

DEEP CREEK FISH COMMUNITY SURVEY REPORT

Great Smoky Mountains National Park

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Overview

During the spring of 2011, Great Smoky Mountains National Park (GRSM) fisheries biologists conducted a series of public meetings in east Tennessee and western North Carolina (NC) to discuss various fisheries issues and provide an opportunity for public questions/comments. During a meeting in NC, several local residents raised the concern that fish communities in lower Deep Creek appeared to have noticeably declined in recent years. Although data from other GRSM large stream communities did not indicate such declines, GRSM fishery managers agreed to try to re-sample some historic Deep Creek sample sites to determine the status of the fish communities. The following report is a brief overview of the results of those samples, with additional comparison to survey data from the same sites conducted in 1985.

Study Area

Two fish community sites were sampled during our August 2011 visit. Sites were selected based upon previous sampling locations such that 2011 data could be compared to data collected in 1985. The first site (Deep Creek at turnaround at end of closed road) was sampled on August 9, 2011 (Figure 1). The second site, located just upstream of the Deep Creek campground bridge, was sampled on August 10, 2011 (Figure 1).

Methods

Each site was sampled using three-pass depletion techniques as outlined in the SD AFS Trout Committee Standardized Sampling Guidelines (SD AFS Trout Committee 1994). Per the guidelines, one electrofishing units was used for every 3-4m of stream width. Staff from NC Wildlife Resources and local volunteers assisted with sampling both sites. For each sample site, block nets were used to meet the assumption of a “closed population”, trained staff conducted all electrofishing and netting meeting the assumption of “equal effort” among passes and each electrofishing pass was spaced at least 45 minutes apart meeting the assumption of “equal catchability” among passes. Individual total length (mm) and weight of all gamefish (e.g., trout and bass) were recorded for each pass. Total number, total weight (g) and a minimum and maximum total length (mm) of all non-gamefish were recorded for each pass. All fish were held in holding cages outside of the sampling area until all sampling was completed. Once completed, all fish were returned to the sampling area. All data were 3-pass depletion data were entered into Microfish 3.0 (van Deventer and Platts 1983; www.microfish.org) to calculate population estimates for each species.

At each site, mean stream width was calculated by measuring stream widths starting at the bottom of the site and continuing every 20m upstream to the end of the site. Total site length (m) was the length from the bottom block net to the upper block net. Site area (m²) was calculated by multiplying the mean stream width (m) by the total site length (m). Stream

discharge (ft³/second), water temperature (°C), conductivity (μS/cm) and stream gradient (%) were also measured at each site. To calculate density (# fish/100m²), the population estimate for a given species was divided by the site area (m²) and multiplied by 100 to get the species density per 100m². Biomass (kg/ha) was calculated by multiplying the population estimate by the mean weight (g), dividing that number by the area (m²), then multiplying the result by 10 to convert from g/m² to kg/ha.

Results

Twenty-one species of fish, representing seven families, were collected at the campground site on Deep Creek in 2011, compared to the twenty-three species in six families collected in 1985 (Figure 2). Five species collected in 2011 were not collected in 1985 (green sunfish, mountain brook lamprey, smallmouth bass, spotted bass and Tuckaseegee darter¹), and six species collected in 1985 were not collected in 2011 (black redhorse, rock bass, silver shiner, telescope shiner, Tennessee shiner, whitetail shiner) (Table 2). The only family not collected in 1985 was the lampreys, which were fairly abundant in 2011.

For most species at the campground site, biomass was relatively similar from 1985 to 2011, except for brown trout (declined), longnose dace (increased), mottled sculpins (increased), rainbow trout (declined), river chub (increased), roseyside dace (increased) and stonerollers (increased) (Figure 2). Total fish biomass was 23% higher in 2011 (101.8 kg/ha) than in 1985 (83.0kg/ha) (Table 2). The biomass at the turnaround site showed a similar trend from 1985 to 2011, except for longnose dace, mottled sculpin, northern hogsucker river redhorse and stonerollers, all of which showed significant increases (Table 3). Total biomass was 149% higher in 2011 (95.7 kg/ha) than in 1985 (38.5 kg/ha) for the turnaround site. Of note in 2011, trout biomass made up 16% of the total biomass at the campground site (Table 2) and 28% of the total biomass at the turnaround site (Table 3).

Comparisons of the numbers of brown trout collected at the campground site and the turnaround site from 1985 to 2011 show differing results (Figure 4). Comparing 1985 to 2011 data, the number of brown trout collected at the campground site declined 65%, whereas the number collected at the turnaround site increased 77% (Figure 4). The largest brown trout collected at the campground site in 1985 was roughly 22" whereas the largest brown trout collected at the same site in 2011 was roughly 15" (Figure 4). The greatest decline in brown trout numbers at the campground site appears to be in the age-0 size class whereas numbers of brown trout >7" appears to be relatively similar from 1985 to 2011 (Figure 4). At the turnaround site, the increase in brown trout numbers appears to be mostly in the 6-12" size

¹ The Tuckaseegee darter *Etheostoma gutselli* was established as a species in 2001 (Etnier and Starnes 1993).

range (Figure 4). The largest brown trout collected at the turnaround site in 1985 (12.5") and 2011 (12") was similar (Figure 4).

