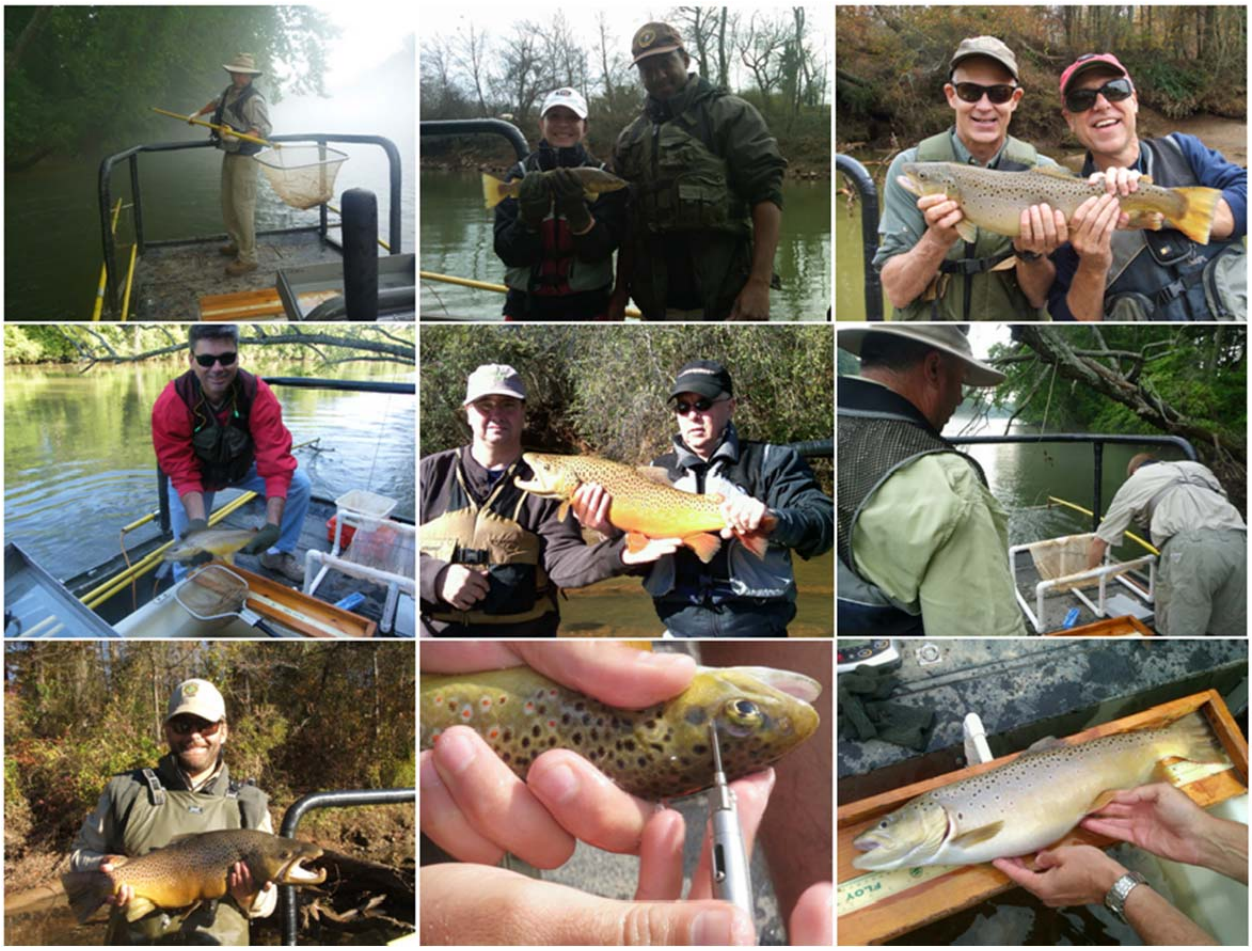
Growth and Movement of Wild Brown Trout in the Chattahoochee River below Buford Dam



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Georgia Department of Natural Resources, Wildlife Resources Division

