Food Habits of Diving Ducks in the Carolinas

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Abstract: Food habits analyses were conducted on 264 diving ducks (7 species) from North and South Carolina during the 1970's. The Baltic clam (*Macoma balthica*) was the predominant food among canvasbacks (*Aythya valisineria*) from the Pamlico River area, whereas sago pondweed (*Potamogeton pectinatus*) predominated in birds from impoundments in North and South Carolina. Shoalgrass (*Halodule beaudettei*) formed 100% of the gullet food and 99% of the gizzard food in redheads (*Aythya americana*) from Pamlico Sound. Lesser scaup (*Aythya affinis*) in North Carolina had fed predominantly on mollusks (*Mulinia lateralis* and *Rangia cuneata*), whereas widgeon grass (*Ruppia maritima*) was the predominant food in birds from South Carolina. In North Carolina, ring-necked ducks (*Aythya collaris*) fed mainly on vegetation, and greater scaup (*Aythya marila*), bufflehead (*Bucephala albeola*), and ruddy ducks (*Oxyura jamaicensis*) fed mainly on *Mulinia lateralis*. Food habits data from this study when compared with historical food habits of these species indicate that most diving duck species were feeding more on invertebrates and less on submerged aquatic vegetation than in the past. North and South Carolina have a diverse food supply and appear to offer waterfowl adequate wintering habitat based on these food habits studies. Present trends in wintering habitat, however, could adversely affect diving duck populations in the future.

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North and South Carolina historically have been important wintering areas for waterfowl. Numerous reports (Pearson et al. 1942, Sprunt and Chamberlain 1945) of early explorers and ornithologists relate the abundance of ducks, geese, and swans that were seen along the coastal areas of the Carolinas. Unfortunately, reliable waterfowl surveys were conducted only since 1955 and, therefore, do not give a good record of the historic abundance of waterfowl in the Carolinas. Early reports of birds in this area, how-

ever, leave little doubt that populations in previous centuries and earlier in this century well exceeded modern-day populations.

Food habits prior to 1940 of most species of diving ducks have been summarized in several extensive reports (Kubichek 1933, Cottam 1939, and Martin and Uhler 1939). These reports are based on ducks combined from many areas, however, and do not give an accurate account of the food utilized by ducks in the Carolinas.

Recent studies have provided a more accurate representation of the food habits of diving ducks from specific areas. In North Carolina, Quay and Critcher (1962) presented data from 197 diving duck gizzards collected from Currituck Sound during the winters of 1947–48 to 1951–52. These data are presented separately for each bird species, but food materials were grouped by genera. Aquatic vegetation predominated in the diving duck gizzards with *Potamogeton, Ruppia,* and *Najas* forming most of volume. Animal matter was found in trace amounts in canvasbacks, scaup, and ring-necked ducks, but greater amounts occurred in redheads (2%), ruddy ducks (6%), and bufflehead (45%).

An extensive cooperative study between the U.S. Fish and Wildlife Service, North Carolina Wildlife Resources Commission, and the Virginia Commission of Game and Inland Fisheries, was conducted from 1958–64 on the ecology of Back Bay, Virginia and Currituck Sound, North Carolina. This study generated 4 large volumes of data on the vegetation, fish, and waterfowl resources and environmental factors of these areas. Unfortunately, shorter reports from this study were never published as anticipated, with the exception of 1 paper by Sincock (1962). These volumes, however, provide a wealth of data concerning the distribution and abundance of waterfowl and their food habits in Currituck Sound and can be used in comparison to current studies. The waterfowl data clearly show that aquatic vegetation predominated in the diet of all diving ducks except buffleheads.

Changes in the waterfowl wintering habitat in North Carolina have been implicated, as in other areas (Perry et al. 1981), as affecting the distribution and abundance of waterfowl populations. Bourn (1929) blamed the removal of locks from the Chesapeake and Albermarle Canal in 1918 and its enlargement in 1922 as the cause for the disappearance of duck food plants from the Back Bay-Currituck Sound area. Other factors implicated in the degradation of waterfowl habitat in North Carolina include salt water intrusion over and through the barrier beaches or from Oregon Inlet, construction and maintenance of the inland waterway, and increasing populations of carp (*Cyprinus carpio*) (Quay and Critcher 1962).

