

NANTAHALA PROJECT – FERC NO. 2692-NC

FISHERIES STUDY

INTRODUCTION

During the biological studies consultation process subsequent to the issuance of the First Stage Consultation Package for the Nantahala Hydroelectric Project, the state and federal resource agencies identified the need for additional fisheries data in the vicinity of the project. Accordingly, a Technical Leadership Team (TLT) comprised of representatives from the North Carolina Wildlife Resources Commission (NCWRC), the United States Fish and Wildlife Service (USFWS), the United States Forest Service (USFS), the Land Trust for the Little Tennessee and the applicant was established to develop fisheries studies for the various Nantahala Area hydro projects. The study for the Nantahala Project consisted of fishery surveys in the Nantahala River bypass between the Project dam and the White Oak Creek confluence, in Dicks Creek and in the mainstem Nantahala River downstream of the powerhouse. The objectives of the study were to: (1) Describe the fishery resources in the Nantahala River mainstem and bypass, and (2) Determine any potential project-related impacts to the fishery resources present in the Nantahala River mainstem and bypass.

METHODS

The fisheries study consisted of depletion population estimates at various locations in the Nantahala River mainstem, Nantahala River bypass and Dicks Creek during the summer/fall 2001 and a review of historical data collected by the NCWRC during 1988 (unpublished data) and Fish and Wildlife Associates (FWA) during 1997, 1998 and 1999 (FWA 2000) at various locations within Dicks Creek and the Nantahala River bypass.

Historical sampling by FWA consisted of depletion population estimates at two locations in the Nantahala bypass between the Project dam and the confluence of Dicks Creek, two locations in the Nantahala bypass between the confluences of Dicks Creek and White Oak Creek and six locations within Dicks Creek. Historical sampling by the NCWRC consisted of qualitative and quantitative collections at various locations in the Nantahala bypass between the dam and powerhouse. Sample dates and descriptions of the various sample locations are presented in Table 1. It should be noted that the locations of the NCWRC collections referenced in Table 1 under Locations A1, AD1 and BD1 were not the exact locations sampled by FWA, but were in the same general vicinity as those locations.

The FWA's historical and current study population sampling and estimates were conducted according to the protocols outlined in the NCWRC's *Trout Stream Management Standardized Sampling and Data Analysis Methods* (Borawa 1996). The NCWRC's historical data were also collected according to these protocols, however, population estimates, fish densities and standing crops were not calculated. For comparative purposes, the NCWRC's data for sample area (ha) and catch numbers and

biomass by species were used to calculate population estimates, fish densities and standing crops for the locations generally analogous to those sampled by FWA.

Catch data were summarized in tabular format by sample location and species for total catch, population estimate, fish density (fish/ha), and fish standing crop (kg/ha). Population estimates and associated statistics were generated with Microfish 3.0 software (Van Deventer and Platts 1989).

RESULTS AND DISCUSSION

Total catches, population estimates, fish densities and fish standing crops varied by location and sample year (Table 2). For ease of comparing multiple years of catch and population data, results are presented and discussed by sample location.

Dicks Creek

Location A1

Location A1, the location immediately upstream of the Dicks Creek Dam, was sampled by the NCWRC during 1988 and by FWA during 1997-99 and 2001. The only species collected from this location during all sample years was wild rainbow trout (Table 2). The absence of other species at this location indicates that the Dicks Creek Dam is serving as a barrier to upstream migration.

The total catch at Location A1 ranged from a low of 25 fish in 2001 to a high of 58 fish in 1997. Population estimates ranged from 25 fish in 2001 to 59 fish in 1997. The average population estimate at Location A1 for the five years sampled was 43 fish. Standing crops ranged from 10.1 kg/ha in 2001 to 22.6 kg/ha in 1998. The average standing crop for the five years sampled was 19.5 kg/ha.

Location A2

Location A2 is located approximately 150 m upstream of Location A1 and was sampled by FWA during 1997-99 and 2001. As was the case with Location A1, the only species collected at Location A2 during all sample years was wild rainbow trout (Table 2).

The total catch at Location A2 ranged from a low of 12 fish in 2001 to a high of 37 fish in 1999. Population estimates ranged from 16 fish in 2001 to 45 fish in 1998. The average population estimate at Location A2 for the four years sampled was 33 fish. Standing crops ranged from 6.0 kg/ha in 2001 to 24.4 kg/ha in 1999. The average standing crop for the four years sampled was 15.6 kg/ha.

Location A3

Location A3 is located approximately 300 m upstream of Location A2 and is the most upstream location sampled. This location was sampled by FWA during 1997-99 and

2001. As was the case with Locations A1 and A2, the only species collected at Location A3 during all sample years was wild rainbow trout (Table 2).

The total catch at Location A3 ranged from a low of 30 fish in 2001 to a high of 48 fish in 1997. Population estimates ranged from 30 fish in 2001 to 52 fish in 1997. The average population estimate at Location A3 for the four years sampled was 42 fish. Standing crops ranged from 9.6 kg/ha in 2001 to 25.1 kg/ha in 1999. The average standing crop for the four years sampled was 19.6 kg/ha.

