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ANTI-PREDATOR BEHAVIOR OF BREEDING EURASIAN WIGEON

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Abstract.—Anti-predator behavior was observed during a study (1983–1985) of the feeding ecology and social behavior of breeding Eurasian Wigeon (*Anas penelope* L.) in western Norway. When Red Fox (*Vulpes vulpes*) appeared, wigeon and other dabbling ducks congregated in a group, became alert, quacked loudly and followed the predator's movement. In contrast, as avian predators appeared, wigeon became alert, retreated into emergent vegetation, or laid down on the shore with their heads stretched out, and remained motionless until the predator passed. Wigeon responded to nest predators, e.g., Common Raven (*Corvus corax*) and Hooded Crow (*C. corone cornix*) by assuming alert postures in 84% and 60% of the occasions in terrestrial and aquatic habitats, respectively. The observed difference between habitats was probably due to the birds' reduced ability to detect predators and escape attacks in terrestrial environments. Foraging wigeon responded to the presence of avian nest predators more by assuming alert postures during the egg-laying and incubation periods than during the prelaying period. Wigeon became alert in 78% (terrestrial habitats) and 66% (aquatic habitats) of the occasions when warning calls were given by four other species. They responded more to warning calls during the egg-laying and incubation periods than during the prelaying period. It is concluded that wigeon have evolved different strategies to escape attack from avian and ground predators. Wigeon may also benefit from warning calls given by other species, because warning calls may allow enhanced predator detection and increased foraging efficiency.

CONDUCTA ANTI-PREDATORA POR PARTE DE INDIVIDUOS REPRODUCTIVOS DE *ANAS PENELOPE*

Sinopsis.—Durante un estudio que se llevó a cabo entre 1983–1985 en el oeste de Noruega, sobre la ecología alimentaria y la conducta social de individuos reproductivos de la Mareca Europea (*Anas penelope*), se observó conducta anti-predatora por parte del ave. Cuando un zorro (*Vulpes vulpes*) aparecía, las Marecas, junto a otros patos se congregaban, asumían posturas de alerta, vocalizaban altamente y seguían los movimientos del depredador. En contraste cuando aparecían aves predatoras, las Marecas asumían posturas de alerta, se retiraban a la vegetación emergente o se acostaban en la playa con su cuello estirado en lo que pasaba el predator. Las Marecas respondieron a depredadores de nidos (Ej. *Corvus corax, C. corone cornix*) asumiendo posturas de alerta en el 84% y 60% de las veces en habitats terrestres y acuáticos, respectivamente. Las diferencias observadas entre habitats se debieron probablemente a la reducida habilidad en las aves para detectar predatores y escapar de éstos en habitats terrestres. Individuos que forrajeaban respondieron, con mayor frecuencia, a la presencia de depredadores de nidos asumiendo posturas de alerta durante el período de incubación que previo a la puesta de huevos. Las Marecas asumieron posturas de alerta en el 78% de los casos en habitats terrestres y en el 66% de los casos en habitats acuáticos, cuando otras cuatro especies de patos dieron llamadas de alerta. Estos respondieron más a estas llamadas de alerta durante el período de puesta de huevos e incubación que durante el período de pre-puesta. Se concluye que *Anas penelope* ha desarrollado a través de la evolución diferentes estrategias para escapar al ataque de predatores aéreos y terrestres. Las aves podrían tambien beneficiarse de llamadas de alerta de otras especies, debido a que estas llamadas podrían facilitar la detección de predatores e incrementar la eficiencia de forrajeo.

Predation is a severe selection pressure on many animals, and the ability to recognize predators and avoid predation are critical elements in the life history strategy of most birds. Consequently, they have evolved different behavioral adaptations to avoid predation when primary defenses (e.g., crypsis) fail (Curio 1976).

Anti-predator behaviors are broadly divided into a) escape, b) defense and c) alarm signals (Curio 1976). To gain protection against predators, some birds associate with other species of birds that are more vigilant (Byrkjedal 1987, Byrkjedal and Kålås 1983), or larger and more aggressive against predators than themselves (Dyrcz et al. 1981, Fuchs 1977). Birds avoid predation through the use of auditory signals. These signals indicate knowledge of a predator's presence and may be intended for the predator itself or as a warning to others (Buchanan 1989).

