OF MOOSE AND MAN: THE PAST, THE PRESENT, AND THE FUTURE OF HUMAN DIMENSIONS IN MOOSE RESEARCH

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ABSTRACT: There is a gap between a growing interest to study the moose/human interface (MHI) and the actual effort made to understand this human dimension (HD) component in moose research. A content analysis of *Alces* 1974-2001 showed that the relative contribution of HD-papers increased until 1991 but decreased thereafter. Of 66 HD-articles published, 68% of the papers covered how "man affects moose" with hunting and collisions the single most important topics, and 15% were about "values" (economic and attitudes). Outside *Alces*, articles appeared that were underrepresented in *Alces* or in the *Proceedings of the North American Moose Conference and Workshop*. I identify four priority HD-areas for future studies: (1) how do people react to changing moose densities and distributions?; (2) which management alternatives are acceptable for managing the urban and suburban MHI and what makes them acceptable?; (3) how important are moose to non-consumptive users?; and (4) what are the population dynamics and attributes of the consumptive moose user and what makes moose important to consumptive users? A scientific challenge is to further merge ecological and social science to integrate this in management strategies.

ALCES VOL. 39: 11-26 (2003)

Key words: consumptive, economy, human, literature review, moose, natural resource use, non-consumptive, science, sociology, wildlife management

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A major focus of wildlife management is managing the interactions between people and wildlife; e.g., moose (*Alces alces*). Research is a foundation for all wildlife management, and research needs to encompass MHI to properly fulfill the needs of management. All wildlife management is based on human values, with "management" itself being a human construct (Decker et al. 2001). We manage moose and other wildlife because the society we live in views them as a resource. Studying the human dimension (HD) component of wildlife management is not new; in fact the field arose when humans made the first attempt to manage wildlife.

The western world witnessed a rise of public concern over conservation issues in the 1800s (e.g., Brusewitz 1992, Decker et al. 2001). The USA saw the birth of the "wise-use" movement (e.g., Glifford Pinchot 1865-1946) and the wildlife preservation movement (e.g., John Muir 1838-1914). Although these movements' perspectives differed widely - Pinchot envisioned a sustainable use and Muir envisioned preservation with minimal human involvement - they agreed that human activity and behavior had to be regulated in relation to natural resource use. Out of Pinchot's ideas grew natural resource policies which have influenced, and continue to influence, natural resource policy worldwide. Pinchot's ideas resulted in policies that centered on the resource itself and promoted development and inclusion of scientific biological knowledge. With respect to moose, active management began during the Pinchot/Muir-era when people started to recognize that human activity (i.e., hunting) had to be

regulated to prevent moose from becoming extinct. In eastern North America, moose populations went towards local extinction because of unregulated commercial and subsistence hunting during the 1800s (Wolfe 1987). In the Swedish-Norwegian union, the Parliament imposed a 10-year ban on moose hunting in 1825 when moose were at very low numbers (Brusewitz 1992). Thus, as early as the 1850s, people had started to manage moose both in Europe and North America (Karns 1998).

The HD-core issues - how and why people value wildlife and wildlife management actions, and peoples' motivations behind consumptive and non-consumptive use of wildlife - first emerged in the early 1970s (Hendee and Potter 1971). The 1970s has been termed "an era of discovery and organization" (Brown and Decker 2001). Hendee (1969) and Hendee and Potter (1971) opened up and vitalized the HD-field by suggesting several topics for research such as hunting satisfaction, population dynamics and characteristics of hunters, non-consumptive use of wildlife, and wildlife economics. Hendee thereafter stimulated the discipline with several important contributions about consumptive as well as non-consumptive use of game and wildlife (e.g., Potter et al. 1973, Hendee 1974, Hendee and Burdge 1974).