Location B1

Location B1 is located just upstream of the Dicks Creek confluence with the Nantahala River bypass. This location was sampled by FWA during 1997-99 and 2001. A total of five species, which included two trout species (rainbow trout and brown trout) was collected from this location (Table 2). All rainbow trout were wild fish, while all brown trout were stocked fish. In addition to trout, the central stoneroller and mottled sculpin were collected at this location. The most abundant species at Location B1 was mottled sculpin, followed by rainbow trout, brown trout and central stoneroller. Rainbow trout, brown trout and mottled sculpin were collected during all years, while the central stoneroller was only collected in 1997, when a single fish was collected.

Rainbow trout catches at Location B1 ranged from a low of 16 fish in 2001 to a high of 59 fish in 1999. Rainbow trout population estimates ranged from 16 fish in 2001 to 71 fish in 1999. Brown trout catches ranged from two fish in 2001 to nine fish in 1999. Due to low catches, brown trout population estimates were equal to the total catch. Mottled sculpin catches ranged from 61 fish in 2001 to 172 fish in 1997. Mottled sculpin population estimates ranged from 70 fish in 2001 to 368 fish in 1999.

Rainbow trout standing crops at Location B1 ranged from 4.1 kg/ha in 1997 to 34.8 kg/ha in 1999. Brown trout standing crops ranged from 0.7 kg/ha in 2001 to 28.0 kg/ha in 1998. Mottled sculpin standing crops ranged from 11.8 kg/ha in 2001 to 73.4 kg/ha in 1999. Total standing crops at Location B1 ranged from 24.3 kg/ha in 2001 to 112.3 kg/ha in 1999. The average total standing crop for the four years sampled was 69.4 kg/ha.

Location B2

Location B2 is located just upstream of the Nantahala penstock crossing of Dicks Creek. This location was sampled by FWA during 1997-99 and 2001. A total of four species, which included all three trout species (rainbow trout, brown trout and brook trout) was collected from this location (Table 2). All rainbow trout and the one brook trout were wild fish, while the one brown trout was a stocked fish. The only non-trout species collected at this location was the mottled sculpin. As was the case at Location B1, mottled sculpin was the most abundant species, followed by rainbow trout. Rainbow trout and mottled sculpin were collected during all years, while the brown trout and the brook trout were only collected in 1999.

Rainbow trout catches at Location B2 ranged from a low of 18 fish in 2001 to a high of 48 fish in 1999. Rainbow trout population estimates ranged from 20 fish in 2001 to 51 fish in 1999. Mottled sculpin catches ranged from 60 fish in 2001 to 109 fish in 1999. Mottled sculpin population estimates ranged from 73 fish in 2001 to 195 fish in 1999.

Rainbow trout standing crops at Location B2 ranged from 9.1 kg/ha in 2001 to 44.1 kg/ha in 1999. Mottled sculpin standing crops ranged from 10.3 kg/ha in 2001 to 54.3 kg/ha in 1999. Total standing crops at Location B2 ranged from 19.4 kg/ha in 2001 to 103.5 kg/ha in 1999. The average total standing crop for the four years sampled was 64.6 kg/ha.

Location B3

Location B3 is located just downstream of the Dicks Creek Dam. This location was sampled by FWA during 1997-99 and 2001. A total of three species, rainbow trout, brook trout and mottled sculpin, was collected from this location (Table 2). All rainbow trout and brook trout were wild fish. Similar to Locations B1 and B2, mottled sculpin was the most abundant species, however, the total catch was only slightly higher than that for rainbow trout. Rainbow trout and mottled sculpin were collected during all years, while brook trout were collected during all years except 1997.

Rainbow trout catches at Location B3 ranged from a low of 4 fish in 1997 to a high of 41 fish in 1999. Rainbow trout population estimates ranged from 4 fish in 1997 to 42 fish in 1999. Only two brook trout were collected in each of the three years they were collected. Because of the low catch rates, the brook trout population estimates were set equal to the total catch each year. Mottled sculpin catches ranged from 13 fish in 1998 to 51 fish in 2001. Mottled sculpin population estimates ranged from 17 fish in 1997 to 55 fish in 2001.

Rainbow trout standing crops at Location B3 ranged from 0.5 kg/ha in 1997 to 27.7 kg/ha in 1999. Brook trout standing crops ranged from 4.2 kg/ha in 2001 to 8.9 kg/ha in 1999. Mottled sculpin standing crops ranged from 7.7 kg/ha in 1998 to 17.3 kg/ha in 2001. Total standing crops at Location B3 ranged from 16.1 kg/ha in 1997 to 49.0 kg/ha in 1999. The average total standing crop for the four years sampled was 36.7 kg/ha.

Nantahala River Bypass

Location AD1

Location AD1 is located in the Nantahala bypass just upstream of the confluence of Dicks Creek. This location was sampled by the NCWRC in 1988 and FWA during 1997-99 and 2001. In contrast to Dicks Creek, the Nantahala bypass exhibited a more diverse species assemblage. A total of ten species, which included all three trout species, rainbow trout, brown trout and brook trout, was collected from this location (Table 2). Collectively, minnows (central stoneroller, mirror shiner, blacknose dace and creek chub) dominated the overall catch during all years. The most abundant single species during all

years was mottled sculpin. The only other species to be collected during all sample years were Northern hog sucker and rock bass.