In 1965, Eurasian watermilfoil (*Myriophyllus spicatum*) was first reported in Currituck Sound and continued to increase its distribution and abundance during the mid 1960–70's (Florschutz 1972). This submerged

aquatic plant was found in 72% of the 170 bird gizzards collected for food habits analyses, and formed approximately 33% of the food volume. Martin and Uhler (1939) state that this plant generally is not considered to be a preferred duck food compared to other aquatics. During the 1960's, watermilfoil constituted 2% of the food of 7 diving duck species in Chesapeake Bay (Perry et al. 1981).

In South Carolina several extensive food habits studies of ducks were conducted in the 1960's (Conrad 1965, McGilvrey 1966, and Kerwin and Webb 1972), although most of this work was with puddle ducks. The management of tidal impoundments in South Carolina in regard to waterfowl foods has been studied in depth (Morgan et al. 1975, Landers et al. 1976, and Prevost et al. 1978). The chemical and ecological conditions under which selected waterfowl food plants grow in South Carolina have also been studied (Percival et al. 1970).

While studying the population status and food habits of waterfowl in Chesapeake Bay (Munro and Perry 1981, Perry and Uhler 1982), it became obvious that changes in the distribution and abundance of waterfowl were taking place in the Atlantic Flyway. Long-term trends seemed to indicate an increase in some species in the Carolinas, while Chesapeake Bay populations were decreasing. Food habits data were needed to determine important food resources of waterfowl in the Carolinas and if changes in the condition of the habitat could be detected in these data. This report presents the findings of these food habits analyses and compares them with historical food habits data. The assistance of the following State and Federal personnel in collection of data for this report is appreciated: E. Bell, T. Bennett, J. Donnelly, V. Eaddy, O. Florschutz, G. Hines, J. Minick, A. Noltemeier, F. Smith, and G. Swain. Drafts of this manuscript were reviewed by O. Florschutz, G. M. Haramis, and H. F. Percival.

Methods

Waterfowl were obtained mainly from enforcement personnel as confiscated birds ($n = 223$) from illegal hunting. Additional birds ($n = 41$) were obtained by shooting (scientific collection) from a slowly moving boat at night or from the shoreline during the day. Gullets (esophagus and proventriculus) and gizzards were examined to determine average volume and the frequency of occurrence of food items. Only 28% of the birds had food in the gullets so most discussion in this report deals with gizzard contents. Although there is a recognized bias (Swanson and Bartonek 1970) with use of gizzard samples, Perry and Uhler (1982) found that gizzard food was correlated closely with gullet food in canvasbacks from Chesapeake Bay. Gizzard

contents appear adequate to show trends in food habits of wintering waterfowl.

Food materials were identified by species and measured volumetrically. The average % volume (aggregate %) and frequency of occurrence (Martin et al. 1946, Swanson et al. 1974) were tabulated for each food item for the various study areas. Percent vegetation in the gullet and gizzard of collected birds includes only natural food and does not include commercial grains that probably came from baiting or feeding. Only major food organisms are presented in tables. All items of trace volume (<0.5%) and with <33% frequency of occurrence are not presented, but are filed at the Patuxent Wildlife Research Center.

Contemporary food habits of diving ducks were compared to previous reports on food habits from the Carolinas and to unpublished food habits data from the Back Bay-Currituck Sound study. Contemporary data also were compared to historical food habits data from the Patuxent Wildlife Research Center food habits file that contains results of gullet and gizzard analyses conducted since 1885.

Results

The Baltic clam (*Macoma balthica*) was the predominant food in canvasbacks from South Creek (86%) and from Pamlico River (73%) (Table 1). This food item was found in 100% of both samples. The stout razor clam (*Tagelus plebeius*) formed 11% of the food volume of the South Creek sample. These clams, however, had no shells and are believed to have been

Table 1. Gizzard Contents of Canvasbacks from North Carolina, 1974–78, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	South Creek ($n = 17$) Feb 1977–Mar 1978	Pamlico River ($n = 15$) Nov 1974–Feb 1977
Animal		
Macoma balthica	86 (100)	73 (100)
Tagelus plebeius	11 (12)	
Rangia cuneata	3 (24)	14 (53)
Nereis sp.	tr[a] (6)	tr (33)
Congeria leucophaeta		8 (13)
Brachidontes recurvus		1 (20)
Mulinia lateralis		1 (20)
% Animal Food	100%	97%
% Plant Food	tr	tr
Average Food Volume (cc)	4.3(90%)	3.9(98%)
Average Grit Volume (cc)	0.5(10%)	0.1(2%)
Total Contents (cc)	4.8(100%)	4.0(100%)

