Reducing Populations of Medium-size Mammalian Predators to Benefit Waterfowl Production in the Prairie Pothole Region

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Introduction

Wildlife management has become more difficult in recent decades due to the increased requests to manage entire communities and to maintain ecosystem processes. However, wildlife managers still place much emphasis on management of particular wildlife populations. Focusing on a population or a set of species greatly simplifies the manager's task by keeping the goals simple. In most cases, the management goal is to increase the population of the target species. In urgent cases, the goal is to get the population above a threshold needed to assure the long-term persistence. In many cases, the management goal is to increase the population size to allow greater recreational use by consumptive users. Most waterfowl management in North America falls into the last category. Waterfowl hunters have consistently called for larger populations of ducks that would allow greater opportunity for hunting. Waterfowl hunters have also been very active in promoting waterfowl-population management so that ducks remain at population levels that allow considerable hunting opportunities. One important aspect of that population management involves the monitoring of population size and the sometimes-contentious regulation of harvest.

A second, and arguably more important, aspect of waterfowl management involves actions that increase duck recruitment or that decrease nonhunting mortality to allow populations to expand (Environment Canada 1986, Williams et al. 1999). Unfortunately, our knowledge of population biology of some ducks, such as sea ducks and scaup (*Aythya* spp.), is still too sparse to allow us to know

what life-stage processes are most influential in causing population change (Austin et al. 2000). For other species, especially the midcontinent mallards (*Anas platyrhynchos*) and some other dabbling ducks, we know enough about population processes to be able to target our management to particular areas and events. For instance, in midcontinent mallards, we have much evidence that the population is driven by events on the breeding grounds (Johnson and Grier 1988, Johnson et al. 1992, Hoekman et al. 2002). Moreover, we know that nest success is the most critical factor influencing population size but that brood survival and hen survival during the breeding season are also important drivers of populations (Johnson et al. 1992, Hoekman et al. 2002).

Drivers of Duck-population Size

Sophisticated quantification of the relative importance of duck-population processes is relatively recent, but managers have long believed that management aimed at increasing productivity was the best way to enhance duck populations. Much effort has been devoted to management on the most important breeding grounds, namely the Prairie Pothole Region (PPR). Initial management effort was focused on protection of large marshes, but analysis of habitat use soon showed that small wetlands were preferentially used by most dabbling ducks (Kantrud and Stewart 1977, Kadlec and Smith 1992). The vast majority of these wetlands occur on private agricultural land and are susceptible to drainage (Turner et al. 1987). In spite of decades of waterfowl-management effort that was accelerated by the North American Waterfowl Management Plan, the rate of wetland drainage appears to be unaltered in the all-important Canadian PPR (Watmough et al. 2002). Pair ponds are the first requirement for any breeding population of ducks; thus, it seems obvious that efforts to protect wetlands must be the primary objective of waterfowl managers (Turner et al. 1987). However, abundant wetlands do not assure good duck production; rather, these wetlands provide the potential for good duck production. Dabbling ducks are also reliant on upland habitat because it is where most species nest; nest success is a critical driver of production (Hoekman et al. 2002).

In the last decade, waterfowl biologists confirmed that the quantity of upland cover is a major factor in nest success (Greenwood et al. 1987, 1995; Reynolds et al. 2001). Unfortunately, these studies also showed that rather large acreages of cover, often greater than 40 percent of the landscape (Reynolds et

al. 2001), were needed to assure that nest success is above the break-even nest success of 15 to 20 percent. It is difficult for managers to achieve that level of nesting cover in agricultural settings, other than those where cattle production requires much perennial cover for grazing or hay production. We do not believe that wildlife managers will be able to acquire, through purchase or easement, enough farmland to restore enough land to upland cover as would be needed to cross the threshold of cover that assures high duck nest success. In areas of the PPR, where annual crops are the predominant land use of the farm community, it is unlikely that much productive and would be idle cover. Moreover, the cost of that land acquisition and management would be well beyond any funding mechanism currently in place in the wildlife community. Fortunately, on the U.S. side of the PPR, the establishment of grassland cover under the Farm Bill has had a major positive impact on duck recruitment (Kantrud 1993, Reynolds et al. 2001). The ephemeral nature of such farm programs makes reliance on this very beneficial nesting cover a risky strategy for waterfowl management. The threat of a dramatic decrease in Conservation Reserve Program (CRP) acreage became apparent in spring 2007 when the George W. Bush Administration proposed changes that would reduce new enrollments and would allow farmers to opt out of their existing CRP contracts.

Over the vast PPR, there are many areas where abundant wetlands provide the potential for duck production, but nest success is below break-even levels (Klett et al. 1988, Greenwood et al. 1995, Drever et al. 2004). In such situations it may be impractical to elevate nest success by increasing perennial nesting cover because the land is too valuable for annual crop production. This dilemma is not new and managers have responded with a variety of techniques to enhance nest success. In most cases the primary reason for nest failure is predation by a suite of medium-sized mammals, most notably red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*) and striped skunk (*Mephitis mephitis*) (Sargeant and Raveling 1992, Sargeant et al. 1993). Thus, many management efforts aim to separate these predators from duck nests. Such techniques include nest structures that make nests inaccessible (Doty and Lee 1974, Eskowich et al. 1998), creation of predator-free patches of cover on islands (Giroux 1981) or on fenced peninsulas (Lokemoen and Woodward 1993), or exclusion of predators from fields of cover with predator-proof fences (Lokemoen et al. 1982). Each of these techniques can be effective at elevating nest success, but each also has logistical or practical concerns that may limit the application of the technique

(Pietz and Krapu 1994, Trottier et al. 1994, Rohwer et al. 2004). For instance, some ducks do not preferentially nest on islands or peninsulas and will not use nest structures.

