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TENNESSEE VALLEY AUTHORITY

River Basin Operations
Water Resources

STATUS OF THE CHANNEL CATFISH POPULATION IN CHICKAMAUGA RESERVOIR FIRST YEAR PROGRESS REPORT

Prepared by
George E. Peck
and
Johnny P. Buchanan

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INTRODUCTION

In 1986 the Tennessee Division of Water Pollution Control (TDWPC) and the Tennessee Wildlife Resources Agency (TWRA) expressed concern to the Tennessee Valley Authority (TVA) over possible declining populations of sauger, white crappie, white bass, and channel catfish in Chickamauga Reservoir as indicated by annual cove rotenone samples and TWRA creel surveys. Operation of Sequoyah Nuclear Plant (SQN) was mentioned as a possible contributing factor in the decline of these species and that the future operation of Watts Bar Nuclear Plant (WBN) might compound any effects to the aquatic biota of Chickamauga Reservoir. A specific concern for channel catfish was that they might be attracted and concentrated seasonally at the SQN diffuser discharge possibly resulting in overharvest. This, as well as other potential plant impacts are being examined and this report is provided on progress to date in addressing the state's concern over the status of the channel catfish population in Chickamauga Reservoir.

To determine if an actual sampling program was needed to evaluate the population status of channel catfish in Chickamauga Reservoir, a low-level effort was begun utilizing existing data from TVA's historical data base. These data were analyzed for trends and compared with similar data from adjacent reservoirs as well as fisherman harvest data collected by TWRA. No field sampling specifically for this project was conducted, although length and weight data for most channel catfish collected during the course of sampling for other projects on Chickamauga Reservoir during 1990 were recorded and stored for analysis during this investigation.

RESULTS AND DISCUSSION

Sport Fishing Harvest

Estimated annual sport fishermen harvest and average weight of channel catfish from Chickamauga Reservoir have been highly variable from 1972 through 1989 (Figure 1) with no evident trend of increasing or declining catch (TVA 1986a, TWRA 1989, TWRA 1990). Sport harvest (number/hr.) was lowest during 1981 and 1984 with no estimates available during 1985 through 1987. This situation may have suggested a negative trend and prompted the initial state concern in 1986. However, total number of channel catfish estimated harvested in 1989 (27,107) was second only to the number harvested during 1976, and estimated biomass in 1989 (23,700 kg) was the highest for the period. Average weight for catfish harvested during 1989 (0.87 kg) was exceeded only during 1982 (0.91 kg) (TWRA 1990).

Estimated harvest of channel catfish from Chickamauga Reservoir in 1988 and 1989 was much higher (Table 1) than from the mainstream reservoirs immediately upstream (Watts Bar) and downstream (Nickajack). Estimated harvest in all three reservoirs increased from 1988 to 1989, with the lowest proportional increase observed in Chickamauga.

Commercial Harvest

Commercial fishing license holders in the state of Tennessee were surveyed by mail in 1990 by TWRA to estimate the harvest of commercial fish species during 1989. Analysis of results was based on a 27 percent response rate (490 fishermen responded to survey forms mailed to all 1805

license holders). The report (TWRA 1990) prepared from results of this survey estimated harvest of 64,855 kg (142,853 lbs) of catfish from Chickamauga Reservoir during 1989. The survey reported harvest for all three species of catfish (i.e., channel, blue, and flathead) together, therefore, data specifically for channel catfish are unavailable. Channel catfish probably rank second to blue catfish in terms of abundance in the commercial harvest of the three catfish species from Chickamauga Reservoir based on observations by the authors. Weight for the total catfish harvest was 4.6 kg/ha (4.14 lbs/ac). By comparison, for the same period, total catfish harvest was estimated at 6.1 kg/ha (5.48 lbs/ac) in Watts Bar Reservoir and only 1.3 kg/ha (1.15 lbs/ac) in Nickajack Reservoir.

