PREDATOR MANAGEMENT FOR DUCKS ON WATERFOWL PRODUCTION AREAS IN THE NORTHERN PLAINS

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ABSTRACT: In 1961, Congress initiated the Accelerated Wetland Acquisition Program, which has resulted in purchase of about 2,450 scattered small Waterfowl Production Area (WPA) management units in the Prairie Pothole Region of Minnesota, Montana, North Dakota, and South Dakota. The WPAs are administered by the U.S. Fish and Wildlife Service (FWS); increased duck production is a major management objective. Duck recruitment rates in much of the four-state area are very low because of high predation, especially on nests. Principal predators responsible for the predation are six mammalian carnivores and one rodent. The actions of predators on WPAs, especially in central and eastern portions of the area, render many areas ineffectual for duck production. A survey of managers of the 22 Wetland Management Districts in the area revealed that little predator management for increased duck production is being conducted on WPAs and that few data are available from which to evaluate effectiveness of methods being used. Public trapping and hunting are permitted on nearly all WPAs. Habitat management is widely practiced but has had limited impact on predation rates. Other predator management activities include limited or experimental use of selective predator control, nesting structures, artificial islands, and electric fences. There is growing demand for cost-effective and acceptable methods to reduce predation, but the number, size, and arrangement of WPAs pose difficult management problems.

INTRODUCTION

The approximately 777,000-km^2 Prairie Pothole Region (PPR) in the northern plains of the United States and Canada produces about half of the continent's ducks annually (Smith et al. 1964). Most of the PPR is intensively farmed and there has been extensive loss of waterfowl habitat to cultivation and drainage. Because of concern about effects of habitat loss on waterfowl populations, Congress passed the Wetlands Loan Act in 1961 and thereby initiated the Accelerated Wetland Acquisition Program. The Act authorized advance appropriation of $105 million to be repaid from future duck stamp sales for acquisition of habitat for migratory waterfowl, primarily in Minnesota, Montana, North Dakota, and South Dakota. These four northern plains states include the United States portion of the PPR. A major goal of the acquisition program was to purchase 243,000 ha of scattered WPAs (Pospahala et al. 1974).

Since 1961, the acquisition program has been extended three times, repayment of the loan deferred to a later date, and the authorized loan increased to $200 million. As of 30 September 1983, the program had resulted in purchase of 196,557 ha of WPAs, of which 95% are in the four PPR states (U.S. Fish and Wildlife Service 1983). There are 22 individual Wetland Management Districts in these states; the Districts encompass about 2,450 individual WPA management units ranging in size from <1 ha to about 1,000 ha. The purpose of this paper is to discuss the status of predator management for ducks on WPAs in the four PPR states.

MANAGEMENT GUIDELINES

Waterfowl Production Areas are part of the National Wildlife Refuge System, but they have special administrative designation. They are marked with signs identifying them as WPAs and are open to hunting, trapping, bird-watching, and other wildlife-oriented recreation unless closed by regulation or special conditions. In describing WPAs, the FWS Refuge Manual states (3 RM 2.2, 12 March 1982):

> "These areas are managed to preserve wetland habitat, to increase the production of waterfowl, to sustain indigenous wildlife, and to benefit the public using these areas."

The need to produce more ducks from such lands to help offset losses of production caused by dwindling habitat elsewhere was recognized early in the acquisition program (Janzen 1964, Gottschalk 1965). Although most managers of WPAs consider waterfowl production to be their primary management objective, management for waterfowl must take into consideration other ecological and recreational values of WPAs.

Management of WPAs requires that decisions be made that nearly always favor some wildlife species at the expense of others. The negative aspects of management decisions on certain species can be subtle, such as occurs from habitat change, or obvious, such as predator control. Managers have few guidelines to aid them in making these decisions. Recently, the role of predator management on FWS lands for the benefit of waterfowl has been clarified. In 1983, the FWS issued a policy statement that reads in part:

> "It shall be the policy of the U.S. Fish and Wildlife Service to appraise the effects of predation on breeding waterfowl on Service lands. In those circumstances where it is determined that waterfowl production objectives are being compromised on Service lands because of predation on waterfowl, their eggs, or their young, and other reasonable efforts have proven unsuccessful, the Service may implement predator management."

Hence, predator management is recognized by the FWS as an acceptable waterfowl management practice, but it may be used only if waterfowl production objectives are being compromised by predation and other reasonable management efforts have failed. The policy statement lists numerous other criteria that must be met before predator management may be implemented, including: the chosen approach must be generally socially acceptable and cost-effective, the management is to be site-specific, habitat must be sufficient to support desired waterfowl production, and state wildlife agencies must concur with proposed reductions of predator populations that are under state jurisdiction.

