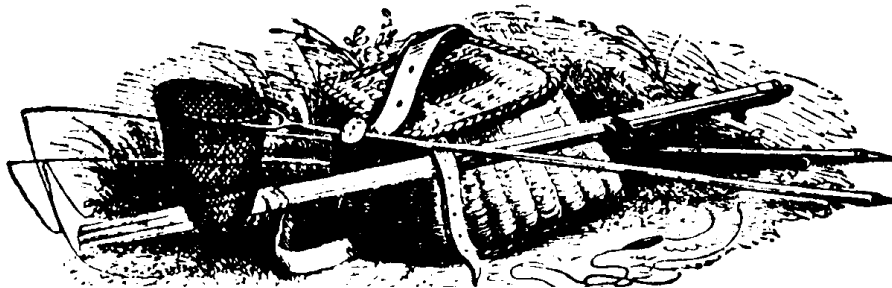
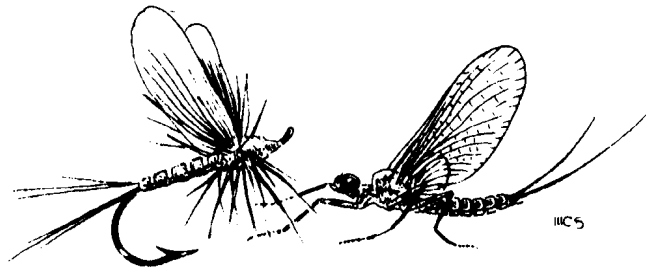
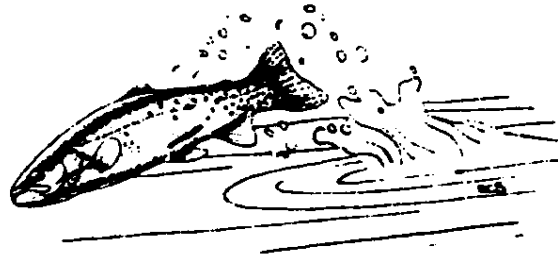


Great Smoky Mountains National Park

1998 Fisheries Management Report



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Introduction

Great Smoky Mountains National Park (GRSM) encompasses over 558,000 acres of Federally protected mountains, which are estimated to be 200-300 million years old. The Park is home to diverse populations of plants, insects, and animals due to variety of forest types, soil types, geological formations, disturbance histories, and elevational changes (1,000 to over 6,000 feet).

The Park has over 2,000 miles of streams, roughly 800 miles of which are thought to contain fishable populations of trout. The Park is home to roughly 53 species of fish. Three of these species, the Smoky madtom, yellowfin madtom, and spotfin chub, are federally threatened or endangered and thus protected in GRSM. Two other species, the flame chub and the duskytail darter, are considered species of special concern.

The brook trout is the only salmonid (i.e. trout/salmon) species endemic to the Park. Brook, brown and rainbow trout were introduced into GRSM by logging companies during the early 1900's to replace trout populations decimated by their logging activities. Stocking of brook, brown, and rainbow trout by the NPS continued until 1975, when Park managers realized that stocking these exotics did not conform to NPS mandates to protect and preserve native species. Today rainbow trout are found in almost every watershed in the Park, brown trout are found in roughly half, and non-native brook trout in about a third of the Park's watersheds.

The purpose of this report is to: (1) inform and educate GRSM staff and resource users about GRSM fisheries management projects, (2) present 1998 sampling locations and results, (3) present 1998 ranger creel results, and (4) describe upcoming projects.

The GRSM Fisheries Program

The mandates of the National Park Service focus on the protection and preservation of its natural resources so as to leave them unimpaired for future generations. To address these mandates, the fisheries program is designed to

establish baseline information on water quality and fish populations through inventory and monitoring (I&M) stations. Baseline information is used to define changes in aquatic systems due to natural and human-induced occurrences. Also, baseline information is vital in making management decisions concerning Park resources.

It is impossible to annually collect and monitor information from every stream in the Park. Therefore, key watersheds are selected throughout the Park which best represent the various disturbance histories (settlement, undisturbed), forest types (second growth, old growth), geology's (sandstone, anakeesta, limestone), and elevational gradients. Information is collected from seven different types of sites: (1) large stream I&M sites, (2) brook trout I&M sites, (3) brook trout restoration I&M sites, (4) brook trout distribution I&M sites, (5) acid deposition I&M sites, (6) general I&M site, and (7) crew training sites.

Large Stream I&M Sites - These sites monitor the diverse gamefish (bass and trout) and non-gamefish (minnows, dace, shiners, suckers, etc.) communities in some of the Park's larger river systems. Many of these species are more sensitive to acid deposition effects than trout and are therefore excellent indicators of severe changes in water quality in the Park.

Brook Trout I&M Sites - Annually, 25-30 monitoring sites, typically at high elevations (>3,000 feet), are sampled throughout the Park to monitor brook and brook/rainbow trout populations. These sites are useful in determining changes in brook trout populations due to competition from rainbow trout, acid rain, or natural occurrences.

Brook Trout Restoration I&M Site - These sites are established and monitored annually after the stream is restored to brook trout to ensure that all rainbow trout have been removed from the system.

Brook Trout Distribution I&M Sites - A few of these sites are established in each watershed during brook trout distribution surveys in order to get brook trout population data at that point in time. These sites are then revisited every 10 years to assess gains/losses in brook trout populations due to acid rain, rainbow trout competition, or other disturbances.

Acid Deposition I&M Sites - A couple streams in the Park have been known to contain trout populations in the past 60-80 years, but today support only small populations or are devoid of fish. The probable causes of these depressed or lost populations are effects associated with acidic deposition. These sites monitor water quality and fish populations to determine the magnitude of acid deposition effects.

General I&M Sites - During some years, special projects, such as road or bridge construction, make it necessary to establish baseline water quality and fish information, before and after construction, to ensure the construction practices do not cause serious damage to Park resources. After completion, if there are no significant changes, these sites are dropped from annual monitoring.

