Flathead Catfish Diet Analysis, Stock Assessment, and Effects of Removal on Sutton Lake, North Carolina

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Abstract: The purpose of this study was to assess the abundance, size composition, and food habits of the flathead catfish *(Pylodictis olivaris)* poopulation in Sutton Lake near Wilmington, North Carolina, and to determine if the flathead catfish population could be diminished by repeated electrofishing over several months. Flathead catfish were collected monthly from June through October 1999 and removed using 2 boat-mounted electrofishing units. A total of 255 flathead catfish weighing 1,550 kg were collected. Individuals >600 mm total length dominated the catch. Fish accounted for 92% of the food items found in the stomachs of flathead catfish collected. During the 5-month sampling period, the number of fish collected each month never declined and no significant changes in size distribution was observed.

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Sutton Lake is a 445-ha cooling reservoir for Carolina Power and Light Company's (CP&L) L. V. Sutton Steam Electric Plant located adjacent to the Cape Fear River near Wilmington, North Carolina. Sutton Lake is one of the few public reservoirs in the southeastern coastal plain and until recent years supported a high quality largemouth bass *(Micropterus salmoides)* and sunfish fishery. North Carolina Wildlife Resources Commission (WRC) biologists believe that the loss of submerged vegetation and a decline in productivity from reduced pumping of process water and nutrient input from the Cape Fear River have been significant factors in the decline of this fishery (Hammers et al. 1995, Hammers and Little 1996). Additionally, CP&L biologists have suggested that the general decline in the sport fisheries of Sutton Lake may be related to the presence of flathead catfish *(Pylodictis olivaris)* that were recently discovered in the lake (CP&L 1998).

Flathead catfish were first found in Sutton Lake during a 1993 rotenone sampling conducted by CP&L (1995). A flathead catfish caught by a bank angler during a recent creel survey (Hammers and Little 1996), reports from WRC personnel, and additional collections of flathead catfish during subsequent cove rotenone sampling (CP&L 1997) indicate that flathead catfish may be becoming more abundant. During 1998, sampling was conducted in an attempt to determine if catfish could be collected in Sutton Lake using low-voltage and low pulse electrofishing techniques with a Smith-Root 7.5 GPP electrofishing unit. In approximately 30 minutes of electrofishing, a total of 6 flathead catfish ranging in size from 376 mm to 975 mm were collected and 3 other flathead catfish were observed but not netted (Hammers and Herndon 1998).

Flathead catfish are highly piscivorous in nature and have been known to alter resident sport fish communities. In waters where flathead catfish have become well established, researchers have documented decreases and in some cases complete disappearance of various sunfish and catfish species (Guier et al. 1981, Nelson et al. 1985, Ashley and Buff 1987, Quinn 1987, Thomas 1993). In addition, Guier et al. (1981) and Thomas (1993) observed that the presence of flathead catfish in samples collected in the Cape Fear River, North Carolina, and Altamaha River, Georgia, changed in abundance from rare to common within a 10-year period.

Largemouth bass, redbreast *(Lepomis auritis),* and other sunfish (*Lepomis* sp.) support poopular fisheries in Sutton Lake. In addition, WRC has stocked about 100,000 channel catfish *(Ictalurus punctatus)* (200 to 460 mm) in Sutton Lake since 1995 (Jeff Evans, WRC pers. commun.). Although anglers reportedly have had some success in harvesting channel catfish, few if any have been collected in WRC electrofishing surveys or CP&L cove rotenone surveys. The presence of a flathead catfish population may explain their absences in these surveys. Based upon the experience of other fishery managers, WRC biologists believed that removal of flathead catfish could help to maintain sunfish species and enhance the survival of stocked channel catfish.

The objectives of this study were to assess abundance, size composition, and food habits of the flathead catfish population in Sutton Lake, and to evaluate electrofishing as a method of removal to control the abundance of flathead catfish.