Trout Unlimited - Upper Chattahoochee, Cohutta, Tailwater, and Kanooka Chapters

Chattahoochee River National Recreation Area

Upper Chattahoochee Riverkeeper

Chattahoochee Coldwater Fishery Foundation

Introduction

The construction of Buford Dam in 1956 created approximately 48 miles of coldwater tailwater habitat in the Chattahoochee River. For management purposes, the Georgia Department of Natural Resources, Wildlife Resources Division (WRD) considers this to represent two different segments, the 36-mile Lanier Tailwater (Buford Dam to Morgan Falls Dam) and the Morgan Falls Tailwater (downstream of Morgan Falls Dam). The Lanier Tailwater was first stocked with trout in 1960 and was long managed using a "put-and-take" stocking strategy (e.g. fish were stocked with the expectation that many would be harvested by anglers shortly thereafter). After research showed that brown trout were reproducing in considerable numbers, WRD ceased stocking brown trout (though rainbow trout stocking continued) in 2005. Subsequent research demonstrated no need to resume brown trout stockings and WRD changed its management strategy on the Lanier Tailwater to accommodate a wild brown trout fishery while maintaining a stocked rainbow trout fishery.

Given the previous use of "put-and-take" management on this section of the Chattahoochee River, little was known about the population dynamics of its resident brown trout. Managers were not concerned about fish growth or diet as growth was not a necessary component of the catchable trout management strategy. Nor were they particularly concerned about the movement of stocked fish over time as the stocking locations mostly targeted high-use access points and seasons. It is important for managers to now understand these population characteristics to evaluate and optimize management strategies.

Goals

The primary goal of this study was to increase knowledge about the population dynamics of wild brown trout in the Lanier Tailwater section of the Chattahoochee River. First, we sought a reliable estimate of growth for the brown trout population. Second, we looked at movement and migration patterns to determine the level of site fidelity for brown trout in this population. Finally, we attempted to learn more about the diet composition of brown and rainbow trout, the available forage for these species, and the potential for competition between the two species, factors which contribute to growth rates. All of this information can help guide a range of future management decisions that can impact the fishery.

A secondary goal of this study was to facilitate discussion and education among the users of the Chattahoochee River and the professionals that are charged with its management. The project design brought individuals together that may not have worked closely together before and provided new experiences for many of the volunteers. Post-report presentation of these findings will bring that discussion to an even wider audience.

Methods

The same WRD biologist led all sampling trips. Each trip also used one to two other personnel from partner agencies and organizations.

Fish were collected monthly from April 2011-May 2012 at four locations (Buford Dam, Settles Bridge, Abbotts Bridge, Jones Bridge, Figure 1) using a boom-mounted boat electrofishing unit. A previously determined annual standardized sampling location was first shocked for 30 minutes of pedal time at all locations except Buford Dam. This site was sampled for 20 minutes due to a historically high abundance of trout and limited livewell space. Water quality metrics (temperature (°F) and dissolved oxygen (ppm)) were collected once at each sampling site for each day. Following the standardized sample and subsequent processing, additional fish were collected from adjacent areas to increase sample sizes for each collection event.