One long-standing, alternative solution for nest predation is to take a more direct approach by reducing numbers of predators of duck nests. Such management was relatively common in the early decades of waterfowl management, and the limited evaluation suggested it was effective at elevating duck production (Balser et al. 1968, Lynch 1972, Duebbert and Kantrud 1974). An executive order by President Richard Nixon in 1972 banned the widespread use of toxicants and effectively halted the use of predator-population reduction to enhance duck nest success for several decades. By the late 1980s and early 1990s, the alarming decline of duck populations, the compelling evidence of the magnitude of duck nest predation (Greenwood et al. 1987, Beauchamp et al. 1996) and the disappointing results of alternative methods to enhance nest success probably provided the impetus to reconsider lethal predator reduction to improve duck nest success.

Does Predator Management Work?

The most pressing question concerning trapping as a means of reducing medium-sized mammal predators to enhance duck nest success was obvious: can trapping work? Many predator ecologists and waterfowl managers believed that trapping would not reduce predator populations or that there would be compensatory predation so that duck nest success would change very little. Thus, the initial research focus was on efficacy of trapping to enhance nest success.

Initial research by scientists at the Northern Prairie Wildlife Research Station suggested that trapping on relatively small units of land, typically quarter sections (160 acres [64.7 ha]) that were waterfowl production areas purchased using duck-stamp dollars, increased nest success relative to control sites (Sargeant et al. 1995). However, nest success on predator-reduction sites remained below levels that could maintain a stable local population (Cowardin et al. 1985). Subsequent research by several graduate students, funded primarily by the Delta Waterfowl Foundation (Delta), produced a very different result. Studies at differing sites, scales and years produced a surprising convergence of results—trapping elevated Mayfield duck (*Genus species*) nest success to between 40 and 50 percent success, well above nest success on control sites (Table 1).

Table 1. Mayfield duck nest success in the Prairie Pothole Region with and without lethal predator management of medium-sized mammalian nest predators from 1994 to 2006.

Type of nests	Percent nest success		Plot	Sample		
	Trapped	Control	size[a]	size[b]	Location	Source
Dabbling duck[c]	6	14	Small	947	North Datota and Minnesota	Sargeant et al. 1995
Dabbling duck[c]	42[d]	23[d]	Medium	2,706	North Dakota	Garrettson and Rohwer 2001
Dabbling duck[c]	36	15	Large	3,305	North Dakota	Hoff 1999
Dabbling duck[c]	53	29	Small	4,240	North Dakota	Chodachek and Chamberlain 2006
Dabbling duck[c]	48	19	Medium	2,376	Saskatchewan	Vance Lester, unpublished data 2000
Dabbling duck[c]	57	36	Large	5,124	North Dakota	M. Pieron, unpublished data 2006
Diving duck[d]	57	29	Medium	167	North Dakota	Mense 1996
American coot[e]	67	75	Medium	233	North Dakota	Mense 1996

[a] Large equals 36 square miles (93.2 km^2); medium equals 16 square miles (41.4 km^2); small is equal to or less than 1 square mile (2.6 km^2) or smaller.

[b] number of nests followed

[c] Species composition primarily was blue-winged teal (*Anas discors*), mallard, gadwall (*A. strepera*), northern shoveler and northern pintail (*A. acuta*)

[d] Species composition primarily was ruddy ducks and redheads

[e] *Fulica americana*

Biological Issues with Trapping

Biological evaluations about predator reduction as duck management logically started with tests of the impacts on nest success. However, the secondary questions soon followed. In the age of ecosystem thinking, some obvious follow-up questions involved impacts on other members of the community. One study questioned the impacts of predator trapping on grassland passerines. Specifically, Nancy Dion tested whether there was a trophic cascade whereby reduction of medium-sized mammals allowed an ecological release of small mammals, some of which might increase nest predation on nests of grassland songbirds. Examination of natural nests and experiments using artificial nests suggested that overall predation rates on trapped blocks did not change (Dion et al. 1999). In contrast, for the grassland nesting shorebirds, primarily upland sandpipers (*Bartramia longicauda*) and Wilson's phalarope

(*Phalaropus tricolor*), predator trapping elevated nest success, though the increase in success was less than for nesting ducks (Jackson 2003, Darren Wiens, unpublished data 2006). Another Delta-funded graduate student, Jeremy Adkins, quantified the increase of mice on the trapped blocks. Rodent-population growth from spring to fall was almost twice as great on the trapped blocks relative to control blocks, but populations on trapped blocks were back to control levels after the winter (Adkins 2003).

