



United States Department of the Interior



NATIONAL PARK SERVICE
Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

IN REPLY REFER TO:

N16
xN22

November 23, 1992

Memorandum

To: Associate Director, Natural Resources, WASO
Attention: Gary Williams, I&M Coordinator

From: Superintendent, Great Smoky Mountains National Park

Subject: Annual Administrative Reports for Prototype Parks

The Annual Administrative Report for Great Smoky Mountains National Park, Reply Due: December 1, 1992, is attached. Comments concerning this submission should be directed to Joe Abrell at 615-436-1245.

Randall R. Pope

Attachment

cc:
Dominic Dottavio, SER (w/attachment)

Annual Administrative Report

Inventory and Monitoring Program

Great Smoky Mountains National Park

I. INTRODUCTION

The Inventory and Monitoring plan of Great Smoky Mountains National Park (GRSM) is based on a hierarchy of scale of biodiversity:

1. LANDSCAPE - vegetation, disturbance history, land use, geology, topography, etc.
2. ECOSYSTEM - spruce-fir, caves
3. WATERSHED - Noland Creek
4. COMMUNITY - aquatic biota, fisheries, exotic forest insects and diseases
5. SPECIES - rare, endemic, heroic, exotic, and bioindicator species

The objectives of the I&M program are to link the levels of the hierarchy with unifying themes:

1. Provide management with information crucial to making informed decisions
2. Incorporate data on perturbations such as air pollution and fire at every level from landscape to species
3. Integrate monitoring efforts with efforts to build and refine predictive models

The limited funding of the initial year (FY92) of the program restricted what could actually be accomplished. Of the 14 program elements specified in the GRSM plan, one (Data Management) was funded at 125% of full funding, one (Watershed Hydrology and Nutrient Cycling) at 57%, 9 were funded at 50% or less, and 3 received no funding (Table 1). This distribution of funds was the end product of a process of evaluation of critical needs in light of funding realities, and does not represent any conclusion by the I&M project managers that those projects not funded in the first year of the program are less important than others. Rather, the project managers felt certain programs could not be delayed because of the need for data continuity, while other programs were designed in such a way that a delay in implementation would not harm their integrity.

The emphasis in the first year was on filling permanent positions, purchasing expensive items such as vehicles, computers, data loggers and environmental monitors, and ensuring that the development of the comprehensive data management plan proceeded on schedule. Two permanent full-time positions were recruited and filled. A computer specialist was hired for the data management function, and a biological technician was hired for the rare plants project. Four 4-wheel drive vehicles were purchased to provide logistical support for the program. Two were purchased with WASO I&M funds and two with SERO I&M funds. Five makes of water quality monitors were evaluated for use in park streams. The most accurate and reliable model was selected and three were purchased for the large stream water quality

project. For the data management function a very fast and powerful computer was purchased along with thousands of dollars of software and peripherals.

*Table 1. Breakdown of expenditures for FY92, Great Smoky Mountains National Park Inventory and Monitoring Program.

Monitoring Program Element	WASO I&M Funding	Other Funding	Total
Data Management	75,000.00	0.00	75,000.00
Cave	0.00	0.00	0.00
Vegetation	0.00	0.00	0.00
Exotic Forest Insect and Disease	0.00	0.00	0.00
Watershed Aquatic Biota	3,100.00	18,715.00	21,815.00
Watershed Hydrology/ Nutrient Cycling	68,000.00	81,500.00	149,500.00
Large Stream Fisheries	3,100.00	42,012.00	45,112.00
Large Stream Macroinvertebrates	1,000.00	2,857.00	3,857.00
Large Stream Water Quality	30,000.00	5,715.00	35,715.00
Rare Plants	37,300.00	6,000.00	43,300.00
Rare Fish	0.00	1,150.00	1,150.00
Brook Trout	10,000.00	8,575.00	18,575.00
Black Bear Population	20,500.00	11,727.00	32,227.00
Cades Cove Deer Population	<u>2,000.00</u>	<u>1,023.00</u>	<u>3,023.00</u>
Totals	250,000.00	179,274.00	429,274.00

*Additional park base FTE of 0.4 was also directed toward this program in FY92 through a combination of tasks performed by secretarial staff, the Natural Resources Supervisor, and the Chief of Resources Management and Science. This amounted to \$16,733.00 of park base funding.

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Project Number: GRSM-N-083 (Monitoring brook trout range decline)

1. Project Title: Brook Trout Monitoring

2. Project Objectives:

a. Monitor current trends in brook trout distribution and decline.

b. Identify the factor(s) most influencing any decline in brook trout range.

3. Principal Investigators: Stephen E. Moore and Bart D. Carter
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738
(615) 436-1251

4. Estimated Funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	10,000	0	NPS-GRSM
b. NPS (Region)	2,360	.29	NPS-SERO
c. NPS (Park Base)	1,115	.08	NPS-GRSM
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	100	.05	SCA
	5,000	.33	TTU
g. Personal/Volunteer	0	.04	NPS, VIP, GRSM
Totals	\$18,575	.79	

5. Habitat Studied: Aquatic (lotic)

Family Studied: Salmonidae

Species Studied: Salvelinus fontinalis

6. (a) Progress:

Brook trout I&M funding for 1992 (\$10,000) was spent entirely on vehicle acquisition as part of the initial start-up phase of the I&M initiative. Support for the monitoring activities during 1992 was generated via a Cooperative Agreement with Tennessee Technical University (TTU), which provided personnel and transportation. The work was accomplished incidental to an NRPP funded project, without which it would not have been possible to accomplish in FY92.

(b) Significant findings:

During 1992, 21 streams containing brook trout populations were sampled to assess population structure and/or genetic integrity (Table 1). When compared to historical databases, five of these streams continue to be encroached upon by non-native salmonids (Figure 1). Of these five, the most dramatic decline in brook trout has been observed in Beech Creek where the population has decreased 49 percent since 1989. Furthermore, rainbow trout have established a viable population in the downstream-most 0.96 km of Dunn Creek, a stream occupied exclusively by brook trout in 1977 (Kelly et al. 1980).

For most streams, 1992 proved to be an exceptional year for brook trout reproduction. Also, in most of the streams monitored density values for brook trout were highly variable (Figure 2); however, almost half of the density in many cases was comprised of Young-of-the-Year (YOY) brook trout. With respect to biomass, brook trout populations in sympatric situations (Figure 3) had values ranging from 3.3 kg/ha to 30.8 kg/ha. The highest biomass values were observed in the seven streams containing allopatric brook trout populations (Figure 3). For these streams, values ranged from a high of 47.9 kg/ha to a low of 1.26 kg/ha. Differences in brook trout biomass in each stream are related to habitat suitability and/or different stages of rainbow trout encroachment.

Recent genetic information pertaining to brook trout in the Southeast has indicated that there is a distinct strain of brook trout indigenous only to the southern Appalachians. For this reason, it has become a top priority to genetically type as many brook trout populations as possible in order to get a better indication of the distribution of this native strain inside the park. During 1992, tissue samples from 21 populations of brook trout were sent to the University of Tennessee for analysis. Based on these analyses, 71 percent of the populations sampled were of the native genotype, 24 percent were hatchery x native genotype, and five percent were pure hatchery genotype (Figure 4). These data suggest

that there is in all likelihood a higher percentage of native strain brook trout in the park than once realized. This information will become very important in terms of reclamation efforts, which must be focused on native genotypes.

(c) Reports and publications during fiscal year:

None

(d) Status of any specimens collected:

Tissue samples for electrophoretic analysis were sent to the University of Tennessee and were destroyed in the analysis procedure.

7. Appendices

(a) Project Staffing:

	<u>FTE</u>
GS-11 Fishery Biologist	0.25
GS-7 Biological Technician	0.50
GS-5 Biological Technician	0.50

(b) Plans for next fiscal year:

Monitoring activities for FY93 will focus on brook trout distribution in one of the park's 45 watersheds and will document the following: (1) Physical, chemical and habitat data for the watershed; (2) calculation of population parameters on a stream-by-stream basis within the watershed; and (3) determination of downstream distribution of allopatric brook trout within the streams of the watershed as well as the upstream limits if possible.

Table 1. Listing of brook trout streams monitored during 1992.
(E.P. = East Prong, M.P. = Middle Prong, W.P. = West Prong)

<u>STREAM</u>	<u>WATERSHED</u>
Balsam Corner Creek (BCC)*	Oconaluftee River
Beech Creek (BC)+	Cataloochee Creek
Bunches Creek (BUC)+	Oconaluftee River
Camel Hump Creek (CHC)+	Pigeon River
Cooks Creek (CC)+	Cataloochee Creek
Dunn Creek (DC)+	M.P. Little Pigeon
Enloe Creek (EC)*	Oconaluftee River
Flat Creek (FC)+	Oconaluftee River
Hyatt Creek (HC)*	Oconaluftee River
Indian Camp Creek (ICC)+	Pigeon River
Marks Creek (MAR)*	M.P. Little River
Meigs Creek (MC)+	E.P. Little River
Pretty Hollow Creek (PHC)+	Cataloochee Creek
Raven Fork (RAV)*	Oconaluftee River
Road Prong (ROP)+	W.P. Little Pigeon
Rock Creek (ROC)+	Pigeon River
Sams Creek (SAM)+	M.P. Little River
Silers Creek (SC)+	E.P. Little River
Starkey Creek (STC)+	M.P. Little River
Straight Fork (STF)+	Oconaluftee River
Taywa Creek (TC)+	Oconaluftee River

* Denotes streams sampled for genetic analysis only, no population data was obtained.

+ Denotes streams sampled for genetic analysis and population structure.

() Identifying acronym assigned to each stream

LITERATURE CITED

Kelly, G.A., J.S. Griffith, R.D. Jones. 1980. Changes in distribution of trout in Great Smoky Mountains National Park, 1900-1977. USDI, Fish and Wildlife Service, Tech. paper #102, Washington, D.C. 10pp.