Crew Training Sites - These sites are used every year to train new crewmembers in the use of backpack electrofishing gear and stream sampling techniques.

Sites Completed In 1998

Crews completed 84 stream surveys in 33 streams and 14 watersheds during 1998. The streams and number of sites sampled are found in Table 1.

Table 1. - Streams sampled during 1998 fishery monitoring surveys in Great Smoky Mountains National Park.

Ranger District	Stream Name	# of Sites	Watershed Name	Site Type
Cades Cove	Abrams Creek	4	Abrams Creek	Large Stream I&M
Cades Cove	Anthony Creek	1	Abrams Creek	Large Stream I&M
Cades Cove	Mill Creek	2	Abrams Creek	Large Stream I&M
East District	Beech Creek	2	Cataloochee Creek	Brook Trout Restoration
East District	Cataloochee Creek	4	Cataloochee Creek	Large Stream I&M
East District	Little Cataloochee	6	Cataloochee Creek	Brook Trout Restoration
East District	Lost Bottom	4	Cataloochee Creek	Brook Trout Restoration
East District	Cosby Creek	2	Cosby Creek	Brook Trout I&M
East District	Rock Creek	3	Cosby Creek	Brook Trout I&M
East District	Indian Camp Creek	3	Indian Camp Creek	Brook Trout I&M
East District	Dunn Creek	2	Dunn Creek	Brook Trout I&M
East District	Cannon Creek	2	MP Little Pigeon	Acid Deposition I&M
Lake District	Ekaneetlee Creek	4	Eagle Creek	Brook Trout Restoration
Lake District	Walkers Creek	1	Hazel Creek	Brook Trout I&M
Lake District	Hazel Creek	2	Hazel Creek	Large Stream I&M
Lake District	Hazel Creek	3	Hazel Creek	Brook Trout I&M
Lake District	Bible Creek	1	Parsons Branch	General I&M
Lake District	Parsons Branch	1	Parsons Branch	General I&M
Little River	Blanket Creek	3	EP Little River	Brook Trout Restoration
Little River	Mannis Branch	3	EP Little River	Brook Trout Restoration
Little River	Ash Camp Branch	3	EP Little River	Brook Trout Restoration
Little River	Fish Camp Prong	2	EP Little River	Brook Trout Restoration
Little River	Silers Creek	3	EP Little River	Brook Trout I&M
Little River	Laurel Branch	1	EP Little River	Fisheries Crew Training
Little River	Little River	4	Little River	Large Stream I&M
Little River	Sams Creek	4	MP Little River	Brook Trout I&M
Little River	Starkey Creek	2	MP Little River	Brook Trout I&M
Little River	Road Prong	2	WP Little Pigeon	Brook Trout I&M
Little River	Roaring Fork	2	WP Little Pigeon	General I&M
Little River	Walker Prong	2	WP Little Pigeon	Brook Trout I&M
Oconaluftee	Bunches Creek	3	Bunches Creek	Brook Trout I&M
Oconaluftee	Flat Creek	1	Bunches Creek	Brook Trout I&M
Oconaluftee	Straight Fork	2	Straight Fork	General I&M

Sampling Results

Brook Trout Monitoring

Brook trout monitoring sites were located between 625 and 1,481m (2,050 to 4,860 feet) in elevation in 1st to 4th order streams. Water temperature ranged from 11.9 to 18.9°C and stream discharge ranged from 0.004 to 0.34m³/sec (0.16 to 11.84 ft³/sec). Stream pH ranged from 5.6 to 7.2, conductivity from 2 to 22 Mhos/cm, and stream gradient from 1.3 to 17.1%.

Brook trout density ranged from 2.9 to 56.7 fish/100m². Young-of-the-year (YOY)(age-0 fish) brook trout comprised 6-72% of allopatric (i.e. brook trout were the only salmonid found there) populations. There appeared to be greater numbers of age-0 brook trout in NC streams indicating the effects of the 1998 floods may have been worse in TN than NC.

Density and biomass comparisons among streams indicate substantial variation in the number of trout per mile of stream (Appendix Table 2). The number of brook trout per mile of stream ranges from 40-3,300 fish/mile, however, most streams average 400-600 brook trout/mile. *For a detailed breakdown of fish sizes, numbers collected, and numbers per mile of stream, please refer to Appendix Table 2.*

Adult brook trout in GRSM rarely live beyond 4 years of age and seldom exceed 200mm (8 inches) in length. In 1999, brook trout monitoring surveys collected 2,502 brook trout of which, 95 (<4%) were greater than 7 inches. In any given year, <10% of all brook trout collected are greater than 178mm or 7 inches.

In several streams where brook and rainbow trout were mixed, there appears to be no major changes in most populations over the last 10 years (Figure 1). Data indicates that in most sympatric (mixed brook and rainbow trout) populations in the Park, rainbow trout encroachment is not a systematic process, and that many populations have reached an equilibrium. These sympatric populations seem to follow an ebb and flow scenario from year to year. Typically, brook trout populations significantly decline only in years of

major storm events between November and March, while rainbow trout typically decline in years with major storm events between February and May.

