Food Preferences of Spring-migrating Blue-winged Teal in Southwestern Louisiana

Scott W. Manley,[1] *U.S. Fish and Wildlife Service, National Wetlands Research Center, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA 70803–7500*

William L. Hohman,[2] *U.S. Fish and Wildlife Service, National Wetlands Research Center, 700 Cajundome Blvd., Lafayette, LA 70506–3152*

Joseph L. Moore, *U.S. Fish and Wildlife Service, National Wetlands Research Center, 700 Cajundome Blvd., Lafayette, LA 70506–3152*

David Richard,[3] *Louisiana Department of Wildlife and Fisheries, Rockefeller State Wildlife Refuge, Route 1, Box 20-B, Grand Chenier, LA 70643*

Abstract: We studied effects of pair status, molt intensity, and year on food selection by migrating male blue-winged teal (*Anas discors*) in southwestern Louisiana during springs 1990 and 1991. Diets consisted primarily of animal foods; but plant material, consisting mostly of seeds, comprised as much as 44%. There was no difference in animal food consumption by paired and unpaired males; however, the proportion of animal material in the male diet was greater in 1990 than in 1991. Animal food consumption was not positively correlated with mean molt intensity. Food preferences of paired and unpaired males were similar in both years. Animal foods, especially benthos and organisms associated with vegetative substrates, were preferred to seeds and free-swimming invertebrates. We recommend that habitat management for spring-migrating blue-winged teal focus on production of invertebrates, especially long-lived forms such as dragonflies, hemipterans (except water boatmen), midges, and other dipterans.

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[1] Present address: Department of Wildlife and Fisheries, Mississippi State University, P.O. Drawer LW, Mississippi State, MS 39762–5917.

[2] Author to whom reprint requests should be addressed.

[3] Present address: J. G. Grey Estate, P.O. Box 40, Lake Charles, LA 70602.

Louisiana is an important staging area for blue-winged teal during spring and fall migration (Bellrose 1980). Blue-winged teal staging in Louisiana require energy to complete migration. They form pairbonds during spring migration and thus, in March and April, simultaneously incur energy costs of both migration and courtship. Additionally, 40% of male blue-winged teal collected in southwestern Louisiana in March 1990 and 1991 were found to be molting >5% of body feathers (W. L. Hohman, unpubl. data). Protein requirements of these males, and females that in spring undergo prebasic molt (Palmer 1976), are probably elevated relative to those of non-molters.

Food habits of blue-winged teal in Louisiana during spring migration are unknown. Previous studies summarizing diets of spring-migrating blue-winged teal in Missouri (Taylor 1978) and Ohio (DeRoia 1989) were based on small samples sizes ($N \leq 20$ birds), requiring investigators to combine data for males and females. Both studies reported high proportions of invertebrates in the diet of spring migrants, but neither study assessed food selection in relation to availability or annual differences in diet. In this study, we examined food selection by spring-migrating male blue-winged teal in Louisiana in relation to pair status, molt intensity, and year in which birds were collected. Management recommendations based on our assessment of food preferences are also presented.

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Methods

Male blue-winged teal were shot at Rockefeller State Wildlife Refuge in southwestern Louisiana (see Paulus [1982] for site description), 21–28 March 1990 and 1991. Collections were made in fresh to intermediate marshes (wetland classification follows Chabreck et al. 1989) where birds were concentrated. Pair status was assigned to spring migrants on the basis of observations made before collection. Paired individuals were those showing active association, i.e., copulation, mutual display, male defense of female, female tolerance of the male, or nonrandom spacing. Individuals were classified as unpaired if they did not show active association with a female. Collections were made throughout the diurnal period and focused on birds observed feeding for a minimum of 15 minutes. We attempted to collect equal numbers of paired and unpaired birds at each sampling site. The same sites were sampled in both years. Immediately after collection, alcohol was injected into the gullets of unopened specimens (Bailey and Titman 1984). Specimens were wrapped in absorbant paper toweling and frozen in sealed plastic bags.

Food availability was sampled at feeding sites by using a 6.1-cm diameter corer inserted to a substrate depth of at least 10 cm. Three, 5, or 10 core samples/site were taken, depending on the number of birds (i.e., 1, 2, or >2 birds) collected at the site. Corer contents (water column and substrate) were washed through a screen (0.3 x 0.3 mm or 0.09 mm^2 openings) and frozen.