EVALUATIONS OF DUCK PRODUCTION

It has been known for a long time that predators in the PPR take many duck hens, eggs, and ducklings each year (e.g., Kalmbach 1938, Sowls 1955, Keith 1961, Moyle 1964), but only lately have sufficient data become available and methods been developed to evaluate predator impacts on duck populations (Johnson and Sargeant 1977, Cowardin and Johnson 1979, Cowardin et al. 1983a). A recent 4-year study of the mallard (Anas platyrhynchos) in central North Dakota revealed the impact predators can have on duck production (Cowardin et al. 1983b). In that study, nest success averaged 8% and only 15% of the hens hatched a clutch. In addition, at least 20% of the hens were killed by predators and there was substantial loss of ducklings. As a result of these losses, recruitment was insufficient to maintain a stable population without an influx of pioneering birds. Nest success of about 15% would have been required to achieve population stability.

Other data indicate these findings reflect the situation in much of central and eastern portions of the four-state area (Johnson and Sargeant 1977, Cowardin et al. 1983b, Talent et al. 1983, Central Flyway Technical Committee Preliminary Report 25 July 1983, unpubl. data, Northern Prairie Wildlife Research Center nest file, unpubl. data). However, data for western portions of the area, especially northwest North Dakota and Montana, indicate nest success and presumably recruitment rates are higher in those areas than in central and eastern areas (Cowardin et al. 1983b). Although data are insufficient to draw firm conclusions about population trends of mallards and other ducks in the four states, they do show that annual recruitment in most of the area is only a small fraction of its potential and that predation is the major limiting factor.

THE PREDATOR FACTOR

Predator populations in the four PPR states vary spatially and temporally (Cowardin et al. 1983b). The predators having greatest impact on ducks in these states are six carnivores and one rodent (Table 1), but other species may be important locally. All take eggs, but only some prey on hens or ducklings; more species affect upland-nesting than overwater-nesting ducks. Except for an assessment of red fox predation on adult ducks (Johnson and Sargeant 1977, Sargeant et al. in press), impacts of individual predator species on duck production have not been quantified.

All species in Table 1, except the coyote, occur on most WPAs in western Minnesota, central and eastern North Dakota, and South Dakota. Franklin's ground squirrels occupy relatively small home ranges and require dense cover of a type prevalent on many WPAs (Choromanski-Norris 1983). Densities are probably greater on WPAs than on most private lands; densities on WPAs are affected by vegetation management practices. The other species have large home ranges, often in excess of 5-10 km^2 (Johnson and Sargeant 1977, Fritzell 1978, Lampe and Sovada 1981, A. B. Sargeant and R. J. Greenwood, unpubl. data). Waterfowl Production Areas provide carnivores with attractive foraging, denning, and resting areas, but it is unlikely that habitat management practices on WPAs affect carnivore densities in the vicinity of WPAs.

Table 1. Predator species having greatest impact on duck production on Waterfowl Production Areas in the Prairie Pothole Region of Minnesota, Montana, North Dakota, and South Dakota, and the principal duck prey types affected. Impacts of greatest consequence are underlined.

Predator species	Upland-nesting ducks			Overwater-nesting ducks		
	Hens	Eggs	Ducklings	Hens	Eggs	Ducklings
Badger (Taxidea taxus)		X				
Coyote (Canis latrans)	X	X	X			
Franklin's ground squirrel (Spermophilus franklinii)		X				
Mink (Mustela vison)	X		X	X	X	X
Raccoon (Procyon lotor)		X			X	
Red fox (Vulpes vulpes)	X	X				
Striped skunk (Mephitis mephitis)		X				

[a]Based on Balser et al. (1968), Duebbert and Kantrud (1974), Eberhardt and Sargeant (1977), Greenwood (1981), Cowardin et al. (1983), Talent et al. (1983), Sargeant et al. (in press), and A. B. Sargeant and R. J. Greenwood (unpubl. data).

The red fox is probably the predator that has greatest impact on duck production in the four states. It is effective in capturing hens (Sargeant et al. in press) and is attracted to duck eggs (A. B. Sargeant, unpubl. data). The movements and feeding habits of foxes are such that a single pair raising pups on a WPA can almost totally eliminate successful duck nesting on the area (Sargeant et al. in press). The red fox is abundant in central and eastern portions of the four-state area but is less common in the west and northwest where coyotes are prevalent. Occupation of an area by coyotes rather than red foxes is the result of interspecific canid competition in which coyotes dominate (Sargeant 1982, Voight and Earle 1983). The presence of coyotes in the western areas is believed to contribute substantially to higher duck-nesting success in those areas (Cowardin et al. 1983b). The western areas are also outside the geographic range of the Franklin's ground squirrel (Hall 1981).