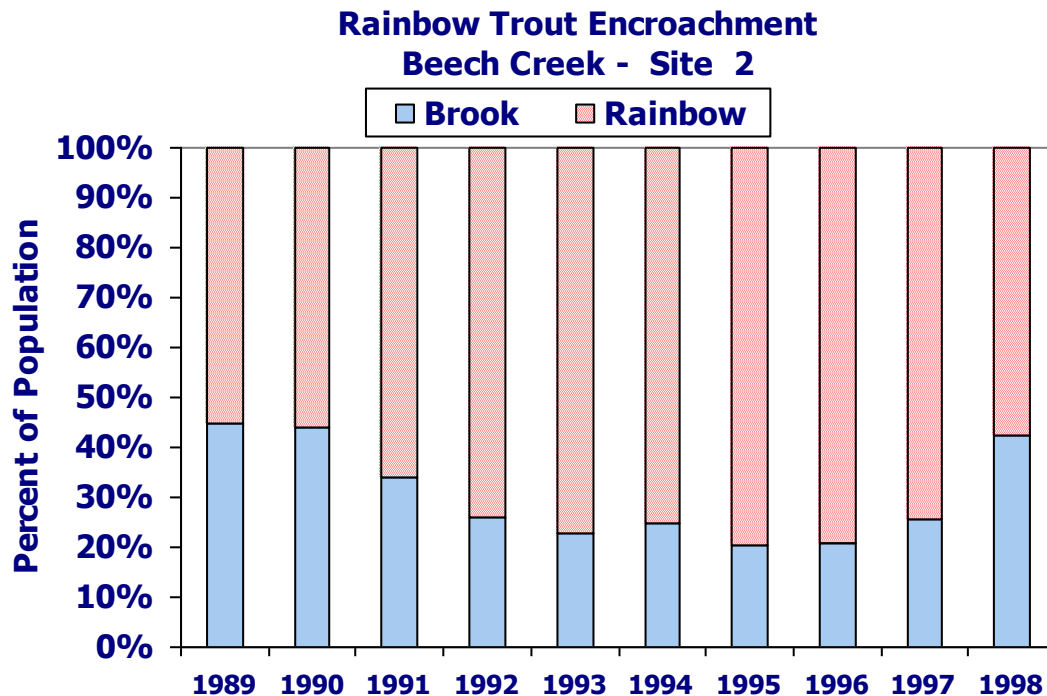


Figure 1. - Composition of brook and rainbow trout in Beech Creek, Great Smoky Mountains National Park, over a 10 year period.

Over the past 4 years, declines of 92 and 96% have been observed in brook and rainbow trout populations in Indian Camp Creek just upstream of the Park boundary. Non-game species present at the same site (blacknose dace, longnose dace, and mottled sculpin) have not indicated similar declines since 1995. The reasons for the declines in brook and rainbow trout at this site are unclear.

Data collected in 1998 indicates that brook and rainbow trout populations in Starkey Creek have not recovered since a spring 1994 flood in the watershed (Figure 2). Coincidentally, brook and rainbow trout populations in Sams Creek, a stream just across the ridge from Starkey Creek, have rebounded well from the 1994 flood. These data suggest that underlying anakeesta formations on Starkey Creek, exposed further after the 1994 flood, may be retarding the re-population

of Starkey Creek. Cannon Creek, a stream in Middle Prong of the Little Pigeon River, whose headwaters are underlain by small amounts of exposed anakeesta, indicates a similar lack of recovery following the 1994 floods. Populations in both streams follow a pattern similar to other Park streams that are prone to acidification. As forests age and acid deposition increases in GRSM, streams underlain by anakeesta slowly lose their buffering capacity and become more susceptible to severe rain events. These severe rain events can cause the drastic reductions in trout populations observed in Cannon and Starkey Creek.

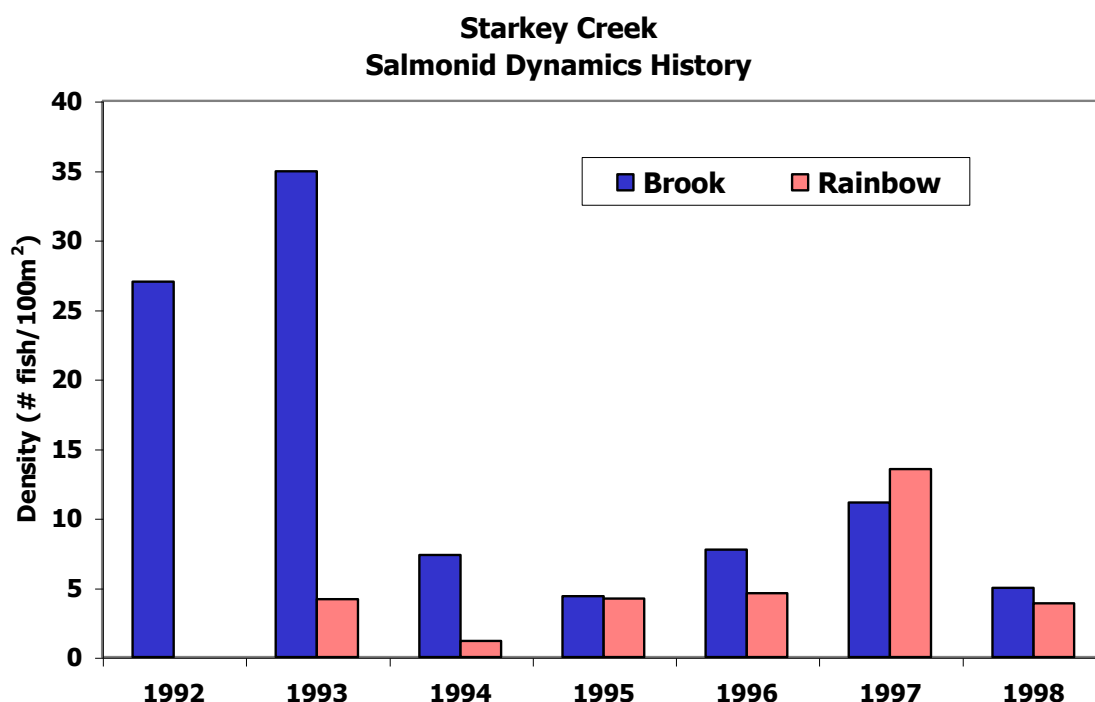


Figure 2. - Brook and rainbow trout density in Starkey Creek, Great Smoky Mountains National Park, between 1992 and 1998.