Figure 1. Fish community structure of brook trout streams vulnerable to invasion of non-native trout species

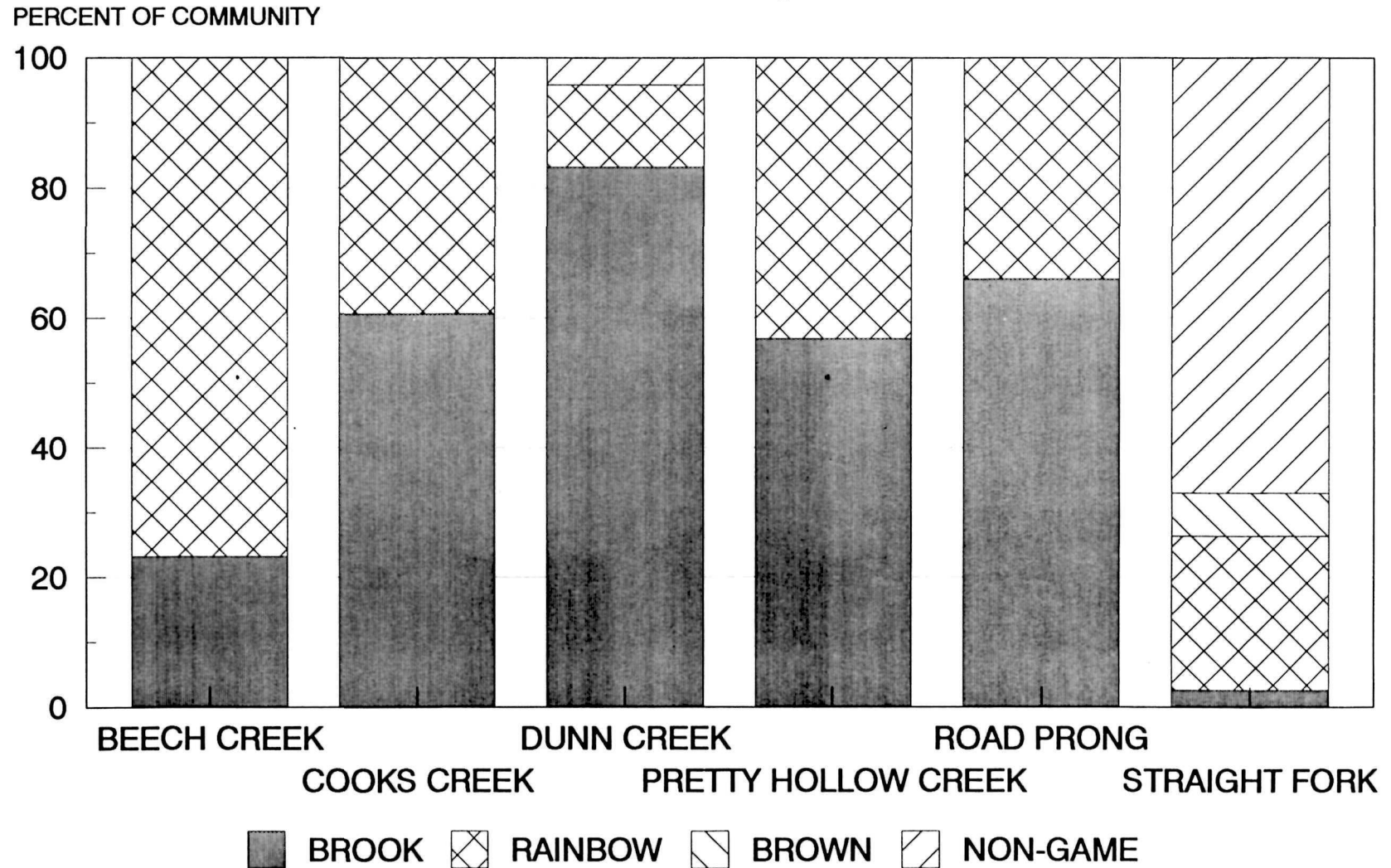
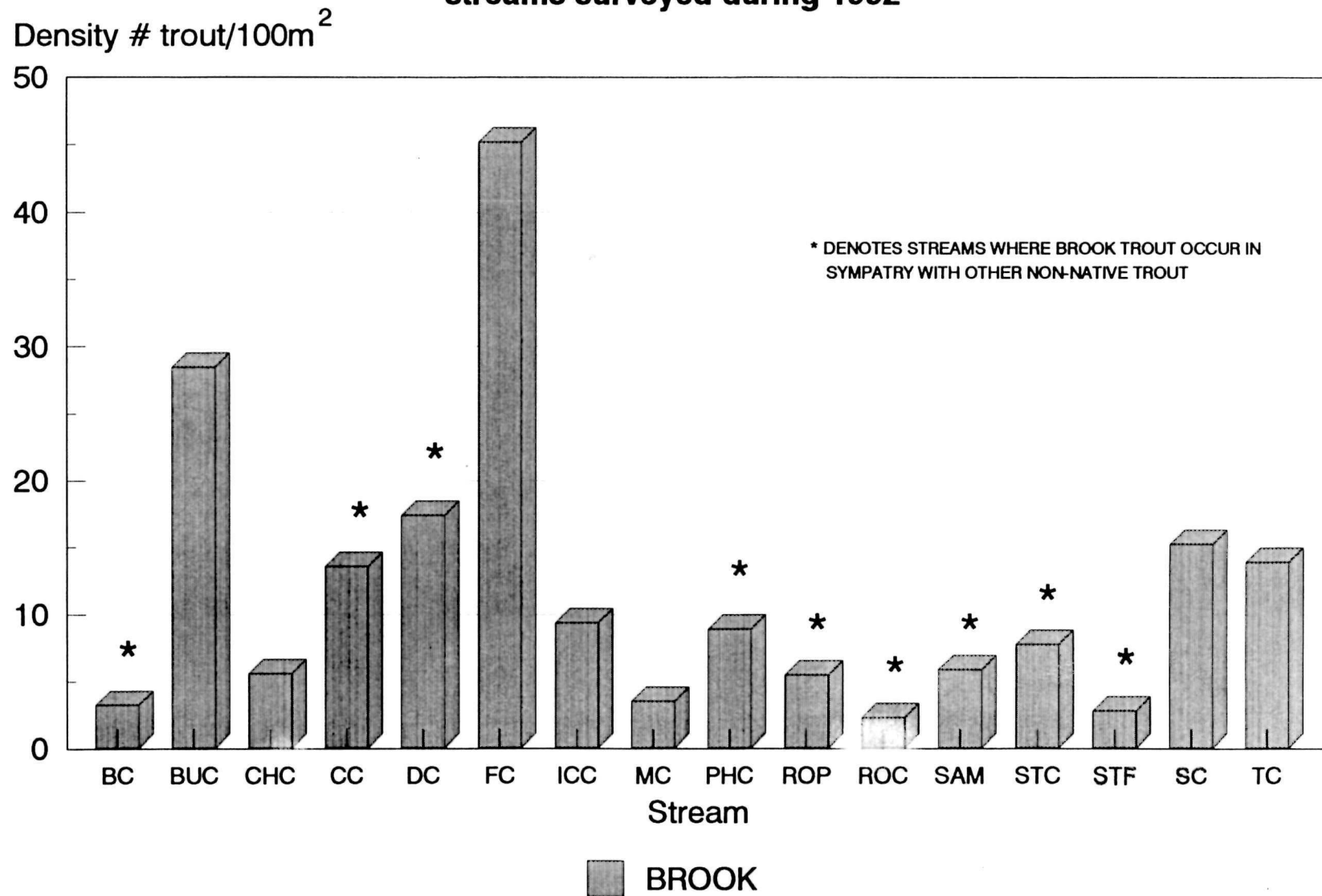
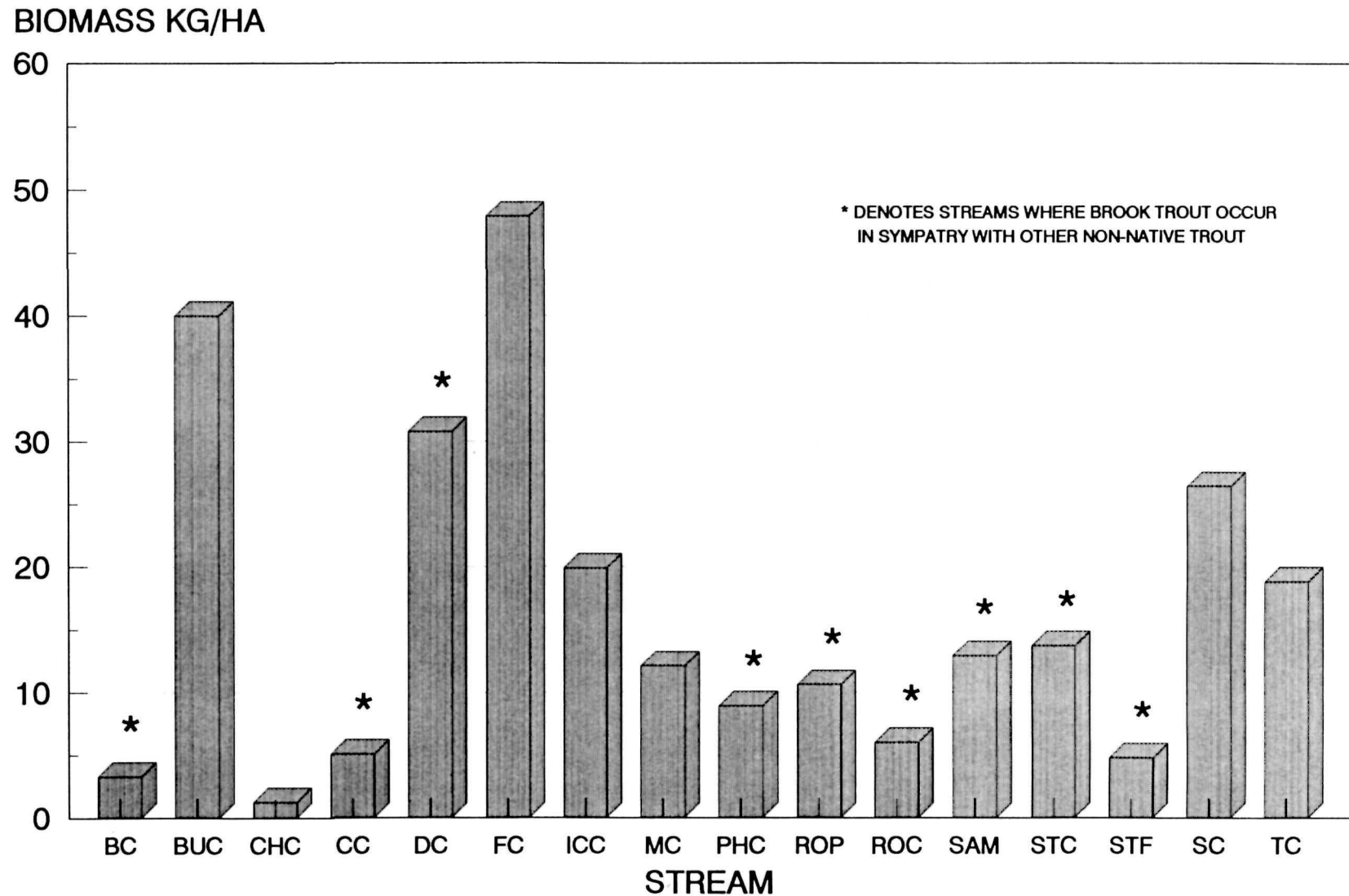