During 1973-1984 the HD-field of wildlife continued to expand and attracted new thinkers and environments that further developed the field (Brown and Decker 2001). Most of this research occurred in North America. Europe was a few steps behind: there were important non-peer reviewed national reports which were significant, but the international, peer-reviewed arena saw few, if any, contributions before the mid-1980s (see Norling 1987). Starting in 1987, several important papers on the bioeconomics of moose came out of Sweden and Norway (e.g., Norling 1987; Mattsson 1990 a, b; Storaas et al. 2001).

In 1984, the HD-field of wildlife management expanded but remained vaguely defined and largely lacked qualitative and quantitative studies (Wolfe 1987, Brown and Decker 2001). Still, 1984 was a landmark year - for the first time there were enough papers for specific socioeconomic sessions at the North American Wildlife and Natural Resource Conference and at the Second International Moose Symposium.

Now, 18 years later I revisit the concerns and predictions that Wolfe (1987) identified at the Second International Moose Symposium in 1984. Wolf concluded "that existing information on most of the topics [e.g., how humans affect moose; values] covered is inadequate" (Wolfe 1987). However, he was not that worried over the scarce existing knowledge and saw no reason for "embarrassment" as the discipline was young but fast emerging. His closing sentence was full of trust for the future: "Hopefully, a decade hence, the amount and quality of information will have improved to the point, where we can provide more definitive answers to the questions raised here" (Wolf 1987:673).

What did the future actually bring? First, I address the hypothesis that the HD-component of moose management has increased between 1984 and 2001. My prediction, based on the general expansion of HD in wildlife management (Brown and Decker 2001), is that the amount of socioeconomic information about moose has increased since 1984. I test this by content analyses of published articles in *Alces* 1974-2001 and in the *Proceedings* of the International Moose Symposia 1984, 1990, 1998, and 2002 (papers presented at the 2002 meeting). Also, I predict that the HD-field received relatively more attention in years with International Moose Symposia (sensu Wolfe 1987).

Second, testing information quality is

difficult to do objectively. I visited the peer-reviewed periodic literature dated 1984 through 2001 to see if outlets other than *Alces* had published HD-articles regarding moose and man. I assumed increasing outlets for moose HD-research results may indicate an improved quality as well as expansion of moose HD expertise. My prediction, based on the general expansion of the field in wildlife management (Brown and Decker 2001), is that the quality of HD and MHI information has increased since 1984 as evidenced by increasing numbers of outlets for publications. Third, I identify areas for future research in the HD/MHI field.

METHODS

I have organized the paper according to the most widely adopted definition of human dimensions (Decker et al. 2001). Human dimensions is how people value moose, how people want moose to be managed, and how people are affected by or affect moose or moose management decisions. I reviewed all papers in *Alces* Volumes 10-37, the *Proceedings* of the International Moose symposia 1984, 1990, 1998, and presented oral contributions at the 2002 Symposium. I classified only full-length articles, not summaries from workshops or abstracts. Articles about moose where classified as a HD contribution if they focused on: (1) values (economic, attitudinal); (2) human effects on moose (hunting, infrastructure, and traffic/collisions with vehicles); (3) moose hunters; or (4) miscellaneous HD-studies.

To category (2) - how humans affect moose - I classified articles about selective harvest. Because of the definition adopted, study systems where humans are a driving force behind the population dynamics of moose are not included in my review (e.g., Ericsson 2001). Originally, I planned for a fifth category (moose affects man) but no articles specifically addressed the topic (besides vehicle collisions which I placed in category (2)). Articles describing general moose management in a particular state/country, surrogate biology (e.g., hunter surveys to assess moose harvest), predator control, and potential human health impacts due to moose meat consumption were not classified as HD-articles (but see, for example, Cretê et al. 1987, Danell et al. 1989, Kim et al. 1998).

Using the electronic databases Agricola, Agris, Biosis, CAB, Econlit, FSTA, and TreeCD, I searched the peer-reviewed periodic literature for papers about moose and human interactions published from 1984-2001.

