MOOSE AND ECOSYSTEM MANAGEMENT IN THE 21ST CENTURY - DOES THE KING HAVE A PLACE? A CANADIAN PERSPECTIVE

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ABSTRACT: Canada's provincial, federal, and territorial governments committed to a Canadian Biodiversity Strategy in 1995 for the conservation and sustainable use of Canada's biodiversity. Contemporary demands on natural resources and the move to ecosystem based management dictated a different approach to resource management than was traditionally the case. Public awareness of biological diversity and understanding of the need for conservation dictated the new approach. Ecosystem management means using an ecological approach to achieve forest management by blending the needs of society with environmental values in such a way that ecosystems remain diverse, healthy, productive, and sustainable. Canada was mapped into ecozones and ecoregions, which are a unique combination of landscape, physiography, and climate. Use of these widely accepted categories facilitates interjurisdictional co-operation. There is increasing evidence that moose play a fundamental role in structure and function of boreal forests. Management guidelines for moose habitat favour wildlife species which use edge and early successional habitats. In Manitoba, use of 5 forest types by 257 wildlife species suggested that managing for moose habitat will accommodate the habitat needs for 62% of the other boreal wildlife species. This reinforces findings elsewhere that moose are an important indicator species and have a major role to play in forest management and conservation of biodiversity.

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Much of the world accepts that conservation of biodiversity in our forests is a high priority issue. This became obvious at the Earth Summit on Biodiversity in Rio de Janiero where a set of forest principles were enunciated "to contribute to the management, conservation and sustainable development of forests and to provide for their multiple and complimentary functions and uses" (United Nations Conference on Biological Diversity 1992).

Internationally, both forestry and wildlife management are currently undergoing major philosophical changes (Dooge *et al.* 1992, Kininmonth and Tarlton 1992, Thomas 1994). Just as forest management is becoming oriented toward ecosystems rather than timber production, wildlife management is becoming more oriented toward biodiversity and communities rather than historical single species game management. It would appear, based on discussion with wildlife managers in both Canada and the United States, that single species management programs will change.

Ecosystems have been defined by the IUNC/UNEP/WWF (1991) as "a system of plants, animals, and other organisms together with the nonliving components of their environment". Gro Harlem Brundtland, chairperson of the World Commission on Environment and Development (1987), suggested that sustainable development will meet the needs of the present without compromising the ability of future generations to meet their own needs and will encompass all forest values including benefits such as wildlife, fish, watersheds, and recreational opportunities.

Conservation and sustainable use are musts if the planet is to survive and offer a sustainable way of life to future generations. The majority of the land in Canada belongs to the crown, thus governments have a major role in management programs. The Canadian Council of Forest Ministers released a national forest strategy (CCFM 1992) outlining a series of strategies to improve forest management in Canada. These formed the basis for the Canada Forest Accord which defined the goal of sustainable forest management as "to maintain and enhance the long term health of our forest ecosystems, for the benefit of all living things both nationally and globally, while providing environmental, economic, social and cultural opportunities for the benefit of present and future generations".

Management goals and objectives should go beyond the number of cords of wood, the number of board feet of lumber, the number of moose harvested, the number of days of recreation, etc., and emphasize natural systems and processes. The Canadian framework is based on 4 factors: (1) a need to manage forests as ecosystems in order to maintain natural processes; (2) recognition that forests simultaneously provide Canadians with a wide range of environmental, economic, and social benefits; (3) an informed, aware, and participatory public is important in promoting sustainable forest management; and (4) a need for forest management which best reflects contemporary knowledge and information.

One problem in implementing ecosystem management concerns databases i.e., forest resource inventory (which in Manitoba includes cover type, site classification, cutting class, crown closure, and species composition) developed for timber management purposes. It is difficult to simplify a complex relationship between a species and its environment into 4 or 5 parameters, and when all species must be considered the task becomes even more complex. Further, the time horizons essential for contemporary ecosystem management and maintenance of biodiversity must reach beyond the 4 year horizon. Thompson and Welsh (1993) have suggested a 100 year or more planning horizon.

