

Remains of Ducks and Other Prey Found Near Fox and Mink Dens on an Iowa Wildlife Refuge

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ABSTRACT - We found 12 bird species, 11 mammal species, 3 kinds of domestic animals, 1 fish species, and duck and pheasant eggshells among prey items from 27 red fox (*Vulpes vulpes*) rearing dens and 14 mink (*Mustela vison*) rearing dens at Union Slough National Wildlife Refuge in northern Iowa, March-July 1984-1985. Five species of adult ducks were the most common prey items. We found 1.6 ± 0.74 SE (range, 0-20) ducks at the surface of each fox den. At one excavated den, half of all ducks recovered were detectable from other surface remains. Dabbling ducks (*Anas* spp.) comprised 98% of the ducks (97% of these were females) found at fox dens but only 60% of the local waterfowl breeding population. Accounting for ducks not brought to dens, we estimated that the five or six fox families hunting on the refuge killed about half of the 245 breeding dabbling females each year. Adult ducks were less common at mink dens (mean = 0.5/den, range, 0-3) than at fox dens. We estimated that mink killed about 1% of the female dabblers breeding at the refuge.

Key words: Predation, red fox, mink, waterfowl, food habits, dabbling ducks

Red fox and mink frequently prey on waterfowl during the spring and summer (Eberhardt 1973, Sargeant et al. 1973, Eberhardt and Sargeant 1977, Johnson and Sargeant 1977, Sargeant et al. 1984, Arnold and Fritzell 1990). Most of the data on waterfowl losses to these predators were gathered from central areas of the prairie pothole region and are lacking for duck nesting habitat in Iowa.

We obtained information about predation on breeding ducks while studying waterfowl production at Union Slough National Wildlife Refuge (USNWR) in 1984 and 1985 (Fleskes 1986).

STUDY AREA

USNWR, established in 1937, has been managed as a waterfowl production area for its entire history. The refuge has a total area of 1150 ha and extends roughly north-south 17.5 km along a narrow drainage valley that includes Schwob Marsh, Union Slough, and Buffalo Creek in Kossuth County, north central Iowa. Permanently flooded wetland covers about half of the land in the refuge. Following the classification of Cowardin et al. (1979), this freshwater wetland is a palustrine system with persistent emergent vegetation dominated by cattails, *Typha latifolia*.

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The wetland is bordered on the east and west sides by a narrow strip of upland that rises abruptly in elevation and averages about 200 m in width. The upland is managed as grassland for nesting waterfowl. Cropland adjoins the refuge on all sides. Farm fields are divided by narrow corridors (fencerows, roads) that intersect refuge boundaries perpendicularly. A more detailed description of the physiography, vegetation, and land use of the area can be found in Burgess et al. (1965) and Fleskes and Klaas (1992).

METHODS

We identified food remains found at red fox and mink rearing dens at USNWR from March through July, 1984 and 1985. Although many small prey are cached or consumed entirely and are often not represented in den remains (e.g., mice, ducklings), uneaten parts of adult waterfowl brought to the dens can be used to determine numbers of adult waterfowl taken (Errington 1937, Eberhardt 1973, Eberhardt and Sargeant 1977, Johnson and Sargeant 1977, Sargeant et al. 1984).

Throughout each spring and summer, we searched on foot for dens along pool borders and on islands. We used all-terrain vehicles to search the uplands over the entire refuge for dens at least four times each year. We believe we found all the red fox dens at USNWR, but searches on adjacent lands were less intensive. Fox dens occupied early in the season lacked surface remains and were probably whelping dens. The number of fox families was determined from direct observation of pups and occupied dens. Mink dens were less conspicuous than fox dens, and we probably missed dens that lacked above-ground food remains. We believe most of the mink dens we found were rearing dens. After occupancy ended in late spring, we thoroughly searched the den sites and collected food remains at the surface and those we could reach in the den entrances. We also completely excavated one red fox den in 1984 to recover subsurface food remains. We collected and analyzed remains using methodology described by Sargeant et al. (1984). Statistical methods follow Snedecor and Cochran (1980).

