J. Great Lakes Res. 20(1):271–276
Internat. Assoc. Great Lakes Res., 1994

Fall Food Habits of American Wigeon at Long Point, Lake Erie, Ontario

Richard W. Knapton
Long Point Waterfowl and Wetlands Research Fund
P.O. Box 160
Port Rowan, Ontario N0E 1M0

Kerrie Pauls[1]
Long Point Bird Observatory
P.O. Box 160
Port Rowan, Ontario N0E 1M0

ABSTRACT. We studied food habits of an abundant migrant, the American wigeon (Anas americana), *staging during the 1991 fall migration at Long Point, a World Biosphere Reserve and a Ramsar site on the north shore of Lake Erie. Food samples from 149 wigeons were analyzed; stems and leaves of aquatic plants (predominantly submerged macrophytes) comprised over 92% aggregate dry mass of the diet, seeds made up 7.8%, and animal matter 0.6%. A diverse array of plant species was identified; however, results indicate that wigeons were showing selectivity in plant species consumed. Stems and leaves of muskgrass* (Chara *spp.*), *elodea* (Elodea canadensis) *and bushy pondweeds* (Najas flexilus *and* N. guadalupensis) (*aggregate percent dry mass 37%, 22%, and 18% for proventriculi, and 15%, 12%, and 38% for gizzards, respectively) comprised the bulk of the diet, although neither bushy pondweed nor elodea wholly dominated submerged macrophyte communities. Several submerged macrophytes, such as coontail* (Ceratophyllum demersum) *and pondweeds* (Potamogeton *spp.*) *which are common and widespread at Long Point and reported frequently as important in the diet of American wigeons elsewhere, were not found at all or only in trace amounts. Some sex, age, and seasonal differences in diet were detected;* Chara *spp. and tubers were eaten more frequently by adults than by immatures,* Elodea canadensis *was eaten in late fall by females but not by males, immatures ate* Myriophyllum spicatum *seeds more frequently than did adults, and* Najas *spp. was consumed more in late fall than in early fall.*

INDEX WORDS: American wigeon, Lake Erie, food habits, food selectivity.

INTRODUCTION

The importance of food resources at staging areas of migratory waterfowl has long been recognized (e.g., Bellrose 1976). The wetlands of Long Point, a World Biosphere Reserve and a Ramsar site, on the north shore of Lake Erie are major staging grounds in fall for several species of waterfowl on migration to wintering grounds along the Atlantic coast and Gulf of Mexico (Dennis and Chandler 1974, Dennis *et al.* 1984). Numbers of American wigeons (*Anas americana*) using the Long Point wetlands in the fall appear to be increasing (Knapton 1992), and wigeons currently constitute the second most frequently shot duck after mallards (*A. platyrhynchos*) brought to the Long Point Waterfowl Management Unit check station. This increase may be due to the recent extension of the known breeding range of the American wigeon across much of Ontario (Palmer 1976, Cadman *et al.* 1987), primarily in northern Ontario and especially along the Hudson Bay and James Bay coastlines. The local abundance of wigeons varies on an annual basis more than for many dabbling ducks, suggesting that part of the population occasionally changes its migration patterns, which may be correlated with changes in food supplies (Bellrose 1976).

Studies of food habits of wigeon on migration (e.g., Mabbott 1920, Stewart 1962, McGilvrey

[1]Current Address: Environment and Resource Studies, University of Waterloo, Waterloo, Ontario N2L 3G1.

1966, Wishart 1983) indicate a diet largely composed of various species of aquatic vegetation with less than 10% animal matter (Palmer 1976). Animal food was consumed in much higher proportions during the early breeding season, especially by females, followed by a decline to almost zero during fall migration (Wishart 1983). Stems and leaves rather than seeds of aquatic plants are the main food types, and are reported to reflect local availability (Bellrose 1976); however, Wishart (1983) determined selective feeding on vegetation during the breeding season. In this study, we determined the food habits of American wigeons at Long Point, and compared diets of males and females, and adults and immatures, during early and late fall. We also compared food consumed with respect to food resources potentially available to foraging wigeons to better understand habitat use and to guide management practices.