Collections of brook trout throughout the eastern United States indicate that the brook trout found in GRSM are a distinct sub-species of brook trout. The taxonomic break appears to be the New River watershed in Virginia. Of the 51 populations studied throughout GRSM, roughly 69% are pure southern Appalachian strain brook trout. Northern strain populations account for 29%, and hybrid populations, 2%. Only pure southern Appalachian strain brook trout are used for reintroduction projects.

Brook Trout Distribution

Brook and rainbow trout distribution surveys were completed in the Oconaluftee River watershed in 1998. Results of the 1998 survey were compared to brook and rainbow trout distribution data collected by Willis King in 1936-1937 to assess change over the 60-year period. Distributions of brook and rainbow trout were assessed in sixteen streams common to both surveys. Sympatric (mixed) rainbow and brook trout populations were identified and compared in six of the sixteen streams, while twelve of sixteen included comparisons of allopatric brook trout populations.

Rainbow trout invaded two streams that were void of rainbow trout in the 1930's survey. Stream lengths of sympatric zones decreased 42% from 11.6 km in the 1930's to 4.9 km in 1998. Rainbow trout moved upstream an average of 1.9 km in four streams. In two other streams, a natural barrier prevented upstream movement of rainbow trout. Brook trout lost an average of 1.6 km in the downstream end of their sympatric zone range in four streams.

Allopatric brook trout zones decreased over the 60-year period in eleven of the twelve streams. Comparisons on one stream indicate that the allopatric brook trout zone remained constant due to a natural barrier preventing upstream migration of rainbow trout. In addition, there were no changes in the upper end of the allopatric brook trout zone of this stream. Allopatric brook trout zones decreased 51% from 22.9 km to 11.6 km in ten of the sixteen streams surveyed. Two allopatric brook trout populations were lost during the 60-year study period. Rainbow trout replaced brook trout in one stream, and in the other stream the brook trout population disappeared for no apparent reason.

Range loss in most of the allopatric brook trout zones is due to rainbow trout encroachment. A total of 8.2km (range 0.1-2.2 km) of allopatric zone was lost in six streams from rainbow trout encroachment. Natural barriers only protected two allopatric brook trout populations from rainbow trout migration. Six of the twelve streams also had range loss from the upper end of the

allopatric zone (headwater reaches). Surveys in 1998 indicate a total decline of 3.4km (range 0.3-0.5 km/stream) in headwater stream reaches.

Cataloochee Creek watershed is selected for trout distribution surveys in 1999. Little Cataloochee Creek, a tributary to Cataloochee Creek, was surveyed in 1998. These data will be analyzed when the remaining Cataloochee Creek watershed distribution survey is completed in 1999.

Brook Trout Restoration

Mannis Branch

Multiple backpack electrofishing removals in one summer (1996) were used to eradicate rainbow trout from Mannis Branch. Rainbow trout were completely eliminated from the stream by May 1997. Brook trout were collected (105) and reintroduced into Mannis Branch in October 1996 and immediately spawned. In May 1997, surveys collected 163 brook trout of which, 92 were age-0 fish from the previous fall indicating good reproduction. Monitoring efforts conducted in 1998 indicate that brook trout density has surpassed that of pre-treatment rainbow trout surveys. Given the current reproductive success and future recruitment, brook trout biomass should surpass pre-treatment rainbow trout levels in the near future.

Leconte Creek

After two removals, 556 rainbow trout were removed from Leconte Creek and placed below the milldam at the Twin Creeks Research Station and/or transported to another stream. All fish placed below the barrier were adipose fin clipped to test and assure the effectiveness of the barrier. The first removal collected 89% (495) of the total rainbow trout removed, while the second removal collected 11% (61). On the first removal, 12% (59) of the fish removed were young-of-the-year (YOY) rainbow trout and 88% (436) were adult. On the second removal, 41% (25) were YOY and 60% (36) of the rainbow trout were adult. Of the total number of rainbow trout removed so far, 15% (84) were YOY and 85% (472) were adult.

No non-game fish were collected above site 10 (~1000m above barrier) in Leconte Creek. Mean gradient of sites 1-9 was <10% (8%), whereas, sites 10-27 had a mean gradient >10% (14%) (Figure 3). Non-game fish populations seemed to be unaffected by the electrofishing removals. Individual blacknose dace (241 and 232) and longnose dace (14 and 17) collected during the first and second removal were nearly identical and appeared to be unaffected by the electrofishing treatments.

We would like to thank Trout Unlimited and Tennessee Wildlife Resources Agency for their field assistance on the project. With the help of our cooperators, two more removals will be completed prior to brook trout reintroduction in October 1999.

