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FOODS OF MIGRATING CINNAMON TEAL IN CENTRAL NEW MEXICO

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Abstract.—Stomach contents of migrating Cinnamon Teal (*Anas cyanoptera*) from four plant zones on Bosque del Apache National Wildlife Refuge, New Mexico were studied. Cinnamon Teal consumed more animal than plant foods (expressed as percentage dry mass) during spring migration but more plant than animal foods during fall migration. Animal food consumption was greatest in Cinnamon Teal collected from alkali (*Scirpus maritimus*)-three-square bulrush (*S. americanus*) and saltgrass (*Distichlis stricta*) habitats; plant consumption was highest in ducks collected from habitat dominated by annuals including smartweeds (*Polygonum* spp.), wild millets (*Echinochloa* spp.) and sprangletop (*Leptochloa fascicularis*), and by cattail (*Typha* spp.)-hardstem bulrush (*S. acutus*) habitats during spring and fall migration. Chironomid larvae were the dominant animal consumed during spring migration; gastropods were the major animal consumed during fall migration. Seeds were dominant among plant materials in stomachs during both spring and fall migration and usually were from the major plant species found within the zone where the bird was collected. During spring, there was no difference in animal foods and molt rank among habitat types.

ALIMENTO UTILIZADO POR *ANAS CYANOPTERA* EN LA PARTE CENTRAL DE NUEVO MÉXICO

Sinopsis.—Se estudió el contenido estomacal de individuos migratorios del pato *Anas cyanoptera* en cuatro comunidades de plantas en el refugio nacional de vida silvestre Bosque del Apache en Nuevo México. Basándose en el porcentaje de materia seca, se encontró que este pato consume mayor cantidad de materia animal durante la migración primaveral y mayor cantidad de materia vegetal durante la migración otoñal. El consumo de materia animal fue mayor en habitats de *Scirpus maritimus, S. americanus* y *Distichlis stricta.* Las aves consumieron mayor cantidad de materia vegetal, tanto durante la primavera como en el otoño, en habitats dominados por *Polygonum* spp., o *Echinochloa* spp. unido a *Leptochloa fascicularis* y áreas con *Typha* spp. y *S. acutus.* Las larvas de chironomidos resultaron ser el organismo más consumido durante la migración primaveral; los gastropodos durante el otoño. Las semillas fueron el principal artículo alimentario tanto en la primavera como en el otoño y éstas resultaron ser de la planta dominante en el lugar en que fueron capturados los patos. Durante la primavera, no se encontró diferencia en el alimento consumido, de origen animal, entre los diferentes tipos de habitats evaluados.

The importance of migratory habitats to overall well being of waterfowl populations has been documented by Heitmeyer and Fredrickson (1981), Weller (1988), LaGrange and Dinsmore (1989) and Smith et al. (1989). These authors found that amount and condition of migratory habitat

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strongly influence condition of waterfowl arriving on breeding grounds. Bosque del Apache National Wildlife Refuge (NWR), located in the Rio Grande Valley of central New Mexico, provides migratory habitat for Central Flyway waterfowl such as Cinnamon Teal (*Anas cyanoptera*). Refuge management was recently converted from an agricultural and impoundment system concerned primarily with providing winter herbage and agricultural grains for geese (*Anser caerulescens* and *A. rossii*) and sandhill cranes (*Grus canadensis*) to a broad-based moist-soil management system that provides native foods for wintering geese and cranes, as well as for numerous other migratory and wintering waterfowl and waterbirds (J. Taylor, pers. comm.). The manner in which waterfowl use these recently created moist-soil habitats on the refuge has not been determined. Our objective was to determine diets of migrating Cinnamon Teal in dominant plant zones in the recently created moist-soil habitats on Bosque del Apache NWR.

STUDY AREA

About 3000 ha of Bosque del Apache NWR are managed (i.e., crop production and moist-soil plant production) for waterfowl and water bird use. Dominant moist-soil plants in managed impoundments include: sprangletop (*Leptochloa fascicularis*), wild millets (*Echinochloa* spp.), smartweeds (*Polygonum* spp.), sedges (*Carex* spp.), saltgrass (*Distichlis stricta*), alkali bulrush (*Scirpus maritimus*), common three-square bulrush (*S. americanus*), hardstem bulrush (*S. acutus*) and cattails (*Typha* spp.). Some of the soils of the Rio Grande Valley are poorly drained and saline (Maker et al. 1972). The majority of managed impoundments and agricultural fields on the refuge are found within poorly drained soil associations.