STUDY AREA

Long Point is a sandspit extending 35 km eastward into the eastern basin of Lake Erie; it is a unique combination of sand dunes, wet meadows, coniferous and deciduous swamps, deep water *Typha* marshes, shallow water grass, and sedge marshes and ponds, and intermediate successional stages (Reznicek and Catling 1989, Prince *et al.* 1992). Wetlands of the Long Point area are a mixture of palustrine and lacustrine types supporting dense and diverse stands of submersed and emergent macrophytes (Reznicek and Catling 1989) in deltaic and riverine wetlands and a 280,000 ha semi-enclosed inner bay.

Emergent vegetation in the inner bay (where wigeons were collected, see below) is dominated mainly by *Typha* spp., with significant components of sedges and bulrushes (*Carex aqualitis*, *C. stricta*, *Scirpus acutus*, *S. validus*), grasses (e.g., *Calamagrostis canadensis*), reed grass (*Phragmites communis*), wild rice (*Zizania aquatica*), and pickerel weed (*Pontederia cordata*) (Reznicek and Catling 1989). The submergent macrophyte communities in the inner bay are rich and diverse, and include beds wholly or partially dominated by the algae muskgrass (*Chara* spp.), coontail (*Ceratophyllum demersum*), elodea (*Elodea canadensis*), pondweeds (*Najas* spp.and *Potamogeton* spp.), water milfoil (*Myriophyllum spicatum*), and wild celery (*Vallisneria americana*). Stands of floating vegetation occur in sheltered inlets; these stands are dominated by the water lillies *Nuphar variegata* and *Nymphalis odorata* (Reznicek and Catling 1989; Knapton, unpubl. data).

METHODS

Wigeons were collected from hunters between 25 September and 20 November 1991, and included birds shot during early morning and evening along the south shore of the inner bay. The proventriculus and gizzard were taken from each bird, bagged separately, and frozen as quickly as possible for later processing. Sex and age of each individual were determined by plumage or cloacal characteristics as described in Kortright (1942) and Bellrose (1976); birds were classed as either immature (= hatch-year) or adult (= after-hatch-year).

Each bird was dissected as soon as possible; some birds may have been processed up to 8 hours after being shot because of delays in hunters bringing their ducks to the check station. Content mass was determined by weighing each gizzard and proventriculus to the nearest milligram before and after contents were removed. Contents were separated into vegetation (leaves, stems), seeds, invertebrates, and grit. Biotic material was identified using Fassett (1975), Martin (1951), Martin and Barkley (1961), Montgomery (1977), and reference collections. Food items were dried to constant mass at 65°C, and weighed to the nearest milligram (Reinecke and Owen 1980). Foods consumed were expressed as percent occurrence and as aggregate percent dry mass (Swanson *et al.* 1974). Data from proventriculi and gizzards were analyzed separately because of the known bias caused by the differential digestion of foods in the gizzard (Swanson and Bartonek 1970). Contents from gizzards as well as proventriculi were analyzed to ensure no food type was missed.

For the purpose of analysis, the food samples are divided into three groups: stems and leaves (including roots and tubers), seeds, and invertebrates. Percent occurrence and proportions of plant material and specific foods in the wigeon diet are compared according to sex, age, and time of year using 3-way analyses of variance and chi-square tests. Time of year is divided into two time periods: early fall (25 September - 17 October) and late fall (17 October - 20 November).

RESULTS

Diet of American Wigeon

Food samples were collected from 124 proventriculi and 149 gizzards. Dry masses of the three food classes in proventriculi totalled 561.1 mg, of which stems and leaves (547.9 mg) were by far the most important group, followed by seeds (6.4 mg), and invertebrates (6.8 mg). Dry mass in gizzards totalled 803.2 mg (stems and leaves 702.3 mg, seeds 99.4 mg, invertebrates 1.5 mg).

