Vigilance behaviour of American Wigeon *Anas americana* foraging in pastures

JACOB L. BERL[1] & JEFFREY M. BLACK[1]*

[1]Waterfowl Ecology Research Group, Department of Wildlife, Humboldt State University, Arcata, California 95521, USA.
*Correspondence author. E-mail: Jeff.Black@humboldt.edu

Abstract

Observations were made of feeding American Wigeon *Anas americana* to assess their vigilance levels in relation to foraging location. American Wigeon increased vigilance levels: 1) while foraging on land compared to on water, 2) while grazing progressively further away from a water source, and 3) after being on land for long periods of time. Vigilance patterns were nearly identical to those recorded for Eurasian Wigeon *Anas penelope* in earlier studies. Males were more vigilant than females when foraging on land. This study contributes to understanding the importance of ephemeral pond habitats to grazing American Wigeon, which are used as anti-predator refuges by actively feeding flocks.

Key words: anti-predator behaviour, distance from water, grazing, head-up posture, scanning.

Relationships between vigilance and foraging are fundamental in waterfowl behavioural ecology because they imply trade-offs between alert behaviour and foraging effort (Lazarus 1978; Lazarus & Inglis 1986; Poysa 1987; Guillemain *et al.* 2002a, 2007a). Besides monitoring mates, competitors and other flock members, vigilant individuals scan the area for potential predators (Pulliam & Caraco 1984; Elgar 1989; Lima & Dill 1990; Owen & Black 1990; Caro 2005; Beauchamp 2009). The feeding ecology and vigilant behaviour of Eurasian Wigeon *Anas penelope* have been well documented in Europe (Owen 1973; Kanel 1981; Owen & Thomas 1979; Mayhew 1987; Mayhew & Houston 1989; Jacobson & Ugelvik 1994a,b; Larsen 1996; Guillemain *et al.* 2003; Portugal & Guillemain 2011), yet there have been no comparable studies of its Nearctic counterpart, American Wigeon *Anas americana*.

American Wigeon wintering and migrating through coastal northern California occupy similar wetland habitats to Eurasian Wigeon occurring in Europe (Lovvorn & Baldwin 1996), and walk onto adjacent saltmarsh or pastures to graze vegetation. American Wigeon, like Eurasian

Wigeon, are faced with the challenge of foraging in an inherently "riskier" environment (*e.g.* increased mammalian predation risk and reduced response time) when on land and away from water (*sensu* Mayhew & Houston 1989; Portugal & Guillemain 2011). Moreover, American Wigeon are confronted with predation risks similar to those of Eurasian Wigeon while foraging on dry land, in that they occupy habitats with analogous mammalian and avian predators.

Vigilance in waterfowl has been shown to be highly variable and can be influenced by a variety of factors, including: 1) sexual differences (Inglis 1977; Mayhew 1987; Black & Owen 1989a,b), 2) distance from a water source (Mayhew & Houston 1989), 3) time of year (Portugal & Guillemain 2011), 4) flock size and position within the flock (Inglis & Lazarus 1981; Mayhew & Houston 1989; Roberts 1996; Black *et al.* 1992), 5) pair and family status (Lazarus & Inglis 1978; Black & Owen 1989a; Guillemain *et al.* 2003, 2007b), 6) presence of other species (Jacobson & Ugelvik 1994b; Larsen 1996), 7) feeding style/method (Guillemain *et al.* 2002b) and 8) visual fields (Guillemain *et al.* 2002a).

This study aimed to determine whether American Wigeon displayed similar vigilant behaviour to their European counterparts. In particular, variation in American Wigeon vigilance levels was examined for birds feeding on different habitats (*i.e.* on land *versus* water), as the birds grazed progressively further from a water source into areas of higher biomass, and also after grazing on land for long periods of time.

Methods

Observations of actively feeding American Wigeon took place on ephemeral ponds in grass pastures near Arcata, California, USA (40°N, 124°W). The majority (90%) of observations were made at three ephemeral ponds in the Jacoby Creek/Gannon Slough Wildlife Area, a pastureland preserve 1 km southeast of Arcata, along the western shore of Humboldt Bay, California. The remaining observations were made at two ephemeral waterbodies on nearby (<10 km away) farmland pastures which were commonly used by American Wigeon. Habitat type consisted of cattle *Bos taurus* grazed pasture and seasonally flooded freshwater ponds and marshes (Barnhart *et al.* 1992). The most common pasture plant species included Velvetgrass *Holcus lanatus*, Bentgrass *Agrostis* sp., Italian Ryegrass *Lolium mulliforum*, Orchardgrass *Dactylis glomerata*, Festuca *Festuca* sp., Clover *Trifolium* sp., and Buttercup *Ranunculus* sp. (Long 1993). Vegetation height was kept short (*e.g.* < 8cm) by intensive cattle grazing. Vigilance behaviour (proportion of time with head-up during focal bird observations) did not differ across sites (Kruskal-Wallis $H_2 = 1.66$, n.s.), so data were lumped for the larger analysis.