Rainbow trout and brown trout were collected during all years, except 1988. All but one of the rainbow trout were wild fish, while all of the brown trout were stocked fish. The only brook trout collected was a single wild fish collected during the 1997 sample.

Population estimates for wild rainbow trout at Location AD1 ranged from 7 fish in 1997 to 19 fish in 2001. Standing crops for wild rainbow trout ranged from 2.3 kg/ha in 1998 and 1999 to 5.9 kg/ha in 2001. Population estimates for stocked brown trout ranged from 3 fish in 1997 and 1999 to 6 fish in 1998. The standing crops for stocked brown trout ranged from 4.5 kg/ha in 1999 to 7.3 kg/ha in 1997. Population estimates for mottled sculpin, the most abundant species, ranged from 371 fish in 1997 to 866 fish in 2001. Standing crops for mottled sculpin ranged from 22.6 kg/ha in 1997 to 52.9 kg/ha in 1988. Overall standing crops at Location AD1 ranged from 69.3 kg/ha in 1998 to 119.8 kg/ha in 1988. The average total standing crop for the five years sampled was 89.8 kg/ha.

Location AD2

Location AD2 is located in the Nantahala bypass upstream of Location AD1 just upstream of the confluence of Rowland Branch. This location was sampled by FWA during 1997-99 and 2001. A total of 11 species, which included two trout species, rainbow trout and brown trout, was collected from this location (Table 2). Similar to Location AD1, minnows (central stoneroller, mirror shiner, blacknose dace and creek chub) dominated the overall catch during all years, and the most abundant single species during all years was mottled sculpin. Also similar to collections at Location AD1, the only other species to be collected during all sample years were Northern hog sucker and rock bass. In terms of abundance, however, Northern hog sucker were substantially less abundant at Location AD2, while rock bass were substantially more abundant at Location AD2. Additionally, two species not collected at Location AD1, green sunfish and smallmouth bass, were collected at Location AD2.

All rainbow trout were wild fish and were collected during all sample years. Brown trout collections included both wild and stocked fish. Wild brown trout were only collected during 2001 (2 fish), while stocked brown trout were collected during 1997 and 1999 (2 fish each year). No brook trout were collected at Location AD2.

Population estimates for wild rainbow trout at Location AD2 ranged from 3 fish in 2001 to 23 fish in 1999. Standing crops for wild rainbow trout ranged from 0.6 kg/ha in 2001 to 6.9 kg/ha in 1997. The population estimate for wild brown trout in 2001 was equal to the total catch of two fish. The 2001 standing crop for wild brown trout was 3.4 kg/ha. The population estimates for stocked brown trout during 1997 and 1999 were equal to the total catches of two fish each year. The standing crops of stocked brown trout during 1997 and 1999 were 3.6 kg/ha and 1.3 kg/ha, respectively.

Rock bass were fairly abundant during all years. Population estimates for rock bass ranged from 17 fish in 1998 to 43 fish in 2001. Standing crops for rock bass ranged from 4.1 kg/ha in 1998 to 12.8 kg/ha in 2001.

Mottled sculpin was the single most abundant species, with population estimates ranging from 199 fish in 1998 to 975 fish in 2001. Standing crops for mottled sculpin ranged from 9.2 kg/ha in 1998 to 34.9 kg/ha in 1997. Overall standing crops at Location AD2 ranged from 41.0 kg/ha in 1998 to 99.3 kg/ha in 1997. The average total standing crop for the four years sampled was 67.8 kg/ha.

Location BD1

Location BD1 is located in the Nantahala bypass just upstream of the confluence of White Oak Creek. This location was sampled by the NCWRC during 1988 and by FWA during 1997-99 and 2001. A total of 10 species, which included two trout species, rainbow trout and brown trout, was collected from this location (Table 2). Overall, species composition at Location BD1 was similar to that at Locations AD1 and AD2, however, blacknose dace, an abundant species at Locations AD1 and AD2, was absent from collections at Location BD1. Additionally, redbreast sunfish, a species not collected at Locations AD1 and AD2 was present at Location BD1. Similar to Locations AD1 and AD2, minnows (central stoneroller, mirror shiner and creek chub) dominated the overall catch during all years, and the most abundant single species during all years was mottled sculpin. Also similar to collections from the two locations upstream of the Dicks Creek confluence, the Northern hog sucker was present during all years, and the rock bass was present during all years except 2001.

Rainbow trout were collected during all sample years and were all wild fish. Brown trout were only collected during 1997, 1998 and 1999 and were all stocked fish. No brook trout were collected at Location BD1.

Population estimates for wild rainbow trout at Location BD1 ranged from 3 fish in 1988 to 24 fish in 1999. Standing crops for wild rainbow trout ranged from 1.5 kg/ha in 1988 to 10.4 kg/ha in 1999. The population estimates for stocked brown trout were equal to the total catches each year, which were four fish in both 1997 and 1998 and one fish in 1999. The standing crops of stocked brown trout were 1.3 kg/ha, 5.1 kg/ha and 1.6 kg/ha during 1997, 1998 and 1999, respectively.

The Northern hog sucker was fairly abundant during all years. Population estimates for the Northern hog sucker ranged from 12 fish in 1999 to 52 fish in 1997. Standing crops for the Northern hog sucker ranged from 8.4 kg/ha in 1999 to 24.9 kg/ha in 1997.