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Methods

Flathead catfish were collected monthly from June through October 1999 using 2 electrofishing boats equipped with Smith-Root 7.5 GPP electrofishing units set at 500 V, DC, 15 pps, and 1 to 2 amps. A pickup boat accompanied each electrofishing boat to assist in capturing stunned flathead catfish. Sampling was conducted when water temperature was >20 C (Quinn 1986). Sutton Lake is an impoundment that contains a long central dike with finger dikes extending from both the central dike and the shoreline. This forms a series of 8 connected pools referred to locally as

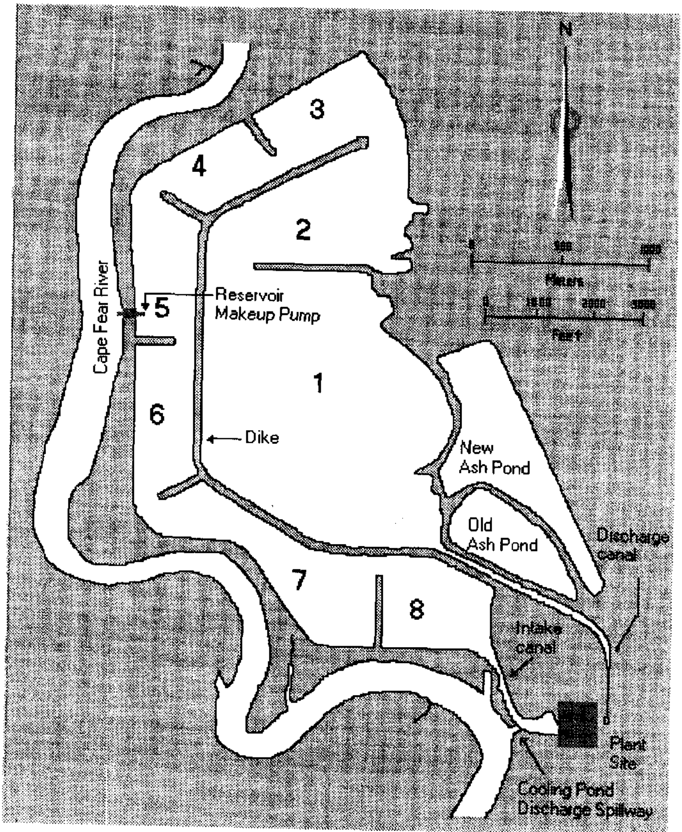

Figure 1. Sutton Lake, North Carolina, flathead catfish sample sites (lakes).

"lakes" that enhance circulation of cooling water. Each "lake" served as a discrete sample site (Fig. 1), and each site was sampled monthly. To standardize sampling effort, a predetermined number of transects were sampled at each site to provide coverage of the entire site. The number of transects sampled at each site was consistent for all months sampled. Because of their large size, sites 1, 2, and 3 each required 6 transects to obtain sufficient coverage. The remaining lakes only required 4 transects each to acquire sufficient coverage. Effort was concentrated around deep channels, sunken logs, log drifts and fish attractors located in deeper pools.

The total number of flathead catfish collected in each sample site was recorded, and all individuals captured were removed from Sutton Lake. Total length (mm) and weight (g) was recorded for each individual. Stomach contents were removed by dissection as described by Bowen (1996) and were identified to lowest possible taxa, counted, and weighed (g). Stomach contents were further quantified by frequency of occurrence, percent composition by number, and percent composition by weight (Bowen 1996). To analyze diet by predator size, flathead catfish were divided into 3 size groups (≤300 mm, 301 to 600 mm, and >600 mm) (Quinn 1987).

To evaluate the effectiveness of electrofishing on reducing flathead catfish abundance, the total number of fish collected within each sample site was compared among months. A Kolmogrov-Smirnoff 1-sample test indicated that the catches were not normally distributed, and therefore a non-parametric Friedman test was used to compare monthly catches. Differences were considered significant at $P < 0.10$.

Another way to assess the effectiveness of electrofishing on reducing flathead catfish abundance in Sutton lake was to examine possible changes in the size distribution of fish collected over the 5-month study. It was expected that if the flathead catfish population could be significantly reduced, size distribution among samples would shift from one consisting of individuals in all size groups, to one dominated by smaller individuals. Past experience has shown that although all sizes of flathead catfish are vulnerable to electrofishing during the warmer months, larger catfish stay stunned longer and are easier to spot when they come to the surface, therefore increasing the efficiency in collecting these individuals. A Kolmogorov-Smirnov 2-sample test was used to determine if differences in monthly size distributions existed. Differences were considered significant at $P < 0.10$.

Results

A total of 255 flathead catfish weighing 1,550 kg were collected and removed from Sutton Lake by electrofishing in summer and fall 1999. Lengths ranged from 234 mm to 1,124 mm, with a mean length of 767 mm. Weights ranged from 86 g to 17,600 g, and the mean weight was 6,081 g.