Waterfowl, such as White-fronted Goose (*Anser albifrons*) (Lazarus 1978) and Green-winged Teal (*Anas crecca*) (Pöysä 1987, Tamisier 1974), often are disturbed by potential predators while feeding. To avoid predation, individuals scan their surroundings between feeding bouts and often depart when a potential predator approaches (Pöysä 1987). Surveys on nonhunting mortality of waterfowl in North America have shown that 70% of predation was by mammals and the remainder by birds, and that the vast majority of depredated birds were dabbling ducks, with only a few geese and swans being taken (Stoudt and Cornwell 1976).

We collected data on anti-predator behavior of breeding Eurasian Wigeon (*Anas penelope*) during a 3-yr study on feeding ecology and social behavior of this dabbling duck in western Norway. Common predators on adult wigeon and other dabbling ducks in our study area were Goshawk (*Accipiter gentilis*) and Red Fox (*Vulpes vulpes*) (J. Stenersen, pers. comm.). Wigeon nests were mainly preyed upon by Red Fox (own obs.), but Hooded Crow (*Corvus corone cornix*) and Common Raven (*C. corax*) may also have been important predators on nests and young (Erikstad et al. 1982, Parker 1984, Skarphèdinsson et al. 1990).

On their wintering grounds in Britain, wigeon prefer feeding sites close to water, which has been interpreted as an anti-predator response (Mayhew and Houston 1989). We are unaware of any study that has examined the behavioral response of wigeon to avian and ground predators, however. In this paper, we describe strategies employed by wigeon to escape avian or ground predators, and their behavior in the presence of nest predators in terrestrial and aquatic habitats during the breeding season.

STUDY AREA AND METHODS

We observed breeding wigeon from Apr. through Jun. 1983–1985 in Sveio (59°33′N, 5°21′E), western Norway. The study area has a fairly flat terrain approximately 30 m above sea level, consisting of farms and moorland with heather (*Calluna vulgaris*), juniper (*Juniperus communis*), and scattered stands of Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), and birch (*Betula pubescens*). Observations were made at three lakes: 1) Lake Bjellandsvatn (10.9 ha), a shallow eutrophic lake with well-developed stands of emergent vegetation, e.g., *Carex rostrata, Equisetum fluviatile* and *Phragmites communis*, and floating-leaved vegetation, e.g., *Potamogeton natans, P. pusillus, Nymphaea alba* and *Glyceria fluitans*; 2) Lake Mannavatn (19.2 ha), a shallow and oligotrophic lake with sparse stands of *C. rostrata, E. fluviatile*, and *P. natans*; and 3) Lake Åsevatn (13.0 ha), a shallow oligotrophic lake surrounded by agricultural areas and plantations of Norway spruce. Emergent vegetation is sparsely developed, but stands of *C. rostrata* and *E. fluviatile* occur in secluded bays. The breeding population of wigeon in the area varied between 30 and 40 pairs since 1983 (Jacobsen and Ugelvik 1990).

Data were gathered from five wigeon pairs in 1983, three pairs in 1984 and four pairs in 1985. We divided the breeding season in to the prelaying period, which was defined as the period of dispersal from small arriving flocks (3–6 pairs) in early April until the day prior to laying the first egg. The egg-laying period was from the day the first egg was laid until clutch completion. Incubation included the period from clutch completion until hatching. During incubation, females spent 1–2 h a day away from the nest. Due to heavy nest predation by fox during incubation, we obtained few data from this period. We have thus combined data from the egg-laying and incubation periods in our analyses.

Although none of the pairs was individually marked, we recognized each bird by individual plumage characteristics. Males and females show great variability in plumage characteristics on the flanks, head and back (Cramp and Simmons 1977).

To minimize disturbance, we observed individual pairs at distances approaching 200 m using binoculars (8 × 40) and a spotting scope (25–40×). The behavior of wigeon was recorded every minute and assigned to the main activity categories based on Afton (1979). All behavioral data were recorded on a portable tape-recorder. We recorded whether wigeon became alert (head-up posture) when avian and ground predators appeared both in terrestrial (agricultural areas close to water and shore) and aquatic (open water, emergent vegetation) habitats. Furthermore, we recorded the responses of wigeon to warning calls given by nearby Eurasian Curlew (*Numenius arquata*), Oystercatcher (*Hamaetopus ostralegus*), Common Redshank (*Tringa totanus*), and Mew Gull (*Larus canus*).

RESULTS AND DISCUSSION

One morning in May 1985, we observed a Red Fox at the shore of Lake Mannavatn. A wigeon pair grazing on the pasture immediately became alert when the fox was about 100 m from them. They then flew into open water and swam parallel to the fox for approximately 1 min at a distance of 30 m as it was walking along the shore.