Figure 2. Estimated density of brook trout in streams surveyed during 1992⁺



+ REFER TO FIGURE 4 FOR STRAIN ANALYSIS OF EACH RESPECTIVE POPULATION

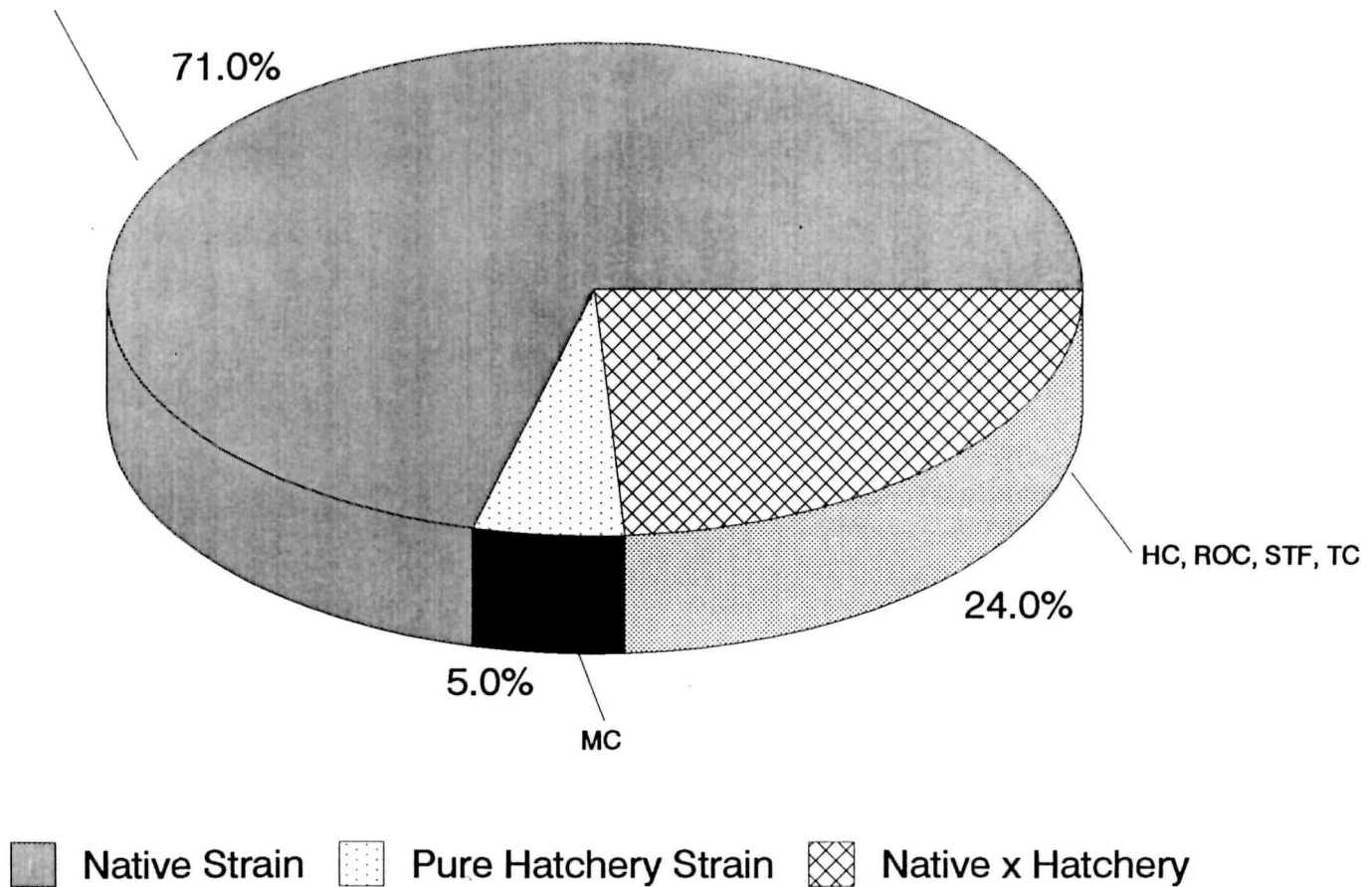
Figure 3. Estimated biomass of brook trout in streams monitored during 1992⁺



+ REFER TO FIGURE 4 FOR STRAIN ANALYSIS OF EACH RESPECTIVE POPULATION

Figure 4. Breakdown of streams containing native, hatchery, or hybrid populations of brook trout from samples taken in 1992

BCC, BC, BUC, CHC, CC, EC, FC,
HC, ICC, MAR, PHC, RAV, ROP,
SAM, STC, SC



UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-010 (Sport fishery monitoring)
GRSM-N-012 (Non-game fishery monitoring)

1. Project Title: Large Stream Fisheries Monitoring

2. Project Objectives:

a. Monitor annual variation in game and non-game fish populations.

b. Monitor physical, chemical, and biotic parameters that may influence fisheries in the park.

c. Monitor the extent of angler use of the fishery resource in the GRSM.

3. Principal Investigators: Stephen E. Moore and Bart D. Carter
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738
(615) 436-1251

4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	3,100	0	NPS-GRSM
b. NPS (Region)	15,247	.43	NPS-SERO
c. NPS (Park Base)	2,255	.12	NPS-GRSM
d. Other Fed. Agency	21,885	.09	USFS
e. State/Local Agency	2,000	.13	NCWRC, TWRA
f. Non-profit Inst.	625	.10	U.T., SCA
g. Personal/Volunteer	0	.26	T.U., TTU, VPI, HTC

Totals \$45,112 1.13

5. Habitat Studied: Aquatic (lotic)

Family Studied: (See Table 1)

Species Studied: (See Table 1)

6. (a) Progress:

WASO I&M funds for FY92 were expended for supplies and personnel. However, utilizing interagency agreements and volunteers the large stream program outlined in the park's long-term monitoring plan was partially completed (see #4). Annual samples were completed in the two streams (Little River and Cataloochee Creek) which have been sampled since 1986.

(b) Significant findings:

During 1992, large stream surveys were conducted in Little River and Cataloochee Creek. Twelve species were collected in Little River and six in Cataloochee Creek (Table 1).

Biomass and density values appeared higher than previous years as both systems are recovering from a drought in 1988 and flooding in 1989 and 1990 (Figures 1-2). On average, in 1992 Little River supported an estimated 35.6 kg/ha (45.2%) of rainbow trout, 7.9 kg/ha (10%) of brown trout, and a combined non-game weight of 35.2 kg/ha (44.7%). In Cataloochee Creek, rainbow trout comprised 19.4 kg/ha (46.2%) of the biomass, and brown trout and combined non-game weight 11.9 kg/ha (28.3%) and 10.7 kg/ha (25.5%), respectively. Relative biomass differences in brown trout and non-game species between the two streams can be attributed to habitat related factors for brown trout (lower frequency of preferred habitat in Little River) and lower non-game diversity in Cataloochee Creek.

Density values for both streams for most species were slightly lower than 1991 (Figures 1-2). However, the rainbow trout value in Little River and brown trout value in Cataloochee Creek were slightly higher than in 1991. This in all likelihood is attributed to the outstanding recruitment year observed for each respective species in each stream.

Age structure of the trout populations in both streams (figure 3) was determined from scale samples. The information obtained from these samples has indicated rainbow trout rarely exceed three years of age and generally do not obtain average lengths in excess of 260 mm. However, one rainbow trout was collected in Cataloochee Creek that was 471 mm in length and was four years old, the longest sampled in the park since 1986. Brown trout, being longer lived, reached ages of eight years and obtained lengths in excess of 508 mm in Cataloochee Creek. In Little River, the oldest brown trout sampled was four years of age and 420 mm in length.

In an attempt to monitor individual fish growth and movements in Little River, visual implant tags (VIT) were used to individually identify 199 rainbow trout and three brown trout in June 1992. Although low in number (4.4%), tag returns in September 1992 have provided beneficial insights into movement patterns and absolute growth of rainbow trout (Table 2). Since none of the tagged brown trout were recovered in 1992, comparisons between the two species could not be made.

(c) Reports and publications during fiscal year:

None

(d) Status of any specimens collected:

None were collected.

7. Appendices

(a) Project Staffing:

<u>NPS</u>	<u>FTE</u>
GS-11 Fishery Biologist	0.10
GS-7 Biological Technician	0.20
GS-5 Biological Technician	0.20
GS-4 Biological Technician	0.20
 <u>OTHER</u>	
Other Fed. Agency	0.09
State/local Agency	0.15
Non-Profit Inst.	0.10
Personal/Volunteer	0.25

(b) Plans for next fiscal year:

Annual sampling will be conducted on Little River and Cataloochee Creek. Individual length and weight data will be collected for all game fish. The total number, weight, maximum and minimum lengths will be collected for each non-game fish species. Physical and chemical data will be collected at each sample site. A portion of the FY93 funding will be used to purchase a vehicle for the project.

Table 1. Listing of fishes collected during 1992 large stream monitoring activities.

<u>STREAM</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>COMMON NAME</u>
Cataloochee Creek	Salmonidae	<u>Oncorhynchus mykiss</u>	Rainbow trout
	Salmonidae	<u>Salmo trutta</u>	Brown trout
	Cyprinidae	<u>Campostoma anomalum</u>	Stoneroller
	Cyprinidae	<u>Rhinichthys atratulus</u>	Blacknose dace
	Cyprinidae	<u>Rhinichthys cataractae</u>	Longnose dace
	Catostomidae	<u>Hypentelium nigricans</u>	Northern hogsucker
Little River	Salmonidae	<u>Onchorhynchus mykiss</u>	Rainbow trout
	Salmonidae	<u>Salmo trutta</u>	Brown trout
	Cyprinidae	<u>Campostoma anomalum</u>	Stoneroller
	Cyprinidae	<u>Nocomis micropogon</u>	River chub
	Cyprinidae	<u>Luxilus coccogenus</u>	Warpaint shiner
	Cyprinidae	<u>Notropis leuciodus</u>	Tennessee shiner
	Cyprinidae	<u>Notropis rubricroceus</u>	Saffron shiner
	Cyprinidae	<u>Rhinichthys atratulus</u>	Blacknose dace
	Cyprinidae	<u>Rhinichthys cataractae</u>	Longnose dace
	Catostomidae	<u>Catostomus commersoni</u>	White sucker
	Catostomidae	<u>Hypentilium nigricans</u>	Northern hogsucker
	Cottidae	<u>Cottus bairdi</u>	Mottled sculpin

Table 2. Mark/recapture results from VIT tagged rainbow trout in Little River, June-September 1992.

<u>TAG#</u>	<u>TL(JUNE)</u>	<u>WT (JUNE)</u>	<u>TL(SEPT)</u>	<u>WT(SEPT)</u>	<u>MOVEMENT*</u>
J66	162.0	42.3	163.0	37.6	Down 25m
J68	175.0	49.8	182.0	58.3	Down 25m
J77	189.0	65.1	198.0	72.1	Down 15m
J50	186.0	63.9	192.0	59.4	Down 15m
J52	174.0	48.3	183.0	48.6	Down 12m

* Down = downstream, Up = upstream. Distance moved is an approximation based on the difference in length between habitat units at time of tagging and recapture.

**Figure 1. Mean biomass and density values for
game and non-game fish collected during
monitoring activities in Little River 1986-92**