Precipitation at Bosque del Apache NWR during 1990 (23.9 cm) was 14% below the 10-yr mean. The driest month, February (1.3 cm), occurred during spring migration of waterfowl. The most precipitation fell in September (5.7 cm), which was during fall migration. Impoundments are flood-irrigated, so rainfall has little effect on impoundment water depth or soil moisture.

METHODS

Nine managed impoundments on the refuge were classified as one or more of four different plant zones: annuals (wild millets, sprangletop and smartweeds); saltgrass; alkali-three-square bulrush; and cattail-hardstem bulrush. Type and amount of the dominant plant zone within each impoundment were estimated from aerial photographs and subsequently verified by visual ground truthing.

Cinnamon Teal were collected within these four plant zones during spring migration (2 Feb.–12 May 1990) and fall migration (15 Aug.–3 Nov. 1990). During spring, all specimens were viewed feeding for at least 10 min before collection with a .22-caliber rifle. As a result of dense fall vegetation, however, it was not always possible to observe Cinnamon Teal feeding. Sounds associated with feeding helped identify ducks feeding in dense vegetation during fall. Fall samples were collected with a 12-gauge shotgun. At each collection site, we measured water depth, vegetation height and estimated vegetation density (0–25% = open, 25–50% = sparse, 50–75% = moderate, 75–100% = dense) at the site where the duck was retrieved.

Culmen measurements distinguished Cinnamon and Blue-winged (*A. discors*) Teal, except for males in breeding plumage (Spencer 1953). Sex was determined by plumage and cloacal examination. Ducks were assigned to an immature or adult age class on the basis of wing characteristics (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1977) and presence or absence of bursa of Fabricius (Hochbaum 1942).

While in the field, we removed digestive tracts from the upper end of the esophagus to the distal end of the proventriculus and preserved them in a 10% formalin solution. Food items in the gizzards were not used in analyses because of bias towards items that resist digestive breakdown (Swanson and Bartonek 1970).

We sorted invertebrates and seeds from digestive tracts and identified them to lowest taxon possible according to Martin (1954), Martin and Barkley (1961), Merrit and Cummins (1984), Pennak (1989) and a seed reference collection at New Mexico State University. Food items were washed with water and blotted on paper towels. Volume was determined by water displacement to the nearest 0.01 ml in a graduated cylinder and/or in microsyringes. Food items were dried for 24 h at 60 C and weighed to the nearest 0.001 g. Food consumption by habitat type was expressed as aggregate percentage volume, aggregate percentage dry mass and frequency of occurrence (Swanson et al. 1974).

Any food item that had <0.01 ml volume or any collected specimen with <0.01 ml of food in the digestive tract was excluded from analysis. We used ANOVA to compare data by habitat type and season on the basis of animal and plant food consumption. A post-hoc Duncan's Multiple Range Test was used to determine differences among plant zones and seasons. These statistical tests were conducted using PROC GLM (SAS 1989a). Strength of the relation between water depth, vegetation density, and vegetation height at collection sites and percentage dry mass of animal and plant foods was determined by Pearson's correlation (PROC CORR: SAS 1989b).

Molt was scored for each specimen and assigned a ranking according to Titman et al. (1990). We used ANOVA to analyze the difference between mean percentage dry mass of animal food consumption and molt rank for female Cinnamon Teal collected during the spring migration (PROC GLM: SAS 1989a). All statistical decision levels were $\alpha = 0.05$.

RESULTS

Food samples were collected from 28 female Cinnamon Teal (16 adults, 12 immatures) during spring migration and from 27 immature Cinnamon Teal during fall migration. Percentage dry mass of animal ($F = 0.34$, df

TABLE 1. Percentage dry mass of animal and plant foods in Cinnamon Teal collected in four habitat types during spring and fall 1990 at Bosque del Apache National Wildlife Refuge.*

Habitat type	*n*	Animal	Plant
Alkali-three-square bulrush	7	65.3 ± 41.2[a]	34.7 ± 41.2[b]
Saltgrass	7	49.3 ± 34.7[a]	50.7 ± 34.7[b]
Annual	23	18.0 ± 21.4[b]	82.0 ± 21.4[a]
Cattail-hardstem bulrush	18	16.2 ± 27.2[b]	83.9 ± 27.2[a]

* Means with the same letter are not significantly different ($P < 0.05$).

