

Food Items of Grass Carp, American Coots, and Ring-necked Ducks from a Central Florida Lake

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Abstract: Examination of food items of 84 grass carp (*Ctenopharyngodon idella*), 73 American coots (*Fulica americana*), and 31 ring-necked ducks (*Aythya collaris*) from Lake Conway, Florida, revealed that all 3 species fed heavily on hydrilla (*Hydrilla verticillata*), Illinois pondweed (*Potamogeton illinoensis*), and nitella (*Nitella furcata*). Introduction of grass carp to control aquatic vegetation may affect waterfowl distribution and abundance if these macrophyte species are present.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:313-318

The high cost and lack of long-term effectiveness of chemical and mechanical methods for control of aquatic macrophytes have led to increased popularity in the use of herbivorous fish. Grass carp (*Ctenopharyngodon idella*), an exotic cyprinid, have been stocked in a variety of water bodies throughout the nation, and are now found commonly in the Mississippi River Valley as far north as Missouri and Illinois. Grass carp are effective in controlling vegetation in pools or ponds (Avault 1965, Cross 1969, Mitzner 1978), but a preference for certain aquatic plants has been observed (Hickling 1966, Cross 1969, Colle et al. 1978, Hardin and Mesing 1981). Generally, succulent plants are readily consumed, and hydrilla (*Hydrilla verticillata*), pondweed (*Potamogeton* sp.), southern naiad (*Najas guadalupensis*), and the algae stonewort (*Chara* sp.) and nitella (*Nitella* sp.) are highly preferred.

Many of the aquatic plant species preferred by grass carp are important food items for waterfowl wintering in Florida (Cottam 1939, Martin and Uhler 1939, Martin et al. 1951, Chabreck 1974, Montalbano et al. 1979). The reduction or elimination of important food plants by grass carp could affect distribution and abundance of waterfowl in Florida. Grass carp were stocked in Lake Conway in central Florida to test their efficacy in controlling aquatic vegetation in a large water body. Food items of the 2 primary waterfowl species wintering on the lake, American coot (*Fulica americana*) and ring-necked duck (*Aythya collaris*), were compared to those of grass carp to determine whether potential for competition exists.

This research was a portion of the U.S. Army Engineers Waterways Experiment Station Large Scale Operations Management Test of Use of Grass Carp to Control Aquatic Vegetation and funded under contract No. DACW-39-76-C-0081. The authors acknowledge Mrs. Willa Mae Hetrick for direction and assistance in analysis of waterfowl food items.

Description of the Study Area

Lake Conway is a 747-ha (1,823-acre) lake in central Florida in south Orange County. The lake is comprised of 5 interconnected pools: South, Middle, East, and West pools, and Lake Gatlin. Lake Gatlin differs from the 4 major pools in vegetation and water quality. Average altitude is 25.7 m MSL, average air temperature is 22° C, and average annual rainfall is 130 cm. There is 1 inflow stream and 1 outflow stream which drains into the Kissimmee Valley Chain of Lakes. Lake Conway is a relatively deep lake for central Florida, with a maximum depth of 10 m in Middle Pool and depths of up to 7 m in each of the remaining pools. Six percent of the lake is <1 m deep and 15% is <2 m (Nall and Schardt 1978).

Fifty-seven aquatic plant species were identified from Lake Conway at the outset of the study, although many were marginal-emergent (Nall and Schardt 1978). Initially, Illinois pondweed (*Potamogeton illinoensis*), hydrilla (*Hydrilla verticillata*), and nitella (*Nitella furcata*) were the dominant aquatic plant species. Much of the natural vegetation has been altered by shoreline development and falling water levels which exposed littoral areas. Only a few natural areas remain with stands of cattail (*Typha latifolia*), pickerelweed (*Pontederia cordata*), umbrella grass (*Fuirena scirpoides*), and maidencane (*Panicum hemitomon*). The substrate is primarily sand with some areas of organic muck.

Methods

Aquatic vegetation was monitored by the Florida Department of Natural Resources using a sampling apparatus described by Nall and Schardt (1978). Percent occurrence and mean standing crop (g wet weight/m²) were recorded

for fixed transects in each pool. Because of its differences from the 4 major pools, Lake Gatlin vegetation data are not presented.

In September 1977, 7,686 (10.3/ha) grass carp from 0.25 to 0.61 kg were stocked in each of the 4 major pools and Lake Gatlin. A total of 84 grass carp were captured from 1977 to 1980 by electrofishing, gill net, or gig. Fish were collected from each of the 4 pools. Collection attempts were made in all major plant species communities: hydrilla, Illinois pondweed, nitella, fanwort (*Cabomba caroliniana*), and bladderwort (*Utricularia* sp.). Foregut contents (from esophagus to the first turn) were removed and identifiable food items were quantitated by water displacement.

Ring-necked ducks and coots were taken by shotgun from November to June 1977 to 1980. Ring-necked ducks had to be decoyed, and, because of the urbanized shoreline, could only be taken from the island area of the East Pool. Coots were taken from each pool except Lake Gatlin which had very few birds throughout the study. Gizzards were removed and frozen for future food item identification. Percent volume for each food item was determined by water displacement. Although examination of gizzards (rather than esophagi) tends to result in an underestimate of occurrence of soft food items such as aquatic insects (Swanson and Bartonek 1970), this method should be suitable to detect consumption of macrophytes. Aggregate percent volume of food items is reported for waterfowl and grass carp.