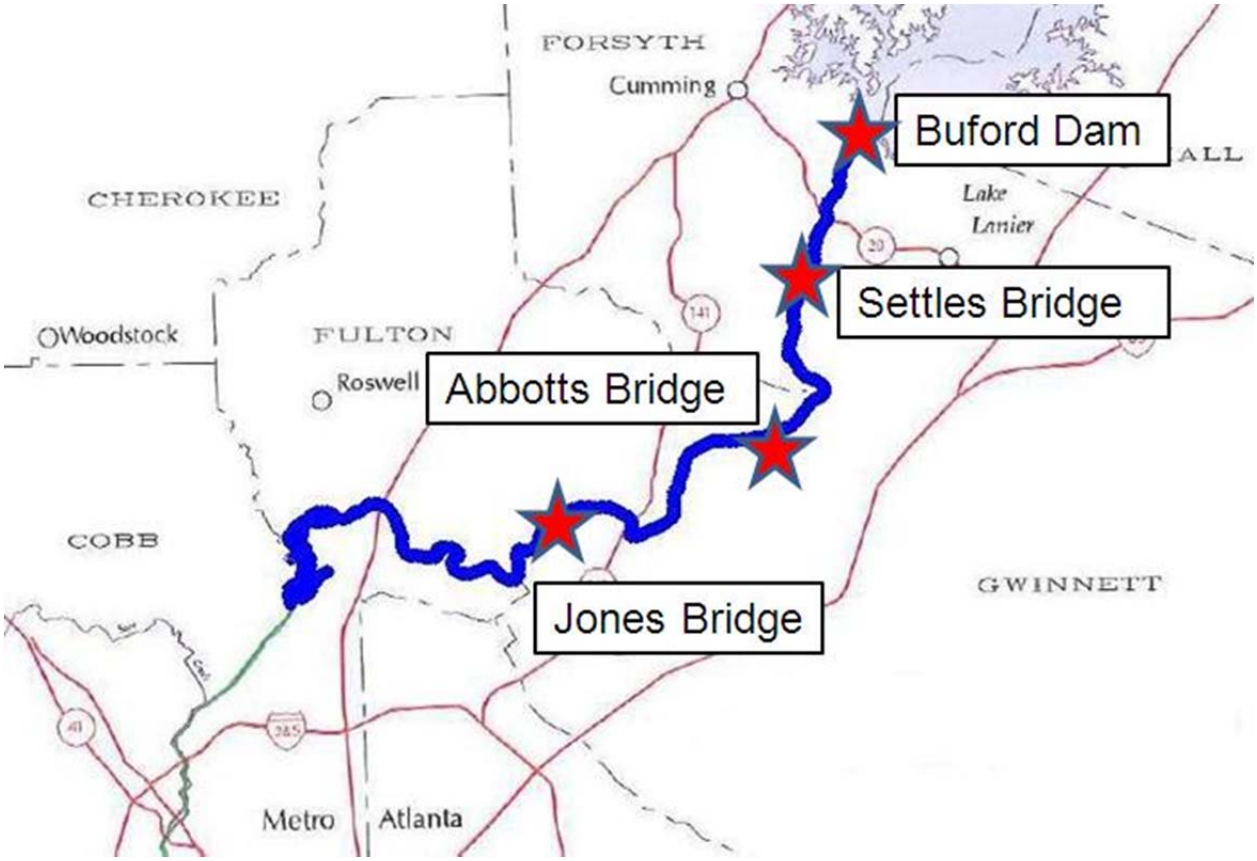

Figure 1. Chattahoochee River, Lanier Tailwater below Buford Dam. Sampling locations are marked by red stars.

Tagging

Brown trout were tagged in April, May, June, August, September, November, and December of 2011 and February and March of 2012 with VI-Alpha tags manufactured by Northwest Marine Technologies. During these months, all rainbow trout collected were counted and released. Brown trout were measured (mm TL), weighed (g), and inspected for previous tags. Fish that did not contain a previous tag had one injected below the translucent skin directly behind one eye with the three-digit alphanumeric code facing outward. Every tenth fish was double-tagged with a tag placed behind both eyes for tag retention analysis. The color of each tag corresponded to the location at which the fish was

tagged (yellow-Buford Dam, red-Settles Bridge, green-Abbotts Bridge, orange-Jones Bridge). Immediately before inserting the tag via an injection needle, these fish were given a low-voltage (~10 V) electronic shock to prevent excessive movement during tagging. Once tagged, the color, code, and location (left or right side) of the tag(s) were recorded and the fish was placed into a holding pen beside the boat to recover. If a fish was previously tagged, the color, code, and location of each tag were recorded and these fish were immediately placed into the holding pen to recover. Upon completion of tagging activities, the fish in the pen were observed for any mortality or poor recovery before being slowly released. Any mortality of tagged fish was recorded.