= 1,25, $P = 0.561$) and plant ($F = 0.38$, df = 1,27, $P = 0.591$) foods eaten did not differ between immature and adult Cinnamon Teal during spring migration. Further, percentage dry mass of animal ($F = 0.28$, df = 1,18, $P = 0.767$) and plant ($F = 0.47$, df = 1,26, $P = 0.522$) foods did not differ between males and females collected during fall migration. Percentage dry mass of animal and plant foods eaten by migrating Cinnamon Teal differed between seasons ($F = 10.61$, df = 1,48, $P = 0.002$). Spring-collected teal contained higher mean percentage dry mass of animal ($\bar{x} = 45.0 \pm 33.8$) than plant ($\bar{x} = 55.0 \pm 33.8$) foods, whereas fall-collected teal contained higher mean percentage dry mass of plant ($\bar{x} = 90.8 \pm 19.1$) than animal ($\bar{x} = 9.2 \pm 19.1$) foods. Food consumption also differed among habitat types ($F = 3.21$, df = 3,48, $P = 0.031$). Teal collected from alkali-three-square bulrush and saltgrass habitats contained highest mean percentage dry mass of animal foods, whereas those collected from annual and cattail-hardstem bulrush habitats contained the highest mean percentage dry mass of plant foods (Table 1). This pattern of mean percentage dry mass of animal and plant food consumption was similar (no interaction) during spring and fall ($F = 0.66$, df = 2,48, $P = 0.524$) migration, so spring and fall data were lumped to analyze for differences in mean percentage dry mass of food consumption among plant zones.

The dominant (aggregate percentage dry mass and frequency of occurrence) animal food consumed in all habitat types during spring migration was chironomid larvae (Table 2); the dominant animal food item consumed during fall migration was gastropod (Table 3). The major plants encountered were from the dominant plant species in the sample areas (Tables 2, 3). The only exception was for birds collected from saltgrass habitats in which aggregate percentage dry mass was greater for smartweeds and hardstem bulrush (Table 2).

Water depth at collection sites ranged from 5.5 to 58.5 cm. Collection sites during fall migration ($\bar{x} = 34.2 \pm 16.3$ cm) were deeper than collection sites during spring migration ($\bar{x} = 16.0 \pm 10.8$ cm) ($F = 4.98$, df = 1,44, $P = 0.030$). Water depths also differed among habitats ($F = 6.15$, df = 3,44, $P = 0.001$). Collection sites in cattail-hardstem habitat were deeper than in other habitats (Table 4). Collection sites in saltgrass and alkali-three-square bulrush habitats were shallowest (Table 4).

TABLE 2. Aggregate percentage volume (Vol), aggregate percentage dry mass (Mass), and percentage occurrence (Occ) of foods in digestive tracts of female Cinnamon Teal collected in four habitat types during spring 1990 at Bosque del Apache National Wildlife Refuge.

	Annuals (n = 8)			Cattail-hardstem bulrush (n = 7)			Saltgrass (n = 7)			Alkali-three-square bulrush (n = 6)		
Food	Vol	Mass	Occ	Vol	Mass	Occ	Vol	Mass	Occ	Vol	Mass	Occ
Animal												
Diptera-Chironomid	45.2	20.7	100.0	17.4	13.0	57.0	35.5	16.6	100.0	54.2	50.4	83.3
Cladocera	13.6	4.5	62.5	14.2	3.7	71.4	14.3	3.2	42.9	9.0	4.0	66.7
Gastropoda	3.2	4.7	25.0	8.7	9.7	57.1	0.5	0.6	14.3	9.1	13.1	66.7
Ephemeroptera-Beatidae	1.3	2.0	12.5	0.7	0.4	14.3	0.5	0.6	42.9	—	—	—
Amphipoda	0.9	0.3	12.5	—	—	—	—	—	—	—	—	—
Copepoda	0.9	1.7	87.5	—	—	—	—	—	—	—	—	—
Coleoptera	0.9	2.7	37.5	1.7	1.0	14.3	3.3	3.8	28.6	7.4	6.8	16.7
Diptera	0.9	0.3	12.5	—	—	—	15.5	15.7	42.9	—	—	—
Odonata-Coenagrionidae	0.4	0.7	12.5	—	—	—	—	—	—	—	—	—
Hemiptera	—	—	—	1.5	0.8	28.6	—	—	—	1.9	0.6	16.7
Ostracoda	—	—	—	0.7	0.4	42.9	4.9	6.0	85.7	—	—	—
Oligochaeta	—	—	—	—	—	—	4.2	4.7	14.3	—	—	—
Isopoda	—	—	—	—	—	—	0.4	0.4	14.3	—	—	—
Hydracarina	—	—	—	—	—	—	0.3	0.3	28.6	—	—	—
Unidentified animal	—	—	—	2.4	0.0	14.3	0.7	0.7	28.6	—	—	—
Misc. animal part	—	—	—	0.3	0.7	28.6	—	—	—	—	—	—
Total animal	67.3	37.6	100.0	47.6	29.7	85.7	80.1	52.6	100.0	81.6	74.9	83.3
Plant												
Smartweeds	7.6	27.0	62.5	3.2	2.4	14.3	4.0	11.7	28.6	—	—	—
Hardstem bulrush	1.1	6.5	37.5	11.6	18.9	71.4	3.0	12.1	42.9	—	—	—
Sunflower (*Heliathus annuus*)	0.8	1.0	12.5	—	—	—	—	—	—	—	—	—
Alkali bulrush	0.4	8.6	37.5	11.5	22.0	71.4	0.3	1.2	28.6	0.7	4.8	16.7
Three-square bulrush	—	—	—	5.3	11.4	42.9	—	—	—	—	—	—
Flatsedge (*Cyperus strigosus*)	—	—	—	1.3	1.7	14.3	—	—	—	—	—	—