Waterfowl biologists also asked questions about how trapping might influence other duck species and other phases of reproduction. The initial emphasis of predator reduction was to elevate nest success of upland nesting ducks. However, Ben Mense did overwater nest searching and found that diving ducks, such as redheads (*Aythya americana*), canvasbacks (*A. valisineria*) and ruddy ducks (*Oxyura jamaicensis*), also had greatly improved nest success on trapped blocks (Garrettson et al. 1996, Mense 1996). Likewise, two examinations of ducklings showed that brood survival for both northern shovelers (*Anas clypeata*; Zimmer 1996) and mallards (Pearse and Ratti 2004) was elevated on blocks that were trapped. Initial work by Garrettson and Rohwer (2001) suggested that duck-breeding populations on trapped blocks were elevated in the year after trapping but that work was based on only 1 year and is the subject of ongoing research.

Social Issues with Predator Management

Almost any wildlife management in this century will involve compromises among parties with differing philosophies. We suspect that the social issues of trapping are probably more complex than the biological concerns about the efficacy of trapping and unintended effects on other members of the community. However, because social issues of predator trapping might not be necessary if trapping proved to have little efficacy at improving duck production, we addressed biological issues first.

Reducing one population using lethal means to benefit a second population is probably as controversial as any wildlife management. There are three somewhat different aspects of this management that have the potential to make it of concern. First, intensive management of any kind is a concern to some in the natural resources community that have adopted a philosophy that nature should not be managed but, instead, left alone so that nonhuman forces shape

populations and communities (Nash 1968, Decker et al. 1991). This nonmanagement philosophy has become more popular among the public in recent decades. A second point of issue is that the lethal aspects of predator trapping would concern anyone with a value system that precludes killing animals, especially higher vertebrates like mammals. The third controversial aspect of predator management is the fact that it involves lethal management that benefits other, relatively common animals, even if they are in high demand by some members of the public.

Several factors probably ameliorate the importance of the first objection of predator management. The idea of leaving ecosystems alone and prescribing no management is probably most appropriate for pristine environments where the community is intact and where the full range of ecosystem functions are still in place. This scenario is a dramatic contrast to most of the PPR where the majority of the prairie has long been under cultivation, where much of the flora is exotic and where the predator community is vastly altered from pre-European settlement times (Cowardin et al. 1983, Sargeant et al. 1993). The elimination of top predators, the abundance of cultivated high-energy foods, such as sunflowers that are readily available in the winter, and the abundance of excellent winter den sites surely cause unnaturally large populations of medium-sized-mammal predators to exist in much of the PPR (Cowardin et al. 1983). Finally, the proponents of no-management are less likely to be actively concerned about areas where the majority of land is privately owned and under intensive management for agricultural production.

Lethal Management

Predator trapping, as it has been experimentally tested (Table 1), involves intensive trapping on blocks of habitat with the goal of substantially reducing the predator population and, thereby, of elevating duck recruitment. This is a form of management that obviously involves killing large numbers of animals (Garrettson and Rohwer 2001). Acceptance of predator management requires a philosophy that allows killing of animals. The visibility of the antihunting and anti-animal-use movement makes it clear that there are individuals that do not embrace any philosophy involving animal use, particularly when animals are killed (Gentile 1987, Rutberg 2001).

Proponents of predator management recognize that causing the death of animals can evoke a deep philosophical divide. Whether they are avid

consumptive users or ardent antihunters, individuals firmly on one side of this divide, are not likely to be swayed by arguments from the other side of the divide (Shaw 1977, Bright et al. 2000). Much literature suggests that values concerning wildlife will influence how people perceive and react to various options for wildlife management (Fulton et al. 1996, Manfredo et al. 1999, Bright et al. 2000, Dougherty et al. 2003). However, it would surely be incorrect to assume that animal death is a clear philosophical divide that will lead to predictable and consistent beliefs and behaviors of most people in North America regarding specific wildlife issues. To the contrary, we suspect the acceptability of a proposed wildlife-management activity, even potentially controversial management involving death of wild animals, will depend on the situation. Human-dimension surveys covering a wide variety of wildlife issues suggest that acceptance of wildlife management is situation specific (Manfredo et al. 1998, Messmer et al. 1999, Decker et al. 2006).

Predictions Regarding Predator Management for Waterfowl

Predator reduction to enhance waterfowl production might be predicted to have relatively low social acceptability because of three independent concerns. First, it is lethal management of some wildlife, which is less acceptable than nonlethal management (Manfredo et al. 1998, Decker et al. 2006). We note, however, that many studies on the acceptability of lethal management deal with charismatic animals, like big cats, wolves and deer (Kellert 1985, Decker et al. 2006), which may not be relevant to medium-sized, mammalian predators. Acceptability of lethal management varies with the species considered (Messmer et al. 1999).

Second, the on-the-ground management relies heavily on trapping, which has long been controversial in North America (Gentile 1987, Proulx and Barret 1991). Although legislative attempts to ban trapping have been remarkably unsuccessful (Gentile 1987), in at least six states, ballot initiatives have limited the use of trapping in the wildlife arena (Deblinger et al. 1999). The fact that ballot initiatives have been a far more effective means of reducing trapping than direct legislation reflects broad public concerns about trapping that are suggested by human-dimensions studies of the topic (Kellert 1981, Manfredo et al. 1999). The success of ballot initiatives to limit trapping also shows that antitrapping advocates can be organized enough to get issues in front of a public that might then form an opinion about trapping, even if most members of the public had not been active stakeholders in the trapping issue (Shaw 1977, Deblinger et al. 1999).