As at other locations, the mottled sculpin was the single most abundant species at Location BD1, with population estimates ranging from 368 fish in 1988 to 1,112 fish in 1997. Standing crops for mottled sculpin ranged from 29.1 kg/ha in 1998 to 53.0 kg/ha in 2001. Overall standing crops at Location BD1 ranged from 78.1 kg/ha in 1998 to

137.4 kg/ha in 1988. The average total standing crop for the five years sampled was 105.9 kg/ha.

Location BD2

Location BD2 is located in the Nantahala bypass upstream of Location BD1 and just downstream of the confluence of Dicks Creek. This location was sampled by FWA during 1997-99 and 2001. A total of 10 species, which included all three trout species, rainbow trout, brown trout and brook trout, was collected from this location (Table 2). Overall, species composition at Location BD2 was similar to that at the other three Nantahala bypass locations. The only sunfish collected at Location BD2 was the rock bass, and only three fish were collected during the four years of sampling. Unlike Location BD1, blacknose dace were present at Location BD2 and were collected during all sample years. Similar to the other Nantahala bypass locations, minnows (central stoneroller, mirror shiner, blacknose dace and creek chub) dominated the overall catch during all years, and the most abundant single species during all years was mottled sculpin. Also similar to collections from the other three Nantahala bypass locations, the Northern hog sucker was present during all years, and the rock bass was present during all years except 2001.

Rainbow trout were collected during all sample years and were all wild fish. Rainbow trout abundance at Location BD2 was the highest of the four Nantahala bypass locations sampled. The high abundance of wild rainbow trout at Location BD2 is probably related to its proximity to Dicks Creek and resulting recruitment from rainbow trout spawned in Dicks Creek. Brown trout were collected during all years and were all stocked fish. A single brook trout was collected during each sample year except 2001. All brook trout were stocked fish.

Population estimates for wild rainbow trout at Location BD2 ranged from 26 fish in 1999 to 54 fish in 2001. Standing crops for wild rainbow trout ranged from 9.3 kg/ha in 1997 to 20.2 kg/ha in 1998. The population estimates for stocked brown trout were equal to the total catches each year, and ranged from 3 fish in 1999 to 24 fish in 2001. The standing crops of stocked brown trout ranged from 5.6 kg/ha in 1997 to 6.2 kg/ha in 1999.

The Northern hog sucker was collected during all years but was less abundant at Location BD2 than at Location BD1. Population estimates for the Northern hog sucker ranged from 4 fish in 2001 to 17 fish in 1997. Standing crops for the Northern hog sucker ranged from 5.5 kg/ha in 2001 to 17.5 kg/ha in 1998.

Consistent with the other three Nantahala bypass locations, the mottled sculpin was the single most abundant species at Location BD2, with population estimates ranging from 313 fish in 1999 to 1,433 fish in 1997. Standing crops for mottled sculpin ranged from 22.6 kg/ha in 1999 to 64.9 kg/ha in 1997. Overall standing crops at Location BD2 ranged from 47.1 kg/ha in 2001 to 105.7 kg/ha in 1997. The average total standing crop for the four years sampled was 70.3 kg/ha.

Nantahala River Mainstem

Location M1

Location M1 is located in the Nantahala River mainstem just upstream of Winding Stairs Road. This location was sampled by FWA during 2001. A total of 5 species, rainbow trout, brown trout, white sucker, Northern hog sucker and mottled sculpin, was collected from this location (Table 2). Trout collections included both wild and stocked rainbow trout and stocked brown trout. Numerically, mottled sculpin and wild rainbow trout comprised 98 % of the total catch at Location M1.

The total catch of wild rainbow trout at Location M1 was 399 fish, yielding a population estimate of 415 fish. The standing crop of wild rainbow trout was 100.0 kg/ha. Only three stocked rainbow trout and one stocked brown trout were caught at Location M1.

A total of 21 white suckers was collected at this location, yielding a population estimate of 21 fish and a standing crop of 42.2 kg/ha. A total of seven Northern hog suckers was collected, but due to a non-descending removal pattern, no population estimate could be calculated for this species. The standing crop for the Northern hog sucker was estimated to be 9.3 kg/ha.

Consistent with the four Nantahala bypass locations, the mottled sculpin was the single most abundant species at the mainstem Location M1, with a total catch of 1,562 fish and a population estimate of 2,235 fish. The standing crop of mottled sculpin at this location was 41.5 kg/ha. The overall standing crop at Location M1 during 2001 was 193.0 kg/ha.

Location M2

Location M2 is located in the Nantahala River mainstem approximately 100 m upstream of Location M1. This location was sampled by FWA during 2001. With the exception of one Northern hog sucker, the total catch at this location was comprised of wild rainbow trout and mottled sculpin (Table 2). Numerically, mottled sculpin comprised 86 % of the total catch.

The total catch of wild rainbow trout at Location M2 was 400 fish, yielding a population estimate of 421 fish. This catch was almost identical to the catch at Location M1, exceeding the Location M1 catch by one fish. The standing crop of wild rainbow trout at Location M2 was 32.2 kg/ha, substantially lower than the standing crop at Location M1 (100.0 kg/ha). This lower standing crop is attributable to the large number of young-of-year and yearling trout caught at Location M2 and the resulting lower average fish weight.