RESULTS

Red Fox Abundance

We found 15 occupied red fox dens in 1984 and 12 in 1985. Based on the location of the dens, the age (Sargeant 1981) and number of pups, and the dates of occupancy, at least six fox families were present in 1984 (1 family/87 ha of USNWR uplands) and five in 1985 (1 family/105 ha of USNWR uplands). The average number of dens per fox family in both 1984 and 1985 was 2.4.

Food Remains at Fox Dens

The most common food item found at the surface of 27 fox dens was duck remains; we found a mean of 1.6 ± 0.74 SE (range = 0-20) ducks at each den (Table

1). Breeding ducks were more numerous at USNWR in 1985 (512 pairs) than in 1984 (302 pairs) (Fleskes 1986), and we found the remains of more ducks at the surface of fox dens in 1985 (mean = 2.6 ± 1.60 SE, $n = 12$) than in 1984 (mean = 0.8 ± 0.33 SE, $n = 15$). However, the difference in means was mostly due to one den in 1985 with 20 ducks and was not significant ($t=1.21$, 25 df, $P>0.20$).

Duck remains were present at 9 of 12 fox dens in 1985 and 6 of 15 fox dens in 1984; the difference was not significant ($X^2=3.30$, 1 df, $P>0.05$). We found duck remains at the surface of at least one occupied den of each fox family. Seven of the 12 dens without duck remains were used early, probably for whelping, and had no food remains of any type on the surface.

On 9 July 1984, we excavated one fox den that had been occupied throughout the 1984 denning season; half of all the ducks present at this den were detectable in surface remains. Remains of eight adult ducks included one female blue-winged teal (*Anas discors*), one female green-winged teal (*A. carolinensis*), four female mallards (*A. platyrhynchos*), a mallard of unknown sex, and one male wood duck (*Aix sponsa*). Other prey items included one American coot (*Fulica americana*), one red-winged blackbird (*Agelaius phoeniceus*), two plains pocket gophers (*Geomys bursarius*), two muskrats (*Ondatra zibethicus*), and two domestic chickens.

Although dabbling ducks comprised 60% of the local duck breeding population (wood ducks, 36%; hooded mergansers (*Lophodytes cucullatus*), 2%; diving ducks 2%; Fleskes 1986), 98% of all identifiable ducks at fox dens ($n=43$) were dabblers ($X^2=26.3$, 1 df, $P < 0.001$). We assume most ducks were taken from nests, because 97% of the dabblers identifiable to sex ($n = 37$) were females.

Of dabbler remains at dens that were identifiable to species ($n=37$), mallards comprised a larger proportion (51%) than was present in the local population (35%) (Fleskes and Klaas 1992). Blue-winged teal remains comprised a smaller proportion (43%) than was present in the local population (58%) ($X^2=4.63$, 1 df, $P < 0.05$).

Effect on Local Duck Population

Considering both surface and subsurface remains, the number of dens used by each fox family, and the estimated number of ducks taken by foxes but not brought to or detected at dens, we estimate that each fox family killed 21.8 female dabblers each season (see Sargeant et al. 1984, pp. 26-28, for discussion of calculations). Thus, foxes killed about half of the female dabbling ducks nesting at USNWR each year (5.5 fox families \times 21.8 female dabblers/ 245 breeding female dabblers = 0.49). The remains of 17 dabblers unassociated with dens were found in uplands. These remains may represent a portion of the ducks taken by foxes but not brought to their dens or remains scattered by older pups.

Food Remains at Mink Dens

We found food remains on the surface near all mink dens; the most common food item was the remains of muskrat (Table 2). Duck remains were present at two

Table 1. Prey remains at the surface of red fox rearing dens at Union Slough National Wildlife Refuge, April to June, 1984-85.