Esophageal and core samples were hand-sorted to remove macroscopic plant and animal material. Plant seeds and tubers and animal material were identified and dried to constant mass ($\pm$0.001 g) at 50° C. Common names of invertebrates and plants followed Pennak (1978) and Scott and Wasser (1980), respectively. Food habits were summarized on an aggregate percent dry mass basis (Swanson et al. 1974*a*). Only food samples from birds containing 5 or more items were included in the analysis (Reinecke and Owen 1980).

The intensity of molt was scored in 7 feather tracts (head and neck, sides and flank, upper breast and back, lower breast and belly, mid-rump and lower back, scapular, and rectral) using procedures of Billard and Humphrey (1972). Molt intensity was averaged over feather tracts to determine mean molt intensity.

The proportion of animal material in the diet was compared by pair status and year using 2-way ANOVA on arcsine square-root transformed data. We used ANOVA to test for year effects on dry mass (average dry mass/taxon/site) of potential foods. These data were transformed ($[x + 1]^{1/2}$) to satisfy homogeneity of variance assumptions. Spearman rank correlation analysis (Conover 1980) was used to examine the association between molt intensity and proportion of animal material consumed by blue-winged teal.

Food preferences were assessed on a dry mass basis by using PREFER, a computer program that assesses preferences using nonparametric procedures (Johnson 1980). Only foods having ≥1% aggregate dry mass or ≥10% frequency of occurrence in use or availability samples were included in the analysis. These included Nematoda (roundworms), Isopoda (sow bugs), Amphipoda (scuds), Decapoda (shrimp), miscellaneous Crustacea (Cladocera, Copepoda, and Ostracoda), Odonata (dragonflies), Corixidae (water boatmen), miscellaneous Hemiptera (Mesoveliidae, Pleidae, Nepidae, and Belostomatidae), Coleoptera (beetles), Chironomidae (midges), miscellaneous Diptera (Stratiomyidae and Tabanidae), Gastropoda (snails), seeds, and Lemnaceae (duckweed) vegetation. Aggregate percent dry mass of taxa collected at sampling sites were assumed to represent food available to blue-winged teal at those sites.

Results

Food Use

Seventy-nine of 100 male blue-winged teal collected in 1990 and 1991 (25 paired and 25 unpaired per year) had ≥5 food items in their esophagi. Diets consisted primarily of animal foods, especially midges, snails, beetles, sow bugs, scuds, dragonflies, and miscellaneous crustaceans (Table 1). Plant material, consisting mostly of seeds, comprised <44% of the diet. The interaction of pair status and year on the proportion of animal material in the diet was not significant (F = 0.00; 1,75 df; P = 0.974). Paired males appeared to consume more animal material than unpaired birds, but the difference was equivocal (F = 3.32; 1,75 df; P = 0.072). The proportion of animal material in the diet was greater in 1990 than in 1991 (F = 6.03; 1,75 df; P = 0.016) (Table 1). Animal food consumption was not correlated with mean molt intensity in 1990 (Spearman $r = -0.09$, $N = 34$, $P > 0.10$), but there was a significant negative association in 1991 (Spearman $r = -0.46$, $N = 45$, $P < 0.01$).

Food Availability

One-hundred and one cores were taken at 22 sites in 1990 and 97 cores were obtained at 19 sites in 1991. There were no differences between years in dry mass densities of plant (F = 0.27; 1,39 df; P = 0.608) or animal (F = 0.05; 1,39 df; P = 0.825) foods at feeding sites (Table 2). Both plant and animal foods occurred at all feeding sites. In both years, seeds and midges were the 2 most abundant foods, representing collectively >87 aggregate percent dry mass. Roundworms, shrimp, and miscellaneous dipterans were present in 1 year only (Table 2). Dry mass densities of duckweed and snails were greater in 1990 than in 1991 (F's > 5.0; 1,39 df; P's < 0.03), but year had no effect on densities of other foods (F's = 0–2.94; 1,39 df; P's > 0.09) (Table 2).