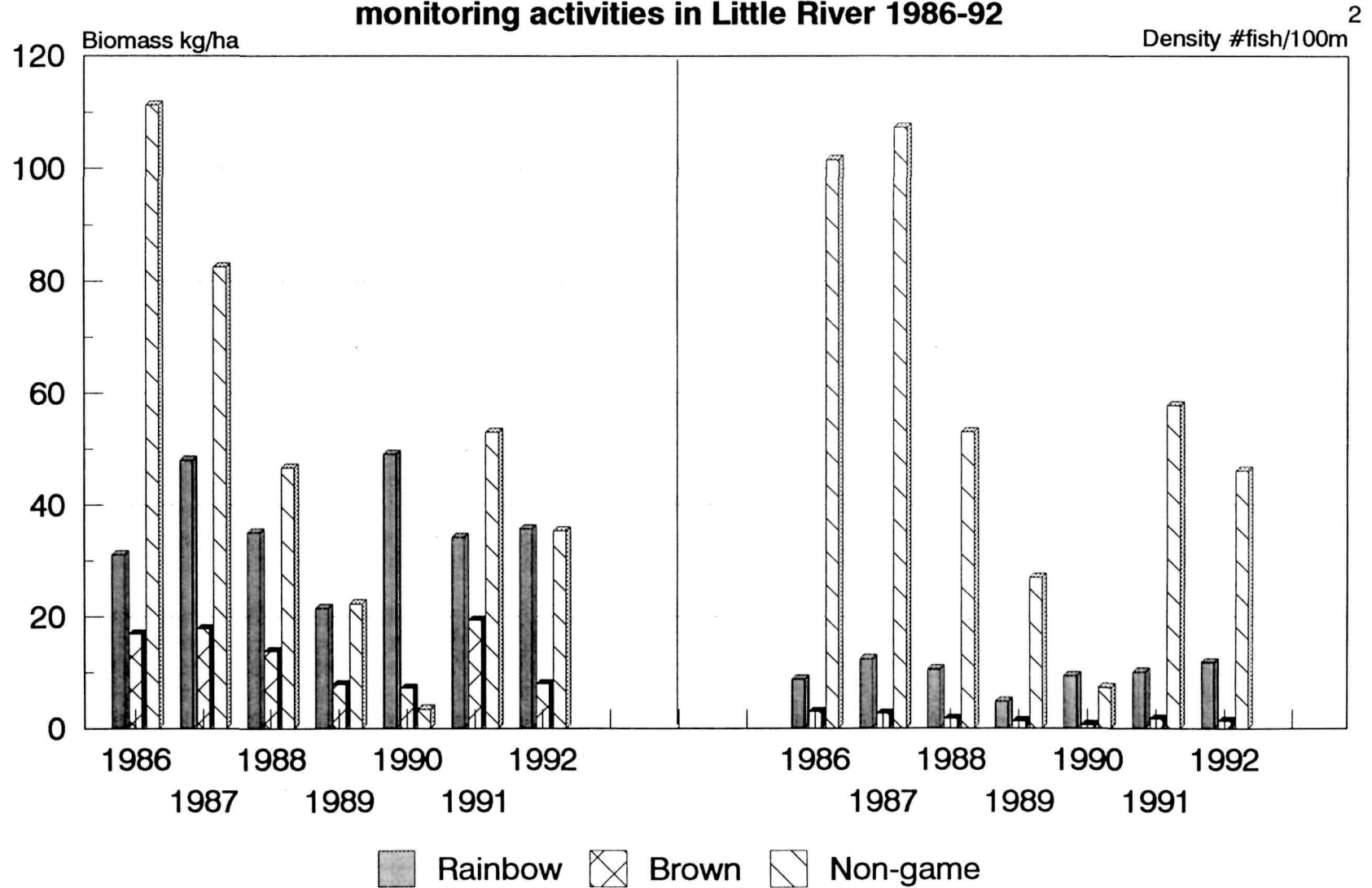
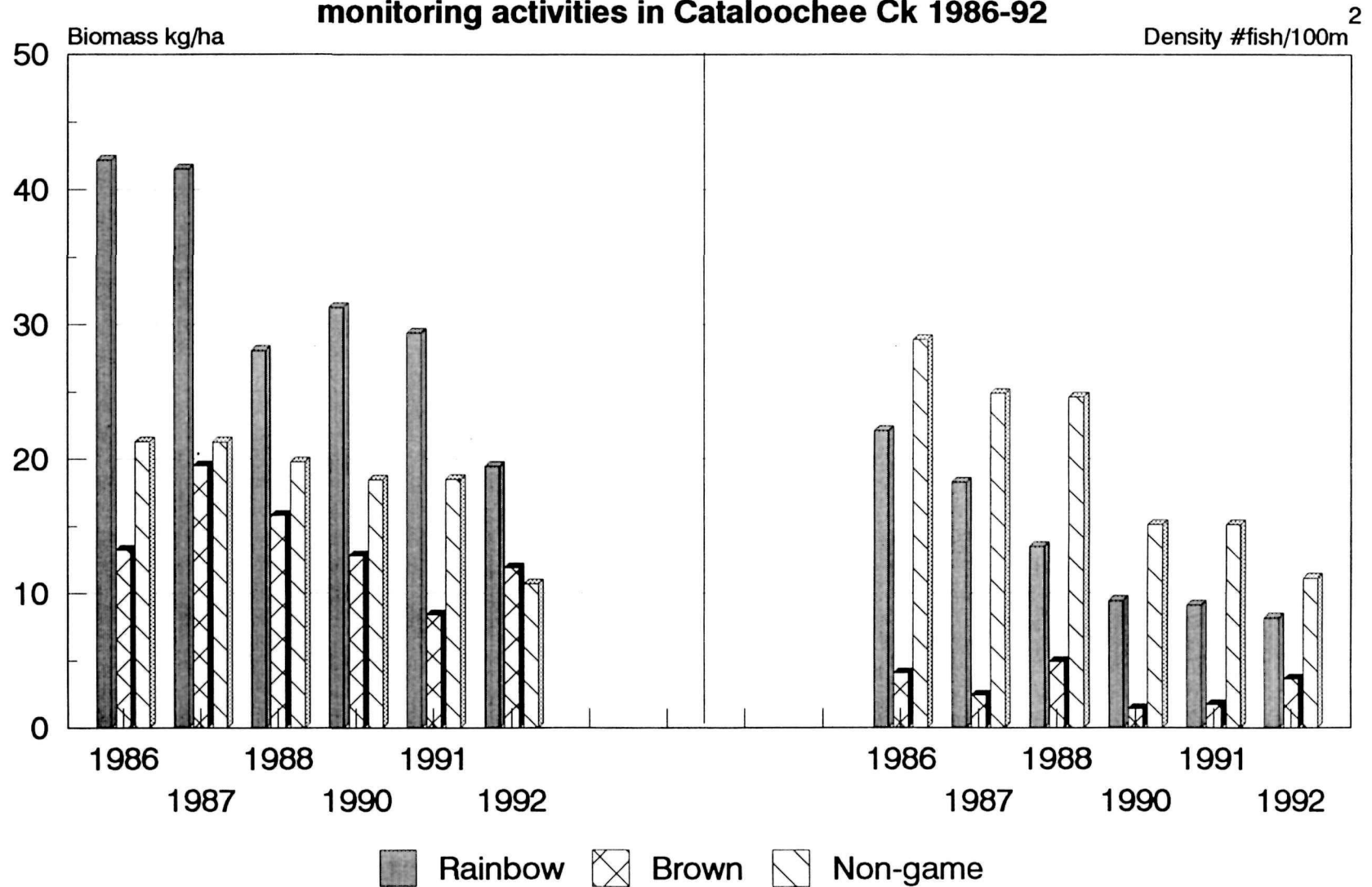
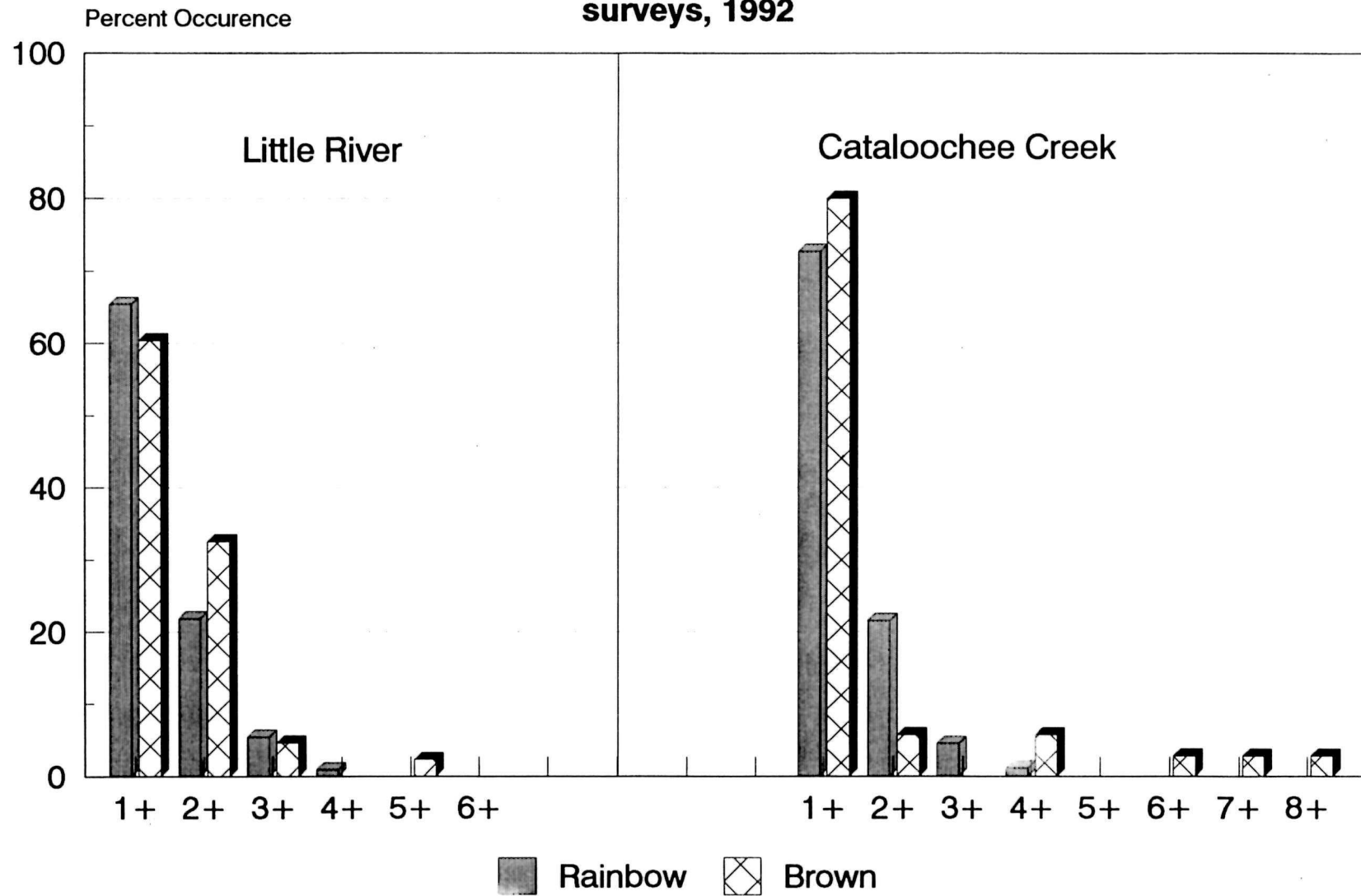


Figure 2. Mean biomass and density values for game and non-game fish collected during monitoring activities in Cataloochee Ck 1986-92



**Figure 3. Age structure of rainbow
and brown trout collected during large stream
surveys, 1992**



UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT

(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Number: GRSM-N-137

1. Project Title: Black bear Population Monitoring

2. Project Objectives:

a. To monitor the relative density, distribution, and activities of black bears in Great Smoky Mountains National Park.

b. To monitor the availability and distribution of hard mast in Great Smoky Mountains National Park.

3. Principal Investigator: E. Kim DeLozier
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Rd.
Gatlinburg, TN 37738
(615) 436-1248

4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	20,500	0	NPS-GRSM
b. NPS (Region)	10,783	0	NRPP
c. NPS (Park Base)	868	0.56	GRSM
d. Other Fed. Agency	76	0.01	USFWS
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0.08	GRSM
Totals	\$32,227	0.65	

5. Ecosystem studied: Southern Appalachians

Orders studied: Carnivora
Juglandales
Fagales

Families studied: Ursidae
Juglandaceae
Fagaceae

Species (or Genera) studied: Ursus americanus
Quercus spp.
Carya spp.
Juglans spp.
Fagus grandifolia

6. (a) Progress:

Bait station surveys are used throughout the southeast and other parts of the country to monitor black bear populations. The bait station survey was developed as part of a black bear research project conducted by The University of Tennessee in the northwest section of GRSM. Bait station visitation rates significantly correlated with annual Jolly-Seber black bear density estimates. Although bait station surveys do not determine density estimates, they are reliable for monitoring the relative density, distribution, and activities of black bears. Black bear bait station surveys have been conducted throughout GRSM since 1981. Parkwide percentage visitation has ranged from 34.0% in 1981 to 70.2% in 1989. Results of the survey are used to assess the status on bears in both the park and the southern Appalachian region.