Consistent with the other Nantahala bypass and mainstem locations the mottled sculpin was the single most abundant species at Location M2. The mottled sculpin catch at Location M2 was 2,471 fish and was the highest catch of all locations reported for this

study. The standing crop of mottled sculpin at this location was 72.6 kg/ha. The overall standing crop at Location M2 during 2001 was 106.6 kg/ha.

LITERATURE CITED

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Table 1. Sample locations and sample dates for Nantahala River depletion population sampling conducted by FWA during 1997-99 and 2001 and the NCWRC during 1988.

Sample Location	Description	Stream Length (m)	Stream Width (m)	Number of Electrofishers	Collector(s)	Sample Dates
Dicks Creek A1	Immediately upstream of Dicks Creek impoundment	100	5.5	2	FWA	June 1997-99
		93.6	4.8	2	NCWRC	August 2001 May 1988
Dicks Creek A2	150 m upstream of Location A1	100	5.2	1	FWA	June 1997-99 August 2001
Dicks Creek A3	300 m upstream of Location A2	100	4.7	2	FWA	June 1997-99 August 2001
Dicks Creek B1	Just upstream of Dicks Creek confluence with Nantahala bypass	100	4.9	1	FWA	June 1997-99 August 2001
Dicks Creek B2	Just upstream of penstock crossing of Dicks Creek	80	4.5	1	FWA	June 1997-99 August 2001
Dicks Creek B3	Just downstream of the Dicks Creek Dam	100	5.3	1	FWA	June 1997-99 August 2001
Nantahala AD1	Nantahala bypass just upstream of Dicks Creek confluence	100	6.3	3	FWA	June 1997-99
		83.8	7.2	3	NCWRC	August 2001 May 1988
Nantahala AD2	Nantahala bypass just upstream of Rowland Branch confluence	100	11.6	3	FWA	June 1997-99 October 2001
Nantahala BD1	Nantahala bypass just upstream of White Oak Creek confluence	100	8.9	4	FWA	June 1997-99
		68.6	9.1	3	NCWRC	August 2001 May 1988
Nantahala BD2	Nantahala bypass just downstream of Dicks Creek confluence	100	8.7	3	FWA	June 1997-99 August 2001
Nantahala M1	Nantahala mainstem just upstream of Winding Stairs Rd.	100	25.2	10	FWA	September 2001
Nantahala M2	Nantahala mainstem \approx 100 m upstream of M1	100	32.2	10	FWA	September 2001

Table 2. Population statistics, density and standing crop by year, location and species from depletion sampling of Dicks Creek, Nantahala River bypass and Nantahala River mainstem during 1988, 1997-99 and 2001.

SPECIES	SAMPLE LOCATION												
	Dicks Creek A1					Dicks Creek A2				Dicks Creek A3			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001	1997	1998	1999	2001
Rainbow trout (wild) <i>Oncorhynchus mykiss</i>													
Total catch	29	58	43	42	25	32	42	37	12	48	43	38	30
Est. population	33	59	54	43	25	32	45	38	16	52	47	38	30
+/- Confidence	9	3	19	3	0	2	6	4	7	8	8	2	1
Number of fish/ha	728	839	768	877	417	591	831	1,348	320	929	839	1,096	600
Kg of fish/ha	21.1	19.5	22.6	24.1	10.1	11.8	20.3	24.4	6.0	24.1	19.5	25.1	9.6
Total Fish	29	58	43	42	25	32	42	37	12	48	43	38	30
Number of fish/hectare	728	839	768	877	417	591	831	1,348	320	929	839	1,096	600
Kg of fish/hectare	21.1	19.5	22.6	24.1	10.1	11.8	20.3	24.4	6.0	24.1	19.5	25.1	9.6

