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Bullsnake Predation on Waterfowl Nests on Valentine National Wildlife Refuge, Nebraska

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Abstract: Bullsnake (Pituophis melanoleucus) predation on upland nesting ducks was monitored on Valentine National Wildlife Refuge (NWR) from 1982-86. The fate of 1,999 duck nests of 9 species was observed under different treatments of land use and control of potential nest predators. Maximum potential levels of bullsnake depredation are masked by nest destruction by mammalian species; bullsnake nest depredation rates were >65% where mammalian predators were controlled, >40% without predator control and <4.0% where both mammalian and reptilian predators were controlled and/or excluded. Duck nest densities were dramatically increased where predator control was accomplished in undisturbed nesting cover.

INTRODUCTION

The major environmental factors contributing to positive waterfowl production include a complex of quality wetlands, dense nesting cover and rigid control of potential nest predators (Duebbert and Lokemoen, 1980). Extensive degradation of habitat is limiting the reproductive potential of waterfowl over their breeding range. Improving the productivity of remaining habitat is one means to counter the downward population trend of waterfowl.

In the early 1970's, a major change in management of wetlands and upland nesting cover was initiated on Valentine NWR. Seven lakes totalling 950 ha were mechanically dewatered and chemically treated to improve water quality by elimination of carp (Cyprinus carpio) infestations. Annual livestock grazing was reduced from 42,000 animal use months (AUMs) to approximately 13,000 AUMs by 1983. Timing of grazing treatments was used to create and maintain tall warm season grass species for nesting cover. Documentation of the response of waterfowl to the change in management direction has been monitored.

Ladd (1969) documented that the sub-irrigated meadows are the primary sites selected by upland nesting ducks on Valentine NWR. Nesting studies carried out during 1970-72 and 74 on 1,260 ha documented that average upland duck nest densities in undisturbed cover (0.6/ha) were double that found in disturbed cover. A greater disparity between undisturbed and disturbed cover nest densities was documented during 1978-82 on 1,658 ha. This information substantiated that upland nesting ducks preferentially selected nesting cover that had been undisturbed for two or more years over disturbed cover (0.8 vs. 0.2 nests/ha). Average mallard (Anas platyrhynchos) nest densities were eight times greater in cover that was undisturbed for two or more years than in any other cover treatment. Since 1980, "preferred" nesting cover increased from 9 to 41% of the total meadow classified priority management for upland nesting waterfowl.

Management strategies to increase waterfowl production on Valentine NWR by improving wetland quality and upland nesting cover have been dampered by excessive nest predation. Sargeant and Arnold (1984) listed the badger (Taxidea taxus), coyote (Canis latrans), Franklin's ground squirrel (Spermophilus frankinii), mink (Mustela vison), raccoon (Procyon lotor), red fox (Vulpes vulpes) and striped skunk (Mephitis mephitis) as predator species having the greatest impact on duck production. Except for the Franklin's ground squirrel and red fox, these predator species occur and have been documented as predators on duck nests on Valentine NWR. Teer (1964) documented long-tailed weasel (Mustela frenata) depredation on eggs of blue-winged teal (A. discors). Long-tailed weasels were documented preying on both eggs and nesting hens in our studies; however, depredations were infrequent, localized and easily controlled. Imler (1945) documented the bullsnake as a major predator of duck nests in the Nebraska Sandhills. Snake predation on waterfowl nests has been reported by others (Aldrich and Endicott 1984 and Wheeler 1984); however, the magnitude of its impact upon production is seldom addressed.

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Summarized are the preliminary results of efforts to increase waterfowl production by removal and/or exclusion of potential waterfowl nest predators. Emphasis is placed on bullsnake depredations and their control during 1982-86.

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STUDY AREA AND METHODS

Valentine NWR is located in the north central portion of the Nebraska Sandhills, 16 km south of Valentine, Nebraska. The refuge totals 28,955 ha including approximately 4,000 ha of marsh and shallow lakes, 20,000 ha of sand and choppy sand sites and 5,000 ha of sub-irrigated meadows.

Control of nest predators was initiated in 1982 on Habitat Unit (H.U.) 18C2; an island which was reduced from 27 to 4 ha during the 5-year study period by rising water levels of the Marsh Lakes. In 1985, control efforts were expanded to the Marsh Lakes proper which includes 930 ha of wetlands, 540 ha of meadow and 2,050 ha of sand and choppy sand sites. Documentation of the mainland control effort was concentrated in H.U. 21B-18C1; a 40 ha area of undisturbed nesting cover where duck production potential was high. Duck nests were located and monitored within the parameters of Klett et al. (1986), Reardon (1951) and Imler (1945).