Cove Rotenone Sampling

Cove rotenone samples have been collected annually from Chickamauga Reservoir using comparable methods, and usually from the same four or five sites, since 1970. This extensive data base shows a wide range of annual density and biomass estimates for channel catfish (Figure 2). The highest density and biomass were recorded in 1981, although the lowest estimated harvest by sport fishermen was also recorded the same year. In 1986 the total biomass of all sizes (i.e. adult, intermediate and young-of-year categories) of channel catfish was the lowest recorded since 1970, while in 1987 the total number was the lowest recorded since 1970. Although no significant trend was found for numbers or biomass of adult channel catfish after analysis of cove rotenone data from 1970 through 1990, both numbers and biomass of intermediate size and numbers of young-of-year channel catfish have shown a significant decreasing

trend since 1970 (TVA 1991). Total number of channel catfish (all sizes) increased in 1988 to the second highest number collected since 1970 (Figure 2). Although cove rotenone samples from Watts Bar and Nickajack Reservoirs have not been collected annually, channel catfish abundance has also been highly variable in those reservoirs (Table 3). There is no consistent rank order among these three reservoirs.

Gill Net Sampling

Extensive gill net data for Chickamauga Reservoir were collected during preoperational and operational monitoring at SQN (TVA 1978, TVA 1986a). The catch per unit effort (CPUE) data in Table 4 were collected over a period of fourteen years employing similar methods (approximately 24 hour sets) and essentially the same sampling locations. The mean CPUE does indicate a general decline in catch of channel catfish from 1980 to 1985.

Additional gill net data from upper Chickamauga Reservoir (Table 5) were collected during preoperational monitoring at WBN (TVA 1986b) and various other projects (e.g., sauger and reservoir-wide monitoring) not specifically targeted at channel catfish. While catch rates in Table 5 are not directly comparable among all years listed, or with data in Table 4, they do provide comparisons within some sampling periods which employed similar gear, methods, and locations. Sampling in upper Chickamauga Reservoir during the period 1977-85 as part of the WBN preoperational monitoring program yielded fluctuating catch rates with no evident trends (Table 5). Sampling in 1986-90, which employed similar gear and methods during roughly the same time period each year, resulted in catch rates that again did not indicate declining abundance of channel catfish in upper Chickamauga Reservoir. This particular time period

approximately coincided with the period that SQN was shut down for safety concerns.

Potential Effects from SQN/WBN

Potential impacts to the channel catfish in Chickamauga Reservoir from operation of SQN and WBN include: (1) loss of planktonic larvae entrained by the condenser cooling water system; (2) loss of juvenile and adult fish impinged on plant intake screens; and (3) effects of thermal discharges on relative abundance and distribution of fish in the reservoir.

Operational monitoring at SQN has shown that entrainment percentages for channel catfish larvae were low in most years (Table 6), and entrainment impacts to the population should be negligible considering the low proportion of the total larval channel catfish produced in Chickamauga Reservoir which drift past SQN (TVA 1986a).

Previous operational monitoring reports have provided estimates of annual impingement based on weekly sampling of juvenile and adult fish on intake screens (Table 7) at SQN. Unlike entrainment, impingement losses are not expressed relative to numbers of fish adjacent to the plant. Instead, they are related to annual standing stock estimates from cove rotenone samples. Impingement mortality is viewed as the estimated quantity of reservoir fish standing stock removed by SQN each year. Based on four years of annual impingement sampling, it was concluded that impingement losses had not constituted an adverse impact to the channel catfish population in Chickamauga Reservoir (TVA 1986a). Impingement monitoring was discontinued in 1985.

No concentration of fish or concentrated fishing pressure has been observed in the SQN thermal plume during winter (TVA 1989). A supplemental creel survey conducted from April 1982 through June 1984 in the vicinity of SQN, although not designed to test the effect of fishing pressure within or outside of the mixing zone, has shown that blue and channel catfish are the primary species caught within the mixing zone or nearest the discharge diffusers during summer and to a lesser extent during winter.

CONCLUSIONS

Analysis of historical and recent data collected using a variety of sample methods failed to reveal any steadily declining trends in adult channel catfish densities in Chickamauga Reservoir from 1970 - 1990. Sport fishing harvest estimates for 1988 and 1989 were higher than estimates for 1983 and 1984. TWRA and TDWPC first expressed concern regarding this species in 1986, and was probably based in part on the decline in harvest of channel catfish from 1983 to 1984 (no creel data were available from 1985 through 1987). However, 1988 and 1989 creel data indicate that sport harvest of channel catfish has increased from the level estimated when concern was first expressed by the state. There is no indication that the channel catfish population of Chickamauga Reservoir has been effected by operation of SQN or is likely to be effected by future operation of WBN.