Feeding Preferences

Spring-migrating male blue-winged teal exhibited significant food preferences in 1990 (F = 13.67; 10,23 df; $P < 0.005$) and 1991 (F = 10.62; 12,32 df; $P < 0.005$). Food preferences of paired and unpaired males were similar in both years (Table 3). Animal foods were generally preferred to plant foods. In 1990, males fed selectively on roundworms, midges, and miscellaneous animals (Annelida, dragonflies, Hemiptera, and Diptera), while seeds and duckweed were under-represented in the diet. In 1991, males preferred dragonflies, miscellaneous hemipterans, crustaceans, and dipterans, and sow bugs; and avoided seeds, scuds, and water boatmen. In general, benthos and organisms associated with vegetative substrates were preferred to free-swimming invertebrates such as scuds and water boatmen.

Discussion

The blue-winged teal diet changes seasonally. Males and females eat mostly aquatic invertebrates during the breeding season (Dirschl 1969, Swanson et al. 1974*b*, Dubowy 1988). Animal food consumption by adults (sexes not distinguished) breeding in Saskatchewan declined after July (Dirschl 1969) but remained high in postbreeding males in Manitoba (Dubowy 1985). Fall migrants and wintering birds were predominantly vegetarians (Glasgow and Bardwell 1962, DeRoia 1989). The

Table 1. Esophageal contents of male blue-winged teal collected at Rockefeller Wildlife Refuge in southwestern Louisiana, 21–28 March 1990 and 1991.

	Aggregate % dry mass				% occurrence			
	1990		1991		1990		1991	
Food taxa[a]	Unpaired (N = 16)	Paired (N = 18)	Unpaired (N = 22)	Paired (N = 23)	Unpaired (N = 16)	Paired (N = 18)	Unpaired (N = 22)	Paired (N = 23)
Animal	86.1	72.9	69.6	56.4	100.0	100.0	90.9	87.0
Nematoda	tr[b]	0.2	tr	0.1	12.5	50.0	9.1	8.7
Copepoda	0.0	0.0	tr	0.1	0.0	0.0	9.1	13.0
Ostracoda	tr	0.9	0.0	tr	6.3	16.7	0.0	4.3
Isopoda	1.0	0.0	1.6	5.3	12.5	0.0	22.7	30.4
Amphipoda	0.7	1.4	1.3	0.4	12.5	22.2	4.5	13.0
Odonata	0.1	0.0	0.0	2.0	6.3	0.0	0.0	4.3
Corixidae	tr	tr	0.2	0.4	6.3	11.1	22.7	13.0
Coleoptera	0.4	4.3	4.5	6.6	12.5	33.3	31.8	30.4
Chironomidae	65.2	47.8	52.6	34.1	100.0	94.4	86.4	69.6
Gastropoda	18.1	13.8	9.4	7.5	43.8	33.3	45.5	39.1
Miscellaneous[c]	0.7	4.5	tr	tr	18.8	22.2	9.1	4.3
Plant	13.9	27.1	30.5	43.6	62.5	72.2	81.8	87.0
Seeds[d]	13.5	26.5	30.5	43.5	56.3	72.2	81.8	87.0
Lemnaceae	0.4	0.6	tr	tr	25.0	22.2	4.5	8.7

[a]Only food taxa with ≥1.0% aggregate % dry mass or ≥10% frequency of occurrence are included.
[b]Trace (tr), aggregate percent dry mass <0.1%.
[c]Miscellaneous animal foods include Annelids, Cladocera, Tabanids, the eggs of aquatic vertebrates, and unidentifiable exoskeleton from aquatic invertebrates.
[d]Seeds are from *Ranunculus* spp., *Cyperus odoratus*, *Cladium jamaicense*, *Leptochloa fascicularis*, *Scirpus* spp., *Echinochloa walteri*, *Sesuvium maritimum*, *Eleocharis parvula*, and *Paspalum* spp.

Table 2. Mass and relative abundance of potential foods at blue-winged teal feeding sites in southwestern Louisiana, 21–28 March 1990 and 1991.