Although the numbers of brown trout collected in each site changed considerably from 1985 to 2011 (Figure 4), the numbers of rainbow trout did not (Figure 5). Rainbow trout numbers at the campground site and turnaround site were relatively unchanged from 1985 to 2011 (Figure 5). The largest rainbow trout collected at the campground (11.4" & 11.8") and turnaround sites (11" & 12.6") respectively were also relatively unchanged from 1985 to 2011 as well (Figure 5).

Comparisons of the trout density of Deep Creek survey sites relative to other large stream systems indicates the Deep Creek communities are similar to those of other park streams at similar elevations (Figure 6). Only those systems influenced by greater productivity associated with limestone geology (Abrams Creek) or possibly wastewater treatment effluent (EP Little River) have greater densities than Deep Creek at similar elevation (Figure 6). When comparing the contribution of trout to the overall biomass park streams, it is apparent that non-game fish are the dominant group versus trout in streams less than 2,000 feet (Figure 7).

Discussion

In general, the 2011 Deep Creek fish surveys indicate the populations are healthy and have not significantly changed since 1985. Although species diversity was similar among years, the differences in species absence/presence indicates some of the redhorse and shiner species noted in 1985 may have been misidentified resulting in the differences noted. Also, given the low densities of species not present among years, some species may have simply been missed among years. Also, there was a difference in the effort among years with four shockers and nine personnel used in both sites in 1985, whereas six and five shockers with 25 people were used in the turnaround and campground sites respectively in 2011 (Table 1). Following the guidelines for equipment effort and personnel in 2011 may explain why a littoral species, such as the mountain brook lamprey, found in the silt/sand of the backwater and bank areas, was collected in 2011 but not found in 1985. One other note is the apparent large increases of some non-game species from 1985 to 2011. Observations by Steve Moore indicate the 1985 samples may have underrepresented non-game species as the focus was mostly on trout, whereas the 2011 samples focused on the entire fish community. Given these sampling anomalies, species assemblages and relative abundances are probably similar among years.

Similar to other large stream systems below 2,000 feet in elevation, non-game fish species was the dominant portion of the biomass comprising 84% and 72% of the biomass at the campground and turnaround sites. As you move upstream in the system, trout biomass becomes a greater portion of the overall biomass until it comprises 100%, usually around 2,500-3,000 feet in elevation within GRSM. Many stream segments around the 1,500-2,000 foot zone

serve as transition zones from cold water to cool-water habitat, in which, species such as smallmouth bass, rockbass and sunfish start to emerge as the dominant predators versus trout. In such areas, droughts and floods play a greater role in reproductive success given the severity of both high summer temperature during droughts and the magnitude and scouring of major floods in spring. Trout densities typically increase as you move up in elevation as mean summer water temperatures decline.

The decline seen in brown trout numbers at the campground site from 1985 to 2011 is curious given the numbers increased at the turnaround site. Adult brown trout numbers appear similar among sites (even greater at the turnaround site), however, age-0 or young-of-year (YOY) brown trout numbers are much lower in 2011 than in 1985. Despite lower numbers of brown trout YOY, rainbow trout numbers are similar among years. The larger average size of YOY rainbow trout among years is apparent and associated with the later sampling date in 1985 (November versus August). Except for one 21.6" brown trout collected at the campground site in 1985, size ranges for both trout species are nearly identical among years. Similar to previous GRSM studies (Kulp and Moore 2005), there is no evidence of cropping of adult trout greater than 7" associated with angling pressure.

In general, the fish community of lower Deep Creek, as represented by the two sites sampled in 2011, appears to be healthy, in good condition and representative a typical low elevation stream community on the Blue Ridge region. Species diversity is high and the general condition of the species present was good to excellent. There were no obvious signs of stress or disease in the species collected, other than ubiquitous and benign commensal parasites like black spot (black grub) and the occasional leach.

Besides the many fish species encountered, several eastern hellbenders *Cryptobranchus alleganiensis* were also encountered at both sites. Hellbenders are considered a "habitat specialist" because its success is dependent on a constancy of dissolved oxygen, temperature and flow found in swift water areas, therefore its presence is another indicator of good water quality conditions. Hellbenders have been in decline nationally due to siltation and sedimentation, blocking of dispersal/migration routes, and destruction of riverine habitats created by dams and other development, as well as pollution, disease and over harvesting for commercial and scientific purposes. The relatively undisturbed nature of park streams like Deep Creek reinforces the need for the continued protection of these aquatic communities in their natural state for the survival of all native species that live in these pristine communities.

Finally, these results provide a good opportunity to make a point regarding interpretation of survey data among years. The results of each survey represent a snapshot of two points in time and are shaped by the environmental factors (i.e. droughts, floods, temperature, predation, etc.), anthropogenic influences (i.e. disturbance, runoff, erosion) and the resulting recruitment

of the years prior to the sampling period. Readers should be mindful that the datasets provide an insightful status of the fish communities at these two points in time, however the ability to predict trend or assess changes over time is limited and not recommended.

Acknowledgments

We thank the many local volunteers, interns, NCWRC staff and others who volunteered or assisted with the Deep Creek stream surveys. Done correctly with the wellbeing of the resource and staff as priority, depletion surveys on large streams are labor intensive and require rather large crews of people. We thank all those who volunteered such that we could evaluate the fish community of lower Deep Creek.

References

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Table 1.—Physical and chemical results of the Deep Creek stream surveys. DPC-16 refers to the turnaround site and DPC-18 refers to the Deep Creek campground site.