Additional length and weight data collected during reservoir-wide fish-community assessment monitoring in 1990 - 1991 will be analyzed and reported during fiscal 1992 to determine relative weight (W_r) and condition factors for channel catfish in Chickamauga Reservoir. Gill net data from biannual collection of channel catfish for radiological analysis in the vicinity of SQN will be analyzed for indications of channel catfish attraction to this area. Harvest (sportfish and commercial) data collected for 1990 by TWRA will also be analyzed during fiscal 1992. Following analysis of the data mentioned above, a final project report will be prepared and submitted during fiscal 1993.

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Table 1. Estimated total number and biomass, and average weight of channel catfish harvested by sport fishermen from Watts Bar, Chickamauga, and Nickajack Reservoirs, 1988–1989 according to TWRA sport fishing creel surveys

		Number	Biomass (kg)	Average Weight (kg)
Watts Bar	1988	10,820	7,500	0.69
	1989	23,611	19,894	0.84
Chickamauga	1988	25,377	19,083	0.75
	1989	27,107	23,700	0.87
Nickajack	1988	8,946	7,781	0.87
	1989	19,787	19,271	0.97

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Table 2. Average number and weight (kilograms) of channel catfish per hectare in Chickamauga Reservoir cove rotenone samples, 1970-1990.

Year	No. of Samples	Young-of-year (1 - 125mm)		Intermediate (126 - 225mm)		Harvestable (226mm +)		Total	
		no/ha	kg/ha	no/ha	kg/ha	no/ha	kg/ha	no/ha	kg/ha
1970	12	3.27	0.02	10.10	0.62	5.71	2.35	19.07	2.98
1971	5	13.52	0.05	15.04	0.92	27.08	12.06	55.65	13.03
1972	4	1.05	0.01	12.32	0.79	23.20	7.33	36.57	8.12
1973	4	1.23	0.01	12.07	0.71	29.68	9.64	42.98	10.36
1974	4	0.52	0.01	3.21	0.19	8.41	3.92	12.14	4.12
1975	4	1.03	0.01	2.39	0.11	10.27	4.13	13.69	4.25
1976	5	1.63	T	6.26	0.32	17.67	12.11	25.56	12.43
1977	5	2.75	0.02	4.55	0.27	12.14	7.12	19.44	7.40
1978	5	1.38	T	0.35	0.01	13.45	4.17	15.18	4.18
1979	5	1.05	0.01	1.40	0.04	22.35	14.19	24.80	14.24
1980	8	4.98	0.02	3.43	0.14	11.50	7.93	19.91	8.09
1981	5	6.41	0.06	4.17	0.12	67.02	59.00	77.60	59.17
1982	5	-	-	0.91	0.03	6.21	5.98	7.12	6.01
1983	5	-	-	-	-	11.22	12.69	11.22	12.69
1984	5	-	-	0.45	0.02	9.80	11.62	10.25	11.64
1985	5	0.44	T	8.40	0.45	7.32	8.97	16.16	9.42
1986	5	2.22	0.01	4.89	0.18	0.44	0.59	7.56	0.79
1987	5	0.45	T	-	-	3.24	3.62	3.69	3.63
1988	5	1.85	0.01	9.62	0.39	35.04	10.10	46.51	10.50
1989	5	-	-	-	-	10.28	6.86	10.28	6.86
1990	5	0.34	T	2.79	0.15	8.87	5.23	12.01	5.37

T = Trace (less than 0.01)

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Table 3. Average number and weight (kilograms) of channel catfish (all sizes) per hectare in Watts Bar, Chickamauga, and Nickajack Reservoir cove rotenone samples from 1970 through 1990.

Year	Watts Bar			Chickamauga			Nickajack		
	no/ha	kg/ha	no. of samples	no/ha	kg/ha	no. of samples	no/ha	kg/ha	no. of samples
1970		NS		19.1	3.0	12		NS	
1971		NS		55.7	13.0	5		NS	
1972		NS		36.6	8.1	4	19.8	0.9	4
1973	84.4	5.8	10	43.0	10.4	4		NS	
1974		NS		12.1	4.1	4		NS	
1975	11.4	2.9	6	13.7	4.3	4		NS	
1976	18.8	6.1	8	25.6	12.4	5		NS	
1977	42.1	8.4	8	19.4	7.4	5	9.0	0.3	4
1978	57.1	4.4	2	15.2	4.2	5		NS	
1979	16.5	11.2	2	24.8	14.2	5	4.7	2.9	4
1980	85.5	17.0	4	19.9	8.1	8	29.2	1.7	6
1981		NS		77.6	59.2	5	3.3	2.2	4
1982		NS		7.1	6.0	5		NS	
1983		NS		11.2	12.7	5		NS	
1984		NS		10.3	11.6	5		NS	
1985		NS		16.2	9.4	5		NS	
1986	*233.02	43.70	2	7.6	0.8	5		NS	
1987		NS		3.7	3.6	5		NS	
1988	127.0	23.3	2	46.5	10.5	5		NS	
1989		NS		10.3	6.9	5		NS	
1990		NS		12.0	5.4	5		NS	