When testing for trends over time in the publication *Alces*, the number of HD-articles was described as a proportion of all articles. The random variation in a time series can make it difficult to detect an underlying trend, thus smoothing is a standard technique of emphasizing or describing a trend (Brown and Rothery 1993). In my case, as the publication year of a single article may be a random event, a better measure of development of HD in moose research may be a 5-year moving average. By that I implicitly assume that a single year is representative of what had been done the previous 2 years and at least 2 years thereafter. I performed all statistical analyses with SAS (SAS Institute 1989).

RESULTS

Content Analyses

Alces.— In *Alces* 1974-2001 (Volumes 10-37) 584 articles were published of which 11% (n = 66) were HD-articles (Table 1). In the *Proceedings* of the International Symposia (1984, 1990, 1998), and of articles presented at the 5th International Symposium 2002, 9% (17 of 148) were HD-articles (Table 2). I found no difference in the proportion of HD-articles in *Alces* compared to the *Proceedings* (P = 0.46, t-test).

Table 1. Content analysis of *Alces* Volumes 10-37 (1974-2001).

					Values		Man affects moose				
Year/Vol.	Papers	HD-papers	HD-ratio	5-yr. mean	Economic	Attitudes	Hunting	Infrastructure	Traffic	Moose hunters	Misc
2001/37	23	4	17%		1	1	1			1	
2000/36	21	0	0%								
1999/35	19	3	6%	10%		1	2				
1998/34	23	1	4%	8%			1				
1997/33	19	2	11%	12%						1	1
1996/32	17	2	12%	10%			2				
1995/31	26	4	15%	11%		1	2		1		
1994/30	23	2	9%	13%			1		1		
1993/29	31	3	10%	18%	1						2
1992/28	22	4	18%	16%			4				
1991/27	25	10[1]	40%	20%			1		9		
1990/26	20	1	5%	20%			1				
1989/25	19	5	26%	18%		1	2			1	1
1988/24	26	3	12%	13%			1	1			1
1987/23	14	1	7%	13%		1					
1986/22	21	3	14%	9%	1		1		1		
1985/21	26	1	4%	12%			1				
1984/20	16	1	6%	12%			1				
1983/19	17	5	29%	11%			4		1		
1982/18	17	1	6%	11%							1
1981/17	18	2	11%	12%		1	1				
1980/16	31	1	3%	7%			1				
1979/15	16	2	13%	6%			2				
1978/14	15	0	0%	5%							

Table 1. Continued

					Values		Man affects moose				
Year/Vol.	Papers	HD-papers	HD-ratio	5-yr. mean	Economic	Attitudes	Hunting	Infrastructure	Traffic	Moose hunters	Misc
1977/13	22	1	5%	6%						1	
1976/12	14	1	7%	5%							1
1975/11	26	2	8%				2				
1974/10	17	1	6%		1						
Total	584	66	11%		4	6	31	1	13	4	7
% of HD-articles					6%	9%	47%	2%	20%	6%	11%

[1] indicates special theme issue.

Table 2. Content analysis of *Proceedings* of the International Moose Symposia 1984, 1998, 1990, and 2002.

				Values		Man affects moose				
Year/Vol.	Papers	HD-papers	HD-ratio	Economic	Attitudes	Hunting	Infrastructure	Traffic	Moose hunters	Misc
2000/5th	55	9	16%	1		2		2	2	2
1998/4th	21	0	0%							
1990/3rd	22	1	5%							1
1984/2nd	50	7	14%	4		2		1		
Total	148	17	9%	5	0	4	0	3	2	3
% of HD-articles				29%	0%	24%	0%	18%	12%	18%

In *Alces*, the number of HD-articles were not simply linearly related to year (Model: #HDarticles = #Articles Year; $P_{model} = 0.23$; Fig. 1). Using the moving average publication rate in the time-series analysis, the proportion of HD articles has increased over time ($P_{model} = 0.02$, $R^2_{adj} = 0.188$, $n = 26$; Fig. 2). Inspection of Fig. 2 suggests two trends, with 1990 as the cut-off year; an increasing trend 1976-1990 and a decreasing trend 1991-1999.