Stems and leaves. Stems and leaves accounted for 91.6% aggregate dry mass of all foods (Table 1). More than 75% of the aggregate dry mass of stems and leaves in proventriculus and gizzard samples were comprised of bushy pondweeds (*Najas flexilus* and *N. guadalupensis*), elodea, and *Chara* spp. (Table 1). Aggregate percent dry mass was similar between samples taken from gizzards and proventriculi; however, proportionately more *Chara* and less *Najas* were found in proventriculi than in gizzards, perhaps indicating a greater rate of digestion of nonvascular plants such as *Chara* (Table 1) (see also Swanson and Bartonek 1970). The range of items consumed was broad and diverse (Table 1).

Seeds. Seeds were found almost exclusively (>95%) in gizzards (Table 2). Seeds amounted to 7.8% dry mass of all foods eaten. However, our estimate of 7.8% seeds eaten may be an upper estimate caused by the slower digestion of hard seeds than leaves in the gizzard (Swanson and Bartonek 1970). The largest group of species by aggregate percent dry mass were pondweeds *(Potamogeton)*, of which *P. richardsonii* was the most important (Table 2). The next most numerous group (at 22.7 aggregate percent dry mass) were bulrushes (*Scirpus* spp.), *S. acutus* being the most frequently found (Table 2). Two birds had eaten large numbers of the seeds of pickerel weed (*Pontederia cordata*), and six birds had fed heavily on the seeds of *P. richardsonii*. Twenty-two of 81 females had consumed seeds, in comparison to only 10 of 68 males ($X^2 = 3.4$, $P = 0.06$).

TABLE 2. Food habits of staging American wigeon at Long Point, Ontario, fall 1991; seeds. N (gizzards) = 32, N (proventriculi) = 8.

	Aggregate % dry mass	% occurrence
Potamogeton richarsonii	37.4	4.0
P. natans	9.0	5.4
P. pectinatus	8.0	4.0
P. gramineus	3.9	6.0
Pontederia cordata	11.5	1.3
Scirpus acutus	12.7	21.5
S. americanus	8.8	4.7
Scirpus spp.	1.2	1.3
Myriophyllum spicatum	4.7	9.4
Sparganium eurycarpum	1.1	2.3
Najas flexilus	0.7	1.3
Sagittaria latifolia	0.4	1.3
Vallisneria americana	0.4	0.7
Zizania palustris	0.1	1.3
Phragmites australis	0.1	1.3
Unidentified seeds	0.4	3.4

TABLE 1. Food habits of staging American Wigeon at Long Point, Ontario, fall 1991; stems and leaves. N (gizzards) = 149, N (proventriculi) = 124.

	Aggregate % dry mass		% occurrence	
	Gizzard	Proventriculus	Gizzard	Proventriculus
Najas flexilus/guadalupensis	37.3	18.4	37.6	8.7
Chara spp.	21.5	36.9	14.8	9.4
Elodea canadensis	17.2	21.9	12.1	8.7
Vallisneria americana	5.2	0.9	8.1	1.3
Myriophyllum spicatum	4.6	1.7	4.7	0.7
Utricularia vulgaris	1.3	0	1.3	0
Potamogeton pectinatus	0.2	0	1.3	0
P. richardsonii	0.1	0	0.7	0
Potamogeton spp.	1.5	0	1.3	0
Sagittaria latifolia	0.8	0.1	1.3	0.7
Zizania palustris	0.1	0.6	2.0	0.7
Nymphaea odorata	0.1	0.1	0.7	0.7
Miscellaneous tubers	7.7	13.2	6.7	10.7
Miscellaneous vegetation	2.3	6.3	14.1	6.0
Miscellaneous roots	0.3	0.1	0.7	0.7

Invertebrates. Invertebrates were only found in proventriculi, and constituted only 0.6% dry mass of all foods eaten. Only 17 individual invertebrates were eaten by the 149 ducks; caddis fly larvae (*Trichoptera* spp.) were the primary animal food, accounting for 76% aggregate percent dry mass. Even assuming that animal matter is more readily digested than plant material, animal matter formed an insignificant portion of the diet.