The third component of predator management for waterfowl that is likely to compound social concerns is the management goal itself. In this case, the goal of management is to increase the population of a set of ducks as game animals that is relatively abundant where it would influence hunting opportunities. Opinion surveys of various segments of the public show that the same type of management will have a range of acceptance depending on the reasons for management. Human safety issues often can engender the greatest support for intensive or lethal wildlife management (Manfredo et al. 1998, 1999; Messmer et al. 1999). Management that preserves ecosystem function or that protects endangered species will often yield less support than if the management goal is to protect human welfare. But, it will yield greater acceptance than if the goal is to increase game species (Messmer et al. 1999, Decker et al. 2006). Acceptance of lethal predator management with the goal of game-animal production also can vary depending on who benefits and on economic impacts to local communities (Decker et al. 2006).

Contrasting Predictions and Survey Results on Predator Management for Waterfowl

We might expect that the social acceptance of lethal predator management to increase duck production would be low because it combines three aspects of wildlife management that tend to engender little support: lethal management, trapping and a goal of game-animal production. However, the existing survey data that directly apply to predator management for duck production suggest that lethal predator reduction is acceptable among much of the public (Messmer et al. 1999). A mail survey of 1,500 random U.S. households that asked about controlling skunks, raccoons and foxes to improve duck nest success found that almost 60 percent of respondents fell on the side of supporting or strongly supporting this management. Individuals that opposed or that strongly opposed such management comprised less than 13 percent of respondents (Messmer et al. 1999). The same survey also asked about controlling these medium-sized predators to aid ring-necked pheasant (*Phasianus colchicus*) and gray partridge (*Perdix perdix*) populations (both exotic species) or to increase songbird populations. Surprisingly, there was less support (55 percent) for predator management for songbirds (a rapidly declining set of birds) than for waterfowl or for pheasants and partridge (56 percent). As expected, there was greater support (67 percent) for protecting endangered piping plovers

(*Charadrius melodus*) by controlling foxes (Messmer et al. 1999). We caution that this rather unexpected level of support for predator management for game animals may reflect the respondent population. The respondents (39.7 percent) were overrepresented by midwestern and rural residents, by those with a history of consumptive resource use, and by older men (Messmer et al. 1999), all of which likely biased results toward a more accepting view of predator management (Deblinger et al. 1999, Dougherty et al. 2003).

The wording of the survey by Messmer et al. (1999) may have inflated the apparent public acceptance of predator management for waterfowl. The survey began with background information on predator management. That information may have been biologically correct, but the respondents only got one side of a story, which surely would not have happened if there was debate about a pending policy issue (Shaw 1977, Deblinger et al. 1999). For example, the preamble to questions about management for duck nests emphasized the importance of the PPR for ducks, made it clear that farming had increased the ability of predators to find and raid duck nests, and suggested that nest success has fallen to dangerously low levels (Messmer et al. 1999). The nonneutral wording and the information provided before the survey questions may have lead to the high support for predator management. However, such information dissemination would be relevant if there was a debate about management policy.

We believe that there is much need for more detailed information about social acceptance of predator management to increase duck production, especially given that this management appears to be one of the most effective methods available to increase duck production (Rohwer et al. 2004). In particular, the survey work should target different aspects of the public and stakeholders.

Acceptance in the Waterfowl Management Community

Social acceptance of a management technique is likely to play a major role in the implementation of that technique. In this era of diverse stakeholders, intense political pressure on management agencies and frequent litigation, it is reasonable to anticipate that some managers will avoid management techniques that are highly controversial and that will inflame some stakeholders. However, the opinions of managers about various management options will probably also have much influence on whether a particular technique is implemented. West and Messmer (2004) recognized the importance of managers' views and surveyed federal and state land managers in duck-production areas of the United States.

While managers appeared well aware of the extent that predation of nests, hens and ducklings inhibits duck recruitment, their scoring of the acceptability of predator management did not appear to be any greater than public opinion about predator reduction (Messmer et al. 1999). It is also interesting that managers ranked dense nesting cover, elevated nesting structures, nesting islands, fenced nesting cover and fences on nesting peninsulas as more effective than predator trapping. Our review of duck nest success and of brood survival literature suggests that managers are not well informed about the relative efficacy of these techniques for elevating duck recruitment (Rohwer et al. 2004). We note, however, that managers' scoring of the effectiveness of any technique may have integrated both biological efficacy of elevating nest success and some assessment of cost efficiency.

We are aware that many biologists and managers have two concerns about funding for predator reduction in waterfowl management. First, there is concern about the cost efficiency. Predator management is an annual expense, so many wildlife managers assume that, in the long run, habitat management is always more cost effective, especially when management permanently secures habitat through fee title or perpetual easements. However, this assumption is unlikely to be correct for two reasons. First, the biological impact of upland-habitat protection and of restoration to improve duck nest success is not as dramatic as predator management (McKinnon and Duncan 1999), and it is very dependent on the scale of implementation (Greenwood et al. 1987, Reynolds et al. 2001). Second, habitat maintenance with fee title lands or monitoring for easement violations are annual costs for habitat management that are far from trivial (Hollevoet and Dixon 2007) and can overshadow the annual management costs of predator reduction, which are less than $2.00 per acre.