Of the 66 HD-articles published in *Alces* 1974-2001, the majority (68%, $n = 45$) were published in category (2) "man affects moose" (hunting, $n = 31$; traffic, $n = 13$; and, infrastructure, $n = 1$). The second largest contributing category was category (1) "values" with 15% ($n = 10$) of the HD-articles. "Miscellaneous" HD-articles (category 4) with 11% ($n = 7$), and hunting HD-articles (3) 6% ($n = 4$).

Outside the *Alces* world. —Thirty-two HD-articles were found in alternate journals published 1984-2001. A majority (66%, $n = 21$) of the HD-articles were from category (1), 25% ($n = 8$) were in category (2), 6% ($n = 2$) from category (3), and 1 in category (4). Articles dealing with "values" were more heavily represented in the alternate literature than *Alces* (66% vs. 15%)

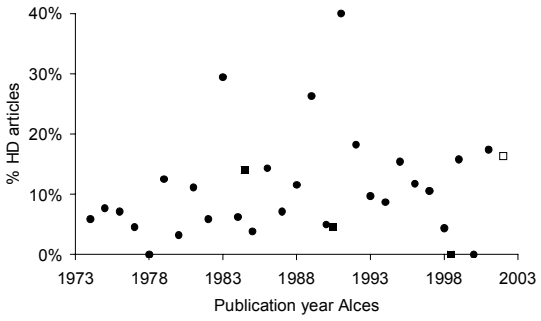

Fig. 1. The proportion of full-length human dimension articles in relation to the total number of articles in *Alces* 1974-2001, and in the *Proceedings* of the International Symposia 1984, 1990, 1998, and 2002. Filled circles represent *Alces*, filled squares represent *Proceedings* 1984, 1990, and 1998, open square represents articles presented at the 2002 International Symposium.

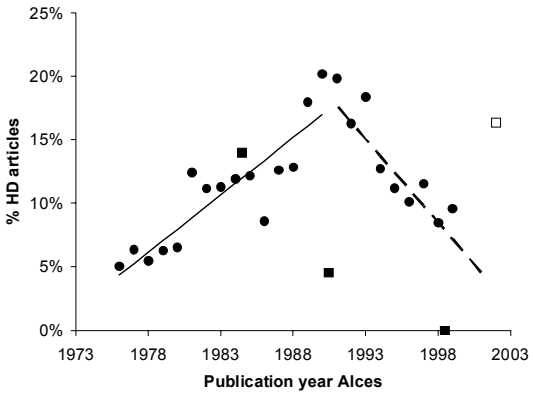

Fig. 2. The proportion (5-year moving average) of full-length human dimension articles in relation to the total number of articles in *Alces* 1974-2001, and in the *Proceedings* of the International Symposia 1984, 1990, 1998, and 2002. Filled circles represent *Alces*, filled squares represent *Proceedings* 1984, 1990, and 1998, open square represents articles presented at the 2002 International Symposium. The solid lines represent the positive trend in HD publication rate 1974-1990, the broken line the trend 1991-1999.

Journals that published more than one peer-reviewed article in the HD-area were *Arctic* ($n = 2$), *Canadian Journal of Forestry* ($n = 3$), *Journal of Wildlife Management* ($n = 2$), *Scandinavian Journal of Forest Economics* ($n = 2$), *Scandinavian Journal of Forestry Research* ($n = 3$), *Society and Natural Resources* ($n = 3$), and the *Wildlife Society Bulletin* ($n = 5$).

Literature Review

Values. — To make proper and socially justifiable decisions about consumptive and non-consumptive use, values have to be assigned and moose management is no exception. When we talk about "values" we normally mean either peoples' thoughts and actions (i.e., attitudes and behavior towards something like moose) or economic

values (Brown et al. 2001, Pierce et al. 2001).

The economic value of moose can be classified into two major categories (Steinhoff et al. 1987); exercised values (direct and indirect benefits of moose) and option values (to enjoy, to experience, or to use moose in the future). Studies dealing with exercised value of moose dominate the literature.