PREY	1984		1985		Total	
	indvs ^a	dens	indvs	dens	indvs	dens
Adult Ducks						
Mallard (<i>Anas platyrhynchos</i>)	6	4	13	6	19	10
Blue-winged teal (<i>A. discors</i>)	3	3	13	3	16	6
Northern shoveler (<i>A. clypeata</i>)	0	0	2	1	2	1
Gadwall (<i>A. strepera</i>)	0	0	1	1	1	1
Unknown dabbling (<i>A. spp.</i>)	2	2	2	2	4	4
Wood duck (<i>Aix sponsa</i>)	1	1	0	0	1	1
Total Adult Ducks	12	6	31	9	43	15
Other Birds						
Ring-necked pheasant (<i>Phasianus colchicus</i>)	4	3	10	4	14	7
Mourning dove (<i>Zenaida macroura</i>)	1	1	0	0	1	1
Am. Crow (<i>Corvus brachyrhynchos</i>)	0	0	1	1	1	1
Blue jay (<i>Cyanocitta cristata</i>)	1	1	0	0	1	1
Blackbird ^b	4	3	2	2	6	5
Bobolink (<i>Dolichonyx oryzivorus</i>)	1	1	0	0	1	1
Brown-headed Cowbird (<i>Molothrus ater</i>)	1	1	0	0	1	1
Unknown passerine	1	1	0	0	1	1
Total Other Birds	13	5	13	6	26	11
Eggs						
Duck	0	0	2	2	2	2
Pheasant	0	0	2	1	2	1
Mammals						
Vole (<i>Microtus spp.</i>)	1	1	3	1	4	2
Pocket gopher (<i>Geomys bursarius</i>)	6	3	3	3	9	7
Thirteen-lined ground squirrel (<i>Spermophilus tridecemlineatus</i>)	2	2	0	0	2	2
Eastern Cottontail (<i>Sylvilagus floridanus</i>)	1	1	3	3	4	4
Muskrat (<i>Ondatra zibethicus</i>)	4	3	1	1	5	4
Opossum (<i>Didelphis virginiana</i>)	0	0	1	1	1	1
Mink (<i>Mustela vison</i>)	0	0	1	1	1	1
Striped skunk (<i>Mephitis mephitis</i>)	1	1	0	0	1	1
Raccoon (<i>Procyon lotor</i>)	1	1	0	0	1	1
White-tailed deer fawn (<i>Odocoileus virginianus</i>)	0	0	2	1	2	1
Total Mammals	16	5	14	6	30	11

Domestic Animals						
Fowl	6	4	6	3	12	7
Pig	2	2	8	4	10	6
Cow	0	0	1	1	1	1
Fish						
Carp (<i>Cyprinus carpio</i>)	1	1	0	0	1	1

^aMinimum number of individual animals represented by remains.

^bTwo red-winged blackbirds (*Agelaius phoeniceus*), 4 unknown species.

of six dens in 1984 and at two of eight dens in 1985. We found 0-3 (mean=0.5 ± 0.25 SE) ducks at the surface of each mink den (n=14). The difference in means between years was not significant (t=1.16, 20 df, P>0.20). Five of seven ducks were dabblers and three of six ducks for which we could determine sex were females. We found American coot remains at three dens.

Effect on Local Duck Population

We did not determine the total number of mink families present on the refuge and thus can only roughly estimate their effect on the local population of breeding waterfowl. If we assume that all existing mink dens with duck remains were found and that 37% of all remains at a den were detectable from surface remains (Eberhardt 1973), then mink killed about 1% of the dabbler females breeding at USNWR each nesting season.

Table 2. Prey remains at the surface of mink rearing dens at Union Slough National Wildlife Refuge in April to June, 1984 (n = 6) and 1985 (n = 8).

PREY	1984		1985		Total	
	indvs ^a	dens	indvs	dens	indvs	dens
Adult Ducks						
Mallard	3	2	1	1	4	3
Unknown dabbler	0	0	1	1	1	1
Wood duck	1	1	0	0	1	1
Lesser scaup (<i>Aythya affinis</i>)	1	1	0	0	1	1
Total Adult Ducks	5	2	2	2	7	4
Other Prey						
American coot	2	2	2	1	4	3
Muskrat	4	4	3	3	7	7
Carp	2	2	3	3	5	5
Vole	0	0	2	2	2	2

^aMinimum number of individual animals represented by remains.