The availability and distribution of fall foods, particularly hard mast, is a primary factor regulating the density of black bears in GRSM. Annual variations in hard mast production significantly affect food habits, movements, habitat preference, and reproduction of black bears. The park and the states of Georgia, North Carolina and Tennessee utilize tree count surveys during August/September for determining the availability and distribution of hard mast. This annual survey was incorporated into the park's overall monitoring program in 1977. Results from the hard mast survey are compared with data from adjacent land management agencies to determine an overall estimate of mast production in the southern Appalachian region. Hard mast survey data also provides information to adequately assess the status and productivity of the park's bear population.

The 1992 black bear bait station survey was conducted from July 9 to July 29. Nineteen bait station routes were established along 338.1 km (211.3 mi) of trails and roads. A total of 416 bait stations were established; however, 12 bait stations could not be relocated. Therefore, only 404 bait stations were included in analyses. Overall sampling density was one bait station/5.1 km². Data analysis was completed and an annual progress report was prepared.

The 1992 hard mast survey was conducted from August 13 to August 29. Thirty-four routes were established along 217.6 km (136 mi.) of trails and roads. A total of 272 trees, representing seven mast producing species, were surveyed for an overall sampling density of one tree/7.6 km². Data analysis was completed and an annual progress report was prepared.

(b) Significant findings:

The 1992 black bear bait station survey indicates an increase in the GRSM bear population. Parkwide percentage visitation was 66.3%, the second highest rate since the survey was initiated in 1981. Percentage visitation increased significantly in the eastern half of the park and decreased slightly in the western half. The increase in parkwide bait station visitation may be due to the distribution and/or shortage of natural bear foods. There was very little production of berries and other soft mast in the park. Because of the lack of natural foods, bears may have been more mobile, which may have increased bait station visitation rates. The increase in the bear population and scarcity of natural foods also has resulted in a significant increase in the number of bears causing problems in developed areas both within the park and in areas adjacent to the park.

The 1992 hard mast survey suggests a failure in hard mast production in the park. Only 46.3% (n=126) of the trees surveyed produced hard mast. Hard mast indices for white oaks, red oaks and beech were 1.65, 2.05 and 1.80, respectively. Index values for all oaks combined was 1.88. These index ratings indicate poor mast production according to the Whitehead scale. Mast production in North Carolina (total oaks index=1.99) was slightly higher than Tennessee (total oaks index=1.77), although both indices also indicate poor production. The scarcity of hard mast in GRSM has forced many bears to forage long distances outside the park, which has resulted in an increase in roadkills, hunter kills and bear related complaints surrounding the park. Scarcity of both summer foods (soft mast) and fall foods (hard mast) will likely result in high mortality for cub and yearling bears, low reproduction for adult female bears, and a decline in the park's bear population.

(c) Reports and publications during fiscal year:

Annual progress reports were prepared for both the black bear bait station and hard mast surveys. A copy of the bait station data also was sent to Mr. Ken Johnson, research associate at The University of Tennessee. Mr. Johnson prepares an annual progress report for the southern Appalachian region. He is also preparing a Wildlife Monograph summarizing the black bear bait station survey in

the southern Appalachian region. A copy of the hard mast data was sent to the Tennessee Wildlife Resources Agency.

(d) Status of any specimens collected:

No specimens were collected.

7. Appendices

(a) Project Staffing:

<u>NPS</u>	<u>FTE</u>
GS-11 Wildlife Biologist	0.02
GS-7 Wildlife Biological Technician	0.11
GS-6 Wildlife Biological Technician (2)	0.11
GS-5 Park Ranger	0.01
WG-5 Wildlife Handler (3)	0.22
 <u>OTHERS</u>	
Student Conservation Assistant (4)	0.10
Volunteers (3)	0.08
 Total	 0.65

(b) Plans for next fiscal year:

The hard mast and bait station surveys will be conducted in FY 93 to monitor the availability and distribution of hard mast and the relative density, distribution and activities of black bears in Great Smoky Mountains National Park.

Table 1. Black bear bait-station survey results for Great Smoky Mountains National Park, 1992.

Bait-line Location	Number of sites	Number Visited by Bears	Percent Visitation
<u>Cataloochee-Balsam Mountain Section</u>			
Mt. Sterling/Pretty Hollow Gap/Cataloochee	17	13	76.5
Cataloochee Divide	22	12	54.5
Heintooga/Round ^a Bottom Road	27 (5) ^b	21	77.8
AT/Bradley Fork/ Smokemont	18 (1)	10	55.6
Subtotal	84 (6)	56	66.7
<u>Cosby/Mt. Leconte Section</u>			
Big Creek/Low Gap/ Cosby	20	12	60.0
Greenbriar/Low Elev. Tr./Texas Creek	33	27	81.8
AT/Mt. Leconte/Trillium Gap/Greenbriar	26	21	80.8
Subtotal	79	60	75.9
<u>Deep Creek/Fontana 20 Mile Section</u>			
Noland Divide Trail	21 (1)	10	47.6
Silers/Welch Ridge/ Hazel Creek	34	19	55.9
20-Mile/Wolf Ridge/ Gregory/Birch Spring Loop	32 (2)	13	40.6
Eagle Creek	16	6	37.5

Table 1. Continued.

Bait-line Location	Number of sites	Number Visited by Bears	Percent Visitation
Clingman's Dome/ ^c Silers	10	1	10.0
Subtotal	113 (3)	49	43.4
<u>Elkmont/Cades Cove Section</u>			
Cove Mountain Trail	16	15	93.8
Sugarland Mountain Trail	22	15	68.2
Silers/Miry Ridge/ Elkmont	21	16	76.2
Bote Mountain/Spence/ Russell/Anthony Creek	27	20	74.1
Hannah Mountain/ Rabbit Creek	21 (1)	19	90.5
Sam's Gap/Gregory Bald	8 (1)	7	87.5
Rich Mountain Road	13 (1)	11	84.6
Clingman's Dome/ ^c Silers	10	1	10.0
Subtotal	138 (3)	104	75.4
Totals	404 (12)	268	66.3

^aBait sites on this line were checked for bear visits after 7 nights.

^bNumber in parenthesis indicate the number of sites that were stolen or not found; these sites were not included in determining percent visitation.

^cThis line ran the boundary between two sections and was used for subtotals for both surveys; duplication was omitted in totals.

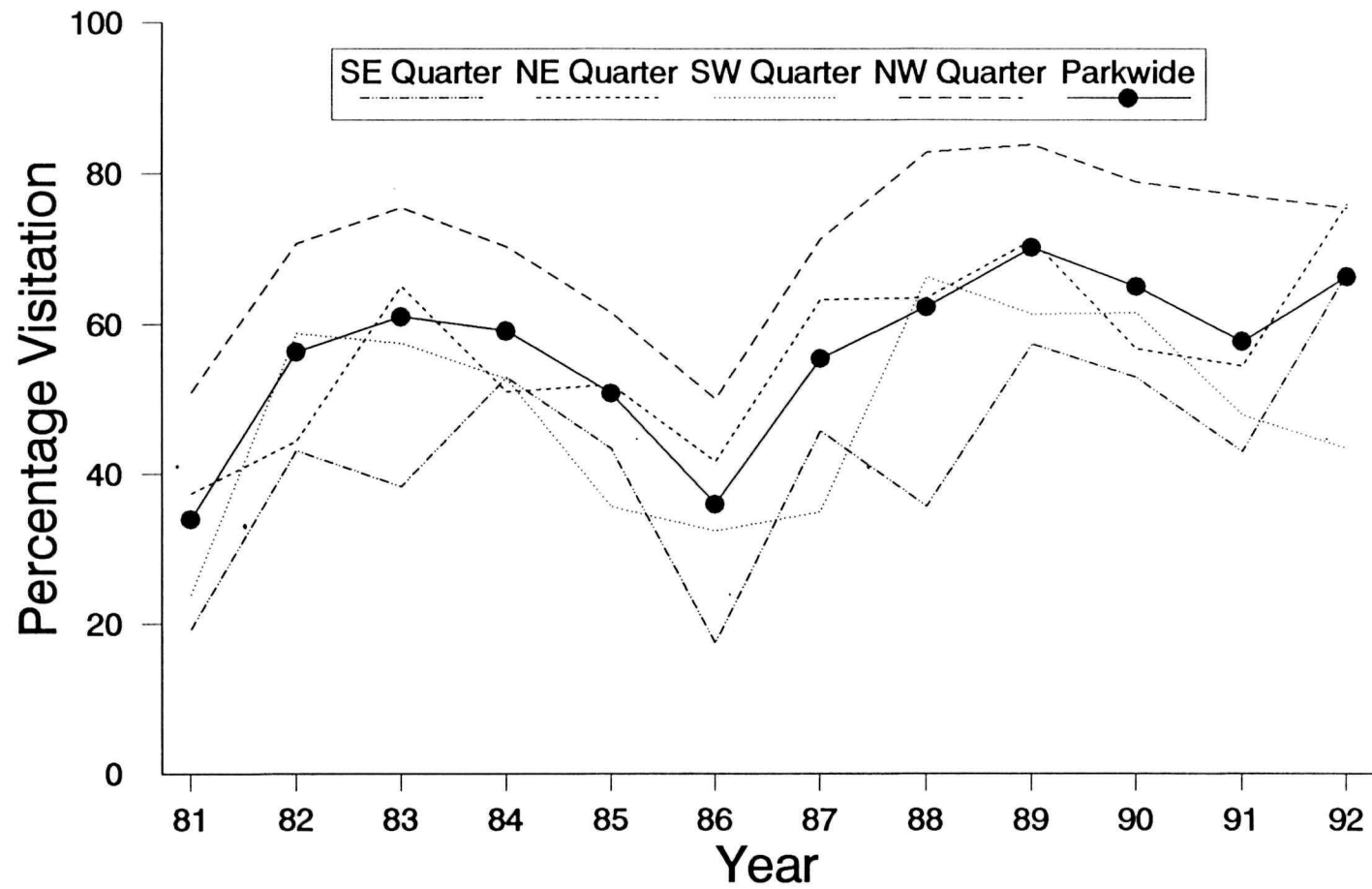


Figure 1. Black bear bait station survey trend lines for Great Smoky Mountains National Park, 1981-1992.

Table 2. Hard mast index, by route and tree group, for Great Smoky Mountains National Park, 1992.

ROUTE	WHITE OAK	N	RED OAK	N	TOTAL OAK	N	HICKORY	N	PECAN	N	WALNUT	N	BEECH	N
Chilhowee														
#1 Hwy 129	0.20	5	2.67	3	1.13	8	.	0	.	0	.	0	.	0
#2 Bunker Hill Rd	1.00	4	1.50	4	1.25	8	.	0	.	0	.	0	.	0
#7 Foothills Prkw	3.00	2	3.50	6	3.38	8	.	0	.	0	.	0	.	0
#8 Rabbit Ck Tr	1.40	5	1.00	3	1.25	8	.	0	.	0	.	0	.	0
Subtotal	1.13	16	2.38	16	1.75	32	.	0	.	0	.	0	.	0
Cades Cove														
#3 Rich Mtn Rd	1.60	5	1.33	3	1.50	8	.	0	.	0	.	0	.	0
#4 Cades Cove Lp	1.50	6	3.00	2	1.88	8	.	0	.	0	.	0	.	0
#5 Bote Mtn	1.25	4	1.75	4	1.50	8	.	0	.	0	.	0	.	0
#6 Gregory Bald Tr	2.80	5	2.00	3	2.50	8	.	0	.	0	.	0	.	0
Subtotal	1.80	20	1.92	12	1.84	32	.	0	.	0	.	0	.	0
Little River														
#10 Chestnut Top Tr	1.00	4	1.25	4	1.13	8	.	0	.	0	.	0	.	0
#11 Curry Mtn Tr	1.67	3	1.00	5	1.25	8	.	0	.	0	.	0	.	0
#12 Cove Mtn Tr	2.67	6	1.50	2	2.38	8	.	0	.	0	.	0	.	0
#13 Two-mile/Bullhead Tr	2.67	3	2.60	5	2.63	8	.	0	.	0	.	0	.	0
#15 Sugarland Mtn Tr	2.20	5	1.33	3	1.88	8	.	0	.	0	.	0	.	0
Subtotal	2.10	21	1.58	19	1.85	40	.	0	.	0	.	0	.	0
Cosby														
#16 Greenbriar Pinnacle Tr	1.25	4	2.75	4	2.00	8	.	0	.	0	.	0	.	0
#17 Low Gap Tr	.	0	2.00	8	2.00	8	.	0	.	0	.	0	.	0
#18 Lower Mt Cammerer Tr	1.50	6	1.00	2	1.38	8	.	0	.	0	.	0	.	0
#19 Grapeyard Rdg Tr	1.20	5	1.00	3	1.13	8	.	0	.	0	.	0	.	0
Subtotal	1.33	15	1.88	17	1.63	32	.	0	.	0	.	0	.	0
Subtotal (Tennessee)	1.64	72	1.92	64	1.77	136	.	0	.	0	.	0	.	0

Table 2. Continued.