Comparison of Diet by Sex, Age, and Season

For the purpose of analysis, the 149 wigeons were divided into eight groups as a function of sex (M,F); age (immature, I, or adult, A); and season (early and late fall). Sample sizes for the four early fall groups were 18 MA, 23 FA, 19 MI, and 25 FI, and those for the late fall groups were 15 MA, 11 FA, 16 MI, and 22 FI. Aggregate percent dry mass was compared among the eight groups. Some food taxa with small sample sizes were eliminated from the analysis; these included all animal matter, and about half of the plant species for both stems and leaves, and seeds.

Significantly more stems and leaves of *Najas flexilus & N. guadalupensis* were consumed in late fall than in early fall ($F = 6.70$, $P < 0.01$) by males (68% vs 22%), females (45% vs 14%), adults (39% vs 27%), and immatures (74% vs 9%). There was a significant age effect in the amount of *Chara* spp. eaten; adult males and females consumed much more muskgrass than did immatures regardless of season ($F = 6.96$, $P < 0.01$). Adult and immature females ate stems and leaves of *Elodea canadensis* late in the fall, whereas elodea was not found in males after early fall (sex × season interaction $F = 4.45$, $P < 0.05$). Adults consumed more miscellaneous tubers than did immatures ($F = 4.23$, $P < 0.05$) in both early and late fall. Immatures ate seeds of *Myriophyllum spicatum* more frequently during fall than did adults ($F = 3.96$, $P < 0.05$). Greater quantities of seeds of *Potamogeton richardsonii* were eaten in late fall than in early fall ($F = 3.54$, $P = 0.06$).

Several submerged aquatic plant species that are abundant and widespread at Long Point (Reznicek and Catling 1989) were found in only trace amounts (e.g., stems and leaves of all species of pondweeds *Potamogeton*), or not at all (e.g., coontail), whereas diet analyses of wigeons in Massachusetts, the upper Chesapeake Bay region, and Illinois show pondweeds and coontail as major foods (Palmer 1976). It is unlikely that wigeon at Long Point were failing to encounter coontail or the various species of pondweeds; these plant species have wide distribution and are abundant and accessible (Pauls and Knapton 1993). Furthermore, seeds of pondweeds, especially *P. richardsonii*, comprised over 58% aggregate dry mass of all seeds consumed (Table 2), hence wigeons were consuming the seed heads of *Potamogeton* and leaving the stems and leaves. These results indicate that wigeon were selective in the submerged aquatic plant species that they ate.

DISCUSSION

American wigeons fed primarily on stems and leaves of aquatic plants rather than on seeds or animal matter at Long Point. During migration, wigeons have a greater demand for energy-rich foods than for proteinaceous foods (Wishart 1983); hence, vegetation and seeds with high carbohydrate content are the best energy sources, rather than animal matter. Our results support this: stems and leaves comprised 92% dry mass of the diet, seeds about 8%, and animal matter <1%.

Studies of food habits of wigeons on migration show high diversity of aquatic plant species eaten (e.g., Mabbott 1920, Stewart 1962, McGilvrey 1966), possibly reflecting local availability (Bellrose 1976). Stems, leaves, and seeds of a wide array of aquatic plant species were found in the proventriculi and gizzards of wigeons at Long Point (Tables 1, 2). However, certain species predominated; stems and leaves (by aggregate dry mass) of both species of bushy pondweed, elodea, and muskgrass comprised 77% of food in proventriculi and 76% of food in gizzards. Stems and leaves of other plant species (wild celery, Eurasian milfoil) and miscellaneous tubers accounted for most remaining vegetation. In Manitoba, Wishart (1983) found that males consumed graminoids, and females consumed graminoids and *P. pectinatus*, only traces of which were found in Long Point wigeons.

Further evidence of selectivity in diet comes from a strong preference for submerged over emergent vegetation (Table 1). Stems and leaves of emergents comprised only 1% aggregate dry mass. However, wigeon consumed seeds of several emergents; seeds of bulrushes, pickerel weed, and burreed *Sparganium eurycarpum* comprised >35% aggregate dry mass of all seeds consumed, yet stems and leaves of these plants were not detected.