Of the 255 flathead catfish collected, 124 stomachs (48.6%) contained food items. Fish accounted for 92.3% of the food items found in the flathead catfish stomachs examined. Unidentifiable fish remains (55.6%) and unidentifiable sunfish (25.0%) were the dominant food items by frequency of occurrence for all size classes (Table 1). Analysis by percent by number indicated that unidentifiable sunfish were the dominant prey (38.5%) followed by unidentifiable fish remains (37.6%). Largemouth bass (51.2%) and unidentifiable fish remains (25.7%) were the dominant prey type by weight for all size classes.

In the <300 mm size group, a total of 7 flathead catfish were collected. In the 4 stomachs that contained food items, bluegill *(lepomis macrochirus)* (25.0%) and unidentifiable fish remains (75.0%) were found. Analysis by percent by number showed a similar trend with bluegill (42.9%) and unidentifiable fish remains (57.1%) present. When analyzed by percent by weight, the balance of importance shifted to bluegills (53.3%).

Twenty-two stomachs contained food items in the 301 to 600-mm size group. Unidentifiable fish remains and unidentifiable sunfish were found in 45.5% and 40.9% of the stomachs examined (Table 1). Crayfish (Decapoda) and mussels (Pelecypoda) were the third most important food item at 4.5% each. Analysis of percent composition by number placed unidentifiable sunfish as the dominant prey at 66.1%. When analyzed by percent composition by weight, unidentifiable sunfish remained

Table 1. Stomach contents of 3 size classes of flathead catfish collected in 1999 from Sutton Lake, North Carolina. FO = frequency of occurrence; PN = percent composition by number; PW = percent composition by weight.

	All size classes (*N*=124)			<300 mm (*N*=4)			300–600 mm (*N*=22)			>600 mm (*N*=98)		
Food item	FO	PN	PW	FO	PN	PW	FO	PN	PW	FO	PN	PW
Lepomis macrochirus	7.6	5.6	0.7	25.0	42.9	53.3	1.8	1.8	5.6	7.1	5.3	0.5
Lepomis gulosus	3.2	1.9	1.7				1.8	1.8	5.6	3.1	2.0	1.7
Leopmis microlophus	0.8	0.9	0.1							1.0	1.3	0.1
Unid. *Lepomis*	25.0	38.5	5.8				40.9	66.1	38.5	22.4	29.8	5.0
Pomoxis nigromaculatus	1.6	0.9	1.0							2.0	1.3	1.0
Micropterus salmoides	8.9	5.2	51.2							11.2	7.3	52.6
All centrarchidae	47.1	53.0	60.5	25.0	42.9	53.3	44.5	69.7	49.7	46.8	47.0	60.9
Perca flavescens	0.8	0.9	4.8							1.0	1.3	4.9
All percidae	0.8	0.9	4.8							1.0	1.3	4.9
Pylodictis olivaris	0.8	0.5	3.1							1.0	0.7	3.2
Unid. ictaluridae	0.8	0.5	0.9							1.0	0.7	1.0
Ictaluridae yolk sac & larvae	0.8	0.5	3.7							1.0	0.7	3.8
All ictaluridae	2.4	1.5	7.7							3.0	2.1	8.0
Unid. teleostei remains	55.6	37.6	25.7	75.0	57.1	46.7	45.5	23.2	25.1	57.1	42.4	25.7
All teleostei	92.3	93.0	98.7	100.0	100.0	100.0	90.0	92.9	74.8	92.1	92.8	99.5
Decapoda	3.2	2.8	1.0				4.5	5.4	24.6	3.1	2.0	0.5
Pelecypoda	5.6	4.2	0.1				4.5	1.8	0.6	6.1	5.3	0.1
All invertebrata	8.8	7.0	1.1				9.0	7.2	25.2	9.2	7.3	0.6