ROUTE	WHITE OAK	N	RED OAK	N	TOTAL OAK	N	HICKORY	N	PECAN	N	WALNUT	N	BEECH	N
Cataloochee														
#22 Pretty Hollow Gap Tr	.	0	2.43	7	2.43	7	.	0	.	0	.	0	1.00	1
#23 Cataloochee Divide	.	0	3.25	8	3.25	8	.	0	.	0	.	0	.	0
#24 Cataloochee Loop Rd	2.40	5	3.00	3	2.63	8	.	0	.	0	.	0	.	0
#25 NC284	1.60	5	2.33	3	1.88	8	.	0	.	0	.	0	.	0
Subtotal	2.00	10	2.81	21	2.55	31	.	0	.	0	.	0	1.00	1
Oconaluftee														
#26 Heintooga-Round Rd	.	0	1.50	4	1.50	4	.	0	.	0	.	0	2.00	4
#27 US441/NC	1.00	1	1.43	7	1.38	8	.	0	.	0	.	0	.	0
#28 Kephart Prong Tr	.	0	2.75	8	2.75	8	.	0	.	0	.	0	.	0
#30 Thomas Divide Tr	1.86	7	4.00	1	2.13	8	.	0	.	0	.	0	.	0
#40 Heintooga-Round Rd	.	0	1.38	8	1.38	8	.	0	.	0	.	0	.	0
Subtotal	1.75	8	1.89	28	1.86	36	.	0	.	0	.	0	2.00	4
Lake														
#31 Thomas Divide Tr	1.40	5	1.00	3	1.25	8	.	0	.	0	.	0	.	0
#32 NC 9A	3.00	1	4.57	7	4.38	8	.	0	.	0	.	0	.	0
#33 Welch Ridge	.	0	1.25	8	1.25	8	.	0	.	0	.	0	.	0
#41 Jenkins Rdg Tr	2.20	5	1.33	3	1.88	8	.	0	.	0	.	0	.	0
Subtotal	1.91	11	2.33	21	2.19	32	.	0	.	0	.	0	.	0
Twentymile														
#34 Pilkey Ck	1.00	1	1.29	7	1.25	8	.	0	.	0	.	0	.	0
#35 Twentymile Tr	1.00	3	1.60	5	1.38	8	.	0	.	0	.	0	.	0
#36 Lakeshore Tr	1.33	3	1.40	5	1.38	8	.	0	.	0	.	0	.	0
#42 Noland Divide Tr	1.00	4	2.25	4	1.63	8	.	0	.	0	.	0	.	0
Subtotal	1.09	11	1.57	21	1.41	32	.	0	.	0	.	0	.	0
Subtotal (North Carolina)	1.68	40	2.13	91	1.99	131	.	0	.	0	.	0	1.80	5
Grand Total	1.65	112	2.05	155	1.88	267	.	0	.	0	.	0	1.80	5

Table 3. Hard mast index for Great Smoky Mountains National Park, 1985-1992.

Year	White Oak	Red Oak	Total Oak	Hickory	Walnut	Beech
1985	2.85 (71) ¹	2.38 (76)	2.61 (147)	(0)	(0)	(0)
1986	2.82 (78)	3.39 (92)	3.13 (170)	(0)	(0)	(0)
1987	3.41 (96)	3.41 (118)	3.41 (214)	(0)	(0)	(0)
1988	3.27 (77)	3.29 (167)	3.29 (244)	3.50 (4)	(0)	(0)
1989	1.74 (73)	3.56 (156)	2.98 (229)	(0)	(0)	(0)
1990	2.43 (100)	2.82 (104)	2.63 (204)	3.50 (2)	3.33 (3)	4.11 (9)
1991	1.60 (99)	1.63 (148)	1.62 (247)	1.56 (9)	2.40 (5)	3.27 (11)
1992	1.65 (112)	2.05 (155)	1.88 (267)	(0)	(0)	1.80 (5)

¹Number in parentheses indicates sample size for each group of trees.

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Number: GRSM-N-139

1. Project Title: Cades Cove White-tailed Deer Population
Monitoring

2. Project Objectives:

a. To monitor the relative density of white-tailed deer in
Cades Cove.

b. To determine the welfare of the white-tailed deer herd
in Cades Cove.

3. Principal Investigator: E. Kim DeLozier
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Rd.
Gatlinburg, TN 37738
(615) 436-1248

4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	2,000	0	NPS-GRSM
b. NPS (Region)	261	0	NRPP
c. NPS (Park Base)	762	0.03	NPS-GRSM
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0.06	GRSM/UTK
Totals	\$3,023	0.09	

5. Ecosystem studied: Southern Appalachians

Order studied: Artiodactyla

Family studied: Cervidae

Species (or Genera) studied: Odocoileus virginianus

6. (a) Progress:

The white-tailed deer herd in Cades Cove provides one of the most prized viewing opportunities for visitors to the park. Since the 1960s, periodic monitoring efforts have been conducted in Cades Cove to assess deer population densities, herd welfare, herd behavior, movements, habitat utilization, and infectious diseases. Several methods have been used to estimate the population density/welfare of the Cades Cove herd; however, the two methods used to monitor the population on a long-term basis include roadside night counts and abomasum parasite counts (APC). Roadside night counts are simple and cost-effective compared to other techniques. Density estimates are derived by dividing the total number of deer observed by the total area surveyed. APC's are a standard monitoring technique for land management agencies throughout the southeastern United States. APC's are based on the principle that parasites in the abomasum of deer increase as deer herd health and habitat quality decline. Due to lack of funding, APC's have been conducted only three times in the park (1983, 1989 and 1991).

Twenty-two roadside night counts were conducted from April 14 to October 15. Most of these surveys, however, were conducted by staff from the Great Smoky Mountains Institute at Tremont and The University of Tennessee as part of their interpretive or teaching programs. As a result, many of the surveys were nonsystematic or sporadic and included a variety of trained and untrained observers. Deer were not collected for abomasum parasite counts. Equipment needed to conduct roadside night counts and abomasum parasite counts was purchased.

(b) Significant findings:

Because most of the roadside night counts were nonsystematic or sporadic and conducted by untrained observers, data analysis was not performed.

(c) Reports and publications during fiscal year:

No reports or publications were submitted for this fiscal year. However, all survey information is maintained at GRSM.

(d) Status of any specimens collected:

No specimens were collected.

7. Appendices

(a) Project Staffing:

<u>NPS</u>	<u>FTE</u>
GS-11 Wildlife Biologist	0.019
GS-7 Wildlife Biological Technician	0.005
GS-6 Wildlife Biological Technician (2)	0.004
WG-5 Wildlife Handler	0.002
 <u>OTHER</u>	
8 Volunteers	0.062
 Total	 0.09

(b) Plans for next fiscal year:

White-tailed deer roadside night counts will be conducted by trained personnel biweekly during the fall, winter, and spring periods in FY93. In addition, 10 deer will be collected in late August or early September and abomasum parasite counts will be conducted to determine the health status of deer in Cades Cove.

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-078, GRSM-N-107

1. Project Title: Rare Plants Monitoring
2. Project Objectives:
 - a. What are the population dynamics of each targeted plant, as determined by quantitatively modeling the demographics of populations?
 - b. What are the identity and efficacy of pollinators?
 - c. What are the identity and relative abundance of all other plant taxa associated with each site?
 - d. What is the quantifiable impact of known/potential threats?
 - e. Is there a need for management action to protect any of the rare plant populations in the park?
3. Principal Investigators: Janet Rock and Keith Langdon
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738
(615) 436-1250
4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	37,300	1.00	NPS-GRSM
b. NPS (Region)	0	0	
c. NPS (Park Base)	4,000	0.60	GRSM
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	2,000	0.03	SCA
g. Personal/Volunteer	0	0.01	Volunteers
Totals	43,300	1.64	

5. Ecosystem studied: Spruce fir, cove hardwoods, xeric pine types, rock outcrops, many others

Families studied (all are vascular plant families):

Brassicaceae, Caryophyllaceae, Celastraceae,
Asteraceae, Gentianaceae, Lamiaceae,
Ranunculaceae, Rosaceae, Orchidaceae, Araliaceae

Species studied (all are vascular plant species, and nomenclature follows Kartez, 1990):

Synandra hispidula, Cardamine flagellifera (two populations), Cardamine clematitis, Hydrastis canadensis, Scutellaria saxatilis, Geum radiatum, Silene ovata, Evonymus atropurpureas, Cacalia rugelia, Frasera caroliniensis, Liparis loeselii, Panax quinquefolius.

6. (a) Progress:

Rare vascular plants first received some attention in the late 1970s and early 1980s, but the effort collapsed when priorities changed. The current program stems from a 1989 effort to comprehensively address all rare taxa in the park in conjunction with The Nature Conservancy via our Natural Heritage Data Center.

There were 109 occurrences of globally or national rare bryophytes (45 taxa) added to the Natural Heritage Databases. This brings the total number of occurrences (=populations) in the Natural Heritage Datasystem to 1,100.

Using Natural Heritage maps, 54 special protection areas were delineated. These areas are where concentrations of rare plants, animals, and/or natural communities occur.

An upgrade of Heritage's Biological Conservation Datasystem Program was received and installed.

Most of the plants are on an alternate year monitoring schedule, and the 1992 season was an "off" year. All of the taxa above received quantitative assessments of their populations in 1992, but others (not above) received searches for historic occurrences or were quick checked.

- (b) Significant Findings:

Pollination studies were initiated on two taxa, excessive white-tailed deer browse monitored on Euonymus and injurious maintenance activities monitored on the orchids Liparis, Silene and Hydrastis.

- (c) Reports and publications during fiscal year:

The 1989-1990 progress report, "Rare Plant Status Report of Great Smoky Mountains National Park," (140 pages) is being updated to 1989-1992 status.

(d) Status of any specimens collected:

Very few plants and pollinators were collected, but these are still being identified. Repository will be as "working" collection for identification, or in the park's museum.