Grass carp were difficult to capture due to the low stocking rate. Because of the mobility of grass carp (Miller and King 1984) and the limited sample size, differences between pools were not considered, and data for all fish were combined. Similarly, the restricted sample area for waterfowl necessitated pooling food habits data.

Results and Discussion

A general decline in abundance of hydrilla and Illinois pondweed was observed while nitella remained abundant throughout the study (Larry Nall, pers. commun., unpubl. data) (Table 1). Grass carp fed primarily on Illinois pondweed, nitella, hydrilla, and filamentous algae (Table 2). In the 1979–80 season (Sep–Aug), hydrilla consumption decreased considerably, reflecting its near elimination from the lake. The reduction is attributed to grass carp feeding. Filamentous algae was unimportant as a food item in the 1977–78 season but increased in aggregate percent volume in the second and third study years. Because nitella occurred primarily in water depths >3 m, electrofishing and giggering were not effective sampling techniques for this habitat, and its occurrence in grass carp diets may have been underestimated.

American coots sampled in the 1977–78 season fed primarily on hydrilla with Illinois pondweed also important (Table 3). In the second study year, unidentified vegetation was the dominant item by volume, but cattail (*Typha latifolia*) seeds, nitella oogonia, water hyacinth (*Eichhornia crassipes*), and

Table 1. Mean standing crop (g wet weight/m²) of 3 submersed macrophytes on line transects, Lake Conway, Florida, 1977 through 1980.^a

	1977	1978	1979	1980
Hydrilla				
South pool	40.3	30.5	1.7	0
Middle pool	0	0	0	0
East pool	15.6	35.1	2.2	0
West pool	296.9	258.5	0.8	0
Illinois pondweed				
South pool	64.6	112.0	3.1	3.5
Middle pool	59.0	49.4	7.1	28.5
East pool	301.8	277.8	3.2	5.6
West pool	74.3	185.3	3.0	0
Nitella				
South pool	460.7	588.4	408.1	434.0
Middle pool	657.9	1,022.2	245.0	1,106.5
East pool	91.5	310.5	82.1	140.3
West pool	190.4	484.0	17.0	127.1

^a Data from Florida Department of Natural Resources.

Illinois pondweed seeds were found in at least 15% of the specimens. In the 1979–80 season, Illinois pondweed was the primary food item followed by nitella, slender spikerush (*Eleocharis acicularis*), primrose willow (*Ludwigia* sp.), maidencane (*Panicum hemitomon*), and cattail which all exceeded 10% frequency of occurrence. During the entire study, hydrilla, Illinois pondweed, and nitella were the primary food items of American coots sampled.

Ring-necked ducks fed principally on nitella, Illinois pondweed, and hydrilla throughout the study, although the latter species declined in importance the final year (Table 3). Large numbers of nitella oogonia were consumed which represented a miniscule volume. Leaves and seeds of Illinois pondweed were eaten throughout the study and this species dominated aggregate percent volume.

Despite the sampling limitations imposed by the urbanized nature of the

Table 2. Aggregate percent volume and frequency of occurrence of major^a food items of 84 grass carp, Lake Conway, Florida, 1977 through 1980.

Food item	% volume	Frequency of occurrence
Nitella	29.1	41.7
Illinois pondweed	24.8	47.6
Filamentous algae	24.3	29.8
Hydrilla	10.7	34.5
Fanwort	2.4	1.2
Cattail	2.2	2.4
<i>Vallisneria americana</i>	2.2	8.3

^a Comprising $\geq 1\%$ aggregate volume.

Table 3. Aggregate percent volume and frequency of occurrence^a of major^b plant food items in gizzards of 73 American coots and 31 ring-necked ducks, Lake Conway, Florida, 1977 through 1980.

Food item	American coot	Ring-necked duck
Hydrilla	9.5 (43.8)	1.1 (12.9)
Illinois pondweed	6.4 (34.2)	11.3 (29.0)
Nitella	4.1 (8.2)	0.7 (3.2)
Unidentified vegetation	3.0 (13.7)	8.4 (41.9)
Maidencane	1.6 (2.7)	0
Cattail	1.6 (2.7)	0
Slender spikerush	1.5 (2.7)	0
Water hyacinth	1.4 (6.8)	0
Primrose willow	1.0 (4.1)	0
Nitella oogonia	0.2 (13.7)	2.8 (51.6)
<i>Myrica cerifera</i>	0	1.3 (9.7)

^a Frequency of occurrence in parentheses.

^b Comprising $\geq 1\%$ aggregate volume.

study area, overlap in food items of grass carp and the 2 species of waterfowl overwintering on Lake Conway is obvious. The drastic reduction of hydrilla and Illinois pondweed here and in other studies documents the potential of grass carp for altering waterfowl habitat (Miley et al. 1979, Hardin and Mesing 1981). These plant species are important food items which are likely to be reduced even if grass carp are introduced to control an unpalatable species such as Eurasian watermilfoil. Grass carp should not be stocked where these plants occur if waterfowl are an important resource. Considering the abundance of grass carp throughout the Mississippi River system (Guillory and Gasaway 1978, Pflieger 1978) and the tolerance of this species for brackish water (Cross 1970), care should be taken to prevent escapement of stocked fish into waters with access to important waterfowl habitat occurring over much of the Florida coast.

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