Site Fidelity

In addition to monthly collections, dispersal from tagging sites was analyzed at the end of the study. On June 7 and June 21, 2012, fish were sampled via electrofishing (similar methods as above) for 600 seconds beginning at each mile marker location from Mile 348 (below Buford Dam) to Mile 326 (immediately above Holcomb Bridge Rd.). Five of these stations (328, 334, 335, 343, 348) were located within tagging locations from the previous study period. Rainbow trout were counted at each site. Brown trout were inspected for a tag. If a tag was present, the color and number were recorded. Otherwise, the fish was recorded as untagged. All fish were immediately released after data were recorded.

Diet

Diet samples were collected from brown and rainbow trout in July and October of 2011 and January and April of 2012 to provide representative months for each of the four seasons. Up to five fish per species were collected for each 20 mm (approximately 0.79 in) length group to account for diet variance among fish sizes and species. Stomach contents were lavaged using a 500 cc plastic squirt bottle with a plastic elbow-style nipple. The nipple was inserted into the fish's stomach and water was squeezed through it to evacuate the stomach contents into a pan. All identifiable diet items were recorded for each fish, and the fish was placed into a holding pen to recover. Fish were released after all diets were sampled, and any resulting mortality was recorded. These data are only intended to reflect occurrence of individual diet items in each fish and do not account for the amount of each diet item consumed, therefore this sampling design is unable to analyze the overall energetic contribution of any particular food source.

Results

Collection Effort

Partners in this project contributed more than 1,214 hours of in-kind labor in the field. At least one WRD employee was present for every day of sampling, accounting for 510 hours of fieldwork. Trout Unlimited members contributed 472 hours of labor over 57 days, Chattahoochee River National Recreation Area personnel contributed 88 hours of labor over seven days, Upper Chattahoochee Riverkeeper staff contributed 48 hours of labor over five days, and representatives from other groups,

including the US Army Corps of Engineers and the US Senate, provided 48 hours of labor over four days. The Chattahoochee Coldwater Fishery Foundation and/or the Upper Chattahoochee Riverkeeper provided a pilot boat once per month for the first eight months of the study for the technically difficult trip to the Settles Bridge sampling location.

Water Quality

Water temperature ranged from 47.1 °F (January 2012, Settles Bridge) to 60.8 °F (August 2011, Jones Bridge) and averaged 52.3 °F during sampling events. Dissolved oxygen ranged from 1.4 ppm (November 2011, Buford Dam) to 10.2 ppm (March 2012, Buford Dam) and averaged 6.8 ppm. Excluding Buford Dam, dissolved oxygen was never recorded below 3.0 ppm and averaged 7.2 ppm. There was a slight logarithmic relationship between dissolved oxygen (DO) and brown trout condition factor (Kn) (*Kn=0.065ln(DO)+0.8323,* r^2*=0.4736*, i.e. condition was slightly better during periods of higher dissolved oxygen) at Buford Dam, but there was no relationship whatsoever at any of the other sites. There was no apparent correlation between water temperature and condition factor of brown trout.

General Population Characteristics

The proportion of brown trout present in the river compared to rainbow trout ranged from a low of 49.4% in July 2011 to a high of 91.3% in November 2011. This ratio appeared to be correlated to WRD's rainbow trout stocking rates, which are at their highest in the spring and summer. At Settles Bridge, the only location of the four sites which is not locally stocked, this percentage ranged from 79.0% in August 2011 to 98.1% in November 2011 (Figure 2). Brown trout proportion ranged from 39.8% to 82.1% at stocked sites (Figure 2). Condition factor of brown trout sampled was lowest at Settles Bridge in all but two of the fourteen months (August 2011 and January 2012). Condition factor of brown trout was highest at Buford Dam in all but two of the fourteen months (September 2011 and November 2011). Condition factor among all four sites was not significantly different, however.

Brown trout were collected and measured 4,288 times over the course of the study. The size of fish ranged from a minimum of less than 3.25 inches to approximately 27.25 inches. More than 99% of these fish measured between 5 and 17 inches (Figure 3). More than 80% measured between 7 and 11 inches.