[a] tr = volume < 0.5%.

put into the water by commercial fishermen to attract fish to their fish nets. The brackish-water clam (*Rangia cuneata*) was the only other food item of measurable quantities, indicating the importance of invertebrates as canvasback food in this creek.

Rangia cuneata made up 14% of the food volume of the Pamlico River canvasbacks. The false mussel (*Congeria leucophaeta*) constituted 14% of this sample. Other invertebrates formed the remainder of the measurable food sample. Wax myrtle (*Myrica cerifera*) and sago pondweed (*Potamogeton pectinatus*) were the only plants recorded in this sample of birds and occurred in only trace amounts. This sample, as well as the one from South Creek, appears to demonstrate the lack of submerged aquatic vegetation in this area and the dependence of canvasbacks on invertebrate foods.

Ten canvasbacks form Pea Island National Wildlife Refuge had fed predominantly on the seeds, tubers, and rootstalks of sago pondweed, which formed 87% of the food volume (Table 2). The impoundment where the birds were collected had dense beds of sago pondweed and windrows of the upper vegetative parts on the shore. The soft-shelled clam (*Mya arenaria*)

Table 2. Gizzard Contents of Canvasbacks from North and South Carolina, 1976–78, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	Pea Island NW Refuge North Carolina ($n = 10$) 13 Dec 1976	Andersonville Pond South Carolina ($n = 3$) 8 Jan 1978
Animal		
Mya arenaria	9 (30)	
Macoma balthica	2 (40)	
Cybister fimbriolatus		tr[a] (33)
% Animal Food	11%	tr
Plant		
Potamogeton pectinatus	87 (90)	44 (67)
Myrica cerifera	2 (70)	tr (67)
Myrica pensylvanica	tr (40)	
Rubus sp.	tr (40)	
Scipus americanus	tr (50)	4 (67)
Ruppia maritima	tr (30)	6 (100)
Potamogeton pusillus	tr (10)	29 (100)
Nymphaea mexicana		13 (100)
Scirpus validus		3 (33)
Cladium jamaicense		1 (33)
Eleocharis equisetoides		tr (33)
Ilex decidua		tr (33)
% Plant Food	89%	100%
Average Food Volume (cc)	4.9(67%)	2.3(53%)
Average Grit Volume (cc)	2.4(33%)	2.0(47%)
Total Contents (cc)	7.3(100%)	4.3(100%)

[a] tr = volume < 0.5%.

and the Baltic clam constituted 11% of the food volume and represented earlier meals probably in Pamlico Sound. Canvasbacks at Pea Island NWR probably use this area in the daytime and spend the night on the larger and relatively more secure Pamlico Sound.

One canvasback collected from Mattamuskeet National Wildlife Refuge was shot on 4 Nov. 1977 while actively feeding on the southside of the causeway. The gullet contained over 200 winter buds of wildcelery (*Vallisneria americana* (95%), 5 *Gammarus tigrinus* (3%), and 2 *Cyathura polita* (2%). The gizzard contained over 100 winter buds of wildcelery (88%), *Rangia cuneata* (7%), *Sphenophorus* sp. (5%), and traces of *Gammarus tigrinus, Myrica cerifera, Cladium jamaicense,* and *Brasenia schreberi.* The food habits of this bird are reminiscent of historical food habits for this species.

During the winter of 1977–78, less than 500 birds used the Refuge at any one time. During the previous winter, however, an estimated 20,000 canvasbacks were observed feeding in the main pool. Benthic sampling and examination of shoreline windrows indicated an excellent growth of wildcelery during the 1976–77 fall and winter, but a much reduced amount in 1977–78. Refuge personnel attributed the large beds of wildcelery in 1976–77 to the inadvertent intrusion of salt water into the impoundment. The brackish water that resulted apparently improved growing conditions for wildcelery and also was beneficial to the increase of *Rangia cuneata* in the pool. The canvasbacks were quick to utilize this food resource during the 1976–77 winter.