The Canadian Biodiversity Strategy is a response to the United Nations Convention on Biological Diversity (United Nations Conference on Biological Diversity 1992) and is intended as a guide to implementation of the convention. The goals are: (1) to conserve biodiversity and use biological resources in a sustainable manner; (2) to improve our understanding of ecosystems and increase our resource management capability; (3) to promote an understanding of the need to conserve biodiversity and use biological resources in a sustainable manner; (4) to maintain or develop incentives and legislation which supports the conservation of biodiversity and the sustainable use of biological resources; and (5) to work with other countries to conserve biodiversity, use biological resources in a sustainable manner, and share equitably the benefits that arise from the utilization of genetic resources.

Successful implementation of the strategy will be determined largely by the degree that society adopts its vision and principles and contributes to achieving the goals. People's values are a cornerstone of ecosystem management and are used to establish broad goals and objectives for the management of regional ecosystems. The Canadian Council of Forest Ministers (CCFM 1992) adopted 3 principles regarding public participation: (1) the public is entitled to participate in forest policy and planning processes recognizing that this carries with it obligations and responsibilities; (2) effective public participation requires an open, fair, and well defined process with generally accepted procedures and deadlines for decisions; and (3) to participate effectively, the public must be aware and informed, with access to comprehensive and easy to understand information on forest resources.

Public awareness of biological diversity and understanding of the need for conservation has greatly increased (Fenger *et al.* 1993). The Canada Forest Accord demonstrates that forest managers have become sensitive to the value Canadians place on the continued existence of wildlife within the context of sustainable development. A concerted effort to incorporate the needs of wildlife and wildlife values into forest management planning has been the result.

It is unwise for wildlife managers to judge what is good for society from a scientific or technical background. Allowing the public access only to portions of the planning process is also unsatisfactory. Do we want their support? Based on the efforts expended to obtain public support for the 4th International Moose Symposium, the answer is a resounding "yes" as far as our group is concerned.

Wildlife managers typically focus on the high profile species, often excluding participation of the non-hunting public. Ecosystem management gives us the opportunity to partner with all peoples having an environmental conscience and not just with the 10% who hunt. There is a value in bringing together those groups which traditionally have been in a real or perceived adversarial position. The success of efforts to encourage the public to work toward common goals is perhaps an indicator of how well we are achieving maintenance of biodiversity and ecosystem management.

The boreal forest is the largest forest region in Canada and encompasses the majority of moose habitat. This large ecological region is constantly changing due to anthropomorphic and natural factors. Each change favours some species while providing little in terms of benefits to others. Some of these other species may in fact be better indicators of ecosystem health than game species. Involvement of more species offers the potential for participation by other members of the public in addition to hunters.

Past practice on many forested lands was a single species approach to management and guidelines were often designed to provide habitat for large game species such as moose (Delong and Tanner 1996). Biodiversity can be promoted by maintaining the habitats in which selected species are used as indicators with the assumption that if they are managed for, others using the same habitats will be accommodated.

One of the concerns ecosystem management presents is that the current management system has been built up over many years. One must question if the existing structure can adapt to achieve the more comprehensive but nebulous goals of ecosystem health and socially acceptable management. The transition to ecosystem management is severely impeded by outmoded organizational structures which are well suited to the previous objectives but not for today's needs and realities. For example, the administrative boundaries in most provinces and territories add confusion to implementation of an ecosystem-based management approach. I examined the forest management license (FML) for Tolko Manitoba Inc. and within the boundary of the FML there are game hunting areas, forest section, and Department of Natural Resources regional and district boundaries, all of which split ecozones (areas of the earth's surface representative of very generalized ecological units that consist of a distinctive assemblage of physical and biological characteristics and possess environmental characteristics that tend to cohere and endure over the long term (Wicken 1986)) and ecodistricts (integrated map units characterized by relatively homogeneous physical landscape and climatic conditions with a more uniform biological production potential (Ecoregions Working Group 1989)) - these boundaries add to the problems of converting to an ecosystem management approach using natural forest landscapes.