Force account mammalian control activities were conducted during March-May to remove resident predators (Roy and Dorrance 1985) which remained after the opportunity for harvest was available to recreational hunters and trappers. Conibear, live and leg-hold traps as described by Johnson (1983), Wade (1983), Boggess (1983), Knight (1983) and Henderson (1983) were used to capture mammalian predators. Drift fence traps were used to capture bullsnakes (Imler 1945 and Buford 1983), but, the entrance of the funnel opening into the trap was reduced to 25 mm in diameter to minimize capture of non-target species. Electrical fencing (Lokemoen et al. 1982) was used from 1982-84 to prevent mammalian predators from gaining access to H.U. 18C2 via dike; however, it was discontinued in 1985 because of inundation of the dike by high water. In March of 1985-86, coyotes were removed by aerial hunting (Wade 1978).

RESULTS AND DISCUSSION

A total of 1,999 upland duck nests including 7 dabbling and 2 diving duck species were monitored during 1982-86. In 1983-84, Glup (1986) found that the nest densities were greater ($P<0.0810$) in undisturbed cover (1.3 nests/ha) than in grazed cover (0.5 nests/ha). Also extensive duck nest destruction occurred in all cover treatments. Coyotes and bullsnakes destroyed 68% of all nests under observation and 96% of all nests destroyed by predators.

Duck nest destruction by mammalian predators was significantly less in areas where control techniques were applied as compared to areas where control was not carried out. The percentage of nests destroyed by mammalian predators other than coyotes and number of these predators taken both increased after intensive coyote control was initiated (table 1). In the absence of mammalian predation, bullsnake depredations increased to >65%. Thus compensating for nest depredations that otherwise would have been incurred by mammalian species (fig. 1).

Table 1. Potential mammalian predators removed prior to and during the nesting season.

Species	1982	1983	1984	1985	1986
Coyote	1	56	33	175	82
Other[1]	6	33	20	43	56

[1]Other includes raccoon, skunk, mink and badger.

Bullsnake nest predation is generally subtle, occurring over a period of time. Bullsnakes consume 1-5 eggs per visit. Rarely did we document cold eggs in abandoned nests being taken. Also, spoiled eggs in nests being incubated were not taken by bullsnakes. During 1982-85, 110 bullsnakes were removed from H.U. 18C2. Twenty-eight were captured in duck nests consuming or attempting to consume eggs, and in seven instances the hens were

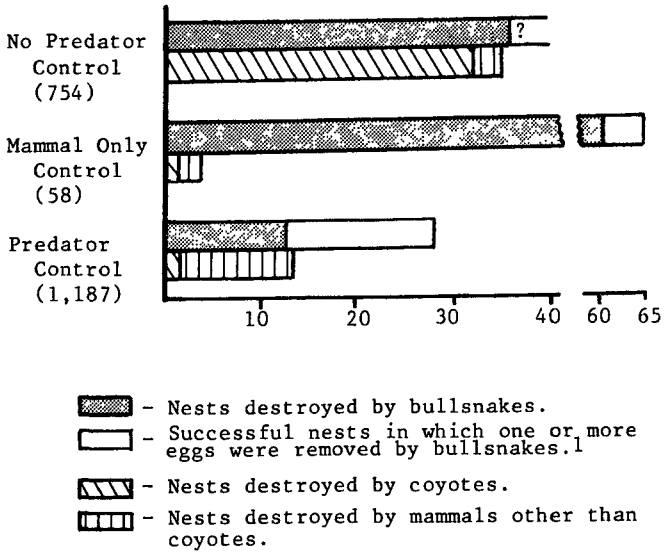

Figure 1. Percent duck nests depredated comparing three predator control management strategies.

[1]? - Information lost in a residential fire.

still on the nests. Bullsnake predation is not limited to eggs, small ducklings may also be taken. In 1985, a 122 cm bullsnake was observed and photographed that had captured a nesting green-winged teal (A. crecca).

Imler (1945) reported that of 274 duck nests under observation on Crescent Lake NWR, bullsnakes completely destroyed 114 (45%) besides taking eggs from many other nests. Bullsnake depredation does not always result in termination of the nest (fig. 1). Although nesting attempts may be defined as successful, clutch sizes are reduced. The mean number of eggs hatched from 345 blue-winged teal nests was 9.6 per normal nest and 6.1 per nests depredated by bullsnakes. Whereas, for 202 mallard nests, 8.2 eggs hatched per normal nest and 6.0 eggs hatched per depredated nest.

Bullsnakes present differential rates of predation on early and later nesting species or individuals depending upon the timing bullsnakes emerge from hibernacula (fig. 2). Glup (1986) found a statistically significant linear decrease ($R^2 = 0.9246$, $P<0.0001$) in nest success during the 1983-84 nesting seasons. During 1985-86, average bullsnake depredation rates on mallards were considerably less than later nesting gadwall (A. strepera) and blue-winged teal (table 2).