Focal bird observations were conducted from 31 January 2011 to 24 March 2011, coinciding with peak American Wigeon migration in Northern California (Hitchcock *et al.* 1993) and the end of the waterfowl hunting season. Procedures for focal bird observations followed the methods of previous vigilance studies on Eurasian Wigeon (see Mayhew 1987;

Mayhew & Houston 1989), including a variable observation time, between 1–3 min (average = 96 s). Individual focal birds were viewed continuously for the duration of each behavioural observation, which were carried out using a 20–60× spotting scope and 8× binoculars from distances of 75–200 m. Foraging in pastures was characterised as grazing, while foraging on water consisted predominantly of dabbling, but also upending and picking items from the water surface. Vigilance was described as: 1) proportion of an observation period with head-up (time vigilant / length of observation), 2) head-up rate (number of head-ups / length of observation; converted to head-ups/s), and 3) scanning duration (time vigilant / number of head-ups). A head-up was recorded when an individual stopped feeding and raised its head and neck above parallel. All time recordings were made using standard stopwatches.

To reduce the likelihood of double sampling, the number of focal observations was restricted to 10 per study site per observation day while alternating between males and females. With an average flock size of 99 individuals (range = 24–280 birds), this limited sampling to < 10% of birds within the flock each day. In all cases, the centremost bird in view of appropriate sex was selected for focal observation.

To assess vigilance at varying distances from water, all on-land focal observations were placed into "distance from water" categories, recorded against 10 cm high wooden stakes at intervals of 0–5 m, 5–10 m, 10–15 m, 15–20 m, 20–30 m, and 30–40 m to ensure accurate distance records but which did not affect birds' feeding behaviour.

Disturbance events (*e.g.* anthropogenic disturbance or overflying raptor) would stimulate "snap back" (quickly run or fly) flock responses to the nearest waterbody. The timing of "snap back" events (*i.e.* total time away from water) was recorded, although their cause was not determined. Additionally the length of time an individual had been foraging on land was recorded at the start of each focal observation.

Food supply was recorded by clipping all above ground vegetation within an 8 × 8 cm frame at the 6 distance categories every two weeks. Green biomass was separated from brown/dead material, desiccated at 60º C for 24 h, weighed immediately upon removal from oven, and converted to g/m^2.

The influence of distance from water on vigilance levels was tested using Kruskal-Wallis analysis of variance. Differences in vigilance between foraging situation and sexes were analysed by Mann-Whitney U tests. Spearman rank correlations were employed to test the relationship between vigilance and time away from a water source. One-way ANOVA was used to test variance in green biomass and time away from a water source in relation to distance categories. Correlation coefficients and line slopes were determined for plots of these relationships. To account for effects of flock size on vigilance, observations were made from flocks with at least 20 individuals (see Mayhew 1987) (range = 24–280, mean = 99, s.e. ± 5.5) and we checked that vigilance was not related to flock size (Spearman rank correlation: proportion vigilant, $r_{117} = 0.106$, $P = 0.24$,

n.s.). In consideration of animal safety and welfare, this work was approved by Humboldt State University Institutional Animal Care and Use Committee Protocol (IACUC Protocol No. 10/11.W.32.E). Means are given ± s.e. values throughout.