The solution to environmental concerns in moose range rests at the landscape level where the right balance of stands in a myriad of structures and patterns can maintain habitats for a diversity of plants and animals. We do not manage a timber stand but rather, a natural forest landscape. The scientific basis for natural landscape management involves understanding how ecosystem structure, function, and related attributes e.g., sustainability, respond to the cumulative effects of management from a short and long term perspective.

Ecosystem management is a logical progression from exploitation through conservation, preservation, multiple-use, and integrated forest resource management (KPMG Management Consulting 1996). It builds on earlier experiences and incorporates both natural and social sciences to a much greater degree than done previously. Forest landscape management commences with management of the use of forest ecosystems to ensure that long term maintenance is not compromised for short term gains (Booth *et al.* 1993). The resources to be managed are the same but a wider variety of forest values will be recognized.

An ecosystem approach means that resource people must shift their focus from parts to wholes, from the interest to the capital (Rowe 1992). Acceptance of the ecosystem approach establishes common ground for those concerned with forestry, wildlife, water, and recreation, and it encourages partnerships in striving toward sustainability.

ECOSYSTEM BOUNDARIES

Management strategies for ecosystems must encompass all landscapes and address multiple temporal and spatial scales (Franklin 1993). Acceptance that ecosystem management is ecologically viable and socially responsible requires a definition of ecosystem boundaries. Haney and Power (1996) suggest that large management units, in which ecological gradients are retained, are better than smaller units. They should be selected based on natural landscape features, and should contain a range of gradients to facilitate species movements in the presence of disturbances such as fire, successional processes, and climatic fluctuation.

The ecosystem classification system devised for Canada involved mapping the country into ecozones, ecoregions (broad, integrated map units characterized by a unique combination of landscape physiography and ecoclimate (Ecoregions Working Group 1983)), and ecodistricts which transcend political boundaries and facilitate discussion of management based on natural features.

It is unlikely that maintenance of biodiversity will be achieved by strategies confined to a small portion of the land base or at the stand level.

THE ROLE OF MOOSE

In addressing the theme of 'moose and ecosystem management in the 21st century' we must examine the relationship of moose and other aspects of ecosystems. There are 2 approaches, namely the physical impact they have on the ecosystem and their role in measuring environmental health/ biodiversity.

Impact on Ecosystems

Moose ecology is closely tied to that of the boreal forest. Browsing by moose influences both the plant species present in the forest and the properties of the soil (Pastor *et al.* 1993). Interactions between moose and the forest provide a good example of how herbivores influence ecosystem properties over different trophic, organizational, and spatial scales.

It is well known that ungulates can markedly change the forest structure by their impact on vegetation and soil (Reimoser and Gossow 1996) and the damage to timber values is well documented (Konig 1976, Mayer 1984, Pollanschutz 1984, Eiberle and Nigg 1987, Gill 1992, Reimoser and Gossow 1996).

Ungulate populations have, in the past, been seen as outputs of plant communities and plants as inputs to ungulate populations (Sinclair 1974, McCullough 1979, Botkin *et al.* 1981, Caughley 1982). Another approach focuses on the consequences of changes on the landscape induced by ungulates which modify conditions for other organisms whether they be above or below ground (Hobbs 1996). The indirect effects of such modifications may exceed the direct consequences of energy and material flows from plants to ungulates (Hobbs *et al.* 1991, McNaughton 1992, Pastor and Naiman 1992). Hobbs (1996) suggested that ungulates are not only outputs of ecosystems but may serve as important regulators of ecosystem processes at several scales of time and space.