Food taxa[b]	Aggregate % dry mass 1990 (N = 22)	Aggregate % dry mass 1991 (N = 19)	% occurrence 1990 (N = 22)	% occurrence 1991 (N = 19)	Dry mass (g/m²)[a] 1990 (N = 22)	Dry mass (g/m²)[a] 1991 (N = 19)
Animal	19.1	23.1	100.0	100.0	2.652 (0.460)	2.870 (0.495)
Nematoda	tr[c]	0.0	18.2	0.0	tr	0.000 (0.000)
Isopoda	0.5	0.7	22.7	47.4	0.077 (0.049)	0.095 (0.053)
Amphipoda	1.4	1.7	72.7	57.9	0.213 (0.067)	0.154 (0.072)
Decapoda	0.0	1.1	0.0	15.8	0.000 (0.000)	0.523 (0.245)
Misc. Crustacea	0.7	tr	59.1	31.6	0.096 (0.057)	0.002 (0.061)
Odonata	0.1	0.4	4.5	5.3	0.022 (0.042)	0.061 (0.045)
Corixidae	2.5	2.3	72.7	73.7	0.217 (0.044)	0.186 (0.047)
Misc. Hemiptera	0.3	0.2	9.1	15.8	0.192 (0.143)	0.068 (0.154)
Coleoptera	1.5	2.4	72.7	73.7	0.197 (0.081)	0.289 (0.087)
Chironomidae	9.0	11.4	90.9	89.5	1.243 (0.279)	1.177 (0.300)
Misc. Diptera	0.0	1.4	0.0	21.1	0.000 (0.000)	0.114 (0.050)
Gastropoda	3.0	1.2	68.2	52.6	0.373 (0.074)	0.130 (0.080)
Fish	0.1	0.3	4.5	10.5	0.018 (0.033)	0.068 (0.035)
Misc. Animal	tr	tr	9.1	10.5	tr	tr
Plant	80.9	76.9	100.0	100.0	28.516 (11.451)	28.084 (12.322)
Lemnaceae	4.7	0.6	63.6	52.6	0.623 (0.152)	0.052 (0.163)
Seeds[d]	76.2	76.3	100.0	100.0	27.893 (11.463)	28.033 (12.336)

[a]Mean (SE).
[b]Only food taxa with ≥1.0% aggregate % dry mass or ≥10% frequency of occurrence are noted in table. Other taxa included in miscellaneous Crustacea (Cladocera, Copepoda, and Ostracoda), Hemiptera (Mesoveliidae, Pleidae, Nepidae, and Belostomatidae), Diptera (Stratiomyidae and Tabanidae), and animal (invertebrate eggs and unidentifiable exoskeleton) categories.
[c]Trace (tr), aggregate percent dry mass <0.1% or <0.001 dry mass (g/m²).
[d]Seeds are from *Ranunculus* spp., *Cyperus odoratus*, *Cladium jamaicense*, *Leptochloa fascicularis*, *Scirpus* spp., *Echinochloa walteri*, *Sesuvium maritimum*, *Eleocharis parvula*, and *Paspalum* spp.

switch to animal foods by spring migrants was evident in blue-winged teal using seasonally flooded impoundments in Missouri (Taylor 1978), Lake Erie marshes (DeRoia 1989), and coastal marshes in Louisiana (this study). Cinnamon teal (*Anas cyanoptera*) exhibit similar dietary shifts (Dubowy 1988, Thorn 1991, W. L. Hohman unpubl. data).

Shifts in food selection by blue-winged teal may reflect changes in food availability or nutritional needs, differences among foods in their metabolic conversion efficiencies, and/or competition (Krapu and Reinecke 1992). The effects of competition on food choice should be most pronounced among conspecifics (Thompson 1989). However, similarities in the food preferences of paired and unpaired males evident in this study and extensive dietary overlap between males and females during spring and summer (Dirschl 1969, Swanson et al. 1974*b*, Taylor 1978, DeRoia 1989, W. L. Hohman unpubl. data) suggest that intraspecific competition has minimal effect on food selection by blue-winged teal. Moreover, blue-winged teal use shallow, seasonal wetlands where foods, particularly invertebrates, may be temporally abundant (Swanson et al. 1974*b*, Weller 1979). Because of the ephemeral nature of these foods and low metabolic return for individual food items, it seems unlikely that defense of feeding sites by blue-winged teal during spring and summer

Table 3. Food preferences for male blue-winged teal collected at Rockefeller Wildlife Refuge in southwestern Louisiana, 21–28 March 1990 and 1991.