Plants formed 100% of the food material from 3 canvasbacks from Andersonville, South Carolina (Table 2). Major plants included sago pondweed (44%), slender pondweed (*Potamogeton pusillus*) (29%), and banana waterlily (*Nymphaea mexicana*) (13%). One other canvasback was collected from a coastal area of South Carolina. The gizzard of this bird contained the dwarf surf clam (*Mulinia lateralis*) and a trace of the channeled barrel bubble (*Retusa canaliculata*). This small sample of canvasbacks from South Carolina indicates the extreme variation in food habits of birds from different habitats.

Shoalgrass (*Halodule beaudettei*) formed 99% of the food in gizzards of redheads from the Cedar Island area of Pamlico Sound. Fifteen of the gullets contained only shoalgrass. Finding shoalgrass in this group of ducks indicates the importance of this plant to redheads in this area. Pamlico Sound is the northern limit in the geographical range of *Halodule beaudettei* (Beal 1977).

One redhead collected from Pamlico Point had fed on sago pondweed (50%), widgeongrass (*Ruppia maritima*) (50%), and sawgrass (*Cladium jamaicense*) (trace). The vegetation found in this bird and the redheads from the Cedar Island area indicate the importance of submerged aquatics for this

species. Similar findings were observed with redheads in Chesapeake Bay (Perry et al. 1981).

Mulinia lateralis was the predominant food in lesser scaup from Bay River (74%), Pamlico River (62%), and Neuse River (83%) of North Carolina (Table 3). *Mulinia* was not found in 4 lesser scaup from South Creek where *Rangia cuneata* formed 86% of the gizzard food volume. *Rangia* formed 15% of the food in the Pamlico River sample. *Macoma balthica* formed 7% of the Pamlico River and 10% of the South Creek samples of food.

Ruppia maritima was the predominant gizzard food (19%) in 17 lesser scaup from South Carolina (Table 4). Other important plants included *Potamogeton pusillus* (8%), *Scirpus americanus* (5%), *Iva frutescens* (5%), and *Ceratophyllum demersum* (4%). Animal food consisted of the lobed moon shell *Polinices duplicatus* (8%), *Mulinia lateralis* (8%), recurved mussel (*Brachidontes recurvus*) (8%), and *Hybrobia* sp. (8%). Five other species of mollusks formed 18% of the food volume, resulting in 56% of the total food volume consisting of animal foods.

Plant food formed 78% of the food volume of 5 ring-necked ducks from Pamlico River and 84% of the food volume of 5 ring-necked ducks from Currituck Sound (Table 5). Sawgrass was the predominant food in the Pamlico River sample and Eurasian watermilfoil the predominant food in the Currituck Sound sample.

One ring-necked duck from Georgetown County, South Carolina had fed mainly on vegetation. Gizzard contents included seeds of *Ruppia maritima* (93%), nymphs of Libellulidae (5%), and seeds of *Sesuvium maritimum* (2%).

Animal food formed 99% of the food volume of 9 greater scaup from the Neuse River (Table 6). *Mulinia lateralis* was found in all birds and formed 94% of the total food volume. Foods of one greater scaup collected from Currituck Sound consisted of *Bittium varium* (60%), *Mitrella lunata* (35%), *Modiolus demissus* (3%), and *Mulinia lateralis* (1%).

Only 2 ruddy ducks (both from Currituck Sound) were collected in this study and their food was very different. One had fed exclusively on *Mulinia lateralis* and the other had fed almost exclusively on Eurasian watermilfoil (Table 6).