CURRENT PREDATOR MANAGEMENT ACTIVITIES

We contacted managers of the 22 Wetland Management Districts to determine type and status of predator-related management activities being conducted on WPAs in each district and to gain insight into manager attitudes concerning predator management for ducks. When asked if predation was a problem on WPAs in their district, 16 managers believed it was, 4 believed it was not, and 2 did not know. All managers reporting no problem were from western parts of the area. The responses, however, must be tempered by knowledge that most managers had little or no data from their districts from which to quantify predator impacts, and that there are no official standards for managers to use to gauge whether or not a problem exists.

Predator management methods currently being used on WPAs and an estimate of their effectiveness in increasing duck production are shown in Table 2. In addition to activities listed, most managers routinely eliminate old buildings and junk piles for aesthetic and safety purposes and to remove potential predator den sites. Permitting public trapping and hunting and upland habitat management are the only two methods being used extensively, but neither is conducted primarily for predator management. The first is a permitted public use activity that is occasionally encouraged whereas the second is conducted by managers and involves considerable investment of manpower and funds. Two other methods, construction of nest structures and nest islands, received widespread use in two districts but little use overall. The other two methods, predator control and electric fences, were used on a limited or experimental basis in a few districts. Managers indicated they have few data with which to evaluate the effectiveness of their predator management activities.

Table 2. Application and estimated effectiveness of predator management methods being used to increase duck production on Waterfowl Production Areas in the 22 Wetland Management Districts in Minnesota, Montana, North Dakota, and South Dakota.[a]

Management practice	Current application				Effectiveness			
	Widespread	Limited	Experimental	None	Effective	Limited effectiveness	Not effective	No data
Predator control	0	1	2	19	1	0	0	2
Public trapping and hunting	22	0	0	0	0	0	1	21
Nest structures	1	5	1	15	2	3	0	2
Nest islands	1	7	1	13	0	2	0	7
Electric fences	0	0	3	19	3	0	0	0
Upland habitat management[b]	21	1	0	0	2	4	1	15

[a] Information was obtained during winter 1983-84 from telephone interviews with managers in each Wetland Management District.

[b] Practices in this category vary greatly but most involve the planting of duck nesting cover consisting of cool-season grasses and legumes or of warm-season grasses.

Comments by managers about predator management varied greatly. Managers are concerned about the problem of low recruitment of ducks from WPAs, but few regard current information as adequate for launching extensive predator management programs. Concerns expressed include the priority of more intensive management of WPAs versus acquiring additional lands or altering land-use practices on private lands, the need to better document the scope and magnitude of the recruitment problem, and the lack of proven and acceptable methods of managing predators. Managers were not opposed to direct predator control, but most regard it as a least-preferred method and believe it should be used selectively. Logistics and economics associated with management of large numbers of scattered WPAs were factors that prevent most managers from seriously considering widespread application of any management method that requires regular attention.

PREDATOR MANAGEMENT OPTIONS

Techniques to reduce predation on ducks on WPAs can be grouped into two broad categories: (1) altering the density or behavior of predators, and (2) reducing vulnerability of prey to predators. In the first category, predator numbers are reduced or food preferences of predators are altered to reduce numbers of duck hens, eggs, and ducklings taken. Benefits of these approaches would nearly always extend onto surrounding private lands and to other prey species. In the second category, the environment is manipulated to reduce predator access to individual hens, nests, and ducklings. With this approach, benefits would be restricted to WPAs and would apply to specific units of habitat or to certain species.

Altering Predator Density or Behavior

Manipulations of predator populations considered to have potential for use on WPAs are extensive predator control, selective predator control, reproductive inhibitors, biological control, and aversive agents. Extensive predator control has been evaluated in two studies in the four PPR states and found to increase duck production substantially (Balser et al. 1968, Duebbert and Lokemoen 1980). However, the control was conducted on large areas and involved use of toxicants, which are not currently approved for operational use to increase duck production on FWS lands. The success represented in these studies was because populations of major predator species were kept low throughout the duck-nesting season. It would be difficult to keep predator populations low if control was restricted to small, isolated WPAs, especially without toxicants. Because predators disperse and rapidly occupy vacant habitat (Sargeant 1972, Storm et al. 1976, Fritzell 1978, Sargeant et al. 1982), individual predators will continually invade WPAs after control is initiated. Extensive predator control can be most efficiently applied to large WPAs or to clustered WPAs where nearby control efforts are complementary.