DISCUSSION

Predation by Red Fox

We found a greater abundance and frequency of ducks at fox dens (mean=1.6 ducks/den, 56% of all dens had duck remains) than has been previously reported in Iowa. Errington (1937) found 0.1 ducks/den and Sargeant et al. (1984) reported 0.01 ducks/den, with 1% of the dens having duck remains. Predation of ducks by foxes is directly related to duck abundance (Sargeant et al. 1984), and the estimates given by Errington (1937) and Sargeant et al. (1984) were for much more extensive areas with a range of waterfowl habitats. Our observed predation rate is similar to the rate of 1.8 ducks/den reported by Sargeant et al. (1984) for eastern North Dakota where breeding ducks are common.

Sargeant et al. (1984) estimated that 13.5% of the female dabblers breeding in an extensive study area in eastern North Dakota were lost to red fox each year. Our estimate is greater, probably because fox densities at USNWR (1.04 families/km² of refuge land) were greater than in eastern North Dakota (0.03-0.16 families/km², Sargeant et al. 1984). We may have overestimated the loss by overestimating the number of fox families at USNWR, as indicated by our low estimate of 2.4 dens used per fox family rather than the higher estimates for foxes in other agricultural habitats (mean = 4.8, range = 3-9, Table 9 in Johnson and Sargeant 1977). However, Sargeant (1972) reported similarly high fox densities on other refuges with low disturbance rates and habitats similar to those at USNWR. We believe our estimate of the number of ducks lost to red foxes is actually conservative, because we may have missed additional dens and fox families on adjacent private lands that we could not search.

Like Sargeant et al. (1984), we found that mallards were more vulnerable to red fox predation than were blue-winged teal. They theorized that this difference occurs because mallards start nesting earlier in the spring, when the availability of alternative prey and the quality of cover are low.

Like others (Johnson and Sargeant 1977, Sargeant et al. 1984), we found that about half of all ducks present at a den were detectable in surface remains. However, the similarity among studies may be coincidental, because we excavated only one den. The ratio of surface to subsurface prey remains at dens depends upon the age of the pups inhabiting the den (Sargeant 1972).

Predation by Mink

Our observation that few nesting dabblers at USNWR were killed by mink is consistent with most previous reports (Eberhardt 1973, Sargeant et al. 1973, Eberhardt and Sargeant 1977). Arnold and Fritzell (1990) reported that mink frequently preyed upon nesting dabbling ducks where intensive cultivation eliminated most nesting cover except near wetlands. Most nesting cover at USNWR is less than 200m from water, but 73% of the dabbling duck nests found during this study were located in upland cover (Fleskes and Klaas 1992) where mink rarely

forage (Arnold 1986). Thus, most dabbling ducks nesting at USNWR are relatively safe from mink until they move to wetlands with their broods (Sargeant et al. 1973).

Management Implications

Excellent water and vegetative cover at USNWR attracts relatively high numbers of breeding dabbling ducks. However, the refuge's nesting population is not self-sustaining because of extensive losses of breeding females to fox and mink predation, coupled with low nesting success (Fleskes and Klaas 1992). Evidently, breeding populations are being maintained by emigrants from other areas. Where conditions like those at USNWR persist, intensive management of predators will be necessary to improve nesting success and hen survival rates.

USNWR is probably representative of many other isolated patches of waterfowl breeding habitat in the prairie pothole region. These isolated patches may serve as ecological traps, or population sinks, for some duck species. Because of intensive agricultural use and fragmentation, sink habitats may now outnumber source habitats (Pulliam 1988) over a major portion of the prairie pothole region. This dramatic change in the landscape may help explain recent declines in dabbling duck populations (U.S. Fish and Wildlife Service 1988).

Where conditions like those at USNWR persist, intensive management of predators will be necessary to improve nesting success and hen summer survival rates. And, we need a better understanding of the relationships among predation rates, duck nesting success, and habitat patch size and shape (Clark and Nudds 1991).

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