¹ NCWRC data

SPECIES	SAMPLE LOCATION												
	Dicks Creek B1				Dicks Creek B2				Dicks Creek B3				
	1997	1998	1999	2001	1997	1998	1999	2001	1997	1998	1999	2001	
Central stoneroller <i>Camptostoma anomalum</i>													
Total catch	1	-	-	-	-	-	-	-	-	-	-	-	-
Est. population	1	-	-	-	-	-	-	-	-	-	-	-	-
+/- Confidence	N/A	-	-	-	-	-	-	-	-	-	-	-	-
Number of fish/hectare	25	-	-	-	-	-	-	-	-	-	-	-	-
Kg of fish/hectare	1.2	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow trout (wild) <i>Oncorhynchus mykiss</i>													
Total catch	40	32	59	16	27	26	48	18	4	30	41	36	36
Est. population	41	34	71	16	27	30	51	20	4	32	42	36	36
+/- Confidence	3	5	17	0	1	10	1	3	1	5	3	1	1
Number of fish/ha	1,036	859	1,775	320	993	1,014	1,386	400	488	1,055	1,043	720	720
Kg of fish/ha	4.1	19.8	34.8	11.8	32.4	32.9	44.1	9.1	0.5	25.5	27.7	18.4	18.4
Brown trout (stocked) <i>Salmo trutta</i>													
Total catch	3	3	9	2	-	-	1	-	-	-	-	-	-
Est. population	3	3	9	2	-	-	1	-	-	-	-	-	-
+/- Confidence	1	N/A	3	N/A	-	-	N/A	-	-	-	-	-	-
Number of fish/ha	76	76	225	41	-	-	27	-	-	-	-	-	-
Kg of fish/ha	2.5	28.0	4.1	0.7	-	-	0.1	-	-	-	-	-	-
Brook trout (wild) <i>Salvelinus fontinalis</i>													
Total catch	-	-	-	-	-	-	1	-	-	2	2	2	2
Est. population	-	-	-	-	-	-	1	-	-	2	2	2	2
+/- Confidence	-	-	-	-	-	-	N/A	-	-	N/A	N/A	N/A	N/A
Number of fish/hectare	-	-	-	-	-	-	27	-	-	66	50	40	40
Kg of fish/hectare	-	-	-	-	-	-	5.0	-	-	8.7	8.9	4.2	4.2
Brook trout (stocked) <i>Salvelinus fontinalis</i>													
Total catch	-	-	-	-	-	-	-	1	-	-	-	-	-
Mottled sculpin <i>Cottus bairdi</i>													
Total catch	172	120	171	61	104	79	109	60	17	13	33	51	51
Est. population	272	238	368	70	123	123	195	73	17	22	36	55	55
+/- Confidence	94	160	241	7	20	61	112	9	3	36	7	4	4
Number of fish/hectare	6,876	6,016	9,200	1,400	4,522	4,155	5,299	1,460	2,073	725	894	1,100	1,100
Kg of fish/hectare	39.1	46.4	73.4	11.8	29.0	41.3	54.3	10.3	15.6	7.7	12.4	17.3	17.3
Total Fish	216	155	239	79	131	105	159	79	21	45	76	89	89
Number of fish/hectare	8,013	6,951	11,200	1,761	5,515	5,169	6,739	1,860	2,561	1,846	1,987	1,860	1,860
Kg of fish/hectare	46.9	94.2	112.3	24.3	61.4	74.2	103.5	19.4	16.1	41.9	49.0	39.9	39.9

Table 2. continued.

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass AD1					Nantahala Bypass AD2			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Central stoneroller <i>Campostoma anomalum</i>									
Total catch	17	56	200	116	165	65	42	28	194
Est. population	17	61	218	121	192	134	48	35	261
+/- Confidence	2	8	15	7	12	133	11	15	27
Number of fish/hectare	279	865	3,090	2,011	3,200	1,558	558	486	2,175
Kg of fish/hectare	3.7	3.0	15.2	11.6	9.9	12.5	7.5	3.9	10.8
Mirror shiner <i>Notropis spectrunculus</i>									
Total catch	79	511	192	132	116	45	89	16	224
Est. population	123	586	279	136	133	77	104	22	290
+/- Confidence	61	36	72	6	9	64	18	19	24
Number of fish/ha	2,022	8,305	3,954	2,261	2,217	895	1,209	306	2,417
Kg of fish/ha	3.6	14.0	5.7	4.3	3.6	1.9	1.8	0.6	4.0
Blacknose dace <i>Rhinichthys atratulus</i>									
Total catch	20	11	93	78	63	16	22	48	85
Est. population	21	11	109	85	80	16	26	57	97
+/- Confidence	4	N/A	18	10	12	2	10	14	7
Number of fish/ha	345	156	1,545	1,413	1,333	186	302	792	808
Kg of fish/ha	0.8	0.3	3.6	2.5	3.0	0.7	0.8	2.6	1.9
Creek chub <i>Semotilus atromaculatus</i>									
Total catch	35	28	85	32	89	78	105	79	151
Est. population	79	42	89	36	92	121	113	95	175
+/- Confidence	N/A	33	6	9	3	60	10	19	11
Number of fish/ha	1,299	595	1,261	598	1,533	1,407	1,314	1,319	1,458
Kg of fish/ha	13.0	6.7	4.3	3.0	3.6	11.1	8.0	8.0	11.2
Northern hog sucker <i>Hypentelium nigricans</i>									
Total catch	25	57	21	23	26	16	7	7	32
Est. population	31	63	21	23	28	16	7	7	32
+/- Confidence	14	10	1	2	3	2	1	1	1
Number of fish/ha	510	893	298	382	467	186	81	97	267
Kg of fish/ha	25.4	40.2	5.6	3.9	3.8	18.3	4.7	1.5	6.9
Rainbow trout (wild) <i>Oncorhynchus mykiss</i>									
Total catch	-	7	15	11	19	9	9	23	3
Est. population	-	7	15	11	19	9	9	23	3
+/- Confidence	-	1	2	1	0	3	3	1	1
Number of fish/ha	-	99	213	183	317	105	105	319	25
Kg of fish/ha	-	5.5	2.3	2.3	5.9	6.9	4.7	2.7	0.6
Rainbow trout (stocked) <i>Oncorhynchus mykiss</i>									
Total catch	-	-	-	-	1	-	-	-	-

¹ NCWRC data

Table 2. continued.