To our knowledge, there have been only two cost-benefit analyses of wildlife techniques used for duck production in the prairies. The pioneering work by Lokemoen (1984) showed that predator reduction was probably the most cost-effective technique for waterfowl management. Unfortunately, the exact methodology used by Lokemoen was unclear. But, his work is widely cited, and he has a well established reputation for his knowledge of waterfowl breeding ecology and management. Recently, Rashford and Adams (2007) completed detailed economic analyses that used the mallard model (Johnson et al. 1987) to generate the recruitment estimates and coupled those with actual management costs. This analysis, based only on mallard production, shows that direct

management activities, such as predator management, are typically more cost effective than habitat-conservation measures in almost any landscape and for any desired recruitment goal (Rashford and Adams 2007).

Perhaps a greater concern of managers is the diversion of resources that might occur if predator management was widely accepted as appropriate waterfowl management. As an example of this concern, the Mississippi Flyway Council passed a resolution that explicitly stated that they did not support the practice of predator removal to improve waterfowl recruitment. The justification suggests a lack of cost efficiency and concern that, in an era of limited resources, expending funds on predator removal necessarily competes with landscape habitat programs. We recognize that habitat protection is necessary to meet long-term goals for waterfowl management, but we also believe that, in the short term, it would be wise to invest some waterfowl-management dollars in intensive management, such as predator reduction, that can substantially improve duck production on existing habitat.

Consideration of Other Stakeholders

Predator management, as practiced in the experimental studies supported by the Delta, almost always involves private lands. That means some of the obvious and active stakeholders in this management are private landowners that control access to their land for trapping and for evaluations of duck production. In the process of funding and coordinating over a dozen graduate projects to evaluate predator reduction, we have interacted with, literally, hundreds of landowners in North Dakota, South Dakota and Saskatchewan. The overwhelming majority of landowners we contacted have allowed us free access to their land. Many landowners actively embrace the trapping effort because they view raccoons and skunks as pests that cause damage to crops or outbuildings. However, a segment of the landowners we contact deny access to their land. Landowner concerns about predator reduction that have been serious enough to deny permission to trap on their property have primarily fallen into two categories: (1) dislike of ducks and (2) dislike of duck-management agencies because of their actions to protect habitat.

In the PPR with the highest duck densities, the primary agricultural crops have historically been cereal grains—mainly spring wheat and barley. Until relatively recently, these crops were cut into a swath in late summer or early fall, and the swath remained in the field for days to several weeks for drying before

it was combined. During this drying period, depredations on waterfowl, especially mallards, geese and sandhill cranes (*Grus canadensis*), could occur and could be severe in years of delayed harvest (Bossenmaier and Marshall 1958, Sugden et al. 1988, Clark et al. 1993). Such depredations appear to be declining in importance because of earlier maturing varieties of grain, reduced time in swaths and direct combining. However, many farmers, particularly older farmers, have experienced what they consider serious economic loss to waterfowl, and some of those farmers have no interest in having larger waterfowl populations as a result of predator reduction. This is likely less relevant in Canada (compared to the United States) because there is compensation paid for loss of crops from wildlife.

Unlike fall grain depredations, which are declining in most of the PPR, there is a growing concern in eastern North Dakota regarding breeding season populations of Canada geese (*Branta canadensis*). Populations of resident geese have greatly expanded in the last decade (U.S. Fish and Wildlife Service 2006) and are now abundant enough that many farmers perceive these geese are causing crop losses by their grazing in the spring on cereal grains. In several cases, farmers denied us permission to trap because they were concerned about increasing populations of resident Canada geese.

The more common reason that landowners refused access relates to prior habitat protection by wildlife agencies, particularly the U.S. Fish and Wildlife Service (USFWS) in the United States. In much of eastern North and South Dakota, especially in the Devils Lake Wetland Management District (in northeastern North Dakota) where much of our predator management research has been conducted, there has been active wetland protection that involves purchase of perpetual easements (Naugle et al. 2001). While this is a voluntary program, many landowners believe that the USFWS took advantage of farmers during an economic crisis. Easement violations have been common (Sidle 1981) and have resulted in negative perceptions of the USFWS for many farmers. A related land issue is the concern by some farmers that too much land is being purchased by the USFWS, which means land is not available for farmers, is not on the county tax roles and is not productive. When asking for permission to trap in North and South Dakota, we made it clear that we did not work for the USFWS. In most cases, that separation from the easement agency helped. But in some cases, farmers lumped all wildlife groups, be they state, federal or nongovernmental as "the Wildlife."

All other concerns of farmers and landowners were far less important and were only voiced by a few individuals. Some landowners were concerned with liability issues associated with allowing the trapper onto their land. A few landowners appreciate seeing predators; some had a friend or relative that occasionally trapped furbearers in the fall for recreation or profit. And, some of these landowners did not want fox or raccoon populations suppressed. Very few landowners expressed concern about potential effects on the ecological community, specifically a trophic cascade that might cause increased rodent populations that might increase agricultural problems. Perhaps the third most common concern of landowners was that the trappers or the students evaluating the trapping would discover an endangered species and report the finding to the Wildlife, which would then disrupt farming activities. We should note that we have never heard a landowner show any concern about trapping based on a philosophical or on a moral concern about predators or on an ethical concern about lethal management.