TABLE 2. Continued.

Food	Annuals (n = 8)			Cattail-hardstem bulrush (n = 7)			Saltgrass (n = 7)			Alkali-three-square bulrush (n = 6)		
	Vol	Mass	Occ	Vol	Mass	Occ	Vol	Mass	Occ	Vol	Mass	Occ
Sprangletop	—	—	—	0.9	0.6	28.6	—	—	—	—	—	—
Saltgrass	—	—	—	—	—	—	2.3	6.5	57.1	—	—	—
Misc. seed parts	21.6	18.2	75.0	18.8	13.2	85.7	7.1	14.0	85.7	1.1	3.7	66.7
Misc. plant parts	1.3	1.2	12.5	—	—	—	3.2	2.1	14.3	—	—	—
Unidentified seed	—	—	—	—	—	—	—	—	—	16.7	16.7	33.3
Total plant	32.8	62.5	100.0	52.6	70.2	100.0	19.9	47.6	100.0	18.5	25.2	100.0

TABLE 3. Aggregate percentage volume (Vol), aggregate percentage dry mass (Mass), percentage occurrence (Occ) of foods in digestive tracts of Cinnamon Teal collected in annual (n = 15), cattail-hardstem bulrush (n = 1), and alkali-three-square bulrush (n = 11), habitats during fall 1990 at Bosque del Apache NWR. Saltgrass habitat was not flooded until after most birds were collected.

	Annuals			Cattail-hardstem bulrush			Alkali-three-square bulrush	
Food	Vol	Mass	Occ	Vol	Mass	Occ	Vol	Mass
Animal								
Gastropoda	10.7	7.3	86.7	8.3	7.8	27.3	12.5	12.7
Ephemeroptera-Beatidae	1.4	0.7	26.7	—	—	—	—	—
Amphipoda	0.0	0.0	6.7	—	—	—	—	—
Coleoptera	0.6	0.3	33.3	—	—	—	—	—
Diptera	0.1	0.3	20.0	—	—	—	—	—
Odonata-Gomphidae	0.3	0.1	6.7	—	—	—	—	—
Odonata-Coenagrionidae	0.2	0.1	26.7	0.3	0.1	9.1	12.5	3.3
Odonata-Libellulidae	—	—	—	0.2	0.1	9.1	—	—
Hemiptera-Corixidae	0.0	0.0	6.7	4.6	0.8	18.2	—	—
Unidentified animal	0.5	0.2	20.0	0.1	0.0	9.1	—	—
Misc. animal part	0.1	0.0	13.3	—	—	—	12.5	2.7
Total animal	13.9	9.0	93.3	13.5	8.8	36.4	37.5	18.7
Plant								
Wild millet	46.7	50.2	93.3	27.9	30.1	54.6	—	—
Smartweeds	10.6	11.9	80.0	7.6	8.3	27.3	—	—
Hardstem bulrush	4.8	8.2	40.0	45.0	43.7	72.7	—	—
Alkali bulrush	—	—	—	—	—	—	25.0	36.0
Three-square bulrush	—	—	—	—	—	—	33.3	43.3
Browntop millet (*Panicum lanuginosum*)	0.6	1.6	13.3	—	—	—	—	—
Rice cutgrass (*Leersia oryzoides*)	0.4	0.4	6.7	—	—	—	—	—
Arrowhead	0.0	0.0	13.3	—	—	—	—	—
Pondweeds (*Potamogeton* spp.)	0.0	0.3	26.7	5.3	8.4	27.3	—	—
Horn pondweed (*Zannichellia palustris*)	—	—	—	0.8	0.8	27.3	—	—
Sprangletop	18.2	12.6	86.7	0.0	0.0	9.1	—	—
Saltgrass	0.4	0.6	20.0	0.0	0.0	9.1	—	—
Misc. seed parts	2.1	0.7	20.0	—	—	—	4.2	2.0
Unidentified seed	2.3	4.5	40.0	—	—	—	—	—
Total plant	86.1	91.0	100.0	86.6	91.3	100.0	62.5	81.3