Results

One hundred and nineteen focal observations of actively feeding American Wigeon were completed over the course of the study. The ducks were more vigilant while foraging on land than water (U_{117} = 1764, P < 0.001, Fig. 1). Vigilance levels significantly increased with distance from water bodies in terms of proportion vigilance (H_6 = 70.87, P < 0.001), rate of head-ups (H_6 = 61.18, P < 0.001), and scanning duration (H_6 = 29.83, P < 0.001) (Fig. 2a,b,c). Individuals were more vigilant with increasing time on land away from water bodies (proportion vigilance, r_{98} = 0.44, P < 0.001); time away from water corresponded positively with "distance from water" categories ($F_{6,98}$ = 11.25, P < 0.001) and the amount of available green biomass increased with distance from water ($F_{6,16}$ = 4.93, P < 0.01, Fig. 2d). The median length of time flocks would graze before a "snap back" to water was 9 min 44 s (s.e. ± 58 s;
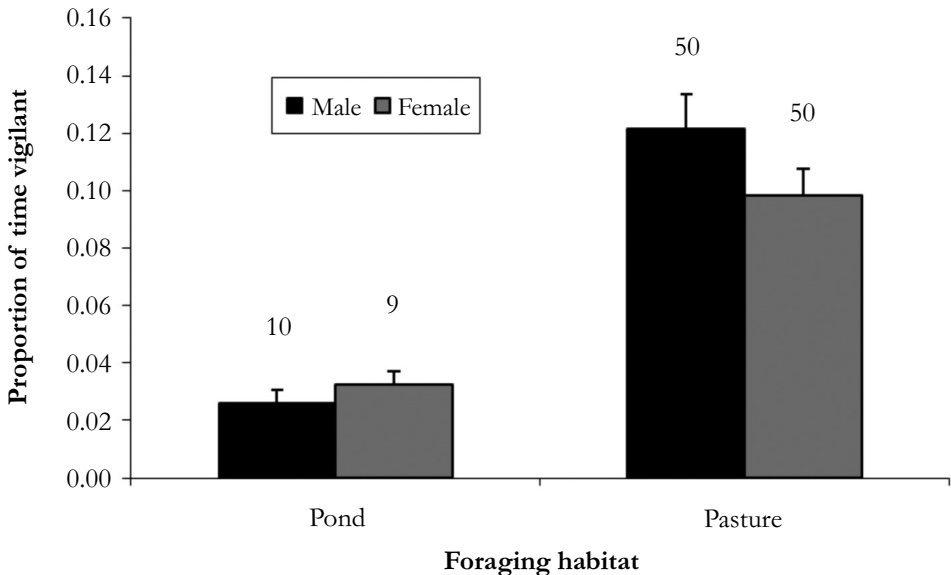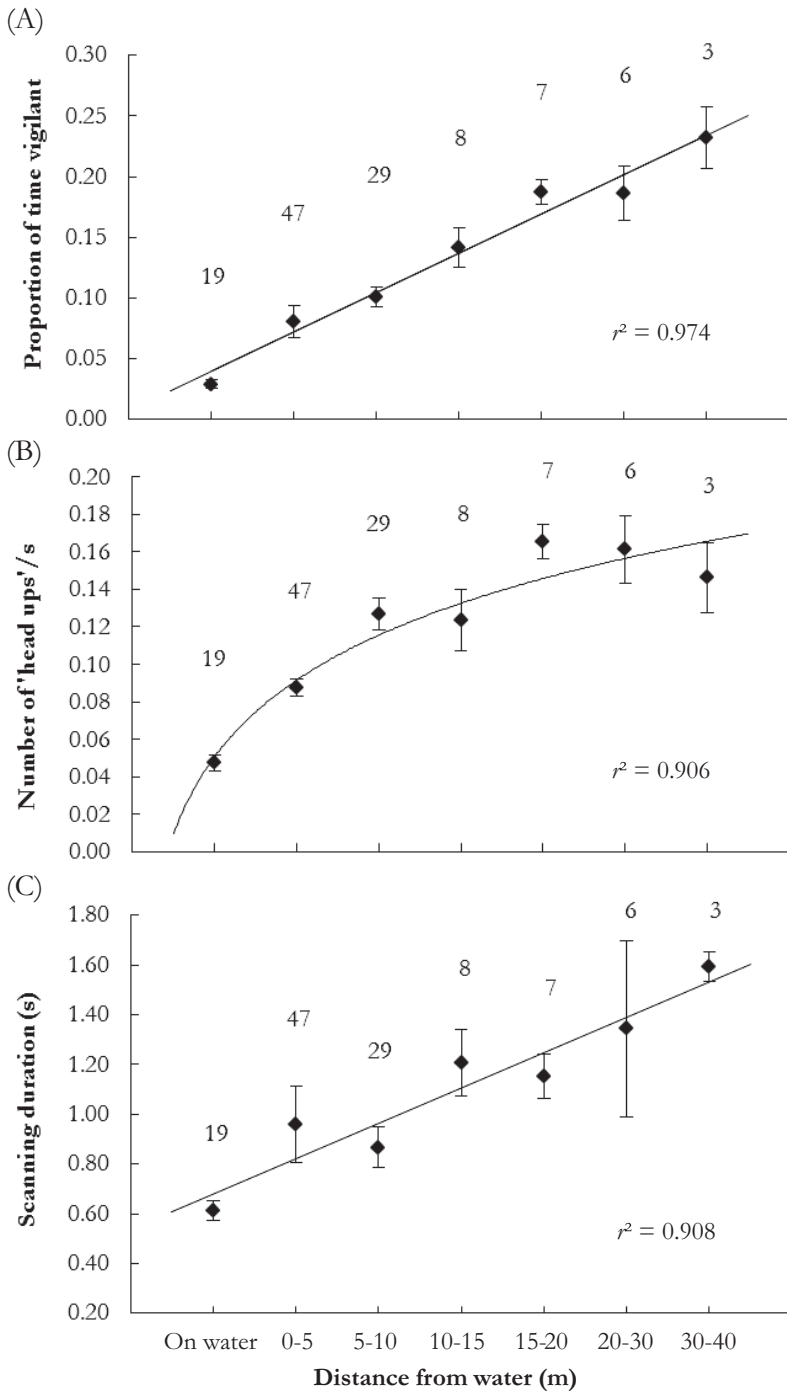