Selective predator control targeted at one or two species can be applied on WPAs, but there are few data on benefits of such control to duck production. Recreational fur trapping and predator hunting are examples of selective predator control methods permitted on almost all WPAs. These methods are without cost to the FWS and result in temporary reductions of local predator populations. It may be possible to encourage greater harvests of some species, but effects on duck production will probably be small because most fur harvests; occur during fall and winter, long before the duck-nesting season. The severe predation discussed in this paper is occurring during a period of relatively high prices for longhair fur; thus, the economic incentive for harvesting predators is already high. Other options include control of individual predator species, especially those that are easily manipulated and generally regarded as undesirable. For example, it might be acceptable and beneficial to reduce Franklin's ground squirrel populations or to remove striped skunks on particular WPAs. Intensive skunk control has been conducted experimentally on and in the vicinity of WPAs in western Minnesota and central North Dakota, resulting in an average increase in nest success of about 10%, although results were variable (R. J. Greenwood and H. A. Doty, unpubl. data).

The destruction of predator young at den sites (denning) on WPAs may have application with respect to certain species, especially red foxes. Dens are focal points of predator activity and, when located in duck-nesting habitat, result in considerable use of the habitat by predators (Sargeant 1972). Till and Knowlton (1983) found that removal of coyote pups from dens resulted in decreased predation on sheep. To what extent removal of red fox pups from a WPA, for example, would influence duck production is unknown.

The use of orally administered reproductive inhibitors is an appealing potential method for reducing predator densities. The reproductive inhibitor diethylstilbestrol has been field-tested with canids, but results are inconclusive or only moderately encouraging (Balser 1964, Allen 1982). Reproductive inhibitors are intended to prevent birth of litters, thereby reducing population size the next year or reducing predation rates of adults that have no young to feed. It is unlikely that application of a reproductive inhibitor to isolated WPAs would noticeably affect predator population size the next year because too few individuals would be affected. The effect that absence of birth of predator litters would have on duck production is unknown.

Biological control may have a role in management of predator populations on some WPAs. The relationship between coyotes and red foxes previously discussed can possibly be used to advantage in certain situations, particularly on large WPAs in localities where both species occur. The protection of resident pairs of coyotes could result in the exclusion of red foxes and increased duck production. However, in some areas coyotes may not be wanted because of their impacts on livestock and other desired wildlife species.

The use of orally administered aversive agents to discourage individual predators from taking specified waterfowl prey, especially eggs, is another appealing potential method for reducing predation. The salty-tasting aversive agent lithium chloride has been field-tested, primarily with respect to reducing coyote predation on sheep, but, as with the use of reproductive inhibitors, results have not been very encouraging (Burns 1983, Horn 1983). This method has received little evaluation with regard to alleviating predation on duck nests. Recently, some success has been reported in averting common crows (Corvus brachyrhynchos) from eating experimentally placed eggs, using tasteless concentrations of the aversive agent 2-, 3-, 5- and 3-, 4-, 5-trimethylphenyl methyl carbamate (Nicolaus et al. 1983).

Reducing Prey Vulnerability

Predator management methods in this category include manipulation of habitat, especially vegetation, and construction of predator barriers. Vegetation manipulation is conducted primarily to create nesting habitat that attracts hens, and secondarily to provide hens with safer nest sites. Other purposes include providing habitat for other wildlife species, soil conservation, and weed control. Cool-season grasses and legumes, commonly referred to as dense nesting cover (DNC), have been planted on many WPAs to increase duck production (Duebbert et al. 1981). In much of western Minnesota, tall, warm-season native grasses of Nebraska origin have been used in place of DNC (N. F. Wallace, pers. commun.). Results of studies in North Dakota and South Dakota in the late 1960s and early 1970s indicated that DNC attracted several species of ducks, especially mallards and gadwalls (A. strepera), and afforded them protection from predators (e.g., Schranck 1972, Duebbert and Kantrud 1974). Subsequent data indicate that although DNC is attractive to most dabbling duck species (H. F. Duebbert, pers. commun.) and generally increases nest success compared with unmanaged cover (Cowardin and Johnson 1979), nest success in DNC is variable and often low. For example", during recent years nest success of 3-10%, with nearly all losses caused by predators, has been observed on many WPAs in western Minnesota and central North Dakota where the principal upland habitat is managed nesting cover (H. A. Doty, R. J. Greenwood, and P. M. Arnold, unpubl. data). Habitat management is the preferred method for reducing predation because of its broad spectrum of values, low maintenance, and noncontroversial nature.