Site/Date	Number of Shockers	Number of Personnel	Elevation (feet)	Water Temp (C)	Conductivity (μS/cm)	Stream Discharge (ft ³ /sec)	Mean Width (m)	Mean Gradient (%)	Site Length (m)	Area (m ²)
DPC-16 Nov 1, 1985	4	9	1,975	19.8	13.7	25.9	16.1	2.1	209.8	3440.7
DPC-18 Nov 3, 1985	4	9	1,780	18.6	14.6	45.0	14.7	3.5	196.8	2893.0
DPC-16 Aug 9, 2011	6	25	1,975	13.0	55.0		13.3		200.0	2660.0
DPC-18 Aug 10, 2011	5	25	1,780	14.0	75.0		15.2		200.0	3040.0

Table 2.—List of fish species collected at the Deep Creek campground sample site within Great Smoky Mountains National Park in August 1985 and 2011. Fish were collected using backpack electrofishing gear and the three-pass depletion sampling technique.

Species	Density		Biomass	
	1985	2011	1985	2011
<i>Blacknose Dace</i>	1.97	0.93	0.75	0.11
<i>Brown Trout</i>	2.11	0.66	15.12	7.15
<i>Black Redhorse</i>	0.16	0.00	13.06	0.00
<i>Creek Chub</i>	0.53	0.03	0.88	0.07
<i>Greenfin Darter</i>	0.13	0.83	0.07	0.44
<i>Gilt Darter</i>	0.26	0.21	0.10	0.07
<i>Green Sunfish</i>	0.00	0.03	0.00	0.06
<i>Greenside Darter</i>	0.13	1.83	0.11	1.52
<i>Longnose Dace</i>	2.83	22.74	1.67	5.69
<i>Mirror Shiner</i>	0.16	0.69	0.03	0.11
<i>Mottled Sculpin</i>	5.43	55.93	2.50	26.29
<i>Mountain Brook Lamprey</i>	0.00	4.80	0.00	2.26
<i>Northern Hogsucker</i>	2.24	2.14	13.33	10.63
<i>Rainbow Trout</i>	2.53	1.90	15.63	8.80
<i>River Chub</i>	0.30	1.18	1.87	6.31
<i>Roseyside Dace</i>	2.27	11.34	1.02	3.06
<i>Smallmouth Bass</i>	0.00	0.03	0.00	0.85
<i>Spotted Bass</i>	0.00	0.07	0.00	0.37
<i>Rock Bass</i>	0.16	0.00	1.28	0.00
<i>River Redhorse</i>	0.03	0.00	0.00	0.00
<i>Stoneroller</i>	5.46	26.13	8.19	25.87
<i>Silver Shiner</i>	0.49	0.00	0.15	0.00
<i>Telescope Shiner</i>	0.07	0.00	0.03	0.00
<i>Tennessee Shiner</i>	0.07	0.00	0.03	0.00
<i>White Sucker</i>	0.13	0.14	2.20	0.72
<i>Warpaint Shiner</i>	1.94	0.66	1.36	0.95
<i>Whitetail Shiner</i>	2.80	0.00	3.61	0.00
<i>Tuckasegee Darter</i>	0.00	0.24	0.00	0.46
TOTAL	32.2	132.5	83.0	101.8

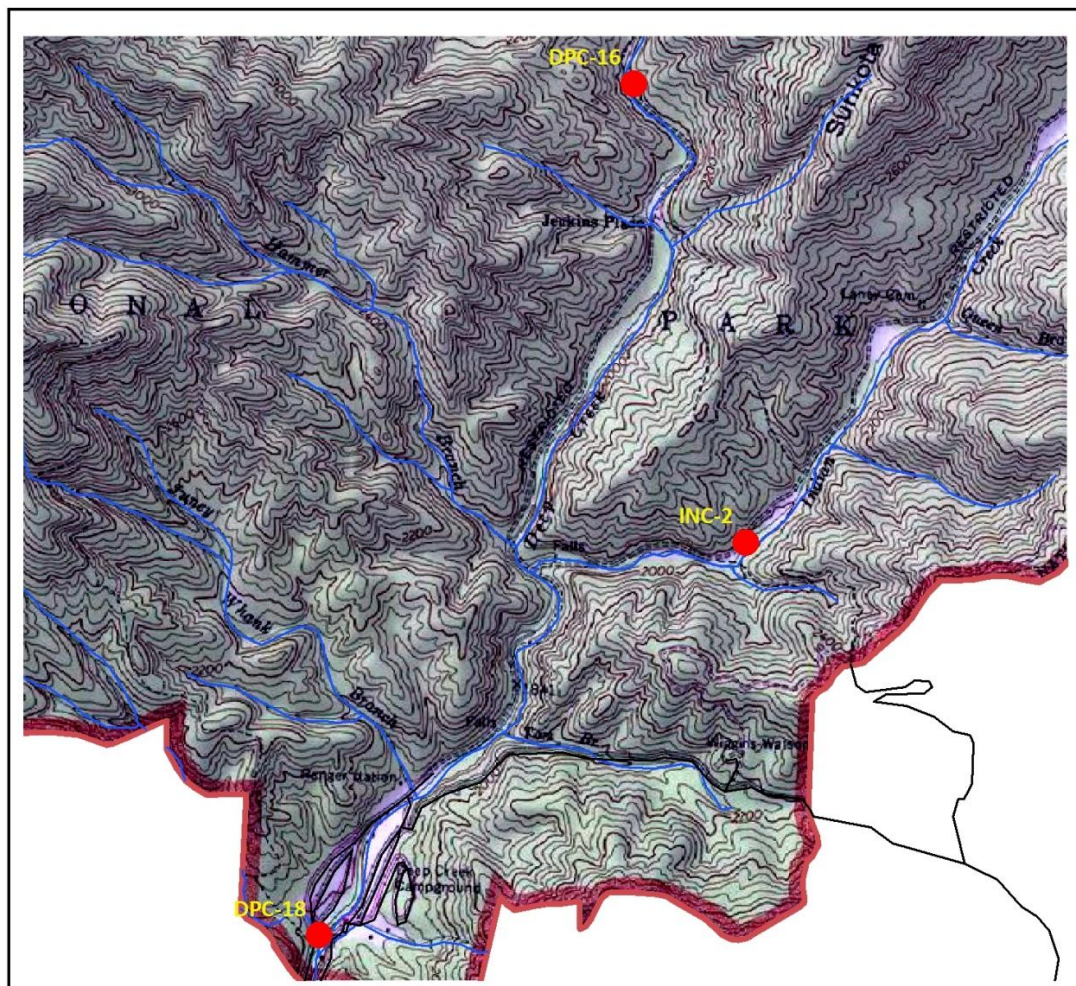
Table 3. — List of fish species collected at the turnaround sample site within Great Smoky Mountains National Park in August 1985 and 2011. Fish were collected using backpack electrofishing gear and the three-pass depletion sampling technique.