Herbivores including moose influence ecosystems by their interactions with food and habitat over several trophic, organizational, and spatial levels, producing complex feedbacks with unexpected results (Starfield and Bleloch 1986, Naiman 1988, DeAngelis *et al.* 1989). Pastor and Naiman (1992) suggest that herbivores control ecosystem processes not only by what and how much they eat but also by what they do not eat. If both browsed and unbrowsed species alter nutrient flows through soils, then the ultimate response of the ecosystem depends to a large extent on the direction, degree, and the lags in the responses of soil nutrient pools. Selective foraging by moose may kill hardwoods and hasten succession to species such as spruce (Houston 1968, Krefting 1974, McInnes *et al.* 1992). Pastor and Naiman (1992) suggest that browsing by moose and beaver which utilize different parts of the hardwood community should cause ecosystem properties to diverge.

Studies of moose and other large mammals demonstrate that soil processes are influenced by herbivory and indirectly control it. Herbivores, vegetation, and the soil microbes that decompose organic matter are 3 interacting parts of feedback loops with both positive and negatives components. Soil processes affect moose by controlling the supply of browse and the rates at which plants recover from browsing (Bergerud and Manual 1968, Peek *et al.* 1976, Botkin *et al.* 1981). Herbivore faecal material carries organic matter and nutrients into the soil which in turn impacts the microbial processes (Tiedemann and Berndt 1972, Mattson and Addy 1975, Woodmansee 1978, Kitchell *et al.* 1979, McKendrick *et al.* 1980, Cargill and Jeffries 1984, Schimel *et al.* 1986).

Moose may impact nutrient cycling by altering the composition of the plant community through selective foraging. This is particularly true in cases where there are high densities of moose.

Large herbivores may impact their food supply in 3 ways. Bergstrom and Danell (1987) and Miquelle and Van Ballenberghe (1989) suggest that moose browsing in fall and winter may release stems from apical dominance resulting in larger stems and leaves the following spring. Vegetative reproduction by adventitious growth may be enhanced by browsing. Others suggest that moderate levels of browsing may affect the carbon-nitrogen balance of the plant and result in higher quality regrowth (Bryant 1981, Bryant *et al.* 1983, Bryant and Chapin 1986). Lastly, moose fertilize plants they feed upon through deposition of faeces and urine (McKendrick *et al.* 1980, Miquelle and Van Ballenberghe 1989).

Despite increasing evidence that moose play a fundamental role in the structure and function of boreal forests (Pastor *et al.* 1988, Miquelle and Van Ballenberghe 1989, Pastor and Naiman 1992), much remains to be discovered about the foraging ecology of this species (Bowyer and Bowyer 1997).

Moose as Indicators of Forest Health and Biodiversity

Many species of forest-inhabiting deer offer strong potential as ecological indicators of forest management and diversity at broad, landscape scales (Hanley 1996). They have high potential for land use planning with much broader implications than single resource commodity production (Hanley 1993, Wallis de Vries 1995). How well do moose function as indicators? They require a wide range of habitat characteristics which broadly encompass the habitat needs of many other wildlife species. Being easily recognized is what makes them so important - they are a symbol of the northern forests.

In many aspects, moose management is landscape management. They have comparatively large home ranges encompassing broad areas of landscape rather than a single cover type. Their requirements for food and cover are axiomatic of a generalist and they are able to adapt to a mosaic of habitat types to satisfy these demands. Their seasonal changes in foods and habitat use are dictated by climate leading to use of a broad range of habitat patches varying from aquatic and riparian zones and mineral licks in summer to upland areas in winter containing palatable browse species. They encompass so many species within their habitat requirements that they are an "umbrella" species. Conservation plans centred around moose favour biologically diverse landscapes, thus their management can assist in meeting biodiversity objectives.