Figure 1. Proportion of time that American Wigeon were vigilant (mean ± s.e.) in relation to foraging habitat and sex, in ephemeral ponds and pastures near Arcata, California, USA, 31 January–24 March 2011. American Wigeon displayed significantly higher proportion vigilance while foraging on pastures than on water (U_{117} = 1764, P < 0.001). Males were significantly more vigilant while foraging in pastures (U_{98} = 1026, P < 0.001), while females were significantly more vigilant while foraging on ponds (U_{17} = 29, P < 0.05).
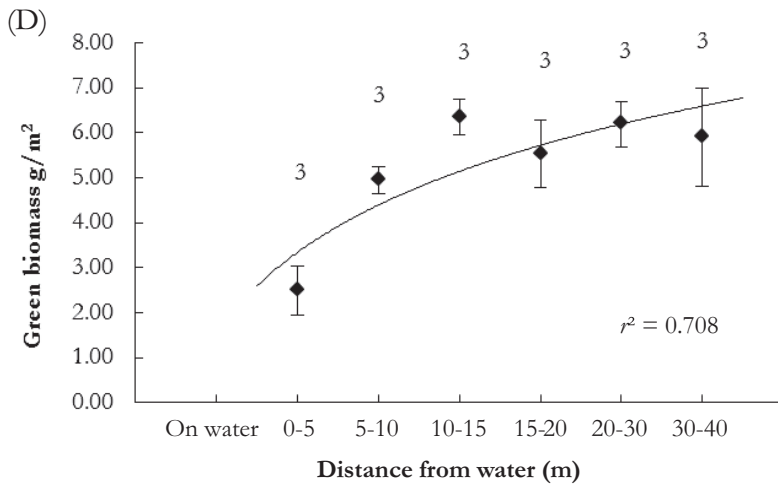
(A)

(B)

(C)

Figure 2. American Wigeon vigilance and biomass assessment in relation to distance from ephemeral waterbodies in grassland pastures near Arcata, California, USA, 31 January–24 March 2011. (A) Proportion of time vigilant (mean ± s.e.) for American Wigeon foraging on water, and at progressively further distances from a water source ($y = 0.0324x + 0.0074$, $r^2_{119} = 0.974$, $P < 0.001$). (B) Rate of "head-ups" (mean ± s.e.) while foraging on water and at progressively further distances from water ($y = 0.059\ln(x) + 0.0508$, $r^2_{119} = 0.906$, $P < 0.001$). (C) Scanning duration (length of individual head-ups) in relation to distance from water ($y = 0.1427x + 0.5345$, $r^2_{119} = 0.908$, $P < 0.001$). (D) Amount of green biomass per m² (mean ± s.e.) available to grazing American Wigeon at different distances from water ($y = 0.139\ln(x) + 0.2605$, $r^2_{21} = 0.763$, $P < 0.01$).

$n = 100$; range = 1 min 25 s – 23 min 33 s). While foraging on land, in potentially riskier environments, the proportion of time being vigilant (Fig. 1) and the rate of head-ups ($U_{98} = 1420$, $P < 0.05$) was significantly higher for males than females.