Species	Density		Biomass	
	1985	2011	1985	2011
Blacknose Dace	0.8	2.7	0.12	0.60
Brown Trout	1.5	1.8	10.75	11.41
Greenside Darter	0.0	0.1	0.02	0.12
Longnose Dace	4.5	39.2	2.26	15.67
Mottled Sculpin	6.7	28.1	4.19	12.38
Northern Hogsucker	0.4	1.7	2.59	10.56
Rainbow Trout	4.2	3.7	14.02	15.17
River Redhorse	0.0	0.2	2.44	17.89
Roseyside Dace	0.2	0.2	0.11	0.10
Stoneroller	0.3	1.5	2.03	8.01
Warpaint Shiner	0.0	0.1	0.00	0.09
River Chub	0.0	0.5	0.00	3.69
TOTAL	18.6	79.8	38.5	95.7

Figure 1. — Map depicting the location of historical fish monitoring sites on lower Deep Creek, located just upstream of Bryson City, NC. The upper turnaround site (DPC-16) was sampled on August 9, 2011, whereas the Deep Creek campground bridge site (DPC-18) was sampled on August 10, 2011.

GREAT SMOKY MOUNTAINS NATIONAL PARK **Deep Creek Watershed, North Carolina**

National Park Service
U.S. Department of the Interior



0 0.25 0.5 1 1.5 2 Miles

Great Smoky Mountains National Park

Area of
Interest



Legend

- Historic_Fish_Sites
- GRSM_Roads_NAD83
- GRSM_Streams_NAD83_Clip
- GRSM_Boundary_NAD83
- GRSM_Lakes_NAD83



September 2011

Figure 2. — Biomass (kg/ha) of fish species collected from the campground area Deep Creek from 1985 and 2011. Total biomass collected from each site is noted in the legend.