Views of Hunters and Trappers

Some hunters have enthusiastically supported the idea of predator management. Most hunters are well aware that habitat is the basic requirement to sustain wildlife populations, but decades of reporting has also made hunters aware of issues with duck nest success on the prairies. Trappers and trapping organizations have also been staunch supporters of predator reduction. We have experienced a few individual fur trappers that are concerned about trapping—that it would reduce populations in areas where they trap. However, there has been strong support for our research on predator reduction, including support from the Minnesota Trapper Association, the Saskatchewan Trappers Association, the Fur Institute of Canada and Fur Takers of America, Incorporated, which has state chapters in both North and South Dakota.

Conclusions

A decade of research has suggested that reduction of medium-size mammalian predator populations can substantially improve duck production on a variety of scales (Table 1). Moreover, analyses of cost efficiencies suggest that predator management is probably one of the best ways to elevate duck recruitment with limited resources, especially in environments where significant

conversion to planted cover is not feasible. Initial studies of effects of trapping on other members of the community, such as other nongame birds, provide no cause for concern.

More research is needed concerning the social acceptance of predator reduction aimed at increasing duck production. Managers express concern about lethal management of predators and about trapping (West and Messmer 2004), which probably reflects their perception that the public will be concerned with predator reduction. We look forward to being able to report in a few years on planned research that samples several segments of the public, land managers, landowners and waterfowl hunters to gauge their acceptance and their activism concerning predator management.

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Reference List

Adkins, J. A. 2003. *Experimental predator removal: A response in small mammal communities and relations to duck nest success*. M.S. thesis, Louisiana State University, Baton Rouge, LA.

Austin, J. E., A. D. Afton, M. G. Anderson, R. G. Clark, C. M. Custer, J. S. Lawrence, J. B. Pollard, and J. K. Ringelman. 2000. Declining scaup populations: Issues, hypotheses, and research needs. *Wildlife Society Bulletin*. 28:254–63.

Balser, D. S., H. H. Dill, and H. K. Nelson. 1968. Effect of predator reduction on waterfowl nesting success. *Journal of Wildlife Management*. 32:669–82.

Beauchamp, W. D., R. R. Koford, T. D. Nudds, R. G. Clark, and D. H. Johnson. 1996. Long-term declines in nest success of prairie ducks. *Journal of Wildlife Management*. 60:247–57.

Bossenmaier, E. F., and W. H. Marshall. 1958. Field-feeding by waterfowl in southwestern Manitoba. *Wildlife Monographs*. 1:1–32.

Bright, A. D., M. J. Manfredo, and D. C. Fulton. 2000. Segmenting the public: An application of value orientations to wildlife planning in Colorado. *Wildlife Society Bulletin*. 28:218–26.

Chodachek, K. D., and M. J. Chamberlain. 2006. Effects of predator removal on upland nesting ducks in North Dakota grassland fragments. *The Prairie Naturalist*. 38:25–37.

Clark, R. G., H. Boyd, and B. Poston. 1993. Crop damage, autumn waterfowl populations and cereal grain harvests in the prairie provinces of western Canada. *Wildfowl*. 44:121–32.

Cowardin, L. M., A. B. Sargeant, and H. F. Duebbert. 1983. Problems and potentials for prairie ducks. *Naturalist*. 34:4–11.

Cowardin, L. M., D. S. Gilmer, and C. W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. *Wildlife Monographs*. 92:1–37.

Deblinger, R. D., W. A. Woytek, and R. R. Zwick. 1999. Demographics of voting on the 1996 Massachusetts ballot referendum. *Human Dimensions of Wildlife*. 4:40–55.

Decker, D. J., R. E. Shanks, L. A. Nielson, and G. R. Parsons. 1991. Ethical and scientific judgements in management: Beware of blurred distinctions. *Wildlife Society Bulletin*. 19:523–7.

Decker, D. J., C. A. Jacobson, and T. L. Brown. 2006. Situation-specific "impact dependency" as a determinant of management acceptability: Insights from wolf and grizzly bear management in Alaska. *Wildlife Society Bulletin*. 34:426–32.

Dion, N., K. A. Hobson, and S. Lariviere. 1999. Effects of removing duck-nest predators on nesting success of grassland songbirds. *Canadian Journal of Zoology*. 77:1,801–6.

Dougherty, E. M., D. C. Fulton, and D. H. Anderson. 2003. The influence of gender on the relationship between wildlife value orientations, beliefs, and the acceptability of lethal deer control on Cuyahoga Valley National Park. *Society and Natural Resources*. 16:603–23.

Doty, H. A., and F. B. Lee. 1974. Homing to nest baskets by wild female mallards. *Journal of Wildlife Management*. 38:714–9.

Drever, M. C., A. Wins-Purdy, T. D. Nudds, and R. G. Clark. 2004. Decline of duck nest success revisited: Relationships with predators and wetlands in dynamic prairie environments. *The Auk*. 121:497–508.

Duebbert, H. F., and H. A. Kantrud. 1974. Upland duck nesting related to land use and predator reduction. *Journal of Wildlife Management*. 38:257–65.

Environment Canada. 1986. *North American Waterfowl Management Plan*. Environment Canada: Ottawa, Ontario.