Buffleheads were collected from Pamlico River ($n = 9$), Currituck Sound ($n = 4$), and Bay River ($n = 3$). *Mulinia lateralis* formed 100% of the food volume of the Pamlico River sample, 99% of the Bay River sample, but only 32% of the Currituck Sound sample. The remaining food volume from the Currituck Sound sample included the seeds of wildcelery (22%), small fish (*Fundulus* sp. and *Lepomis gibbosus*) (23%), mud crabs (*Rhithropanopeus*

Table 3. Gizzard Contents of Lesser Scaup from North Carolina, 1974–78, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	Bay River ($n = 78$) 31 Dec 1977–7 Jan 1978	Pamlico River ($n = 28$) 27 Nov 1974	Neuse River ($n = 23$) 8 Dec 1976	South Creek ($n = 4$) 10 Mar 1978
Animal				
Mulina lateralis	74 (79)	62 (88)	83 (87)	
Retusa canaliculata	2 (60)	tr[a] (65)	1 (35)	
Rangia cuneata	1 (5)	15 (54)		86 (100)
Gammarus sp.	1 (5)			
Natica pusilla	1 (4)			
Rhithropanopeus harrisii	1 (2)	tr (4)	tr (9)	
Lepomis gibbosus	1 (1)			
Terebra sp.	1 (1)			
Brachidontes recurvus	tr (20)	7 (38)	tr (13)	4 (50)
Gemma gemma	tr (20)	2 (31)	1 (13)	
Odostomia sp.	tr (17)	tr (65)	tr (9)	
Macoma balthica	tr (6)	7 (50)		10 (100)
% Animal Food	82%	93%	85%	100%
Plant				
Najas gracillima			9 (13)	
Ruppia maritima	4 (49)	2 (84)	tr (30)	
Myriophyllum spicatum	4 (7)			
Eleocharis cellulosus	2 (4)	tr (4)		
Myrica cerifera	1 (43)	tr (19)	tr (17)	
Ilex decidua	1 (12)			
Potamogeton pectinatus	1 (12)	tr (4)	tr (4)	
Quercus sp.	1 (4)		2 (4)	
Sparganium americana	1 (2)		tr (9)	
Cladium jamaicense	tr (17)	tr (46)	tr (22)	
% Plant Food	15%	4%	11%	tr
Average Food Volume (cc)	3.9(87%)	3.5(70%)	5.6(95%)	9.6(98%)
Average Grit Volume (cc)	0.6(13%)	1.5(30%)	0.3(5%)	0.2(2%)
Total Contents(cc)	4.5(100%)	5.0(100%)	5.9(100%)	9.8(100%)

[a] tr = volume < 0.5%.

Table 4. Gizzard Contents of 17 Lesser Scaup from South Carolina, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	24 Nov 1977–8 Jan 1978
Animal	
Polinices duplicatus	8 (35)
Mulinia lateralis	8 (12)
Brachidontes recurvus	8 (6)
Hydrobia sp.	8 (6)
Nassarius obsoletus	6 (12)
Turbonilla sp.	5 (18)
Congeria leucophaeta	5 (6)
Pyramidella sp.	4 (12)
Retusa canaliculata	3 (29)
Odostomia impressa	1 (12)
% Animal Food	56%
Plant	
Ruppia maritima	19 (65)
Potamogeton pusillus	8 (41)
Scirpus americana	5 (24)
Iva frutescens	5 (6)
Ceratophyllum demersum	4 (6)
Nymphaea mexicana	1 (6)
Myrica cerifera	tr[a] (35)
% Plant Food	42%
Average Food Volume (cc)	2.2(61%)
Average Grit Volume (cc)	1.4(39%)
Total Contents (cc)	3.6(100%)

[a] tr = volume < 0.5%.

harrisii) (15%), *Myriophyllum spicatum* (2%), *Pinus taeda* (1%) and *Macoma balthica* (1%).

Two buffleheads from Georgetown County, South Carolina exhibited different feeding habits. One bird had fed exclusively on the unhulled seeds of *Spartina alterniflora* and the other had eaten *Hydrobia* sp. (60%), *Ruppia maritima* (38%), *Potamogeton pusillus* (1%), *Pinus taeda* (1%), and *Corixidae* (trace). Although the South Carolina sample for buffleheads was small, it indicates greater use of vegetation than in the North Carolina sample.

Volume of food found in the ducks ranged from 10.0 cc for redheads to 1.1 cc for ruddy ducks. The percentage of gizzard contents made up of grit ranged from 47% in canvasbacks from South Carolina to 0% for buffleheads in Pamlico and Bay Rivers. In general, diving ducks, which fed mainly on invertebrates, had less grit than ducks which fed mainly on vegetation. The hard clams in the gizzards of diving ducks are used to grind the food making the use of grit unnecessary or less important.