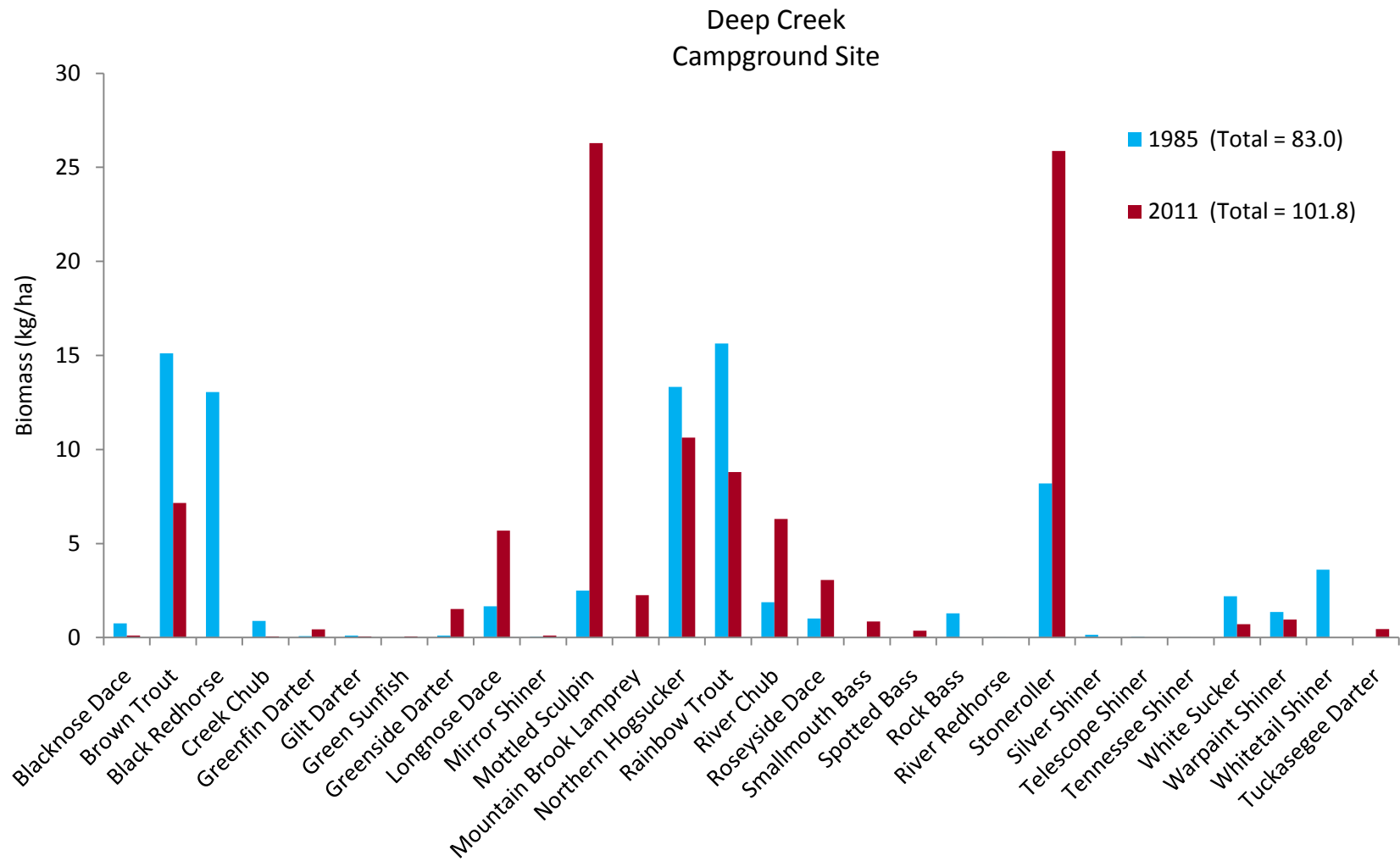


Figure 3. — Biomass (kg/ha) of fish species collected from the Deep Creek Road turnaround area of Deep Creek from 1985 and 2011. Total biomass collected from each site is noted in the legend.