On four occasions during the period mid May–early Jun. 1983 we observed a fox hunting at Lake Bjellandsvatn. It systematically checked bushes and heather. When wigeon (and other dabbling ducks) detected the fox, they congregated in a small dense flock (up to 12 individuals), swam in open water parallel to the predator at a distance of 20–30 m from the shore and quacked loudly. When the fox disappeared, the flock dispersed into pairs and single males. Wigeon and other ducks probably follow the predator's movement to: 1) keep track of the fox; 2) signal to the fox that it already is detected; and 3) divert the predator's attention, thus reducing its success at finding nests.

On one occasion (early Jun. 1983), a fox jumped into a dense (*Carex*) bed in Lake Bjellandsvatn probably to catch half-grown Mallard (*Anas platyrhynchos*) ducklings foraging intensively on insects on the vegetation. The ducklings rushed out of the vegetation immediately after the unsuccessful attack, and disappeared into reed beds.

Twice we observed a female Goshawk flying over the study lakes. In the first case at Lake Mannavatn in 1983, one wigeon pair was grazing on cultivated crops close to water. When the Goshawk appeared, the wigeon pair immediately raised their heads in alert position, rushed from the cultivated crops to the shore and laid down with their necks and heads stretched out. The birds were motionless and well camouflaged among stones and blocks on the shore where they remained for approximately 1 min, long after the Goshawk passed. At Lake Bjellandsvatn in 1984, a wigeon pair was foraging in shallow water containing scattered emergent vegetation. When the Goshawk appeared, the male immediately stopped foraging, laid his head down to the water surface and became motionless. The female first performed a wings-up display close to her mate, after which the pair disappeared into dense emergent vegetation.

When a pair of Golden Eagles (*Aquila chrysaetos*) circled high over Lake Mannavatn (early May 1984), one wigeon pair immediately rushed from cultivated crops, where they grazed about 10 m from water edge, to a rocky shore and laid down with their heads and necks stretched out. The birds were motionless for approximately 2 min. The same behavior was observed in another wigeon pair at Lake Åsevatn (Apr. 1983) as a Rough-legged Hawk (*Buteo lagopus*) was detected high in the air. In both cases, the ducks remained motionless until the raptor disappeared.

In Jun. 1984, we observed an Eagle Owl (*Bubo bubo*) passing over Lake Bjellandsvatn early in the morning. Upon its detection, wigeon (one pair and one single male), Green-winged Teals (*Anas crecca*) (two single males and one female with about 2-wk-old ducklings), and Mallards (three males plus one female with half-grown ducklings) immediately rushed into dense emergent vegetation and disappeared.

Dabbling ducks may dive if attacked by an avian predator. In May 1985, we observed a Goshawk pursuing a male Green-winged Teal in the air. The Green-winged Teal dropped into the lake from a height of 10 m and immediately dived to escape the attack.

Although we have not observed predator attacks on wigeon, our time budget data revealed that wigeon were more alert in terrestrial than in aquatic habitats (28%, $n = 1250$ min obs. vs. 17%, $n = 1770$) ($\chi^2 = 52.17$, df = 1, $P < 0.001$). The most plausible explanation is that predation risk increases when the birds move away from water, where it takes longer

TABLE 1. Percent of time Eurasian Wigeon became alert after potential nest predators appeared in terrestrial and aquatic habitats during prelaying and egg-laying/incubation periods. n = sample size. NS = not significant.

Species	Periods	Terrestrial habitats %	Terrestrial habitats n	Fisher's exact probability	Aquatic habitats %	Aquatic habitats n	Fisher's exact probability
Common Raven	Prelaying	90.9	11	NS	63.1	19	NS
(*Corvus corax*)	Egg-laying/incubation	100.0	9		100.0	4	
Hooded Crow	Prelaying	71.8	39	0.037	47.5	40	0.024
(*C. corone cornix*)	Egg-laying/incubation	92.3	26		83.3	12	
Total		83.5	85		60.0	75	

to seek concealment and escape a potential attack (see Mayhew and Houston 1989). When Common Ravens and Hooded Crows, both predators on nests or young but not on adults, approached, the ducks became alert in 83.5% (n = 85) of the occasions in terrestrial habitats, and in 60.0% (n = 75) of the occasions in aquatic habitats ($\chi^2 = 11.06$, df = 1, $P < 0.001$) (Table 1). We suggest that the response of assuming alert postures to the presence of Hooded Crows and Common Ravens is partly because they resemble potential predators on adults.

Wigeon became proportionally more alert each time potential nest predators approached during the egg-laying and incubation periods than during the prelaying period in both terrestrial ($\chi^2 = 5.00$, df = 1, $P < 0.05$) and aquatic habitats ($\chi^2 = 6.81$, df = 1, $P < 0.01$) (Table 1).