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass AD1					Nantahala Bypass AD2			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Brown trout (wild) <i>Salmo trutta</i>									
Total catch	-	-	-	-	-	-	-	-	2
Est. population	-	-	-	-	-	-	-	-	2
+/- Confidence	-	-	-	-	-	-	-	-	N/A
Number of fish/ha	-	-	-	-	-	-	-	-	17
Kg of fish/ha	-	-	-	-	-	-	-	-	3.4
Brown trout (stocked) <i>Salmo trutta</i>									
Total catch	-	3	6	3	2	2	-	2	-
Est. population	-	3	6	3	-	2	-	2	-
+/- Confidence	-	5	2	3	-	13	-	7	-
Number of fish/ha	-	43	85	50	-	23	-	28	-
Kg of fish/ha	-	7.3	5.4	4.5	-	3.6	-	1.3	-
Brook trout (wild) <i>Salvelinus fontinalis</i>									
Total catch	-	1	-	-	-	-	-	-	-
Est. population	-	1	-	-	-	-	-	-	-
+/- Confidence	-	N/A	-	-	-	-	-	-	-
Number of fish/hectare	-	14	-	-	-	-	-	-	-
Kg of fish/hectare	-	3.0	-	-	-	-	-	-	-
Mottled sculpin <i>Cottus bairdi</i>									
Total catch	122	257	421	472	718	156	153	268	682
Est. population	596	371	484	509	866	576	199	315	975
+/- Confidence	N/A	82	33	20	30	902	41	30	65
Number of fish/hectare	9,796	5,258	6,859	8,461	14,433	6,698	2,314	4,375	8,125
Kg of fish/hectare	52.9	22.6	26.8	37.2	52.3	34.9	9.2	20.0	30.5
Rock bass <i>Ambloplites rupestris</i>									
Total catch	13	7	2	1	2	15	17	25	42
Est. population	18	7	2	1	2	28	17	28	43
+/- Confidence	N/A	3	N/A	N/A	N/A	51	1	8	2
Number of fish/hectare	296	99	28	17	33	326	198	389	258
Kg of fish/hectare	20.4	3.0	0.4	0.4	2.5	9.4	4.1	8.0	12.8
Green sunfish <i>Lepomis cyanellus</i>									
Total catch	-	-	-	-	-	-	-	-	3
Est. population	-	-	-	-	-	-	-	-	3
+/- Confidence	-	-	-	-	-	-	-	-	0
Number of fish/hectare	-	-	-	-	-	-	-	-	25
Kg of fish/hectare	-	-	-	-	-	-	-	-	0.1

¹ NCWRC data

Table 2. continued.

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass AD1					Nantahala Bypass AD2			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Smallmouth bass <i>Micropterus dolomieu</i>									
Total catch	-	-	-	-	-	-	1	-	-
Est. population	-	-	-	-	-	-	1	-	-
+/- Confidence	-	-	-	-	-	-	N/A	-	-
Number of fish/hectare	-	-	-	-	-	-	12	-	-
Kg of fish/hectare	-	-	-	-	-	-	0.2	-	-
Total Fish	311	938	1035	868	1201	402	445	496	1418
Number of fish/hectare	14,547	16,327	17,333	15,376	23,533	11,384	6,093	8,111	15,575
Kg of fish/hectare	119.8	105.6	69.3	69.7	84.6	99.3	41.0	48.6	82.2

¹ NCWRC data

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass BD1					Nantahala Bypass BD2			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Central stoneroller <i>Campostoma anomalum</i>									
Total catch	197	136	63	106	96	10	9	5	9
Est. population	223	154	67	117	107	11	9	5	9
+/- Confidence	20	17	7	12	7	5	2	1	1
Number of fish/hectare	3,557	1,588	691	995	1,189	107	87	54	100
Kg of fish/hectare	63.7	28.1	14.1	17.6	21.6	2.2	1.4	1.1	2.1
Mirror shiner <i>Notropis spectrunculus</i>									
Total catch	66	172	35	69	107	64	53	6	-
Est. population	128	220	96	326	110	75	60	6	-
+/- Confidence	112	40	211	1,065	3	15	11	386	-
Number of fish/ha	2,041	2,268	990	2,772	1,222	728	583	65	-
Kg of fish/ha	4.9	4.4	2.7	4.3	1.8	1.6	0.9	0.2	-
Blacknose dace <i>Rhinichthys atratulus</i>									
Total catch	-	-	-	-	-	15	26	5	7
Est. population	-	-	-	-	-	28	27	5	7
+/- Confidence	-	-	-	-	-	51	4	3	1
Number of fish/ha	-	-	-	-	-	272	262	54	78
Kg of fish/ha	-	-	-	-	-	1.3	0.9	0.3	0.4
Creek chub <i>Semotilus atromaculatus</i>									
Total catch	22	81	46	88	117	31	16	10	15
Est. population	26	85	46	95	125	64	16	10	15
+/- Confidence	10	6	2	9	5	94	1	2	0
Number of fish/ha	415	876	474	808	1,389	621	155	108	167
Kg of fish/ha	2.3	5.9	3.1	5.4	5.6	3.8	0.8	1.5	0.7

¹ NCWRC data

Table 2. continued.