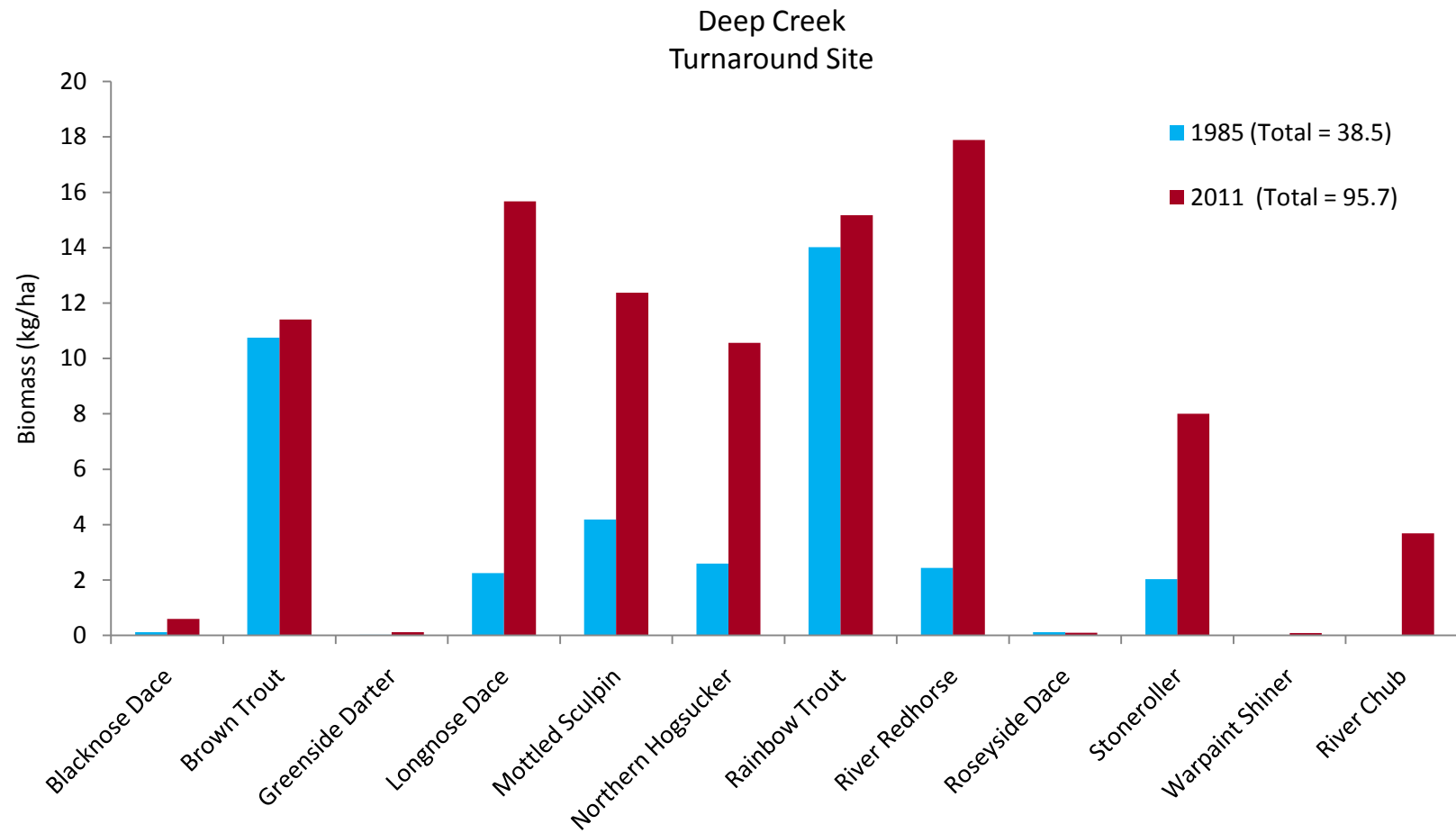


Figure 4. — Length frequency distribution of brown trout collected from the Deep Creek campground and the road turnaround area of Deep Creek from 1985 and 2011. The total number of brown trout collected from each site is noted in the legend.

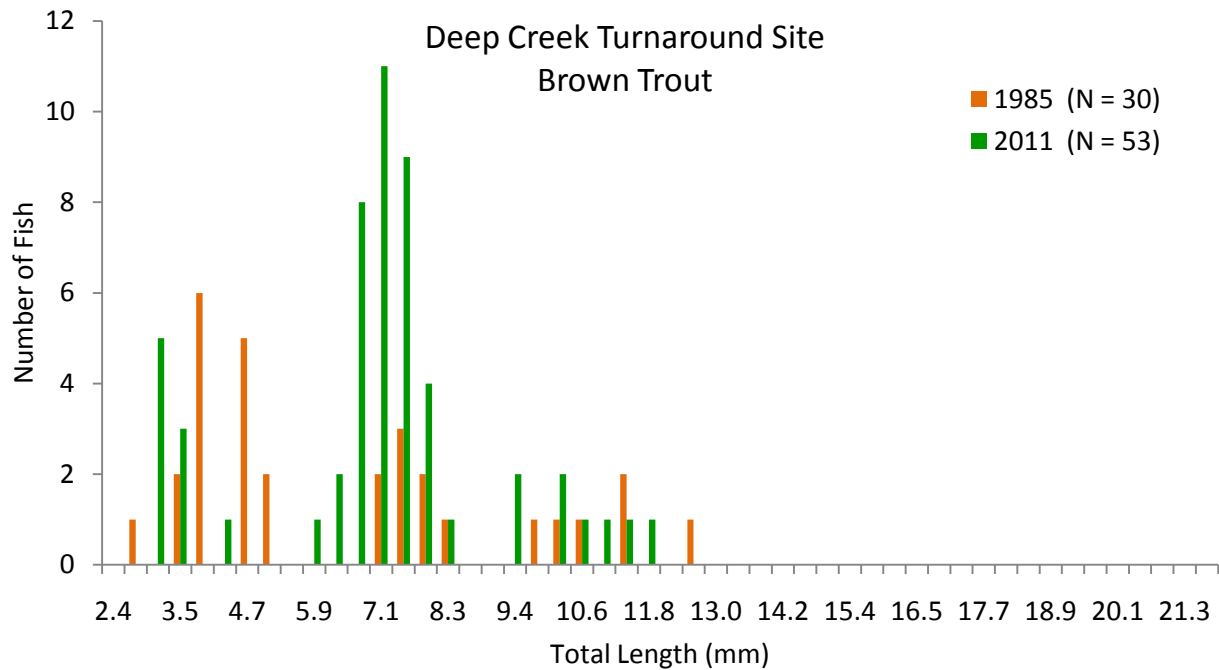
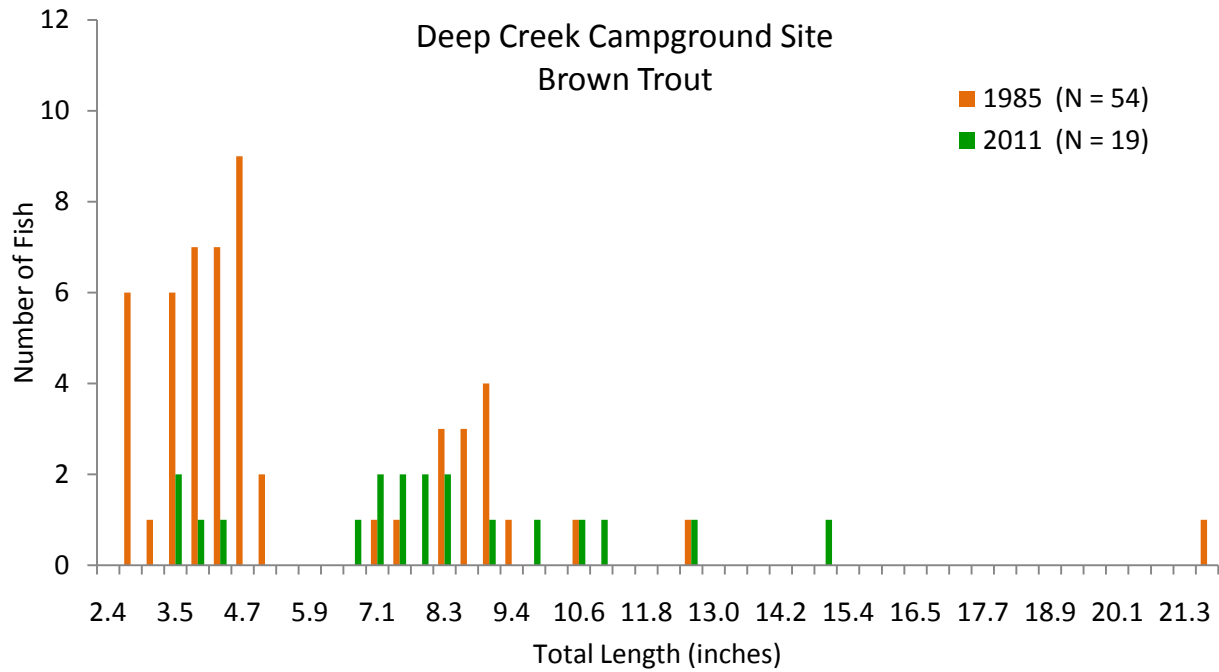