Eskowich, K. D., D. McKinnon, G. Brewster, and K. Belcher. 1998. Preference and use of nest baskets and nest tunnels by mallards in the parkland of Saskatchewan. *Wildlife Society Bulletin*. 26:881–5.

Fulton, D. C., M. J. Manfredo, and J. Lipscomb. 1996. Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife*. 1:24–47.

Garrettson, P. R., F. C. Rohwer, J. M. Zimmer, B. J. Mense, and N. Dion. 1996. Effects of mammalian predator removal on waterfowl and non-game birds in North Dakota. *Transactions of the North American Wildlife and Natural Resources Conference*. 65:445–52.

Garrettson, P. R., and F. C. Rohwer. 2001. Effects of mammalian predator removal on upland-nesting duck production in North Dakota.*Journal of Wildlife Management*. 65:398–405.

Gentile, J. R. 1987. The evolution of antitrapping sentiment in the United States: A review and commentary. *Wildlife Society Bulletin*. 15:490–503.

Giroux, J. F. 1981. Use of artificial islands by nesting waterfowl in southeastern Alberta. *Journal of Wildlife Management*. 45:669–79.

Greenwood, R. J., A. B. Sargeant, D. H. Johnson, L. M. Cowardin, and T. L. Schaffer. 1987. Mallard nest success and recruitment in prairie Canada. *Transactions of the North American Wildlife and Natural Resources Conference*. 52:298–309.

Greenwood, R. J., A. B. Sargeant, D. H. Johnson, L. M. Cowardin, and T. L. Shaffer. 1995. Factors associated with duck nest success in the Prairie Pothole Region of Canada. *Wildlife Monographs*. 128:1–57.

Hoekman, S. T., L. S. Mills, D. W. Howerter, J. H. Devries, and I. J. Ball. 2002. Sensitivity analysis of the life cycle of midcontinent mallards.*Journal of Wildlife Management*. 66:883–900.

Hoff, M. J. 1999. *Predator trapping on township-sized blocks: Does duck nesting success increase?* M.S. thesis, Louisiana State University, Baton Rouge, Louisiana.

Hollevoet, R., and C. Dixon. 2007. Integrating science with on-the-ground management: A two state plan for ground nesting birds. *Transactions*

of the North American Wildlife and Natural Resources Conference. 72: 270–86.

Jackson, C. R. 2003. *Breeding ecology of prairie nesting shorebirds: Relationships with habitat, land use and predators*. M. S. thesis, University of Saskatchewan, Saskatoon.

Johnson, D. H., and J. W. Grier. 1988. Determinants of breeding distributions of ducks. *Wildlife Monographs*. 100:1–37.

Johnson, D. H., D. W. Sparling, and L. M. Cowardin. 1987. A model of the productivity of the mallard duck. *Ecological Modelling*. 38:257–75.

Johnson, D. H., J. D. Nichols, and M. D. Schwartz. 1992. Population dynamics of breeding waterfowl. In *Ecology and management of breeding waterfowl,* eds. B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, 446–85. Minneapolis, Minnesota: University of Minnesota Press.

Kadlec, J. A., and L. A. Smith. 1992. Habitat management for breeding areas. In *Ecology and management of breeding waterfowl,* eds. B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, 590–610. Minneapolis, Minnesota: University of Minnesota Press.

Kantrud, H. A. 1993. Duck nest success on Conservation Reserve Program land in the Prairie Pothole Region. *Journal of Soil and Water Conservation*. 48:238–42.

Kantrud, H. A., and R. E. Stewart. 1977. Use of natural basin wetlands by breeding waterfowl in North Dakota. *Journal of Wildlife Management*. 41:243–53.

Kellert, S. R. 1981. Trappers and trapping in American society. *Proceedings of the Worldwide Furbearer Conference*. 3:1,971–2,003.

Kellert, S. R. 1985. Public perceptions of predators, particularly the wolf and coyote. *Biological Conservation*. 31:167–89.

Klett, A. T., T. L. Shaffer, and D. H. Johnson. 1988. Duck nest success in the Prairie Pothole Region. *Journal of Wildlife Management*. 52:431–40.

Lokemoen, J. T. 1984. Examining economic efficiency of management practices that enhance waterfowl production. *Transactions of the North American Wildlife and Natural Resources Conference*. 49:584–606.

Lokemoen, J. T., and R. O. Woodward. 1993. An assessment of predator barriers and predator control to enhance duck nest success on peninsulas. *Wildlife Society Bulletin*. 21:275–82.

Lokemoen, J. T., H. A. Doty, D. E. Sharp, and J. E. Neaville. 1982. Electric fences to reduce mammalian predation on waterfowl nests. *Wildlife Society Bulletin*. 10:318–23.

Lynch, G. M. 1972. Effect of strychnine control on nest predators of dabbling ducks. *Journal of Wildlife Management*. 36:436–40.

Manfredo, M. J., H. C. Zinn, L. Sikorowski, and J. Jones. 1998. Public acceptance of mountain lion management: A case study of Denver, Colorado, and nearby foothills areas. *Wildlife Society Bulletin*. 26:964–70.

Manfredo, M. J., C. L. Pierce, D. Fulton, J. Pate, and B. R. Gill. 1999. Public acceptance of wildlife trapping in Colorado. *Wildlife Society Bulletin*. 27:499–508.