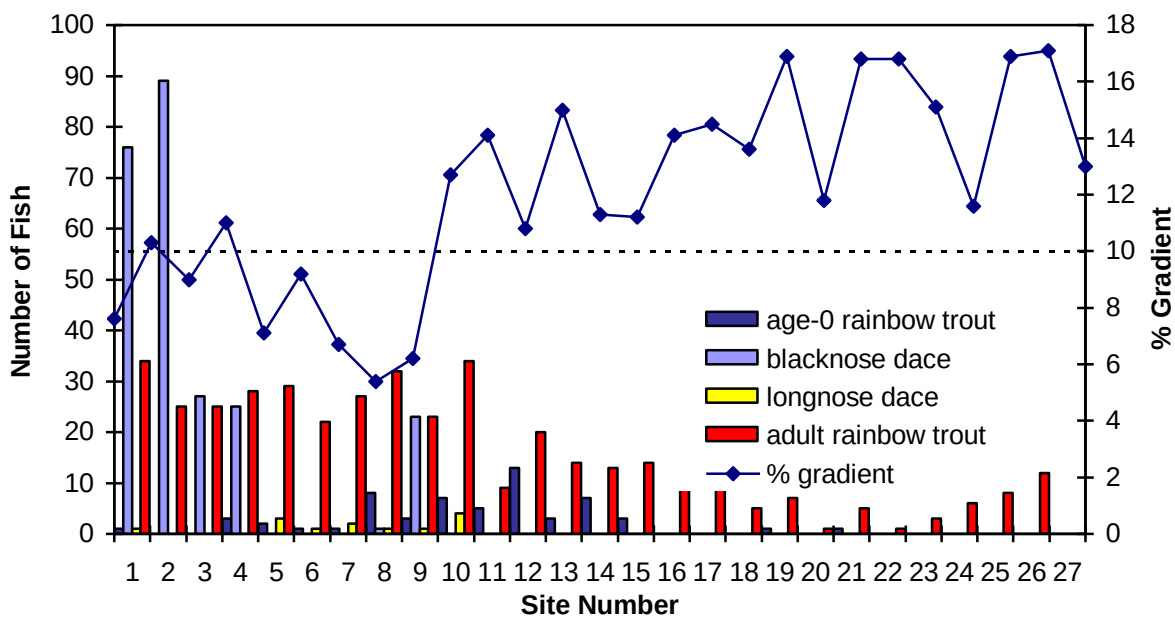


Figure 3. - Distribution of fishes and percent gradient of Leconte Creek sites 1-27.

Pilkey Creek

Pilkey Creek is a small, third order stream which flows into Fontana Reservoir in North Carolina. Surveys conducted in 1998 indicated there were no fish above a waterfall located approximately 300m above Fontana Reservoir. Electrofishing equipment, backpack mounted fish carriers, trucks, boats, and an all terrain vehicle were used to transfer 177 southern Appalachian strain brook

trout from upper Hazel Creek in August 1998. The brook trout were released into three locations on Pilkey Creek. There were 50 fish released at the first site, which is about 300 meters above Fontana Reservoir. Fifty-seven fish were released in the second site about 500m above the reservoir. There were 70 brook trout released in the third site, which is about 1,100m above Fontana Reservoir. Only 3 out of 180 brook trout (<2%) died during the 7.5-hour transfer process.

Technical support from North Carolina Wildlife Resources Commission and field assistance by Trout Unlimited volunteers made this project possible. Annual monitoring of Pilkey creek is scheduled to begin in September 1999 and will continue annually for several years.

"Mark-n-Move" Surveys

"Mark-n-move" surveys consist of three steps: (1) locating a potential fish barrier (i.e. waterfall or cascade); (2) adipose fin clipping (marking) and transferring rainbow trout, located above the barrier, to the stream section below the barrier (moving); (3) re-surveying the site the following year to see if marked rainbow trout were able to migrate back above the potential fish barrier. Electrofishing equipment is used to collect trout for marking and relocating below the potential barrier. If no marked fish are found above the barrier, plans for future restoration with electrofishing are developed.

Mark-n-move surveys were completed on Ash Camp Creek, Little Cataloochee Creek, and Ekaneetlee Creek. Ash Camp Creek is a second order stream in the East Prong of Little River watershed, Little Cataloochee Creek is a fourth order stream in the Cataloochee Creek watershed, and Ekaneetlee creek is a third order stream in the Eagle Creek watershed. Step three (described above) will be accomplished on these streams during the 1999 field season.

Large Stream Monitoring

Five of the Parks large stream systems were sampled in 1998: Abrams Creek, Cataloochee Creek, Hazel Creek, Little River, and Straight Fork. These systems provide a snap shot of the diversity of habitat and fish species diversity found across the Park. A comparison of current and historic US Fish and Wildlife Service (USFWS) monitoring data of species composition among these large stream sites has not significantly changed since the early 1970's. Species richness in GRSM large stream systems indicates excellent habitat and water quality conditions in nearly every stream. Species richness varied among large streams sampled (Figure 4). Elevation and habitat differences of each site account for most of the variability in species present in each site.

Sensitive species such as salmonids and dace showed no significant changes in abundance or condition during 1998. Brown and rainbow trout densities ranged from 0.8-2.8 fish/100m² (12.8-44.8 fish/mile) and 0.7-16.7 fish/100m² (11.2-267.2 fish/mile). Young-of-year (YOY) brown and rainbow trout comprised between 22-71% and 34-76% of each respective trout species in large stream samples indicating relatively strong year classes of both species during 1998. Annual changes in density and biomass indicate annual variation in these populations is greatly due to abiotic events such as droughts and floods. Young-of-year salmonid production is driven by large flood events (>1000 cfs).

Rainbow trout typically live 3-4 years in the Park, while an occasional 5-year old fish is collected. Historic data indicates annual mortality rates for rainbow trout in GRSM ranges from 60-70% from ages 1-4. Brown trout typically live 5-8 years with an occasional fish living to 12 years of age. Most rainbow trout average 4-10 inches with an occasional fish reaching 14 inches. Most brown trout average 6-14 inches with an occasional fish reaching 25 to 30 inches and 8-10 pounds. *For a detailed breakdown of fish sizes, numbers caught, and numbers per mile of stream, please refer to Appendix Table 2.*