Figure 5. — Length frequency distribution of rainbow trout collected from the Deep Creek campground and the road turnaround area of Deep Creek from 1985 and 2011. The total number of rainbow trout collected from each site is noted in the legend.

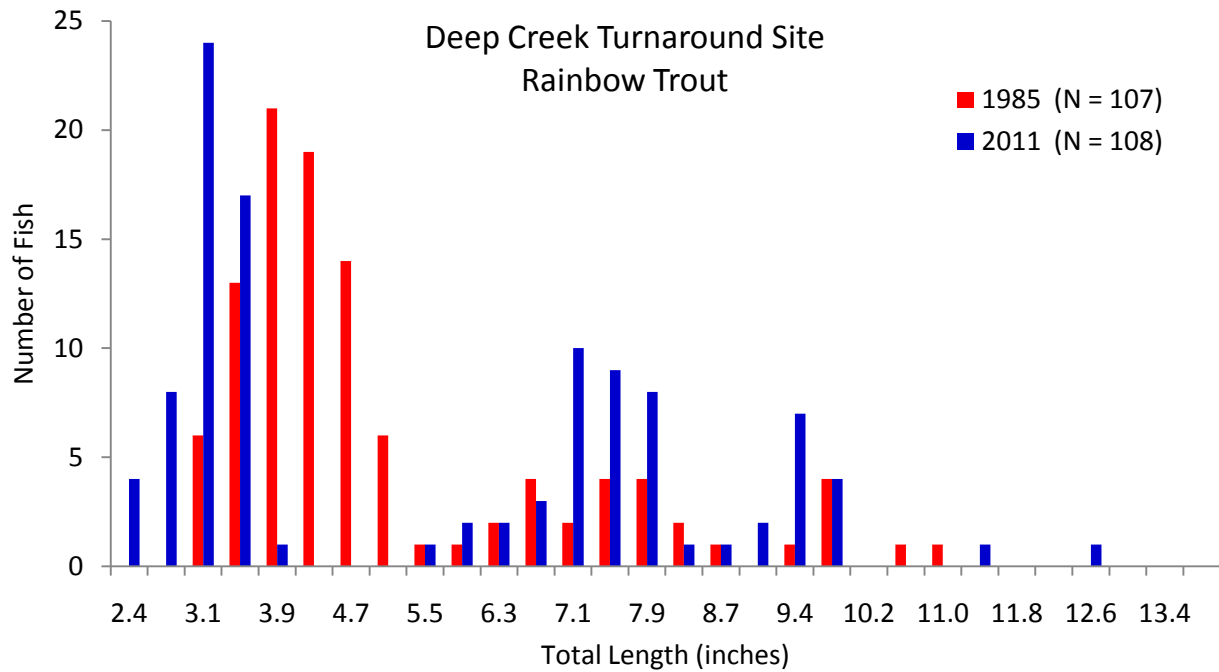
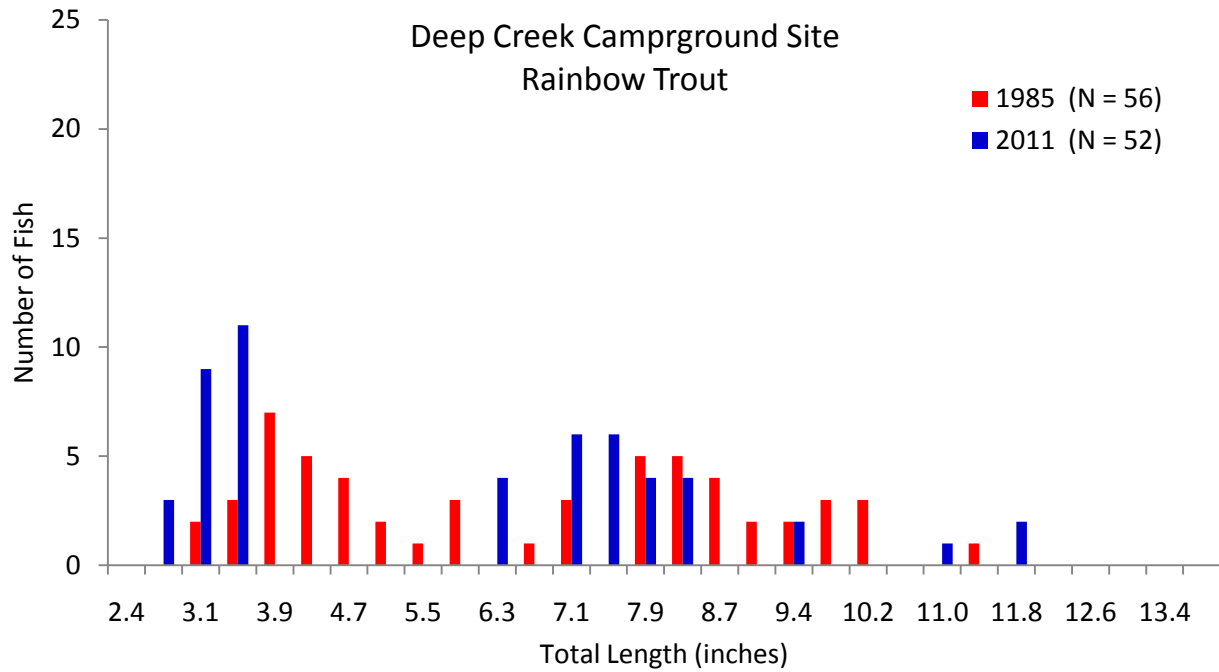