The first author to systematically identify, classify, and describe the potential role of moose as a recreational resource was David Lime in 1975, although single topics had been touched upon earlier (Cobus 1972). Lime discussed several potential exercised and option values in his analysis of moose as a non-consumptive resource. In the years thereafter little new information was published aside from reviews by Bisset (1987), Wolfe (1987), and Timmermann and Buss (1998). Despite this, little up-to-date hard facts exist today about moose as a non-consumptive resource. Timmermann and Buss (1998) suggested that "attributing economic value to moose, specifically non-consumptive expenditures, is difficult." Judging from published studies I do not fully agree. Non-consumptive use, and especially valuation of wildlife, receive considerable attention worldwide (e.g., Decker and Goff 1987, Mattsson and Li 1993, Brown et al. 2001). Thus, the methods and techniques are there. I believe it is more a question of involving social science in moose research and management.

Studies focusing on exercised values of moose, with special reference to moose hunting and hunters, started to appear in the mid-1980s. At the Second International Moose Conference 1984, Bisset (1987), Bluzma (1987), Norling (1987), and Wolfe (1987) provided comprehensive reviews from North America, Sweden, and Russia. Shortly thereafter followed a series of [bio]economic studies (Johansson et al. 1988; Sødal 1989; Mattsson 1989, 1990a, 1990b; Mattson and Li 1993; Ericsson et al. 2000; Storaas et al. 2001). Mattsson's studies are inter- and intradisciplinary important as they integrate ecological data with economic data, and deal with values beyond meat, license revenues, gadgets, and travel cost. Central questions in Mattsson's work are determining the marginal benefit of a moose and how this changes when the number of moose varies over time. However, few recent studies exist in this field besides work from Canada (Newfoundland, Condon and Adamowicz 1995; Saskatchewan, Morton et al. 1995; Ontario, Sarker and Surry 1998) and the USA. (Maine, Boyle and Clark 1993).

Much work needs to be done in the field of economic values and valuation. Especially needed are calculations of net economic benefit that take into account consumptive as well as non-consumptive use of moose in relation to damage, collisions, forestry management (Euler 1975, Boxall et al. 1996, Boxall and Macnab 2000, Courtois et al. 2001), and cost of moose management in relation to policy implementation (Ericsson et al. 2000). Also desirable are studies that address option values of moose in relation to, for example, various biodiversity goals and policies. Studies that target the asymmetric costs and benefits in moose management are also needed (Ericsson et al. 2000, Skonhoft 2002). New, updated national studies are required for all jurisdictions.

Attitudes. — A good example of both human attitudes towards moose and citizen participation in moose management was the reintroduction proposal for New York State, USA, 1992. New York State used several means (public meetings at various stages, EIS, public comment period, public surveys, etc.) to ask the public if they should proceed with a moose reintroduction proposal or not (Lauber and Knuth 1997, 1998, 1999). This process of public involvement is becoming

increasingly important for moose managers and policy makers.

Two stimulating papers have applied solid social science theory, addressing both beliefs and attitudes towards moose hunting. Both papers go beyond the limited question "Do you support or oppose moose hunting?". Donnelly and Vaske (1995) studied people's beliefs and attitudes towards a proposed moose hunt in New Hampshire, and Whittaker et al. (2001) studied beliefs and attitudes about an urban moose hunt near Anchorage, Alaska.

With respect to moose hunters, studies have addressed hunter satisfaction with management, such as the introduction of selective harvest regimes, but only for Ontario and Quebec, Canada, and for Maine, USA (Ontario, Rollins 1987, Rollins and Romano 1989, Wedels et al. 1989, Hansen et al. 1995; Quebec, Sigouin et al. 1999; Maine, Boyle et al. 1993). Thus, there is little current knowledge worldwide about the perhaps most important moose manager, the hunter.