Wigeon frequently reacted to warning calls of Eurasian Curlew, Oystercatcher, Common Redshank and Mew Gull (Fig. 1). Wigeon responded by assuming alert postures (78.3%, n = 115), or flying from cultivated areas to open water where they retreated into emergent vegetation (15.6%, n = 18) after warning calls were given in terrestrial habitats. Wigeon became alert (66.3%, n = 89), or swam from open water and retreated into emergent vegetation (15.7%, n = 14), after warning calls were given in aquatic habitats. The ducks tend to assume alert postures more in terrestrial habitats than in aquatic habitats ($\chi^2 = 3.65$, df = 1, $P < 0.1$). Studies on Green-winged Teals in Finland also have confirmed that this dabbling duck responded to warning calls given by Black-headed Gulls (*Larus ridibundus*) (Pöysä 1988).

Wigeon assumed alert postures significantly more often after alarm calls were given during the egg-laying and incubation periods than during the prelaying periods ($\chi^2 = 5.53$, df = 1, $P < 0.05$ [terrestrial habitats] and $\chi^2 = 8.54$, df = 1, $P < 0.01$ [aquatic habitats]). Wigeon were more likely to fly from terrestrial habitats than from aquatic habitats when warning calls were given ($\chi^2 = 12.54$, df = 1, $P < 0.001$).

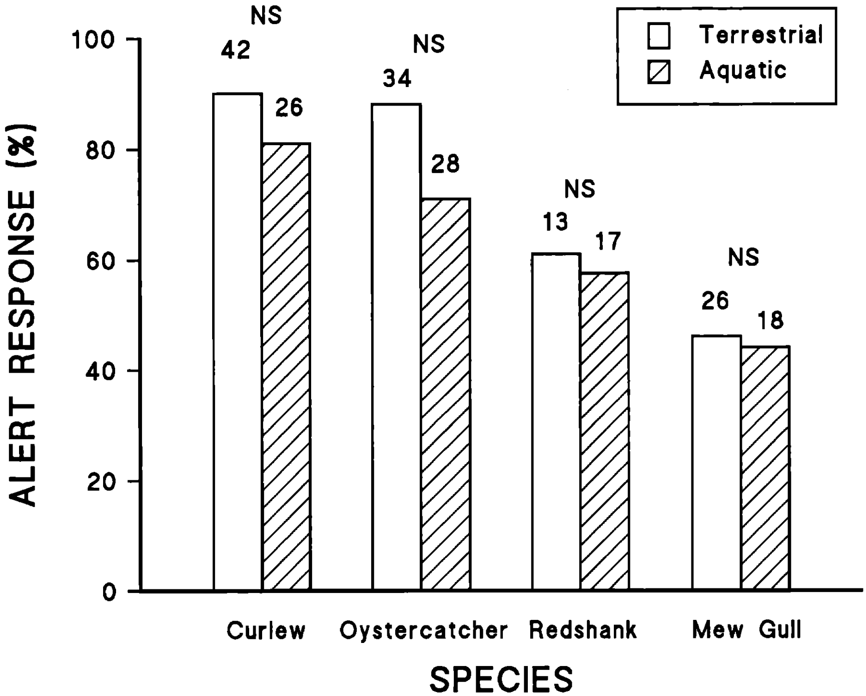

FIGURE 1. Percent of time Eurasian Wigeon became alert after warning calls were given by Eurasian Curlew, Oystercatcher, Common Redshank and Mew Gulls in terrestrial and aquatic habitats. Numbers above columns refer to sample size. NS = not significant.

Staying near warning birds of other species may be advantageous, because alarm calls may allow wigeon to detect avian and ground predators earlier and thereby reduce predation risk. Similar arguments have been outlined by Byrkjedal and Kålås (1983) and Metcalfe (1984). If the potential prey is alerted in an early phase during an attack, the predator's chance of success is low (Kenward 1978). Wigeon spent 30.1% of the time alert when they were alone, and 21.8% of the time alert when other species were present on agriculture. Grazing bouts averaged 15.6 s (n = 120) when they were alone and 20.0 s (n = 144) when other birds were present. Furthermore, peck rates per min averaged 45.7 (n = 114) when they grazed alone and 56.1 (n = 141) when they grazed in association with other species on agriculture. Feeding efficiency is enhanced for several bird species when they associate with other species (Barnard and Stephens 1983, Byrkjedal 1987, Byrkjedal and Kålås 1983).

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