Vegetation density was generally sparse at collection sites and did not differ between seasons ($F = 0.94$, df = 1,42, $P = 0.338$) or among habitat types ($F = 1.19$, df = 3,42, $P = 0.326$) (Table 4). There was no interaction ($F = 0.20$, df = 2,42, $P = 0.823$) between seasons and habitat types relative to vegetation density at collection sites.

Vegetation heights at collection sites were taller during fall migration

TABLE 4. Mean water depth, vegetation density rank and vegetation height at sites where Cinnamon Teal were colllected in four habitat types during both spring and fall migration periods 1990 at Bosque del Apache National Wildlife Refuge.

Habitat type	Water depth (cm)	*n*	Vegetation density (rank score)[1]	*n*	Vegetation height (cm)	*n*
Cattail-hardstem bulrush	34.1 (18.9[a2])	18	1.7 (0.8[a])	18	90.5 (54.6[a])	18
Annual	23.6 (11.8[b])	19	2.4 (0.8[a])	18	86.1 (58.4[a])	15
Alkali-three-square bulrush	12.5 (10.0[c])	7	1.6 (1.0[a])	7	28.8 (31.5[b])	7
Saltgrass	12.2 (7.4[c])	7	1.8 (1.5[a])	6	7.4 (6.3[b])	6

[1] 0 = open, 1 = sparse, 2 = moderate, 3 = dense.
[2] Means with the same letter are not significantly different.

($\bar{x}$ = 102.3 ± 48.4 cm) than during spring migration ($\bar{x}$ = 35.4 ± 47.0 cm) (F = 9.46, df = 1,39, P = 0.004). Vegetation heights at collection sites differed among habitat types (F = 4.52, df = 3,39, P = 0.008). Sites in cattail-hardstem bulrush and annual habitats were in tallest vegetation, whereas collection sites in saltgrass and alkali-three-square bulrush were in shortest vegetation (Table 4). This pattern of vegetation heights within habitat types was the same for spring and fall migration (F = 0.69, df = 2,39, P = 0.505).

Neither water depth (r = −0.25, df = 26, P = 0.204), vegetation density (r = −0.39, df = 21, P = 0.069), nor vegetation height (r = −0.29, df = 21, P = 0.174) at collection sites was correlated with percentage dry mass of animal foods among habitat types during spring migration. Percentage dry mass of animal and plant foods in fall migrants was correlated (r = −0.746, df = 12, P = 0.002) with vegetation density (Table 6); however, water depth (r = 0.01, df = 9, P = 0.979) or vegetation (r = −0.08, df = 9, P = 0.809) height at collection sites was not correlated with percentage dry mass of animal foods from annual habitats during fall. Neither water depth (r = −0.21, df = 9, P = 0.544), vegetation density (r = −0.30, df = 9, P = 0.377), nor vegetation height (r = −0.28, df = 9, P = 0.404) from collection sites in cattail-hardstem bulrush habitats was correlated with percentage dry mass of animal foods during fall. No analysis could be performed for alkali-three-square bulrush and saltgrass habitats during fall because of small sample size.

Three of 28 female Cinnamon Teal were not molting when collected during spring. The remaining 25 were in some stage of prebasic molt (18 in molt rank 1; 7 in molt rank 2). There was no difference in percentage dry mass of animal foods consumed among molt ranks of birds collected during spring migration period (F = 0.29, df = 2,25, P = 0.749). Further, no correlation existed between percentage dry mass of animal foods and molt rank among habitat types (r = 0.180, df = 26, P = 0.379). All Cinnamon Teal collected during fall migration (n = 27) were immature and had a molt rank of 1, which precluded statistical analysis.