Table 5. Gizzard Contents of Ring-Necked Ducks from North Carolina, 1974–78, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	Pamlico River ($n = 5$) 27 Nov 1974	Currituck Sound ($n = 5$) 31 Dec 1977–14 Jan 1978
Animal		
Mulinia lateralis	14 (80)	
Brachidontes recurvus	3 (40)	
Macoma balthica	4 (40)	
Congeria leucophaeta	tr[a] (40)	
Libellulidae		13 (20)
Trichoptera		2 (20)
Physa sp.		1 (20)
% Animal Food	21%	16%
Plant		
Cladium jamaicense	27 (40)	19 (80)
Eleocharis cellulosa	19 (40)	
Potamogeton pectinatus	12 (60)	6 (40)
Ruppia maritima	11 (60)	
Pinus taeda	5 (20)	10 (20)
Myrica cerifera	3 (80)	11 (60)
Iris pseudacorus	1 (20)	
Myriophyllum spicatum		23 (60)
Polygonum punctatum		6 (20)
Polygonum hydropiperoides		1 (40)
Ipomoea hederacea		1 (20)
% Plant Food	78%	84%
Average Food Volume (cc)	5.0(77%)	7.2(78%)
Average Grit Volume (cc)	1.5(23%)	2.0(12%)
Total Contents (cc)	6.5(100%)	9.2(100%)

[a] tr = volume < 0.5%.

Discussion

The food habits data from this study indicate several important contrasts when compared to the historical food habits records of the Carolinas. The use of Eurasian watermilfoil by all species of ducks except redheads is of special interest. This plant was not reported in waterfowl food habits studies or from benthic sampling during 1958–64 when the extensive Back Bay-Currituck Sound study was conducted. Florschutz (1972) reported the presence and importance of this exotic as a waterfowl food during the late 1960s and early 1970's. The present data confirm the continued importance of this plant as a waterfowl food item during the late 1970's.

Another change is the increased importance of invertebrates in the diets of diving ducks. Based on existing historical food habits records and published reports, it is apparent that submerged aquatic vegetation once formed

Table 6. Gizzard Contents of Greater Scaup and Ruddy Ducks from North Carolina, 1976–78, Represented by % Volume and % Occurrence (in parentheses) of Individual Food Items

Food Item	Greater Scaup Neuse River ($n = 9$) 8 Dec 1976	Ruddy Duck Currituck Sound ($n = 2$) 14 Jan 1978
Animal		
Mulinia lateralis	94 (100)	50 (50)
Rangia cuneata	3 (11)	
Retusa canaliculata	1 (33)	
Macoma balthica	1 (11)	
% Animal Food	99%	50%
Plant		
Ruppia maritima	1 (22)	1 (50)
Myriophyllum spicatum		47 (50)
Potamogeton perfoliatus		2 (50)
Myrica cerifera		tr[a] (50)
% Plant Food	1%	50%
Average Food Volume (cc)	5.1(96%)	1.1(73%)
Average Grit Volume (cc)	0.2(4%)	0.4(27%)
Total Contents (cc)	5.3(100%)	1.5(100%)

[a] tr = volume < 0.5%.

a greater percentage of the food than it does at present. Redheads still feed exclusively on vegetation, but canvasbacks, scaup, and bufflehead in estuarine waters now feed more on invertebrates than they did in the past. Vegetation remains the predominant food for canvasbacks feeding in freshwater impoundments (Cely 1980).

The decline of submerged aquatic vegetation in the estuaries of the Carolinas may be related to increased turbidity or herbicides as in Chesapeake Bay (Perry et al. 1981). The dramatic increase of Eurasian watermilfoil in Currituck Sound is similar to increases of this species observed in Chesapeake Bay and may result in a dramatic decrease as occurred in the Bay (Bayley et al. 1968 and Elser 1969). Wintering waterfowl in Currituck Sound appeared to be utilizing this exotic more than did waterfowl in Chesapeake Bay.

Based on these food habits data, North and South Carolina appear to have a diverse food supply in the coastal areas and presently offer waterfowl adequate wintering habitat. Impoundments in the Carolinas have historically been important feeding areas for waterfowl and should continue to provide a good food source. Present trends in wintering estuarine habitat, especially in North Carolina, however, could adversely affect diving duck populations and these trends should be closely monitored.

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