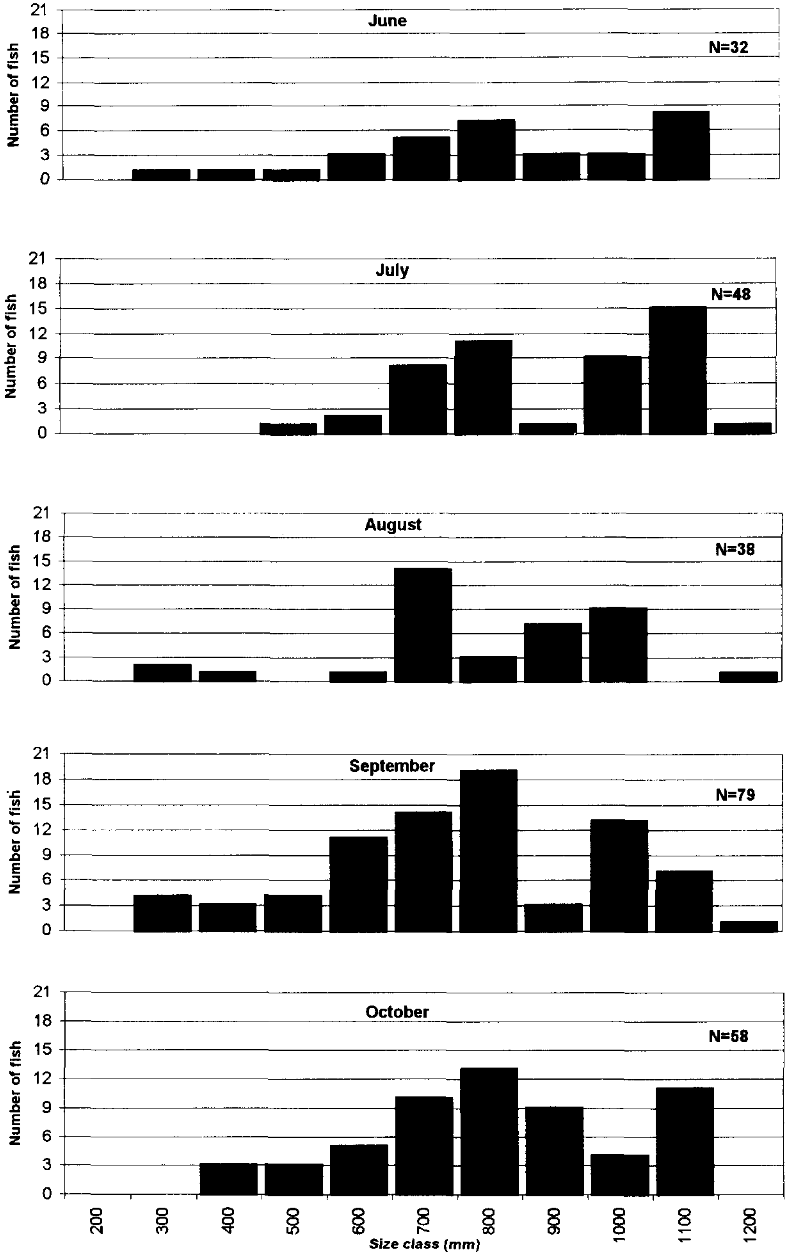

Figure 2. Number and length distributions of flathead catfish collected per month from Sutton Lake, North Carolina.

as the dominant prey (38.5%), followed by unidentifiable fish remains (25.1% and crayfish (24.6%).

The >600-mm size group included 96 flathead catfish stomachs that contained food items. Unidentifiable fish remains (57.1%) and unidentifiable sunfish (22.4%) were the dominant food items by frequency of occurrence (Table 1). Largemouth bass only appeared as a food item in this size group and were found in 11.2% of the stomachs examined. Analysis of percent composition by number indicated the same trend in diet as those reported for frequency of occurrence. However, percent composition by weight placed largemouth bass as the dominant prey type. Largemouth bass accounted for 52.6% of the total weight of food items collected. Unidentifiable fish remains were second in percent composition by weight at 25.7%.

Monthly catch analysis determined that catch was not significantly different (P=0.106) between months. Furthermore, a positive trend in the total number of fish collected per month was observed (Fig. 2).

Monthly size distribution analysis of flathead catfish collected during the first and last samples were not found to be significantly different (P=0.135; Fig. 2). Further analysis indicated that the size distributions of fish collected in August, September, and October were significantly different from the sample taken in July (Fig. 2). The June sample was not found to be significantly different from any other sample.

Discussion

Flathead catfish have become well established in Sutton Lake since their discovery in 1993. Of the 255 collected, 82.0% were greater than 600 mm total length (Fig. 2). In addition, although the current population size is unknown, it is much larger than expected. A removal population estimate proposed for this study could not be calculated due to increasing number of fish collected over the 5 sampling periods (Fig. 2). Georgia Department of Natural Resources personnel (Ga. DNR) saw similar trends in the number of fish collected during the early years of electrofishing removal program on the Altamaha River; with catches remaining constant from 1997 to 1999 (Rob Weller, Ga. DNR, pers. commun.).

Sampling crew efficiency could be considered a contributing factor in the increased number of fish collected per month on Sutton Lake. Flathead catfish reactions to electrofishing varied depending on their size and orientation relative to the electrofishing boat. Therefore, skillful boat operation and netting were required in order to obtain a successful capture. As the sampling crew gained experience, the number of flathead catfish that were observed but not netted decreased. Nevertheless, this increase in sampling efficiency may not fully explain the overall magnitude of the increase in the number of fish collected per month.