McKinnon, D. T., and D. C. Duncan. 1999. Effectiveness of dense nesting cover for increasing duck production in Saskatchewan. *Journal of Wildlife Management*. 63:382–9.

Mense, B. J. 1996. *The effects of predator removal and nest-site selection on productivity of over-water nesting birds in North Dakota*. M.S. thesis, Pittsburg State University, Pittsburg, Kanasas.

Messmer, T. A., M. W. Brunson, D. Reiter, and D. G. Hewitt. 1999. United States public attitudes regarding predators and their management to enhance avian recruitment. *Wildlife Society Bulletin*. 27:75–85.

Naugle, D. E., R. R. Johnson, M. E. Estey, and K. F. Higgins. 2001. A landscape approach to conserving wetland bird habitat in the Prairie Pothole Region of eastern South Dakota. *Wetlands*. 21:1–17.

Nash, R. 1968. Conservation as quality of the environment. In *The American environment: Readings in the history of conservation*, ed. Roderick Nash, 155–6. Reading, Massachusetts: Addison-Wesley.

Pearse, A .T., and J. T. Ratti. 2004. Effects of predator removal on mallard duckling survival. *Journal of Wildlife Management*. 68:342–50.

Proulx, G., and M. W. Barret. 1991. Ideological conflict between animal rightists and wildlife professionals over trapping wild furbearers. *Transactions of the North American Wildlife and Natural Resources Conference*. 56:387–99.

Pietz, P. J., and G. L. Krapu. 1994. Effects of predator exclosure design on duck brood movements. *Wildlife Society Bulletin*. 22:26–33.

Rashford, B. S., and R. M. Adams. 2007. Improving the cost-effectiveness of ecosystem management: An application to waterfowl production. *American Journal of Agricultural Economics*. 89:775–68.

Reynolds, R. E., T. L. Shaffer, R. W. Renner, W. E. Newton, and B. D. J. Batt. 2001. Impact of the Conservation Reserve Program on duck recruitment in the U.S. Prairie Pothole Region. *Journal of Wildlife Management*. 65:765–80.

Rohwer, F. C., J. Scarth, and R. Olson. 2004. Seasonal reduction of medium-sized mammalian predator populations to enhance waterfowl production: An evaluation of biological factors and barriers to adoption. *Transactions North American Wildlife and Natural Resources Conference*. 69:129–49.

Rutberg, A. T. 2001. Why state agencies should not advocate hunting or trapping. *Human Dimensions of Wildlife*. 6:33–7.

Sargeant, A. B., and D. G. Raveling. 1992. Mortality during the breeding season. In *Ecology and management of breeding waterfowl*, eds. B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu,396–422. Minneapolis, Minnesota: University of Minnesota Press.

Sargeant, A. B., R. J. Greenwood, M. A. Sovada, and T. L. Shaffer. 1993. *Distribution and abundance of predators that affect duck production—Prairie Pothole Region; U.S. Fish and Wildlife Service Resource Publication 194*. Washington, DC: U.S. Department of the Interior.

Sargeant, A. B., M. A. Sovada, and T. L. Shaffer. 1995. Seasonal predator removal relative to hatch rate of duck nests in waterfowl production areas. *Wildlife Society Bulletin*. 23:507–13.

Shaw, W. W. 1977. A survey of hunting opponents. *Wildlife Society Bulletin*. 5:19–24.

Sidle, J. G. 1981. Wetland easements and their enforcement in North Dakota. *Wildlife Society Bulletin*. 9:273–9.

Sugden, L. G., R. G. Clark, E. J. Woodsworth, and H. Greenwood. 1988. Use of cereal fields by foraging sandhill cranes in Saskatchewan. *Journal of Applied Ecology*. 25:111–24.

Trottier, G. C., D. C. Duncan, and S. C. Lee. 1994. Electric predator fences delay mallard brood movements to water. *Wildlife Society Bulletin*. 22:22–6.

Turner, B. C., G. S. Hochbaum, F. D. Caswell, and D. J. Nieman. 1987. Agricultural impacts on wetland habitats on the Canadian prairies, 1981–1985. *Transactions of the North American Wildlife and Natural Resources Conference*. 52:206–15.

U.S. Fish and Wildlife Service 2006. *Waterfowl breeding population and habitat survey for South and North Dakota, 2006.* U.S. Fish and Wildlife Service. http://www.fws.gov/migratorybirds/reports/wps06/dakotas.pdf.

Watmough, M. D., D. W. Ingstrup, D. C. Duncan, and H. J. Schinke. 2002. *Prairie habitat joint venture habitat monitoring program phase 1: Recent habitat trends in NAWMP targeted landscapes, technical report series no. 391*. Edmonton, Alberta: Canadian Wildlife Service.

West, B. C., and T. A. Messmer. 2004. Impacts and management of duck-nest predation: The managers' view. *Wildlife Society Bulletin*. 32:772–81.

Williams, B. K., M. D. Koneff, and D. A. Smith. 1999. Evaluation of waterfowl conservation under the North American waterfowl management plan. *Journal of Wildlife Management*. 63:417–40.

Zimmer, J. M. 1996. *Effects of predator reduction on the survival and movements of northern shoveler broods*. M. S. thesis, Louisiana State University, Baton Rouge.