Moose have high stature in ecosystem management because Canadians place a high cultural value on them. They are part of the wildlife mosaic which Filion *et al.* (1981) suggests is important to Canadians. They have a long history in Canada as a game species and as a symbol of the boreal forest. This public recognition makes them an ideal tool for garnering public support for management programs.

Habitat Suitability Index (HSI) models assist in quantifying habitat values for landscapes and their ability to support various species. These models combine many physical and biological factors into one quantitative index of habitat quality for a given species on a selected landscape (Hanley 1994). It is in that regard that moose can play a significant factor in ecosystem management in the 21st century. Use of HSI models along with a wildlife habitat assessment modelling process can provide forest managers with reliable analytical tools along with other technologies to assist in the decision making process.

The Forest Resource Inventory

The best source of information on the boreal forest in Manitoba is the forest resource inventory (FRI). Most provinces/territories have some variation of this. This data set provides information on commercial and noncommercial forest land. Kuhnke and Watkins (1996) described the process followed in Manitoba to condense the FRI into a useable habitat association matrix of 30 habitat types, with 18 species representing the habitat types used by 257 vertebrate species from the boreal zone. The objective was to select enough species so that the full spectrum of habitat types are used and that the selected species can act as an umbrella for other wildlife found in the boreal area. The habitat association matrix developed, condensed a multitude of habitat types into a select few which would form the foundation for the species selection process. The assumption made was that the species selected will, generally speaking, reflect the habitat requirements used by the other species found in the boreal area. Moose were one of these species. Others have used a similar approach (Bonar *et al.* 1990).

Baker and Euler (1989) state that in Ontario, 213 wildlife species occur primarily in forest management units in the boreal region. Of those, 83% should have sufficient habitat provided by one or more provisions in the moose habitat guidelines for Ontario. In Saskatchewan Greif (1993) found that by managing for moose, 19 birds and 11 mammals were among the species which would benefit. The life requisites of all 257 species found in the boreal area in Manitoba were broken down into 5 categories, namely reproduction (R), feeding (F), cover (C), unique requirements (U), and a category which included all (A) categories. The 'A' component of all other species was then examined, recognizing that food alone without other requirements being satisfied would not suffice. Other species would be required to have an 'A' component falling in the 'A' component value for moose to be included in the species list for which moose function as an umbrella. The analysis revealed that managing for moose would accommodate at least 63% of the other wildlife species found in the boreal forest.

Forest management favouring moose will promote biodiversity in Canada. Management programs focused on these nomads will favour biologically diverse natural forest landscapes thus the benefits of managing for this species are obvious. The task of providing for species with different habitat requirements now becomes more manageable.

MOOSE AS A RESEARCH TOOL

In the context of natural landscape management moose can function as a research tool. Wallis de Vries (1996) modelled the effects of food and cover distribution on ungulate behaviour and found that the spatial heterogeneity of food resources was a significant factor in determining ungulate distribution. Further, he suggests that ungulate aggregation is promoted by greater average travel distances between patches and by a greater clustering of food patches. Emphasis on the role of spatial heterogeneity in ungulate foraging is justified simply on the basis of management considerations. Management agencies need to develop new ecosystem-orientated wildlife guidelines for the timber industry which reflect contemporary approaches to forest management. Riser (1995) suggested emphasis on identifying critical structuring processes and associated spatial and temporal scales.

CONCLUSION

Ecosystem management and sustainable development means different things to different people. To government policy makers it should mean pushing back the planning horizon from the 4 year mandate of elected governments to at least a 20-30 year time frame. Sustainable development will impact everything we do, an ideology that is now the prevailing paradigm. The polls suggest that 80 % of Canadians rate environmental concerns at the top of the scale (Filion *et al.* 1993).

Moose can play a key role in ecosystem management. Management agencies must be willing to change from the comfort of the status quo and wildlife managers in turn must recognize that moose are an important tool which can be used to facilitate the process and play a major role in maintaining appropriate biodiversity long with the sustainable use of species inhabiting the boreal forest.

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