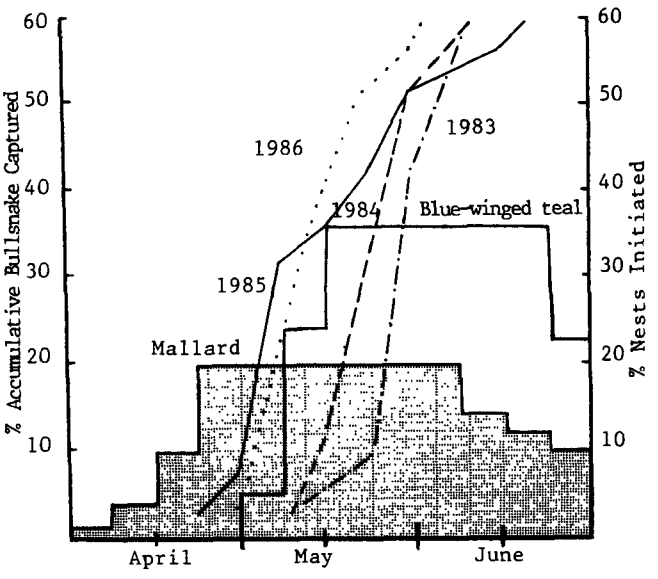

Figure 2. Date bullsnakes emerged from hibernacula in relationship to mallard and blue-winged teal nesting chronology -- 1983-86.

Table 2. Average bullsnake predation rates for duck nests under observation -- 1985-86.

Species	Nests	% Bullsnake Depredation	% Bullsnakes Destroyed
Mallard	249	12.5	7.6
Blue-winged teal	426	34.0	22.3
Gadwall	114	33.0	19.0

Bullsnakes have generally been considered sedentary in nature (Imler 1945, Fitch 1949 and Parker and Brown 1980), but, Fox (1986) reported activity ranges of 4-17 ha for bullsnakes on Crescent Lake NWR. Telemetry studies on Crescent Lake NWR substantiated that bullsnakes do not communally den in the Nebraska Sandhills, but, rather individually use pocket gopher (Geomys bursarius) burrows extensively throughout the year. Therefore, limiting present known options of bullsnake control to intensive trapping.

A total of 658 bullsnakes were captured with 1,242 m of drift fence traps in 1985. In 1986, 786 bullsnakes were captured with 2,985 m of fence. Population densities of bullsnakes on Valentine NWR are unknown; however, the number of bullsnakes captured exceeded duck nests located on the study area where intensive predator control was initiated in 1985. A trapping effort of 7.5 m of drift fence traps per 0.4 ha reduced bullsnake depredation on duck nests by 21% and nest destruction by 12% (Table 3).

Table 3. Bullsnake control and waterfowl productivity -- H.U. 21B-18C1.

Year	Bullsnakes Captured[1] #	Bullsnakes Captured[1] #/ha	Duck Nests #	Duck Nests #/ha	Bullsnake Depredation % Nests Depredated	Bullsnake Depredation % Nests Destroyed
1985	409	10.1	194	4.8	49	27
1986	319	7.9	146	3.6	28	15

[1]Does not include hatchlings.

Greater success in reducing duck nest depredation by bullsnakes was achieved in H.U. 18C2. Bullsnakes gain access to this island from the mainland by swimming less than 100 m. Predator control activities were intitiated on H.U. 18C2 in 1982; however, bullsnake numbers and depredations were not suppressed until intensive trapping was accomplished on the adjacent mainland during 1985-86 (table 4).

The management strategy applied to H.U. 18C2 during the five years provided an environment favoring mallard production. From 1982-86, mallard nests increased from 13 to 114 while blue-winged teal nests decreased from 117 to 31. Low return rates of blue-winged teal (Sowls 1955) evidently prevented them from responding similarly to mallards even though high nest success was achieved (table 4).

Table 4. Bullsnake control and effect upon duck production - H.U. 18C2.

Year	Duck Nests/ Ha	Bullsnakes Captured	Bullsnake Depredations % Nests Depredated	Bullsnake Depredations % Nests Destroyed	Mayfield Nest Success
1982	5.2	28	40	16	33
1983	8.4	30	23	7	75
1984	29.1	32	38	23	43
1985	40.8	12	12	3	67
1986	44.5	8	6	1	69

Productivity resulting from a management strategy that emphasized environmental factors which contribute to positive waterfowl reproduction ranged from 21.7 ducklings per ha on the mainland to 232 for the island study areas. Conversely, strategies applied to these same areas in the past in which one or more of the major environmental factors for positive production were lacking, productivity ranged from 1.0 to 2.3 ducklings per ha.