Nesting structures, islands, and electric fences are three types of predator barriers. Elevated nesting structures are attractive to mallards in some areas and generally result in high nest success (Bishop and Barratt 1970, Doty et al. 1975). Elevated structures have been less effective in western Minnesota than in central North Dakota (H. A. Doty, unpubl. data) and recent results for central North Dakota are less encouraging than in early studies (Sidle and Arnold 1982, P. M. Arnold, unpubl. data).

Currently, there is much discussion about construction of artificial islands on WPAs, a practice that has been used extensively both by Ducks Unlimited in Canada (Giroux 1981) and by the FWS on NWRs. Dense concentrations of nesting ducks with high nest success have been observed on islands at numerous locations in the PPR states (e.g., Hammond and Mann 1956, Drewien and Fredrickson 1970, Duebbert 1982, Duebbert et al. 1983). Islands with brush or dense herbaceous cover are especially attractive to mallards and gadwalls, but benefits to duck production are contingent on lack of predation. The most outstanding example of a productive island is 4.5-ha Miller Lake Island in northwestern North Dakota where 2,561 duck nests were found during 1976-80; nest success averaged 85% (Duebbert et al. 1983). That island is in a large alkaline lake, 180 m from shore and was free of mammalian predators. Islands built to increase duck production in the relatively small freshwater wetlands found on most WPAs, in contrast, will usually be attractive and accessible to mink, raccoons, and possibly some other predators.

Recently, electric fences have been tested to exclude mammalian carnivores from units of managed nesting cover on WPAs. Lokemoen et al. (1982) reported nest success inside electric fence exclosures of 65% in North Dakota and 55% in Minnesota, compared with 45 and 12% in controls, respectively. Higher success has been obtained in ongoing tests in North Dakota, which include selective control of Franklin's ground squirrels and carnivores that gained access to the exclosures (R. J. Greenwood and P. M. Arnold, unpubl. data). There is optimism that, with refinement, fences can be used to create secure nesting areas that function like islands and result in substantial increases of local populations of some duck species.

DISCUSSION

Predator management is a frustrating subject to administrators and managers of the waterfowl resource in the northern plains. Emphasis on improving duck production from lands acquired under the Accelerated Wetlands Acquisition Program is certain to continue as the quality and quantity of waterfowl habitat on private lands in the PPR continue to decline. Waterfowl Production Areas contain some of the best waterfowl production habitat remaining in the PPR states, because nearly all land in private ownership is cultivated annually or heavily grazed (Higgins 1977, Cowardin et al. 1983b). As a result, many WPAs are islands of habitat that have become too important to leave unmanaged.

Waterfowl production habitat that appears excellent can be unproductive for ducks because of effects of excessive mortality induced by man, disease, and predators. When addressing predation, many managers are faced with a dilemma. While WPAs attract nesting ducks and can be managed to attract more ducks, predation renders many WPAs ineffectual for duck production. It is unlikely that this situation will be resolved without changes in predator populations, or possibly changes in agricultural practices that alter duck nesting and predator-foraging patterns. What then are a manager's options?

Most research on waterfowl predation in the PPR has focused on determining impacts of predation on duck production and on ascertaining the relative importance of individual predator species. Many of the studies were initiated in the mid to late 1960s when the prevailing attitude was that predators had minor impact on other wildlife populations. That work established that predation is a major factor limiting duck production in the PPR (Cowardin et al. 1983b). Now there is a growing demand for effective and cost-efficient management methods to solve the problem, As indicated in this paper, however, there are few proven methods available and, unfortunately, there is little ongoing research on predator management.

The problem of high predation rates on ducks nesting in the PPR is complex and solutions are not likely to be simple or universally applicable. Efficient, effective, and acceptable predator manage-

ment requires that managers have available a variety of proven methods. Treatment then can be applied when and where needed. Selective treatment, however, requires that managers be *very* familiar with the WPAs they manage and know the source and magnitude of predator impacts. Predator management will be expensive but it offers the potential for high returns in duck production, especially when integrated with habitat management (Cowardin and Johnson 1979, Duebbert and Lokemoen 1980), and may be one of the most cost-efficient methods available for increasing duck production from WPAs (Lokemoen in press).

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