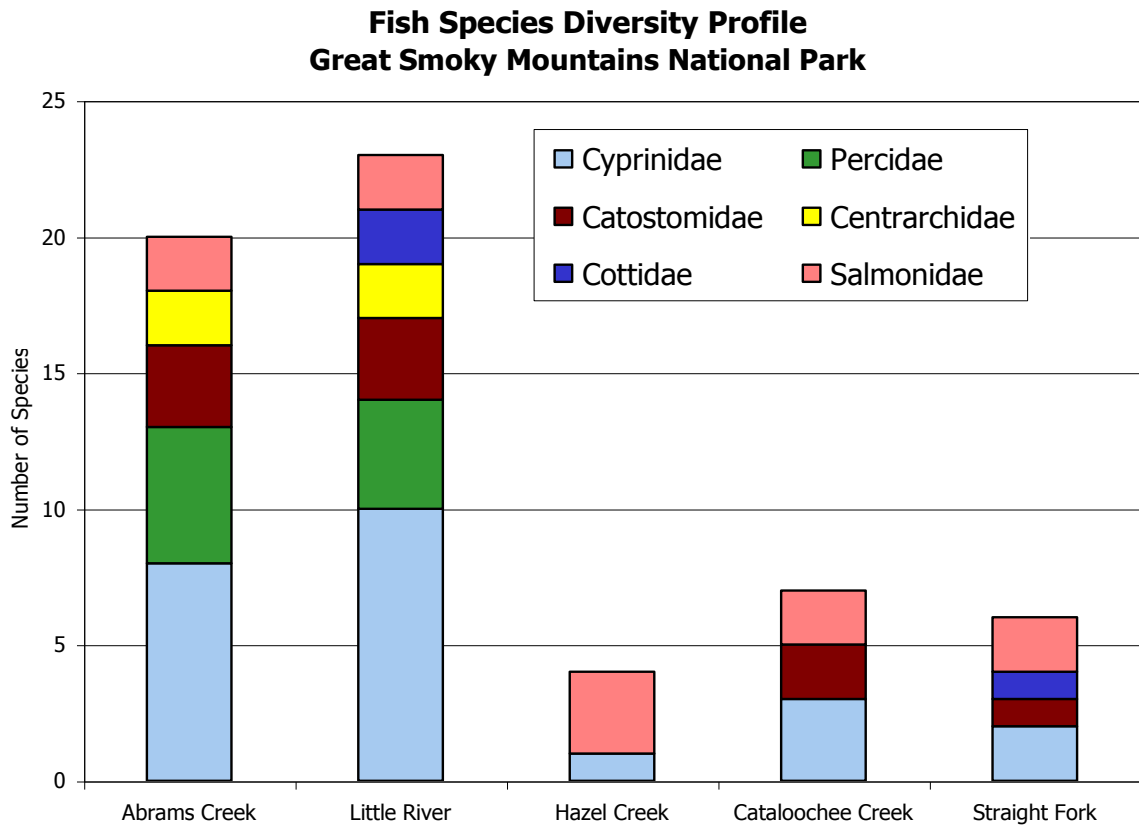


Figure 4. Fish species diversity from various large stream systems sampled in Great Smoky Mountains National Park during 1998. Species represented here only account for species found in the sites sampled during 1998 and do not reflect the entire stream system.

Smallmouth and rockbass densities declined slightly in site-1 of Abrams Creek during 1998, most likely due to the extremely low summer water levels (Figure 5). Both species demonstrated good reproduction in 1998 indicating that previous habitat limitations have been partially resolved. Sedimentation effects appeared to be improving over the lower reaches of Abrams Creek and should continue to improve as sediment is flushed out of the system. Data indicate that many of the riffle species (i.e. darters), which live in areas unaffected by sediment inputs, have remained relatively stable throughout the study period.

Non-game species are affected differently by large flood events depending upon the timing and magnitude of the flood and individual life history patterns. An excellent example of these interactions can be demonstrated using

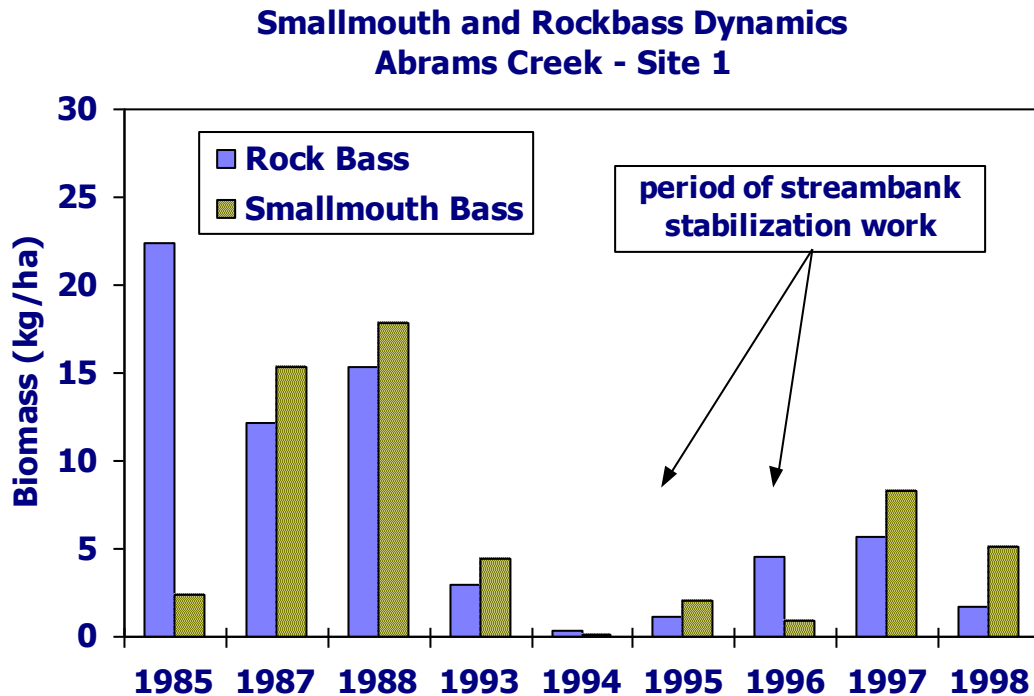


Figure 5. Summary of rock bass and smallmouth bass biomass from Abrams Creek large stream sampling efforts between 1985 and 1998. Samples were not conducted in 1986 and 1989-1992 due to inadequate funding and manpower. This site was added to the annual monitoring scheme in 1993 to assess streambank stabilization and water quality improvement efforts in Cades Cove.

Cataloochee Creek. During the severe drought years of 1986 to 1988, stoneroller populations increased dramatically while longnose dace populations declined (Figure 6). After severe floods of 1990 and 1991, longnose dace populations rebounded well while stonerollers began to decline. Between 1994 and 1998, heavy floods resulted in the continued decline of stonerollers while longnose dace continued to expand. Biologically, seasonably lower water levels and higher water temperatures, typically associated with droughts, tend to favor stonerollers. However, high water levels and cooler water temperatures favor longnose dace, which are typically a coldwater species associated with headwater environments. Therefore, the longnose dace and stoneroller dynamics observed between 1986 and 1998, given the water discharge and species biology, are not alarming.