Discussion

Vigilance behaviour by individual American Wigeon increased significantly as they moved further away from water. Increased investment in head-up scanning behaviour rather than head-down grazing seemed to be due to a perceived increase in predation risk when out of the water. This suggestion parallels those of Mayhew (1987) and Mayhew & Houston (1989) who quantified a similar response in Eurasian Wigeon foraging on coastal pastures in Scotland. Furthermore, this behaviour has been documented for other waterbirds, as Schütz & Schulze (2011) found for spring-migrating Ruffs *Philomachus pugnax* in eastern Austria, which increased their scan rates while foraging on terrestrial compared to semi-aquatic habitats. In coastal northern California, grazing American Wigeon apparently also used pond habitats for safety, as vigilance levels substantially decrease once they "snap back" into the water. Moreover,

American Wigeon became more vigilant after being away from water for long periods of time. Time away from water appeared to have such an impact on perceived predation risk that all flock members would stop grazing after extended periods away from water and return to ponds in the absence of a disturbance stimulus, occurring in 5 out of 21 observations (24%) when they were on land longer than 10 min. Regrouping flocks on the pond would then return to land for a renewed grazing bout. Foraging flocks of American Wigeon were rarely observed in pastures lacking water bodies. These observations corroborate Mayhew & Houston's (1989), suggesting water bodies act as refuges for wigeon to escape predation or disturbance. Grazing on land has long been regarded as a "risky" foraging method in waterfowl (*e.g.* Mayhew & Houston 1989; Portugal & Guillemain 2011). Overall, American Wigeon vigilance rates (time spent vigilant: average = 9.7% ± 0.7%, $n = 119$) were remarkably similar to those observed in Eurasian Wigeon (*c.* 10%) (Mayhew 1987; Portugal & Guillemain 2011).

Larsen (1996) suggested that Eurasian Wigeon dependence on water for anti-predator protection can be offset by the presence of large-bodied geese. American Wigeon fed on eelgrass *Zostera marina* near Black Brant *Branta bernicla nigricans* on nearby Humboldt Bay, but usually grazed in single species flocks on pastures (JLB & JMB, pers. obs.). During this study Aleutian Cackling Geese *Branta hutchinsii leucopareia* were recorded feeding near (within 100 m) American Wigeon flocks on 12% of the observations. However, these interactions appeared to be chance inter-species use of shared habitat, rather than an organised mixed-species flock. American Wigeon vigilance increased slightly in the presence of the geese (12.3% ± 1.4%) compared to situations without geese (9.3% ± 0.7%), although the difference was not significant ($U_{117} = 495$, $P = 0.08$, n.s.).

Male American Wigeon were more vigilant than females while grazing on land and seem to reduce investment in vigilance when in the water. Although pairing status was not evaluated in this study, it is likely that the observed increase in male vigilance can be attributed to paired males providing mates with enhanced foraging opportunities. Mayhew (1987) and Portugal & Guillemain (2011) found increased vigilance levels in male Eurasian Wigeon compared to females while foraging on land in potentially "riskier" situations. It is likely a portion of increased male vigilance at further distances from water resulted in "low-cost vigilance" due to increased food handling time in areas of high grass biomass (Portugal & Guillemain 2011), which would allow males to maximize foraging efficiency and alert behaviour. It is also possible that a portion of the increased scanning behaviour was directed at potential competitors in areas with different food densities. Grass biomass was reduced from repeated depletion by ducks at distances that were closer to the water (see Mayhew 1987; Portugal & Guillemain 2011). Variation in vigilance by flock members has been described in habitats with different amounts and types of food for a range of waterfowl species (*e.g.* Scott 1980; Black & Rees 1984; Black & Owen 1989b; Kotrschal *et al.* 1993).

Similar to Eurasian Wigeon (Owen 1973; Owen & Thomas 1979; Mayhew 1988), American Wigeon used foraging tactics other than grazing to obtain food, including dabbling and upending. American Wigeon flocks in coastal California feed on eelgrass beds and other freshwater wetland vegetation (*e.g. Potamogeton* sp., *Lemna minor*, *Rumex acetosella*; JLB & JMB, unpubl. data). The degree to which individuals in this region incorporate each feeding style and food resource into their activity budget and diet is currently unknown. Knowledge of how wintering and migrating American Wigeon use different food resources would allow resource managers to better provide adequate habitat (*sensu* Cadwalladr *et al.* 1972; Owen & Thomas 1979; Colwell & Dodd 1995; Lovvorn & Baldwin 1996).

Acknowledgements

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Photograph: American Wigeon taking flight, by Leslie Scopes Anderson.