MANAGEMENT IMPLICATIONS

There are excellent opportunities for increasing waterfowl productivity on lands dedicated to that purpose. However, management needs to focus on practical strategies which are physically possible and therefore long-term in nature -- attitudes and historical priorities may also need to be reassessed.

Degradation of wetland quality, lack of adequate nesting cover and excessive nest predation are the primary obstacles confronting nesting ducks. Where these environmental factors were addressed on Valentine NWR, high duckling productivity was realized. Duck nest success and density were both significantly increased especially for those species with strong homing tendencies such as the mallard.

An effective nest predator control program needs to include all potential nest predator species. Predator control can be most efficiently carried out with an intensive effort immediately prior to and during the nesting season. The bullsnake is an extra element, evidently unique to the Nebraska Sandhills, which complicates an effective and efficient nest predator control effort. Presently, refuge-wide duck nest predator control is not practical; therefore, intensive management is being limited to areas with potential for high duck production.

LITERATURE CITED

Aldrich, W.A. and C.G. Endicott. 1984. Black rat snake predation on giant Canada geese eggs. Wildl. Soc. Bull. 12: 263-264.

Boggess, E.K. 1983. Mink. Prevention and Control of Wildlife Damage (R.M. Timm, Ed.). pp C 61-64.

Buford, J.L. 1983. Non-Poisonous Snakes. Prevention and Control of Wildlife Damage (R.M. Timm, Ed.). pp. F 7-11.

Duebbert, H.F. and J.T. Lokemoen. 1980. High duck nesting success in a predator reduced environment. J. Wildl. Manage. 44: 428-437.

Fitch, H.S. 1949. Study of snake populations in central California. The American Midland Naturalist. 41: 552-560.

Fox, J.J. 1986. Ecology and management of the bullsnake in the Nebraska Sandhills. Final Report - Crescent Lake NWR. 2 pp.

Glup, S.S. 1986. The effect of land use practices and predation on waterfowl production on the Valentine NWR in Nebraska. M.S. Thesis. Uni. Nebr. - Lincoln.

Henderson, F.R. 1983. Weasels. Prevention and Control of Wildlife Damage (R.M. Timm, Ed.) pp. C 87-91.

Imler, R.H. 1945. Bullsnakes and their control on a Nebraska wildlife range. J. Wildl. Manage. 9: 265-273.

Johnson, N.C. 1983. Badgers. Prevention and Control of Wildlife Damage (R.M. Timm, Ed.) pp. C 1-3.

Klett, A.T., H.F. Duebbert, C.A. Faanes, K.F. Higgins. 1986. Techniques for studying nest success of ducks in upland habitats in the prairie pothole region. U.S. Fish Wild. Serv., Resour. Publ. 158. 24 pp.

Knight, J.E. 1983. Skunks. Prevention and Control of Wildlife Damage (R.M. Timm. Ed.). pp C 81-86

Ladd, W.N. 1969. Relationship of predation and land use to duck nesting on Valentine NWR, Nebraska. M.S. Thesis. Colo. State Uni., Fort Collins. pp. 110

Lokemoen, J.T., H.A. Doty, D.E. Sharp and J.E. Neaville. 1982. Electric fences to reduce mammalian predation on waterfowl nests. Wildl. Soc. Bull. 10: 318-323.

Parker, W.S. and W.S. Brown. 1980. Comparative ecology of two colubrid snakes in northern Utah. Publ. in Biol. and Geol. Milwaukee Public Museum. 7: 76-95.

Reardon, J. 1951 Identification of waterfowl nest predators. J. Wildl. Manage. 15: 386-395.

Roy, L.D. and M.J. Dorrance. 1985. Coyote movements, habitat use and vulnerability in central Alberta. J. Wildl. Manage. 49: 307-313.

Sargeant, A.B. and P.M. Arnold. 1984. Predator management for ducks on waterfowl production areas in the northern plains. Proc. 11th Vertebrate Pest Conference (D.O. Clark, Ed.) Uni. Calif., Davis. pp. 161-167.

Sowls, L.K. 1955. Prairie ducks: a study of their behavior, ecology and management. The Stackpole Co., Harrisburg, PA. and Wildl. Manage. Inst., Washington D.C. pp. 193.

Teer, J.G. 1964. Predation by long-tailed weasels on eggs of blue-winged teal. J. Wildl. Manage. 28: 404-406

Wade, D.A. 1978. The use of aircraft in predator damage control. Proc. 7th Vertebrate Pest Conference (c.c. Siebe, Ed.) Uni. Calif., Davis. pp. 154-160.

_____1983. Coyote Prevention and Control of Wildlife Damage (R.M. Timm, Ed.). pp. C 31-41

Wheeler, W.E. 1984. Duck egg predation by fox snakes in Wisconsin. Wildl. Soc. Bull. 12: 77-78.