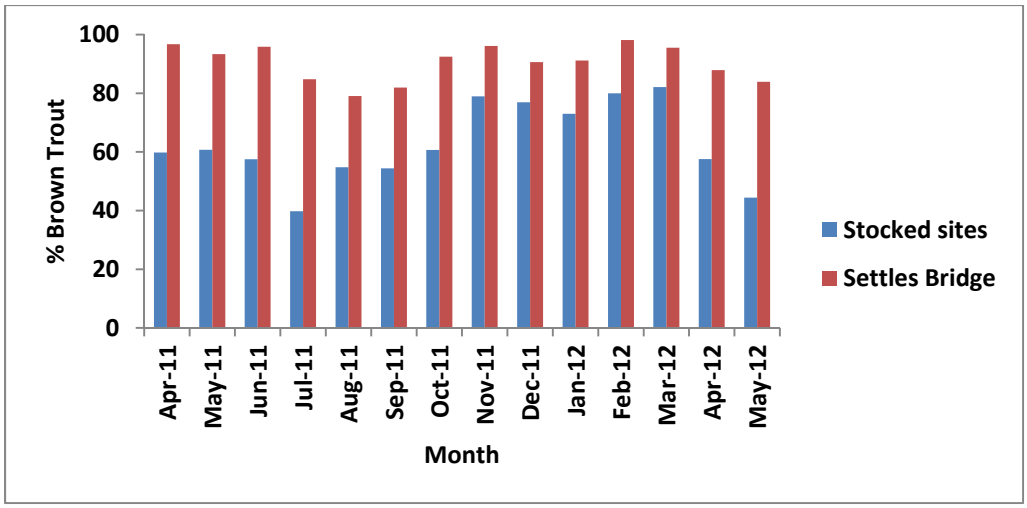

Figure 2. Contribution of brown trout to total trout collected monthly at three stocked locations (Buford Dam, Abbotts Bridge, Jones Bridge) and one unstocked location (Settles Bridge).

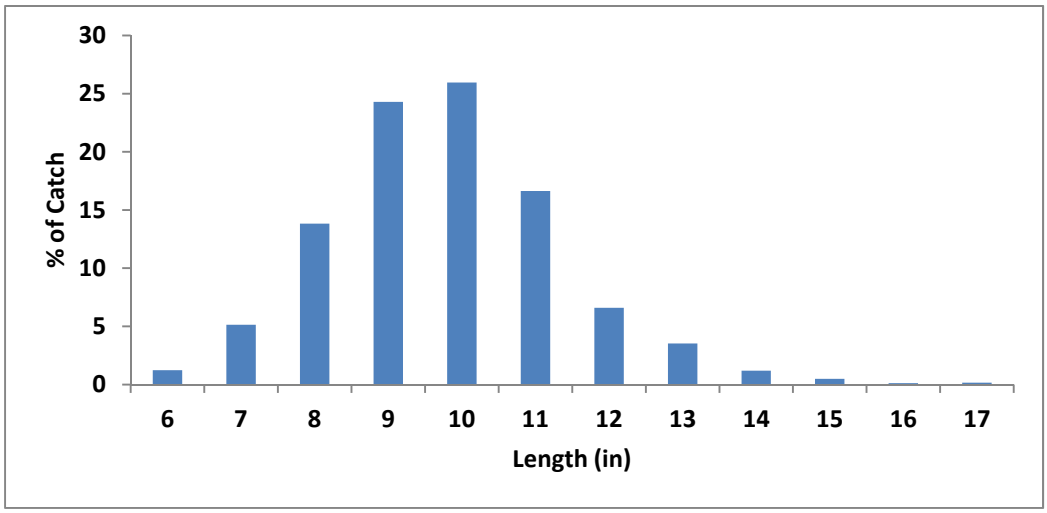

Figure 3. Length-frequency histogram of all brown trout between 6 and 17 inches collected via electrofishing from April 2011-May 2012 on the Chattahoochee River, Georgia.

Recapture of Marked Fish

A total of 2,385 brown trout were tagged at the four sites combined. Of these, 563 individuals were recaptured over the course of the study. A total of 397 were recaptured once, 106 twice, 36 three times, 11 four times, 12 five times, and one fish (at Settles Bridge) was recaptured six times.