Figure 6.— Density (number of fish/100m²) of brown and rainbow trout collected from two sites on Deep Creek in 1985 and 2011 in comparison to similar large stream sites around GRSM. Streams are arranged from high to low elevation for comparative purposes. Site elevation is represented by the blue line on the secondary y-axis.

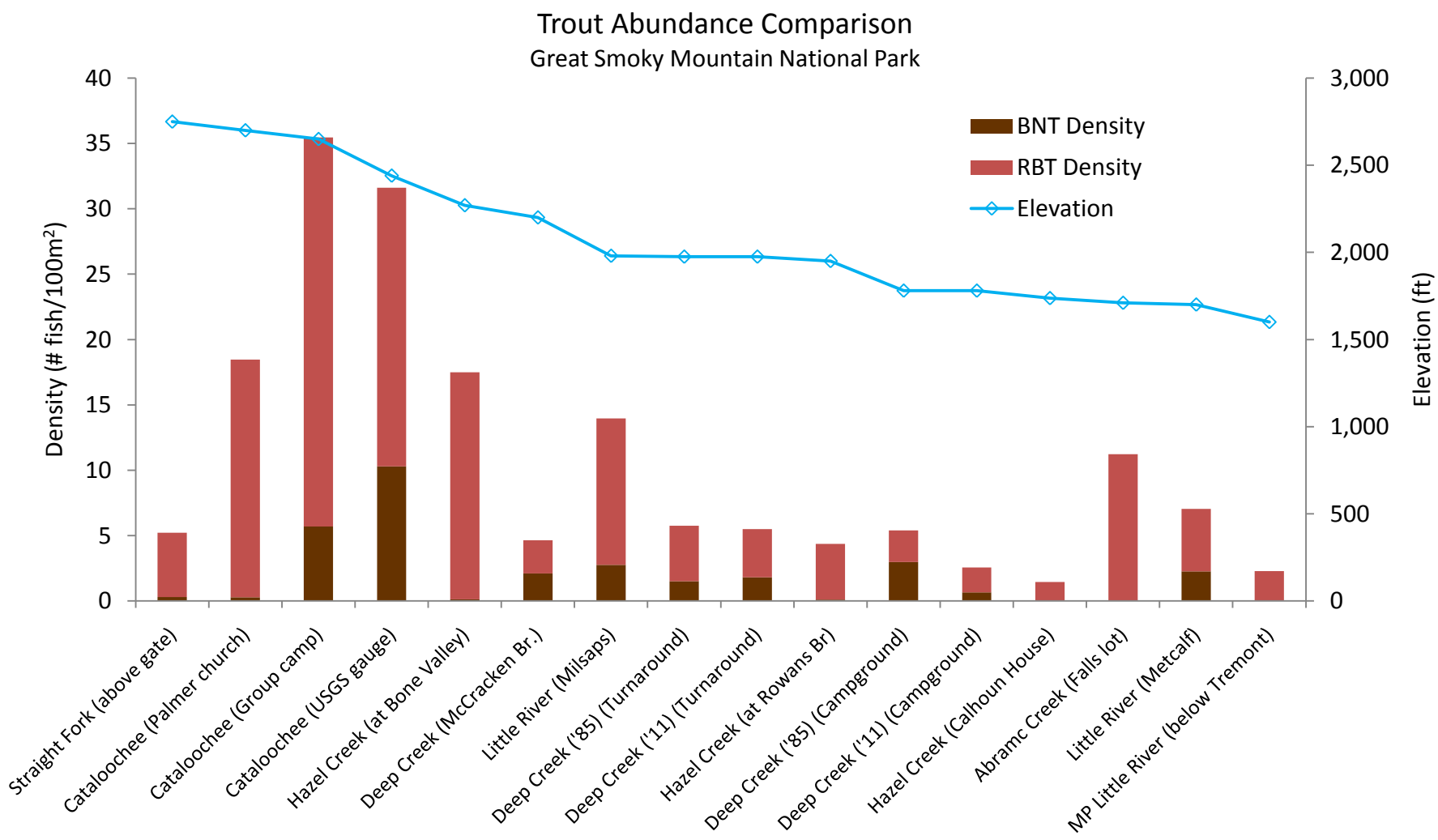


Figure 7. — Trout and non-gamefish biomass trout collected from two sites on Deep Creek in 1985 and 2011 in comparison to similar large stream sites around GRSM. Streams are arranged from high to low elevation for comparative purposes. Site elevation is represented by the blue line on the secondary y-axis.