Year Pair status	Preference rank[a] 1	2	3	4	5	6	7	8	9	10	11	12	13
1990 (*N* = 33)	NEM[b]	MIS	CHI	ISO	CRU	GAS	COL	AMP	COR	LEM	SEE		
Unpaired (*N* = 16)	NEM	MIS	GAS	ISO	CHI	CRU	COL	COR	AMP	LEM	SEE		
Paired (*N* = 17)	NEM	MIS	CHI	ISO	COL	CRU	GAS	AMP	COR	LEM	SEE		
1991 (*N* = 45)	ODO	HEM	CRU	DIP	ISO	DEC	GAS	CHI	COL	LEM	SEE	AMP	COR

(*continued*)

Table 3. Continued.

Year Pair status	Preference rank[a]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Unpaired (N = 22)	HEM	DEC	ODO	CRU	ISO	DIP	CHI	GAS	LEM	COL	AMP	SEE	COR
Paired (N = 23)	ODO	HEM	DIP	CRU	GAS	ISO	COL	DEC	CHI	LEM	SEE	AMP	COR

[a]Rank 1 = most preferred.

[b]AMP = Amphipoda, CHI = Chironomidae, COL = Coleoptera, COR = Corixidae, CRU = miscellaneous Crustacea, DEC = Decapoda, DIP = Diptera, GAS = Gastropoda, HEM = Hemiptera, ISO = Isopoda, LEM = *Lemna* sp., MIS = miscellaneous animal (Annelida, Odonata, Hemiptera, and Diptera), NEM = Nematoda, ODO = Odonata, and SEE = seeds. Foods underscored with the same line are statistically similar ($P > 0.05$).

would be energetically feasible. Competition and its effect on habitat use most likely occur during winter, when available food resources may be limited relative to other periods of the annual cycle (Dubowy 1988, Thompson 1989).

Dietary similarities among birds with different nutritional requirements (e.g., breeding males vs. females) and time constraints (e.g., paired vs. unpaired males) imply that availability has a major influence on food selection by blue-winged teal. Spring-migrating blue-winged teal in southwestern Louisiana, however, exhibited significant food preferences (i.e., food use independent of availability). Moreover, although the abundance of plant and animal foods was the same at feeding sites in 1990 and 1991, spring-migrating blue-winged teal ate more animal material in 1990 than in 1991.

In spite of elevated energy costs incurred by spring migrants that would seem to favor use of high energy plant foods rather than proteinaceous animal foods, male blue-winged teal in southwestern Louisiana preferred animal to plant foods. During the laying period, females presumably ingest animal material to offset increased protein costs associated with egg formation (Swanson et al. 1974*b*). The importance of animal foods to breeding blue-winged teal was evident in Ontario, where habitat selection was positively correlated with the abundance of invertebrates (Joyner 1980). Nonetheless, protein requirements for reproduction are small for males relative to females, and females obtain reproductive protein primarily from exogenous sources at the time of egg formation (Rohwer 1986). It is unlikely, therefore, that the shift to animal foods by spring migrants is anticipatory of reproductive requirements. Molting waterfowl may have elevated protein requirements (Heitmeyer 1985); however, Thorn (1991) found no association between molt intensity and invertebrate consumption for female cinnamon teal collected during spring. Likewise, in this study, animal food consumption and molt intensity were greater in 1990 than in 1991, but the association was not significant in 1990 and was negative in 1991.

Management Recommendations

Although factors affecting food choice by spring-migrating male blue-winged teal are still not well understood, it is evident from this study that birds actively select invertebrates. We recommend that management of wetlands for spring-migrating blue-winged teal focus on production of invertebrates, especially long-lived forms such as dragonflies, hemipterans (except water boatmen), midges, and other dipterans. This can best be accomplished in fresh to intermediate marshes by manipulating water levels to produce 30%–70% interspersion of emergent vegetation and open water. Open water areas vegetated with submersed aquatics, especially pondweeds (*Potamogeton* spp.) and naiads (*Najas* spp.), favor long-lived invertebrate taxa and therefore are highly desirable. Partial drawdowns should be undertaken in summer to dry peripheral (elevated) areas and enable annuals such as *Echinochloa walteri* and *Leptochloa fascicularis* to germinate. Water depth should be regulated in spring so that birds are able to feed on benthos. In conclusion, management of fresh to intermediate coastal marshes that promotes vegetative diversity and zonal interspersion of vegetation is needed to insure continued high use of these important wetlands by blue-winged teal and other late-migrating waterfowl.

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