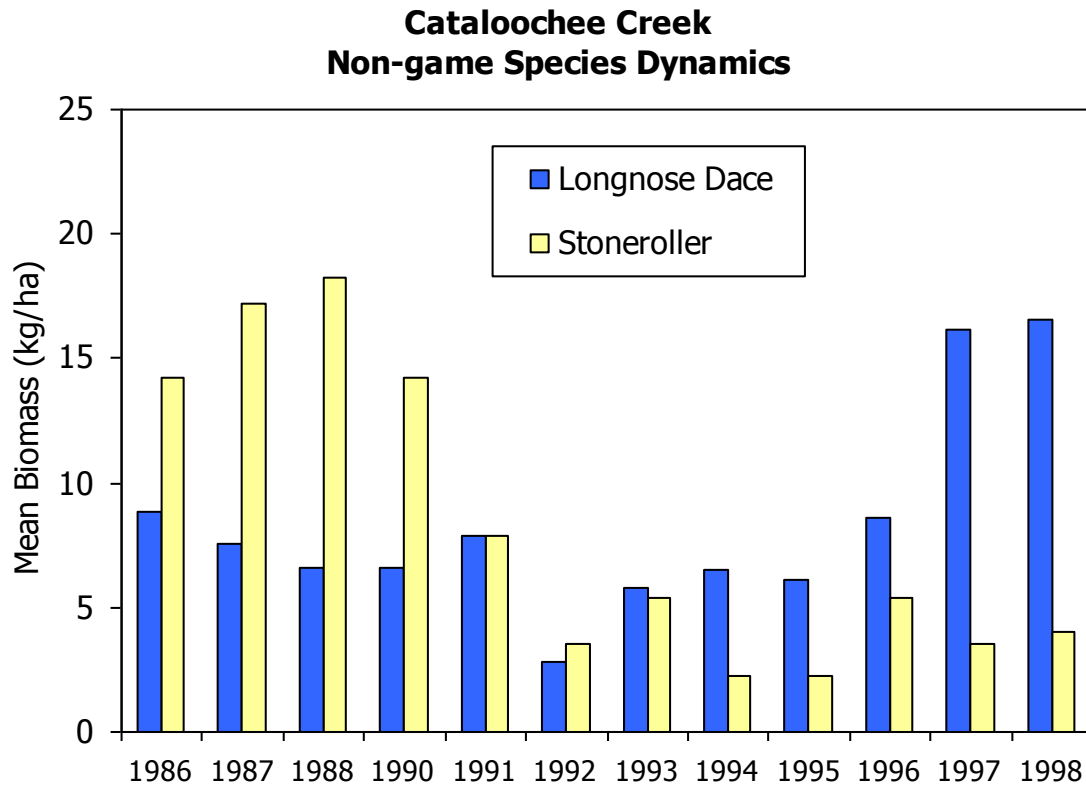


Figure 6. - Longnose dace and stoneroller dynamics on Cataloochee Creek from 1986 to 1998, Great Smoky Mountains National Park. No sample was collected on this site in 1989 due to severe rain events and subsequent high water levels.

Ranger Creel Reports

Ranger creel reports are an important tool, which helps define angler trends and use patterns throughout the entire Park. Ranger creel reports afford rangers an opportunity to contact anglers and other Park visitors and generate useful catch and harvest information throughout the Park. Local anglers are designated as those who live within 50 miles of the Park boundary while non-local anglers live outside this 50-mile boundary.

Rangers conducted 457 angler creel surveys during 1998 in GRSM (Figure 7) (Appendix Table 3). East and Lake District rangers collected 61% of the total number of surveys collected. Of the 457 anglers surveyed, 251 (55%) were local and 206 (45%) were non-local (Appendix Table 3). Except in the East District, where local anglers comprised 61% of those surveyed, most districts

were evenly split between local and non-local anglers. Overall, angler trends varied greatly by Ranger District.

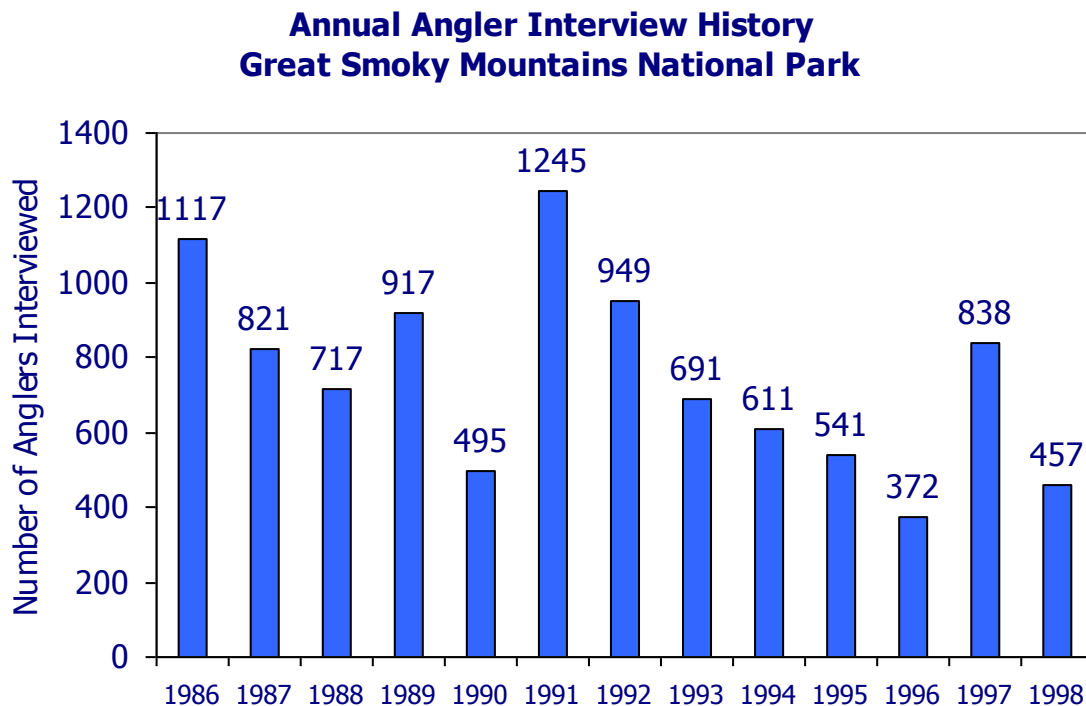


Figure 7. Number of anglers interviewed by GRSM law enforcement rangers during annual ranger creel surveys from 1986 to 1998.