7. Appendices

(a) Project Staffing:

<u>NPS</u>	<u>FTE</u>
GS-11 Natural Resource Specialist	.25
GS-7 Biological Technician	1.00
GS-5 Biological Technician	.35
 <u>OTHER</u>	
Student Conservation Assistants	.30
Volunteer	.10

(b) Plans for next fiscal year:

As plans now stand, one or two new pollination studies will be initiated, about 15 rare plant populations will receive re-measurement, and we hope to add as many as five new populations to the long-term monitoring network, including a category I federal candidate lichen. Additionally, two or three of our extreme endemics will have their geographic ranges modeled (ground truthed) using GIS.

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-069, GRSM-N-071, GRSM-N-144,
GRSM-N-151, GRSM-N-155, GRSM-N-156

1. Project Title: Watershed Aquatic Biota Monitoring
2. Project Objectives:
 - a. To develop long-term aquatic biota data for research watersheds.
 - b. To determine which species or groups are the most sensitive indicators of ecosystem stress and change.
 - c. To monitor watershed streams for early indications of ecosystem stress or change.
3. Principal Investigator: Dr. Charles R. Parker
Resource Management and Science
Division
Great Smoky Mountains National Park
107 Park Headquarters Rd.
Gatlinburg, Tennessee 37738
(615) 436-7120 [VOICE]
(615) 436-5598 [FAX]
4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	3,100.00	0	I&M
b. NPS (Region) ¹	13,000.00	0	SERO I&M
c. NPS (Park base)	5,715.00	0.50	salary [Parker]
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$21,815.00	0.50	

¹Vehicle purchase

5. Habitat studied: Aquatic ecosystem: Noland Creek

Families or Orders studied:

OLIGOCHAETA. CRUSTACEA: ISOPODA. INSECTA:
TRICHOPTERA, PLECOPTERA, EPHEMEROPTERA,
DIPTERA, others.

Name of species (or Genera) studied:

CRUSTACEA: ISOPODA: Asellidae, Lirceus spp.
INSECTA: TRICHOPTERA: Goeridae, Goerita n.sp.
Hydropsychidae, Parapsyche apicalis
Hydroptilidae, Palaeagapetus celsus
Lepidostomatidae, Lepidostoma spp.
Limnephilidae, Pycnopsyche sonso,
P. antica
Philopotamidae, Dolophilodes
distinctus, Wormaldia moesta
Rhyacophilidae, Rhyacophila n.sp.,
R. mycta, R. torva
Sericostomatidae, Fattigia pele
Uenoidae, Neophylax mittelli
PLECOPTERA: Chloroperlidae, Sweltsa lateralis
Leuctridae, Leuctra ferruginea, L.
triloba, Paraleuctra sara
Peltoperlidae, Tallaperla spp.
Perlodidae, Isoperla spp.
Nemouridae, Amphinemura wui, A.
nigritta, Soyedina carolinense
EPHEMEROPTERA: Baetidae, Baetis spp.
Ephemerellidae, Ephemerella spp.
Heptageniidae, Epeorus dispar
Siphonuridae, Ameletus
cryptostimulus

6. (a) Progress:

The sampling methods are established and in use. Analyses of the data are being developed with the expectation that it will be possible to reduce the sampling effort from weekly to every other week or less. Weekly sampling will continue throughout FY93 until data to support the efficacy of less frequent sampling are developed.

The species list continues to expand as less common species are encountered and identifications are obtained for groups such as the Chironomidae and Tipulidae. Certain species have been selected for intensive study. These include the two new species, other species of Rhyacophila, Palaeagapetus celsus, and the several species of mayflies, and the leuctrid and nemourid stoneflies. Graduate students will be recruited to undertake detailed studies of the life histories, ecology and sensitivity of these species to environmental parameters.

A vehicle for use with this and the Large Stream Benthic Macroinvertebrate and Large Stream Water Quality monitoring projects was purchased with Southeast Region Inventory and Monitoring funds.

(b) Significant findings:

Two species of caddisfly new to science have been discovered in Noland Creek. Both are being described by the Principal Investigator (PI).

(c) Reports and publications during fiscal year:

Parker, C.R. (in prep.) A new species of Goerita (Trichoptera: Goeridae) with a review of the genus. Transactions of the American Entomological Society.

Parker, C.R. (in prep.) Rhyacophila (Trichoptera: Rhyacophilidae), a new species from the Southern Appalachian Mountains. Proceedings of the Entomological Society of Washington.

(d) Status of any specimens collected:

Most specimens collected for this study are dried, ashed at 500°C, and weighed. A small number of specimens are retained as voucher specimens in the park collection. Type specimens of the new species are deposited in the National Museum of Natural History.

7. Appendices

a. Project staffing:

The PI will continue to commit approximately 0.1 FTE of his time to the project, assisting with the field work and doing most of the identifications. A term technician will have responsibility for setting and retrieving the net each week, processing the drift and seston samples, and performing other duties related to project maintenance. These duties will require 0.4 FTE of his time.

b. Plans for next fiscal year:

The project will continue as begun. With increased funding in FY93 we will obtain the services of outside experts to identify specimens of groups the PI is not an authority on, such as tipulids and oligochaetes. Graduate students will be recruited from local universities to conduct the detailed studies of species mentioned above.

<u>FY93</u>	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	15,500.00	0	I&M
b. NPS (Region)	0	0	
c. NPS (Park base)	5,990.00	0.50	salary [Parker]
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$21,490.00	0.50	

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-049, GRSM-N-050, GRSM-N-052, GRSM-N-054, GRSM-N-055, GRSM-N-056, GRSM-N-057, GRSM-N-058, GRSM-N-059, GRSM-N-103

1. Project Title: Data Management

2. Project Objectives:

a. To record, organize, sort, catalog, index, and archive data generated by or essential to the I&M program of the park.

b. To provide appropriate levels of access to participants and other interested persons to data collected by ongoing I&M projects.

3. Principal Investigator: Dr. Charles R. Parker and Dr. Michael Kunze
Resource Management and Science Division
Great Smoky Mountains National Park
107 Park Headquarters Rd.
Gatlinburg, Tennessee 37738
(615) 436-7120 [VOICE]
(615) 436-5598 [FAX]

4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	75,000	1.00	I&M
b. NPS (Region)	0	0	
c. NPS (Park base)	0	.50	Parker
d. Other Fed. Agency	0	0	
e. State/Local Agenc	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$75,000	1.50	

5. Ecosystem or habitat studied: NA

Families or Orders studied: NA

Species (or Genera) studied: NA

6. (a) Progress:

Natural resources data are very complex, voluminous, expensive and time-consuming to gather, and may represent the only available record of unique transient or ephemeral ecological processes and events. In addition, ecological processes may occur over long periods of time that span the working careers of more than one scientist. Data must be properly documented, organized, and archived to ensure that they will be available and useful to scientists and resource managers now and in the future.

The park has undertaken a comprehensive data management strategy. For several years the Research Administrator has made a consistent effort to identify, obtain and catalog all existing data sets of natural resource value. These efforts have resulted in the production of a report that summarizes existing data sets (Peine et al., 1985), and the development of a research data management protocol for use by resource management and research personnel in the park (MacKenzie 1987). GRSM was the pilot park for the NPS when it gained a Natural Heritage Datacenter in 1988. Natural Heritage is an integrated map and database documentation system for inventorying and monitoring all occurrences of rare or exemplary "elements" (which may be plants, animals, or communities). It was developed by the Science Division of The Nature Conservancy, which introduced the system in the 1970s. The park received hundreds of "element occurrences" from state governments in 1988 and since that time has built the total number of occurrences that are mapped and in the system to 1,200. Natural Heritage is dynamic and will be revised continuously as monitoring data are updated.

In order to develop a comprehensive I&M data base for the Park, Dr. Michael Kunze was hired as a GS-334-9 Computer Specialist. Dr. Kunze has responsibility for consultation on and implementation of the GRSM Natural Resources Database (NRDB) as envisioned by Dr. Parker and other I&M participants. A 486/33MHz EISA personal computer with 32 MB of RAM and a 1.1 GB hard drive was acquired. Software for data management, programming, word processing, desktop publishing, graphics, statistical analysis, and electronic communications were purchased. While the final format of the NRDB is still under development most project data files are kept individually by Principal Investigators (PIs). However, significant progress has been made in developing a common front end. This front end graphically displays general park resources data and a summary of watershed, vegetation, old growth, disturbance history and other data

generated by GIS software on a Sun workstation. The base map display that can be zoomed to any scale on areas of active research will serve as a connecting point to specialized project data. The front end is written in Microsoft Visual Basic, and the connection to other software packages by object linking and embedding is currently being developed.

(b) Significant findings:

NA

(c) Reports and publications during fiscal year:

The prototype GRSM NRDB is not a report but a computer program. It is available for examination and testing by the other PIs and to interested persons having the commitment to and knowledge of park resource issues to be able to comment constructively on the program's capabilities and limitations.

(d) Status of any specimens collected:

NA

7. Appendices

a. Project staffing :

The I&M proposal as funded calls for a full-time data manager and office assistant. The park has appointed Dr. Parker as half-time data manager (0.5 FTE), and has hired Dr. Kunze as a full-time GS-334-9 Computer Specialist. Dr. Kunze is a highly qualified individual with outstanding computer skills. We will seek the assistance of a volunteer or temporary employee through other funding sources to enter data into the database and/or the GIS in FY93.

b. Plans for next fiscal year:

In FY93 the NRDB will be moved from the prototype stage to the first release. Data will be available from each portion of the GRSM I&M program funded in FY92, and these will be incorporated into the system. A connection will be established between the NRDB and the Natural Heritage Datacenter, permitting direct mapping of element occurrences from the Datacenter in the NRDB. Guidelines will be established for the storing and archiving of all I&M data generated by each project funded in FY93.

<u>FY93</u>	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	75,000	1.00	I&M
b. NPS (Region)	0	0	
c. NPS (Park base)	0	.50	
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$75,000	1.50	

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-011, GRSM-N-013, GRSM-N-051, GRSM-N-083, GRSM-N-116, GRSM-N-118

1. Project Title: Large Stream Benthic Macroinvertebrate Monitoring

2. Project Objectives:

a. To develop long-term aquatic biota data for large streams, for streams having significant brook trout populations, and streams having threatened and endangered fish species.

b. To determine correlations of macroinvertebrate data with large stream fish surveys and water quality monitoring data.

c. To develop baseline data on aquatic macroinvertebrates for comparisons with future data.

3. Principal Investigator: Dr. Charles R. Parker
Resource Management and Science
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Great Smoky Mountains National Park
107 Park Headquarters Rd.
Gatlinburg, Tennessee 37738
(615) 436-7120 [VOICE]
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4. Estimated funding amount(s) expended during current FY.

	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	1,000	0	I&M
b. NPS (Region)			
c. NPS (Park base)	2,857	0.10	Salary [Parker]
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$3,857	0.10	

5. Ecosystem or habitat studied: Aquatic ecosystems

Families or Orders studied: OLIGOCHAETA. CRUSTACEA: ISOPODA. INSECTA: TRICHOPTERA, PLECOPTERA, EPHEMEROPTERA, DIPTERA, others.