Invertebrates constituted 0.6% aggregate dry mass in the diet of wigeons at Long Point. Other studies of migrating and wintering wigeon have shown a higher amount of animal matter (up to 7%, Palmer 1976) in their diet. Much of this animal matter was molluscs, primarily Gastropoda. Of the 8.4 mg in the diet of wigeons at Long Point, only 2% was molluscs (Gastropoda).

The most frequently eaten macrophytes by all sex/age groups were bushy pondweeds *Najas* spp., a finding similar to Rawls (1958) who reported that *N. guadalupensis* comprised the major plant food of wigeon at Reelfoot Lake, Tennessee. *N. flexilus* is widely distributed in marshes and submerged macrophyte communities in the inner bay, and *N. guadalupensis* is fairly widely distributed in the Inner Bay (Pauls and Knapton 1993). However, nowhere is either species dominant in submerged plant communities, indicating a degree of preference shown by foraging wigeons for bushy pondweeds. Significantly more bushy pondweed was consumed by all groups later in the season than earlier. This may have been due to the greater availability of *Najas* beds later in the fall as the water level of Lake Erie fell, thereby exposing greater areas of *Najas* and making them more accessible. Alternatively, wigeon, known to kleptoparasitize diving waterbirds (e.g., Knapton and Knudsen 1978), may have stolen *Najas* and other submerged macrophytes from the large gatherings of foraging *Aythya* or possibly American coots *Fulica atra* at Long Point later in fall.

Differences in some foods consumed emerged between males and females, adults and immatures, and time of season. *Chara* spp. and tubers were eaten much more frequently by adults than by immatures, during early and late fall. Adult wigeons might have a higher grit grinding capacity than do immatures. *Chara* is encrusted with calcium deposits (Hotchkiss 1972), hence requiring a high degree of grinding for digestion, a capacity possibly better developed in adults than in immatures. Seeds of *Potamogeton richardsonii* were consumed more frequently in early fall. This is undoubtedly due to the seed set of the plant early in the fall, and hence being readily available. The sex × season difference in consumption of elodea stems and leaves and the age difference in consumption of milfoil seeds are not easily understood.

We found a wide selection of species of aquatic macrophytes in the diet of American wigeons at Long Point in fall, in keeping with other studies (Palmer 1976, Bellrose 1976, Wishart 1983) which have also found a similarly wide array of plant species. However, at Long Point, wigeons showed selectivity in the species and amounts of plants consumed. Coontail and several species of *Potamogeton*, which are widespread and abundant at Long Point (Reznicek and Catling 1989), were either not eaten or eaten only in trace amounts, in contrast to studies elsewhere that showed these macrophytes as principal foods. Perhaps the preference for specific food taxa, as wigeon are showing for *Najas* spp. at Long Point, reflects the energy/nutrient value of the food.

ACKNOWLEDGMENTS

We thank the Ontario Federation of Anglers and Hunters and the Long Point Provincial Park for allowing us to collect specimens at the Long Point Waterfowl Management Unit, and the Bluff's Hunting Club and the Long Point Company for providing us with specimens. We were aided in the field by Steve Wilcox and Chris Drummond who helped to extract proventriculi and gizzards. L. Lamb, B. Warner, D. A. Sutherland, R. Bailey, and I. McKenzie provided valuable assistance in plant, seed, and mollusc identification, and E. Harvey helped in statistical analysis. We thank C. D. Ankney, J. P. Ball, M. S. W. Bradstreet, C. Custer, and T. D. Nudds for helpful comments on the manuscript. Funding was supplied by the Long Point Waterfowl and Wetlands Research Fund, through the support of the Bluff's Hunting Club, Ontario Ministry of Natural Resources, Canadian Wildlife Service, Nature Conservancy of Canada, Long Point Bird Observatory, and Ontario Environmental Youth Corps. Logistical support was received from the Long Point Bird Observatory. This is publication 93-05 of the Long Point Waterfowl and Wetlands Research Fund and a contribution of the Long Point Bird Observatory..

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Submitted: 1 July 1993
Accepted: 17 November 1993