficult to adjust during a hunting season. Even if these components function flawlessly, most moose in Sweden are harvested in the first weeks of the hunting season (Ball et al. 1999); therefore, from a practical standpoint, non-emergency changes and deviations would likely occur the following year.

Accounting for MVCs and predation was relatively well developed in all counties. Predation, for example, could be estimated precisely from wolf monitoring (Sand et al. 2011). Conversely, with respect to other ungulates—such as in Södermanland where red deer, roe deer, fallow deer, and wild boar (*Sus scrofa*) are abundant—current monitoring of populations, damage, and forage forecasts were considered highly insufficient; neither wild boar nor deer are systematically monitored in Sweden (Apollonio et al. 2010). Deer populations could

be assessed with pellet-group counts, but density estimates are dependent upon species-specific identification of pellet groups and defecation rates (Neff 1968). It might also be possible to expand hunter observations to include other deer with the methods of Kindberg et al. (2009), where effort-corrected observations of brown bears was suggested as a useful monitoring technique. Adequate evaluation would be required before implementing this approach into moose management plans. Despite progress with genetic monitoring of browsing damage (Spong 2011), information about different ungulate forage selection and food overlap is generally lacking. Overall, our results suggest that critical knowledge-gaps exist with both hunters and landowners that preclude their effective participation in, and use of many monitoring techniques.

Conclusions

We found strong stakeholder support for the moose management goals to balance social and ecological values. Although the willingness to embrace ecosystem stewardship was pervasive among stakeholders, the moose management program faces several challenges in fully implementing an ecosystem-based, adaptive moose management system. This includes the need to clarify primary concepts like "ecosystem-based" and "local", and to have all stakeholders clarify and agree about definitions within the plan and the role and responsibility at each level; such an approach should help mitigate conflicts and avoid further confusion.

Several obstacles were identified concerning monitoring, the key tool enabling environmental stewardship. Specifically, unclear responsibilities and inadequate funding threaten local and regional data collection, both of which could jeopardize stakeholder stewardship.

The importance and benefits of monitoring and reporting, as emphasized by the respondents, must be communicated to the grass-root level to enhance future participation; i.e., the responsibility of individual stewardship. Demonstrating that monitoring is a worthwhile effort of individual hunters or landowners is perhaps the most difficult challenge. It is important to create a sustainable moose management system in balance with forage resources, traffic safety, and large carnivore populations, as well as other land uses and biodiversity objectives (Moller et al. 2004).

Unless these challenges are resolved, the primary objective of the new moose management system risks the same failure as with previous plans. To address the monitoring issues, an addition or revision of the regulations (Environmental Protection Agency 2011) regarding the purpose of monitoring is suggested; this approach would be positive for all stakeholders and should facilitate their commitment to the system. The issue of monitoring costs, specifically regarding forest resources, needs to be addressed directly with full support of stakeholders to achieve adequate participation. Lastly, information regarding coexistence and co-management of ungulates in management areas needs to be incorporated into the system, an approach similar to that for large carnivores in Sweden (Andrén et al. 2011).

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