Name of species (or Genera) studied:

CRUSTACEA: ISOPODA: Asellidae, Lirceus

INSECTA: TRICHOPTERA: Goeridae, Goera
Hydropsychidae, Arctopsyche,
Cheumatopsyche, Hydropsyche,
Parapsyche
Hydroptilidae, Palaeagapetus
Lepidostomatidae, Lepidostoma,
Theliopsyche
Limnephilidae, Apatania, Frenesia,
Pycnopsyche, Pseudostenophylax
Philopotamidae, Dolophilodes,
Wormaldia
Rhyacophilidae, Rhyacophila
Uenoidae, Neophylax
PLECOPTERA: Chloroperlidae, Alloperla,
Chloroperla, Suwallia, Sweltsa
Leuctridae, Leuctra, Paraleuctra
Perlodidae, Isoperla
Nemouridae, Amphinemura, Soyedina
EPHEMEROPTERA: Baetidae, Baetis
Ephemerellidae, Drunella,
Ephemerella
Heptageniidae, Epeorus, Heptagenia,
Stenacron, Stenonema
Leptophlebiidae, Leptophlebia,
Paraleptophlebia
Siphonuridae, Ameletus, Isonychia

6. (a) Progress:

A Southeast Regional hiring freeze prevented any field work from being accomplished for this project in FY92. The sampling equipment was constructed and some supplies were purchased. A vehicle was purchased with SERO Inventory and Monitoring funds (see Watershed Aquatic Biota report).

(b) Significant findings:

NA

(c) Reports and publications during fiscal year:

NA

(d) Status of any specimens collected:

NA

7. Appendices

a. Project staffing:

The Principal Investigator will commit approximately 0.1 FTE of his time to the project, assisting with the field work and doing most of the identifications. Those groups on which the PI is not an authority will be sent to contractors for identification. The GS-404-6 Biological Technician will devote approximately 10% of his time to this project. Since this part of the I&M program is closely connected with the Large Stream Fisheries and Brook Trout Monitoring projects, field work will be accomplished in cooperation with those efforts. This will result in an efficiency of scale that is not reflected in the budget figures below.

b. Plans for next fiscal year:

Field work has begun with the lifting of the hiring freeze in FY93. Seven sites have been sampled. Additional sites will be sampled as long as the weather permits. Full sampling of all sites will be accomplished in the coming field season. Additional supplies will be purchased.

<u>FY93</u>	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	8,240	0	I&M
b. NPS (Region)			
c. NPS (Park base)	5,990	0.20	salary [Parker]
d. Other Fed. Agency			
e. State/Local Agency			
f. Non-profit Inst.			
g. Personal/Volunteer			
Totals	\$14,230	0.20	

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Project Number: GRSM-N-152

1. Project Title: Watershed Monitoring of High Elevation
Ecosystem

2. Project Objectives:

The objective of the work is to establish and maintain long-term monitoring of core watershed components at a high-elevation spruce-fir watershed at GRSM. The monitoring program is designed to track key indicators of ecosystem health within this important yet fragile high elevation forest system. The program is not an experimental research project. Data are collected using standard protocols and sufficient intensities such that any long-term trends in ecosystem parameters can be sufficiently documented. Factors responsible for any observed changes will only be inferred. However, by ensuring the collection and maintenance of core data sets on key watershed parameters, the program is designed to attract collaborative research and monitoring efforts that would (1) produce more extensive and intensive information on long-term trends in ecosystem functioning, (2) allow for the delineation of mechanisms of change, and (3) result in the development of predictive models of ecosystem change. As has occurred in other long-term watershed programs, the trend data and deciphered correlations between ecosystem parameters should produce improved understanding of ecosystem functioning and lead to the development of testable hypotheses of the mechanisms and of the anthropogenic impacts to ecosystem functioning.

3. Principal Investigator: Dr. Stephen C. Nodvin
National Park Service-Cooperative
Park Studies Unit
Department of Forestry, Wildlife
and Fisheries
University of Tennessee
Knoxville, TN 37901-1071
(615) 974-0739

4. Estimated funding amount(s) expended during current FY.

	\$	FTE	Name
a. NPS (WASO I&M)	68,000	0	UT-CPSU
b. NPS (Region)	34,000	0	SERO Funding
	30,000	0.4	SERO scientist
c. NPS (Park Base)	7,500	0.1	Aquatic biologist
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	10,000	0.1	UT
g. Personal/Volunteer	0	0	
Totals	\$149,500	0.6	

5. Ecosystem or Habitat studied:

Southern Appalachian high elevation red spruce-Fraser fir forest ecosystem

Families or Orders studied:

(Refer to Annual Administrative Report Project Title: Watershed Aquatic Biota Monitoring)

Species (or Genera) studied:

(Refer to Annual Administrative Report Project Title: Watershed Aquatic Biota Monitoring)

6. (a) Progress:

FY92: Hydrologic devices, installed on Noland Creek streamlets, were connected to a Campbell data logger to allow continuous electronic recording of streamwater export from the watershed. A Hydrolab in-stream monitor was also installed and connected to the data logger for continuous recording of stream pH, conductance, and temperature. The two streamlets were sampled weekly. Precipitation and throughfall collectors were sampled weekly during the winter season and bi-weekly during the remainder of the year. All samples were analyzed for pH, conductance, and major anions and cations. Stream invertebrate samples were collected weekly from one of the streamlets using 24 hour drift sampling (refer to Annual Administrative Report Project Title: Watershed Aquatic Biota Monitoring). One of two Belfort rain gages was recalibrated and upgraded by the manufacturer for electronic data recording. The other gage had been upgraded in the previous fiscal year.

(b) Significant findings:

Precipitation and throughfall measurements continue to show that this site receives some of the highest rates of sulfur and nitrogen deposition in North America. Stream monitoring demonstrated that 1) the streams draining the watershed are poorly buffered and chronically acidified, 2) the streams experience episodic acidification: in an observed episode stream pH dropped by 1 pH unit and alkalinity by 20 microequivalents per liter in response to several storms over a three week period, 3) nitrate is the predominant anion for most of the year in these streams with sulfate next most important, and 4) nitrogen export in streams is very high relative to other forest systems.

(c) Reports and publications during fiscal year:

Williams, E.M. and S.C. Nodvin. 1991. Assessment of Nitrogen Export From a High Elevation Watershed. The Seventeenth Annual Scientific Research Meeting; The Uplands Areas of the Southeast Region in Gatlinburg May 16-17, 1991

Williams, E.M. and S.C. Nodvin. 1991. Assessment of Nitrogen Export From a High Elevation Watershed. Extended Abstracts from the Fourth Tennessee Water Resources Symposium. Knoxville, Tennessee. September 24-26, 1991. Tennessee Section of the American Water Resources Association. CONF-910923-Absts. pp. 100-104.

Williams, E.M. and S.C. Nodvin. 1991. Assessment of Nitrogen Export From a Spruce-Fir Watershed Second Annual Southern Appalachian Man and the Biosphere Conference in Gatlinburg November 4-5, 1991

Nodvin, S.C., H. Van Miegroet, S.E. Lindberg and E.M. Williams. 1992. Nitrogen Export From A High Elevation Spruce-Fir Watershed. Bulletin of the Ecological Society of America. vol. 73: Presented at joint annual meeting of the American Institute for Biological Sciences and the Ecological Society of America. August 9-14, 1992. Honolulu, HI.

(d) Status of any specimens collected:

(Refer to Annual Administrative Report Project Title: Watershed Aquatic Biota Monitoring)

7. Appendices

(a) Project staffing:

<u>Title</u>	<u>FTE</u>	<u>Institution</u>
Research Ecologist	0.4	NPS-CPSU-UT/SERO
Aquatic Biologist	0.1	GRSM
Professor of Forestry	0.1	UT Dept of Forestry
Research Assistant	1.0	UT Dept of Forestry
Senior Research Technician	1.0	UT Dept of Forestry

(b) Plans for next fiscal year:

The NPS-CPSU at the University of Tennessee has obtained access to a new Environmental Sciences Lab within the Department of Forestry, Wildlife and Fisheries at the University of Tennessee. Up to FY93 the majority of water samples collected have been analyzed by a contract laboratory. Funding from I&M and other programs are being used to furnish the laboratory with equipment so that all samples can be analyzed in-house. This action should provide: long-term savings on analytical costs, better quality control, and faster turnaround. The new equipment will provide for the analysis of parameters in water samples which have not been previously measured: organic nitrogen, aluminum, silica, and dissolved organic carbon.

High resolution stereo-photography (1:500) and topographic data will be obtained for the watershed. The highly accurate topographic data will be referenced at 6 ground control points using Geographic Positioning System (GPS) survey instruments. Digitization of the stereo-imagery will provide high resolution digital elevation data. The digital data will be used to develop detailed topographic maps (up to 2 foot contours) and to accurately determine the watershed boundary and area.

The high resolution photography and topographic maps will be utilized in the vegetation mapping of the watershed during the summer of 1993.

Rain gages used to measure throughfall and precipitation will be connected to Campbell data loggers for digital collection of precipitation information. Data collection on paper charts will continue as a backup procedure.

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

ANNUAL ADMINISTRATIVE REPORT
(Long-term Monitoring)

Park: Great Smoky Mountains National Park

Region: Southeast

RMP Proj. Numbers: GRSM-N-010, GRSM-N-011, GRSM-N-012, GRSM-N-013, GRSM-N-144, GRSM-N-152, GRSM-N-156, GRSM-N-157

1. Project Title: Water Quality Monitoring

2. Project Objective:

To provide long-term water quality data on selected park streams in support of the Fisheries Monitoring and Benthic Macroinvertebrate Monitoring projects.

3. Principal Investigator: Dr. Charles R. Parker
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4. Estimated funding amount(s) expended during current FY.

	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	30,000	0	I&M
b. NPS (Region)	0	0	
c. NPS (Park base)	5,715	0.20	salary [Parker]
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	\$35,715	0.20	

5. Ecosystem or habitat studied: Aquatic ecosystems

Families or Orders studied: NA

Species (or Genera) studied: NA

6. (a) Progress:

In FY92 five makes of water quality monitoring equipment were evaluated. Manufacturers were contacted and requested to provide units for testing. Each unit was tested for performance and other characteristics in park streams. After a lengthy test period, one model was found to provide the most accurate measurements of pH and conductivity of the five examined. Three units with probes were purchased for installation in FY93.

A vehicle was purchased using SERO Inventory and Monitoring funds (see Watershed Aquatic Biota report).

(b) Significant findings:

Standard water quality monitoring equipment is not suitable for use in the low ionic strength water of the park. None of the manufacturers anticipated the difficulties their equipment would encounter in the park, but most of them eventually were able to provide probes that worked satisfactorily. One manufacturer built a probe specifically designed to work in park streams and, in fact, this probe was the most accurate of those tested.

(c) Reports and publications during fiscal year:

Parker, C.R. and C.E. Noseworthy. 1992. "Evaluation and Selection of Water Quality Monitors for the Inventory and Monitoring Program." Report for the Superintendent, Great Smoky Mountains National Park. 42 p.

(d) Status of any specimens collected:

NA

7. Appendices

a. Project staffing:

A GS-404-6 Biological Technician has been hired to work on this project as well as on the Watershed Aquatic Biota and the Large Stream Benthic Macroinvertebrate projects. This individual will devote 0.10 FTE to the water quality project. The Principal Investigator will commit approximately the same amount of his time.

b. Plans for next fiscal year:

The water quality monitors purchased with FY92 funds will be installed at the three locations specified in the proposal. Alternative installations are being tested in LeConte Creek in front of Uplands Field Research Laboratory to determine the best method for permanent installation in the field.

This test period will last through February to provide ample time to assess different arrangements and to permit the staff to become familiar with the operation of the equipment. A backup water quality monitor will be purchased with FY93 funds.

<u>FY93</u>	<u>\$</u>	<u>FTE</u>	<u>Name</u>
a. NPS (WASO I&M)	26,260	0	I&M
b. NPS (Region)	0	0	
c. NPS (Park base)	5,990	0.30	salary [Parker]
d. Other Fed. Agency	0	0	
e. State/Local Agency	0	0	
f. Non-profit Inst.	0	0	
g. Personal/Volunteer	0	0	
Totals	32,250	0.30	