NS = No sample taken
* 110.77 fish per hectare in this sample were represented by young-of-year fish (1-125 mm).

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Table 4. Annual catch per unit effort (CPUE) for channel catfish collected during quarterly gill net sampling, Sequoyah Nuclear Plant preoperational and operational monitoring, 1971-1977 and 1980-1985 respectively.

	CPUE (number per net night)				
Year	Station 1 (TRM 473.0)	Station 2 (TRM 483.2) SQN	Station 3 (TRM 495.0)	Station 4* (HRM 1.0)	Mean Total CPUE
1971	0.45	1.06	0.84	0.30	0.68
1972	0.46	0.58	0.67	0.69	0.60
1973	0.99	0.71	0.52	0.24	0.67
1974	0.32	0.45	0.79	-	0.52
1975	0.22	0.37	0.34	-	0.31
1976	0.42	0.78	0.51	-	0.57
1977	0.39	0.53	1.56	-	0.79
1980	0.66	1.51	0.82	-	1.00
1981	0.46	0.38	0.57	-	0.47
1982	0.24	0.63	0.45	-	0.44
1983	0.17	0.30	0.28	-	0.25
1984	0.29	0.34	0.36	-	0.33
1985	0.06	0.48	0.20	-	0.25

* Sampling at this site was terminated in spring 1973.

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Table 5. Annual catch per unit effort (CPUE) for channel catfish observed during TVA netting studies in upper Chickamauga Reservoir, (TRM 515.0 - TRM 529.9), during 1977 - 1990.

Year	CPUE by net-type XGN	GN	HN	CPUE unit	Reference
1977		-	0.07	net night	TVA 1986b
1978	0.60	-	0.01	"	"
1979	0.91	-	0.01	"	"
1982	0.61	-	0.02	"	"
1983	0.82	-	0.07	"	"
1984	0.75	-	0.02	"	"
1985	1.08	-	0.02	"	"
1986	-	0.39**	-	net hour	Hevel 1988
1987	-	2.27**	-	net hour	Hevel 1988
988	-	0.61**	-	net hour	Hickman 1989
1989	-	0.92**	-	net hour	Hickman et al 1990
1990	-	1.12**	-	net hour	Hickman et al 1991

* XGN = experimental gill net; GN = gill net; HN = hoop net.
** Includes both 2" mesh gill nets and experimental gill nets, which were not analyzed separately.

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Table 6. Estimated combined percent entrainment estimated for blue and channel catfish at Sequoyah Nuclear Plant, 1980-1985.

Year	Percent hydraulic entrainment (seasonal mean)	Percent entrainment (blue and channel catfish combined)	Actual number of larvae collected by species (stations combined)
1980	2.2	13.07	23 blue 108 channel
1981	13.4	8.42	17 blue 75 channel
1982	12.6	7.67	19 blue 49 channel
1983	5.7	9.42	23 blue 37 channel
1984	5.7	45.90*	12 blue 37 channel
1985	12.2	27.88	12 blue 28 channel

* Based on 17 specimens collected over two sample periods at the skimmer wall and plant transects; total of 49 larvae collected.

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Table 7. Estimated annual impingement of channel catfish at Sequoyah Nuclear Plant, 1981-1985.

Year	Estimated total impingement	*Percentage of standing stock impinged
1981	387	0.03
1982	179	0.18
1983	387	0.24
1984	358	0.24
1985**	212	0.14

* Based on numbers (not biomass) of fish impinged relative to numerical standing stock estimate derived from cove rotenone samples taken the same year, with the exception of the 1985 estimate which used 1984 rotenone data.

** Based on 212 days of impingement as compared to 365 days for previous years.

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