In most districts, anglers fished between 1.6-3.0 hours/trip, although trips in the Lake District averaged 3.3-4.3 hours/trip. Parkwide, anglers caught 0.6 to 1.6 fish/hour. Catch rates of local anglers were higher than non-local anglers in each district except the East district, where non-local catch rates (2.2 fish/hr) were higher than local (1.7 fish/hr) catch rates.

Local anglers harvest most of the fish in the Park. In fact, 37% of the local anglers interviewed harvested 82% of the fish Parkwide during 1998. The percent of local anglers who harvest fish was highest in the East (41%) and Lake (51%) districts, indicating a majority of these anglers fish specifically to harvest. In the Lake District, 82% of the anglers interviewed (51% local and 31% non-local) harvested fish.

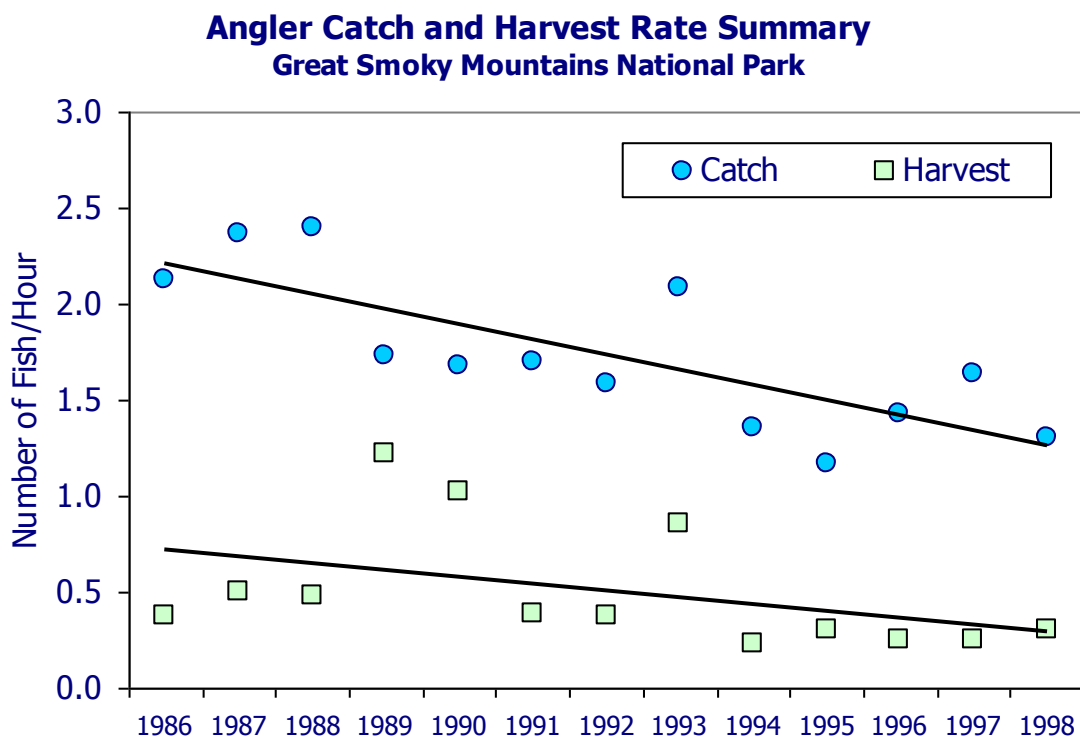


Figure 8. Angler catch and harvest rate summary from 1986 to 1998 in Great Smoky Mountains National Park.

Angler catch and harvest rates have declined roughly 40% between 1986 to 1998 (Figure 8). With the growing popularity of catch-and-release throughout the US, the declining harvest rates are not surprising. However, the reasons for the declining catch rates Parkwide are unclear. Long-term monitoring data from numerous sites throughout the Park indicate populations are variable from year to year, but do not show declines similar to angler catch rates.

For a breakdown of Parkwide ranger creel results by ranger district, please see Appendix Table 3.

Upcoming Projects

Major projects upcoming in 1999 include continuing brook trout restoration efforts on the Leconte Creek (Little River District) – Pilkey Creek (Lake District) project, additional mark-n-move surveys, and additional brook trout distribution surveys.

Two additional rainbow trout removals, using backpack electrofishing gear, will be required prior to brook trout reintroduction into Leconte Creek in October 1999. Brook trout will be collected from Greenbrier Creek in the Cosby Creek watershed and Indian Camp Creek. Pilkey Creek will be surveyed to monitor the success of brook trout reintroductions conducted in 1998.

Pending a grant, the 1999 fisheries crew will perform "mark-n-move" surveys on McGinty Creek and Gunter Fork Creek. Both McGinty Creek (third order) and Gunter Fork Creek (second order) are located in the Big Creek watershed. These streams are candidates for brook trout restoration, if barriers are shown to be effective against rainbow trout re-invasion.

The watershed selected for brook trout distribution surveys in 1999 is the Cataloochee Creek watershed (East District). Brook trout inventories will be conducted on all portions of the watershed and should be completed in 1999.

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