Man Affects Moose

Hunting. — Studies, often ad-hoc to moose population studies, have addressed general topics about regulated or selective moose harvest (Child 1983, Euler 1983, Gollat and Timmermann 1983, Pierce et al. 1985, Timmermann and Gollat 1986, Cretê 1987, Child and Aitken 1989, Boer 1991, Heydon et al. 1992, Timmermann and Whitlaw 1992, Hooper and Wilton 1995, Wilton 1995, Ferguson and Messier 1996, Goudreault and Milette 1999, Lamoureux 1999, Schwartz 2002), as well as more specific topics such as demographic consequences of selective harvest (e.g., Baker 1975, Schwartz et al. 1992, Wilton 1992, Timmermann and Rempel 1998, Ericsson 2001), trophy-management (Smith et al. 1979), miscellaneous moose hunting "experiments" (Crichton 1979, 1980), impact of Native hunting (Crichton 1981, Feit 1987), moose alertness in relation to hunting (Bangs et al. 1984, Wilton and Bisset 1988, Garner et al. 1990, Ericsson and Wallin 1996, Baskin et al. 2002), moose social structure in relation to hunting (Timmermann and Gollat 1994), and the impact of forest management practices (Eason 1989).

Moose hunters. — Some studies have systematically examined the characteristics of moose hunters and human aspects of moose hunting (e.g., Timmermann 1977, Euler 1985, Norling 1987, Child and Aitken 1989, Ferguson et al. 1989, Redmond et al. 1997, Ball et al. 1999, Heikkilä and Aarnio 2001, Broman et al. 2002, Gåsdal and Rysstad 2002). However, we still know relatively little about the composition, demography, population dynamics, and socio-economic characteristics of the human predator.

Infrastructure. – Humans considerably affect moose through society's infrastructure. Collisions between moose and vehicles on roads and railroads have received attention in both *Alces* and other peer-reviewed journals. The contributions have evolved, along with moose population increases, from quantifying the problem to evaluating the means and efforts to reduce the number of deadly impacts (e.g., Björnstig et al. 1986, Child and Stuart 1987, Andersen et al. 1991, Becker and Grauvogel 1991, Child et al. 1991, del Frate and Spraker 1991, Jaren et al. 1991, Lavsund and Sandegren 1991, McDonald 1991, Modafferi 1991, Rattey and Turner 1991, Jolicoeur and Crête 1994, Belant 1995, Farrel et al. 1996, Garret and Conway 1999, Joyce and Mahoney 2001, Rea and Child 2002).

Few studies have dealt with urban sprawl and the effect of human settlement (Schneider and Wasel 2000), hydroelectric projects (Ballard et al. 1988), or potential barriers to moose movements, dispersal and migration, and habitat use (McDonald 1991, Forman

and Deblinger 2000, Ball and Dahlgren 2002). All would benefit from further research.

Response to other forms of human disturbance such as military activity (Andersen et al. 1996) and snowmobile traffic (Colescott and Gillingham 1998) have received little attention relative to the amount of studies addressing human disturbance to other deer species. Current studies usually describe moose behavioral response directly after the construction of potential barriers, but management and infrastructure planners need more than snapshots of reality, thus the need for longer term data collection. However, only recently have GPS and GIS-techniques been used to better understand the interaction of landscape and temporal features of moose and human infrastructure (e.g., Gundersen et al. 1998).

DISCUSSION

The analysis and literature review indicates a declining proportion of human dimension publications in moose research and management over the last 10 years. With the exception of the 5th International Symposium, years with an International Symposium do not seem to stimulate a higher proportion of HD-contributions (Fig. 2). Wolfe's (1987) prediction of an expanding HD-area was fulfilled up to 1991; thereafter the relative HD-publication rate in *Alces* has declined (Fig. 2). However, people have used outlets other than *Alces* and the International Symposia, but this does not fully compensate for the decreasing trend in *Alces* since 1991; e.g., just 5 HD-moose papers appeared in the *Wildlife Society Bulletin* and 2 in the *Journal of Wildlife Management* 1984-2002. However, present data suggest that alternate journals are publishing HD-papers which are underrepresented in *Alces*. Recently moose papers written by social scientists ($n = 3$) have appeared in the journal "*Society and Natural Resources*".