Spawning migration and seasonal behavior of flathead catfish may also have been a factor contributing to the increase in the number of fish collected per month. Sampling effectiveness for flathead catfish in reservoirs seems to be related to prespawning migrations of individuals into near-shore areas followed by post-spawn migrations to deeper areas as water temperatures increase (Cunningham 1998).

Furthermore, flathead catfish typically spawn in late spring and early summer. Justus (1994) noticed reduced catches during this period for 3 consecutive seasons. He suggested that the preferred habitats of spawning adults, such as hollow logs and cavities in shoreline banks and bottoms, might serve to exclude fish from the electrical fields. Quinn (1986) and Justus (1994) had similar catches to those found in this study, with catches peaking from mid August through October.

Food habit analysis demonstrated the primary food source for flathead catfish in Lake Sutton is fish. These findings are similar to other studies, that found flathead catfish exceeding 300 mm fed primarily on fish (Minckley and Deacon 1959, Turner and Summerfelt 1970, Plieger 1975, Ashley and Buff 1987, Weller and Robbins 1999). However, the frequency of occurrence of fish in the stomach contents of flathead catfish in Sutton Lake were higher (92.3%) than values documented in the Cape Fear River in North Carolina (Ashley and Buff 1987) and in the Altamaha River in Georgia (Weller and Robbins 1999). This could be attributed to the small number of stomach contents collected from catfish <300 mm (N=4; Table 1). Flathead catfish <300 mm have been found to feed primarily on invertebrates (Ashley and Buff 1987, Quinn 1987, Weller and Robbins 1999).

When attempting to determine the impact of a predator on the population dynamics of a given prey, the percentage by number provides the most useful data without regard to the size of the prey (Bowen 1996). In Sutton Lake, centrarchids were the dominant prey species of flathead catfish (53.0%) by number. This percentage is probably conservative considering that it is highly likely that some of the unidentifiable fish remains were also centrarchids. Centrarchids were also the dominant prey by number on the Altamaha River (Weller and Robbins 1999). However, the percent by number of centrarchids in the diet of Sutton Lake flathead catfish was considerably higher than those found on the Altamaha River (8.1%; Weller and Robbins 1991). This is also true for other flathead catfish diet studies conducted on the Flint River in Georgia (Quinn 1987) and the Cape Fear River in North Carolina (Ashley and Buff 1987) where centrarchids accounted for 7.5% and 4.6% of the diet by number, respectively.

Although food habit analysis demonstrated that centrarchids are being heavily preyed upon by flathead catfish, there is no evidence to indicate that flathead catfish are having an impact on the channel catfish being stocked into the lake. Unidentifiable ictalurids only accounted for 0.5% of the diet by number. However, flathead catfish may be preying upon the channel catfish immediately after stocking. It may also be possible that channel catfish may be abundant in Lake Sutton but the electrofishing method used in our survey is not effective for collecting them. Justus' (1994) findings suggest that channel catfish are collected more effectively at lower temperatures and using higher pulse frequencies because of their preference for shallow water habitat.

CP&L biologists have suggested that introduction of flathead catfish in Sutton Lake may be responsible for the absence of larger fish in their rotenone samples (CP&L 1999). Food habit analysis determined that flathead catfish are capable of consuming large fish relative to their own size. It was not uncommon to remove a largemouth bass ranging in length from 300 to 480 mm from a flathead catfish that was 722 to 994 mm. The largest sunfish removed from a flathead catfish (738 mm) was a 144-mm warmouth *(Lepomis gulosus)*. In addition, 18 sunfish were found in the stomach of 1 flathead catfish stomach. This demonstrates the ability of flathead catfish to consume a large quantity of prey.

Evaluation of the number and size distribution of flathead catfish collected monthly indicated that flathead catfish are abundant in Sutton Lake. Furthermore, considering monthly catches increased over the 5 sampling months, removal efforts using repeated low voltage, low pulse DC electrofishing appear to be ineffective. A larger allocation of effort and time or a more effective sampling method will be needed to reduce flathead catfish abundance. Considering the fact that flathead catfish are abundant in Sutton Lake and centrarchids are the dominant prey of these fish suggest that they will impact the largemouth bass and sunfish fishery in Sutton Lake. Further monitoring of both the centrarchid and flathead catfish populations will be needed to better analyze this impact.

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