DISCUSSION

Spring migrant Cinnamon Teal consumed a higher proportion of animal foods than plant foods, whereas fall migrants consumed a higher proportion of plant foods at Bosque del Apache NWR. Shifting from a diet composed predominantly of seeds during fall to one that contains a higher proportion of invertebrates during spring has been previously reported for Northern Pintails (*Anas acuta*), Blue-winged Teal (*A. discors*) and Green-winged Teal (*A. crecca*) (Connelly and Chesemore 1980, Euliss and Harris 1987, Miller 1987, Taylor 1978). Those individuals collected in alkali-three-square bulrush and saltgrass habitats during spring had consumed a larger percentage of animal foods than those collected in other habitats. Feeding sites in these habitats were in shallow water (<15 cm), with short (<29 cm), moderately dense vegetation. A larger percentage of plant foods consumed during fall were from the annual and cattail-hardstem bulrush habitats. Feeding sites in these habitats were deeper (>23 cm) and had taller vegetation (>86 cm) than those in alkali-three-square bulrush and saltgrass habitats.

Chironomid larvae comprised the dominant animal food found in the digestive tract of Cinnamon Teal collected from each habitat type during spring migration, whereas gastropods were dominant in samples collected from each habitat type during fall migration. These findings suggest that the habitats we sampled do not foster different invertebrate assemblages seasonally, or that Cinnamon Teal are selecting a specific invertebrate taxon to feed upon seasonally.

As a result of the difference in sampling techniques and expression of results, caution must be taken when comparing results of our study with previous studies. Our findings that almost half of spring migrant Cinnamon Teal diets consisted of animal matter show greater use of this food type than previously reported. Mabbot (1920) found that food present in 41 Cinnamon Teal stomachs collected from Utah and California between March and October comprised 20% insects and their larvae, mollusk, and miscellaneous animal matter; 34% sedges (genus unknown); and 27% pondweeds. In a second study, five stomachs of Cinnamon Teal collected in British Columbia contained 25% mollusks and 3% insects by volume (Munro 1939). Spencer (1953) and Martin et al. (1951) found even less consumption of animal matter by spring migrant Cinnamon Teal; they found only small or trace amounts of animal matter in the specimens they sampled.

Variety, availability and density of invertebrates are influenced by water chemistry, water depth, aquatic plant composition and time of year (Barber and Kevern 1973, Batema 1987, Krull 1970, Krull and Beyer 1976, Reid 1985, Voights 1976, White 1985). Invertebrate biomass increases as emergent vegetation is replaced by submerged vegetation (Voights 1976). Thus, invertebrates may not have been readily available during fall migration because habitats had not been flooded for long before onset of cold temperatures. Warmer temperature, longer flooding duration, and large amounts of detritus and submerged plants during spring migration, however, probably fostered dense spring invertebrate populations.

Apparently, Cinnamon Teal select the most available plant food item within habitats, because the dominant seed in the diet of collected birds was also a principal species in habitats from which they were collected. This was also thought to be the case for female Mallards (*A. platyrhynchos*) in moist-soil, arrowhead (*Sagittaria* spp.)-dominated and mixed habitats during fall migration in Missouri (Gruenhagen and Fredrickson 1990) and Northern Pintails and Green-winged Teal wintering in seasonal wetlands in California (Euliss and Harris 1987).

Higher consumption of seeds during fall corresponds with higher availability of seeds as maturation of most aquatic and semiaquatic plants occurs in fall. Fall migrant waterfowl find numerous seeds from the present growing season as impoundments are slowly flooded during the fall. By spring, most plant seeds from the previous season have been consumed or are relatively unavailable because of deep water redistribution in sediments, and decomposition.

Seeds consumed during fall migration probably supply energy for migration (Gruenhagen and Fredrickson 1990). The use of invertebrates during fall cannot be ignored, however. Immature fall migrant Cinnamon Teal need high energy foods because of their continuing growth, and all migrants need to replenish endogenous reserves lost while migrating. Further, invertebrates provide essential nutrients unavailable in agricultural grains (Delnicki and Reinecke 1986, Miller 1987, Sugden and Driver 1980).

There was no correlation between the extent of prebasic molt and percentage invertebrate consumption for female Cinnamon Teal collected during spring. Similar findings were reported for female Mallards migrating through northwestern Missouri in spring (Gruenhagen and Fredrickson 1990). Although there was no correlation between molt and invertebrate consumption by Cinnamon Teal, we hypothesize that the high overall amount of animal food consumed during the prebasic molt provides protein required for feather replacement. Other *Anas* (female Mallards) derive protein from exogenous sources for feather replacement (Heitmeyer 1985).

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