Publishing moose papers in alternate journals is an exciting opportunity to strengthen the interdisciplinary interface among biologists, sociologists, economists, anthropologists, political scientists, law scholars, and others. The literature review suggests there is an increasing involvement in the moose world by these other disciplines. This undoubtedly has strengthened the quality of the HD-component in moose research since 1984, although the quantity of HD-papers has declined. It is important for the future that we continue to attract more professionals from other disciplines than natural science. A sure result of more attendees from a wider array of disciplines will be relatively more HD-contributions in *Alces* that will benefit moose management worldwide.

Future Directions

The complexity of moose management has increased since 1984, as has the need for a better understanding of human dimensions. This is demonstrated by the presentations at the 5th International Moose Symposium, 2002. More scientific in-depth assessments of public attitudes toward moose and moose management are needed as moose populations expand into new areas, and move in closer to urban areas.

Hunting is a behavior, and hunters have strong attitudes about moose hunting (e.g., Rollins and Romano 1989, Hansen et al. 1995). Anti-hunting is, for most people, only an attitude - a feeling and a set of beliefs about an object like moose hunting. Attitudes are the broad structures that underlie behaviors. A behavior is like the tip of an iceberg, while the attitude is the part under water: one you can see, the other you must infer. Social scientists often use surveys to infer people's attitudes.

Attitudes become important when they are expressed in behavior. It is the behavioral expression of attitudes by the public that

often concerns managers and policy makers. It thus becomes crucial to understand the beliefs and dimensions of attitudes among consumptive and non-consumptive users of moose (Whittaker et al. 2001). Moose managers need to determine what policies are acceptable to the public, and the likely degree of opposition to existing and potential policies. From my data analysis and literature review I have identified several major trends specific to moose research and management that deserve top priority in the near future;

1. Moose populations continue to increase in size, expand to new areas, and in some places are being re-introduced to former habitats. In some places, such as the Baltic countries, moose populations are decreasing in size and distribution. How do people react to these changing moose populations?
2. With rebounding populations, moose will cause more nuisance and damage. What management alternatives are acceptable to handle conflicts between moose and humans? What makes them acceptable to hunters and the general public?
3. How important are moose to non-consumptive users in relation to other natural resources?
4. The consumptive use of moose will continue to be of central importance. What are the motivations behind the consumptive use of moose? How does the human predator function and think? What are the dynamics of the moose hunter population?

CONCLUSIONS

Despite the growing interest in how humans affect the ecological system in today's society, there is still a gap between this awareness and the effort made to understand the human dimension of natural resource use. There is a recognized need in moose management to integrate traditional population ecology and the social sciences (e.g., sociology, psychology, and economics). Among others, Crichton, Regelin, Franzmann, and Schwartz identified this as the "The Management Challenge" (1998:659). To fulfill the two primary goals of moose management - development of resources and optimization of public benefits - we need more information about the human user. Although humans play a significant and recognized role in moose management, the necessity of collecting and utilizing information about the human user has seldom been properly integrated into moose research. If we wish to manage moose optimally, we must better incorporate the human dimension.

ACKNOWLEDGEMENTS

I gratefully acknowledge the Fulbright Commission and the Swedish Foundation for International Cooperation in Research and Higher Education (STINT) for funding. I thank the Department of Rural Sociology and the Kemp Natural Resources Station at the University of Wisconsin-Madison for providing facilities to collect and analyze these data. I thank the Swedish Research Council for Environment, Agricultural Sciences and Spatial planning (FORMAS) for support during write up and presentation of the results. Constructive comments to earlier versions of the paper by John P. Ball, Lars Edenius, Ed Telfer, and two anonymous reviewers greatly improved the quality of the paper.

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