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass BD1					Nantahala Bypass BD2			
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Northern hog sucker <i>Hypentelium nigricans</i>									
Total catch	13	38	21	12	19	17	15	9	4
Est. population	13	52	24	12	19	17	15	10	4
+/- Confidence	2	27	8	3	0	1	1	6	1
Number of fish/ha	207	536	247	102	211	165	146	108	44
Kg of fish/ha	14.4	24.9	16.8	8.4	15.7	15.2	17.5	8.4	5.5
Rainbow trout (wild) <i>Oncorhynchus mykiss</i>									
Total catch	3	10	6	7	4	32	41	26	36
Est. population	3	11	6	24	4	33	45	26	54
+/- Confidence	N/A	5	N/A	176	1	4	8	1	18
Number of fish/ha	48	113	62	204	44	320	437	280	600
Kg of fish/ha	1.5	5.4	5.3	10.4	2.6	9.3	20.2	10.2	10.0
Brown trout (stocked) <i>Salmo trutta</i>									
Total catch	-	4	4	1	-	7	8	3	24
Est. population	-	4	4	1	-	7	8	3	-
+/- Confidence	-	1	2	N/A	-	2	1	5	-
Number of fish/ha	-	41	41	9	-	68	78	32	-
Kg of fish/ha	-	1.3	5.1	1.6	-	5.6	5.7	6.2	-
Brook trout (stocked) <i>Salvelinus fontinalis</i>									
Total catch	-	-	-	-	-	1	1	1	-
Est. population	-	-	-	-	-	1	1	1	-
+/- Confidence	-	-	-	-	-	N/A	N/A	N/A	-
Number of fish/hectare	-	-	-	-	-	10	10	11	-
Kg of fish/hectare	-	-	-	-	-	1.5	2.1	2.3	-
Mottled sculpin <i>Cottus bairdi</i>									
Total catch	177	463	249	536	615	502	336	255	421
Est. population	368	1,112	461	691	729	1,433	482	313	570
+/- Confidence	223	532	188	72	25	866	91	39	41
Number of fish/hectare	5,869	11,464	4,753	5,876	8,100	13,913	4,680	3,376	6,333
Kg of fish/hectare	38.7	52.3	29.1	42.9	53.0	64.9	25.2	22.6	28.4
Rock bass <i>Ambloplites rupestris</i>									
Total catch	13	9	8	1	-	1	1	1	-
Est. population	13	9	8	1	-	1	1	1	-
+/- Confidence	N/A	3	2	N/A	-	N/A	N/A	N/A	-
Number of fish/hectare	207	93	82	9	-	10	10	11	-
Kg of fish/hectare	11.9	0.5	1.8	0.1	-	0.3	0.4	0.3	-

¹ NCWRC data

Table 2. continued.

SPECIES	SAMPLE LOCATION								
	Nantahala Bypass BD1				Nantahala Bypass BD2				
	1988 ¹	1997	1998	1999	2001	1997	1998	1999	2001
Redbreast sunfish <i>Lepomis auritus</i>									
Total catch	-	-	3	-	-	-	-	-	-
Est. population	-	-	3	-	-	-	-	-	-
+/- Confidence	-	-	N/A	-	-	-	-	-	-
Number of fish/hectare	-	-	31	-	-	-	-	-	-
Kg of fish/hectare	-	-	0.1	-	-	-	-	-	-
Green sunfish <i>Lepomis cyanellus</i>									
Total catch	-	-	-	1	-	-	-	-	-
Est. population	-	-	-	1	-	-	-	-	-
+/- Confidence	-	-	-	N/A	-	-	-	-	-
Number of fish/hectare	-	-	-	9	-	-	-	-	-
Kg of fish/hectare	-	-	-	0.1	-	-	-	-	-
Total Fish	491	913	435	821	958	680	506	321	516
Number of fish/hectare	12,344	16,979	7,371	10,784	12,155	16,214	6,448	4,099	7,322
Kg of fish/hectare	137.4	122.8	78.1	90.8	100.3	105.7	75.1	53.1	47.1

¹ NCWRC data

SPECIES	SAMPLE LOCATION	
	Nantahala Mainstem M1	Nantahala Mainstem M2
	2001	2001
Rainbow trout (wild) <i>Oncorhynchus mykiss</i>		
Total catch	399	400
Est. population	415	421
+/- Confidence	6	7
Number of fish/ha	1,660	1,316
Kg of fish/ha	100.0	32.2
Rainbow trout (stocked) <i>Oncorhynchus mykiss</i>		
Total catch	3	-
Brown trout (stocked) <i>Salmo trutta</i>		
Total catch	1	-
White sucker <i>Catostomus commersoni</i>		
Total catch	21	-
Est. population	21	-
+/- Confidence	1	-
Number of fish/hectare	84	-
Kg of fish/hectare	42.2	-

Table 2. continued.

SPECIES	SAMPLE LOCATION	
	Nantahala Mainstem M1	Nantahala Mainstem M2
	2001	2001
Northern hog sucker <i>Hypentelium nigricans</i>		
Total catch	7	1
Est. population	7	1
+/- Confidence	N/A	N/A
Number of fish/hectare	28	3
Kg of fish/hectare	9.3	1.8
Mottled sculpin <i>Cottus bairdi</i>		
Total catch	1,562	2,471
Est. population	2,235	3,363
+/- Confidence	98	100
Number of fish/hectare	8,940	10,509
Kg of fish/hectare	41.5	72.6
Total Fish	1,993	2,872
Number of fish/hectare	10,712	11,828
Kg of fish/hectare	193.0	106.6