Site Fidelity

Throughout the 14 months of the study, all of the 563 recaptured brown trout were caught within the same location in which they were tagged (i.e. no fish migrated to and were subsequently recaptured

within another sampling location). During June 2012 sampling, no tagged fish were recaptured in a sampling site that was not within one of the four tagging locations and there was no migration between locations. Of brown trout captured at the Buford Dam, Settles Bridge, Abbotts Bridge, and Jones Bridge sampling sites, 13%, 27%, 10%, and 60% contained tags, respectively.

Brown Trout Growth

The average growth of all recaptured brown trout was 1.01 inches/year. This rate varied between sites, seasons, and fish length. These growth rates are summarized in Tables 1-3. Growth rates showed variability for sites and seasons within individual length categories as well, though the trends differed in some cases. The growth rate for the large fish (14+ inches) is not included due to small sample size and the inclusion of these fish within a much larger group (e.g. 14-27+ inches), but values were close to zero. Despite these small values, some individual fish showed much faster growth rates.

Table 1. Average growth rate (inches per year) and sample size of brown trout at four sites on the Chattahoochee River from April 2011-May 2012.

Site	N	in/yr
Buford Dam	157	1.06
Settles Bridge	182	0.81
Abbotts Bridge	84	0.52
Jones Bridge	140	1.52

Table 2. Average growth rate (inches per year) and sample size of brown trout during four seasons on the Chattahoochee River from April 2011-May 2012.

Season	N	in/yr
Winter	29	1.30
Spring	113	1.45
Summer	60	1.00
Fall	54	0.40

Table 3. Average growth rate (inches per year) and sample size of brown trout on the Chattahoochee River over five size ranges from April 2011-May 2012. No value is included for fish over 14 inches due to small sample size.

Size (in)	N	in/yr
6-8	74	2.48
8-10	279	1.12
10-12	162	0.37
12-14	36	0.25
14+	11	N/A*

Diet

Among the individuals that had diet items present, midges were by far the most prevalent item present (68.6% and 54.3% present, respectively). Common diet items are summarized in Table 4. Other items found during diet analysis included mayflies, terrestrial insects, fish (including incidents of cannibalism by brown trout), fish eggs, mosquitoes, snails, various (hemipteran) flies, crayfish, and a frog. 12.2% of all brown trout and 31.7% of all rainbow trout had empty stomachs upon sampling.

Table 4. Percentage of brown and rainbow trout containing common diet items in the Chattahoochee River in July and October 2011 and January and April 2012.

Category	Brown Trout	Rainbow Trout
Midges	68.6%	54.3%
Caddisflies	18.5%	11.2%
Stoneflies	16.4%	11.5%
Ants	9.8%	9.3%
Worms	9.1%	5.3%
Scuds	7.6%	3.4%

Discussion

There were zero instances of tagged brown trout being recaptured in locations significantly beyond where they were tagged, suggesting strong site fidelity. While some individual fish may still move longer distances occasionally, it does not appear that movement/migration is a major factor for the Lanier Tailwater brown trout fishery, even during fall/winter spawning activity. Therefore, it is unlikely that fish move between sections of the river that have different fishing regulations.

Generally, overall growth rates for brown trout were relatively low beyond approximately 10 inches in total length. This is likely a result of the unproductive nature of the Chattahoochee tailwater, which has an approximate alkalinity of 25 ppm compared to more than 100 ppm in some highly productive Southeastern tailwaters (e.g. White River in Arkansas). However, some individual fish exhibited much faster growth. This may be a result of these individuals occupying ideal habitat that maximizes the bioenergetic tradeoff of feeding. Small midges were the dominant component of most trout diets, and the energy required to consume enough of these midges to allow for growth is likely high. Fish which exhibit a preference for larger invertebrates or transition to piscivory could potentially show greater growth rates. Growth was highest at Jones Bridge, which could be a result of higher productivity due to nutrient loading from tributary input at this downstream location and slightly increased temperatures. Growth was second-highest, however, at Buford Dam, which should exhibit the lowest productivity due to lack of tributary input, relatively sterile water discharged from below the thermocline of Lake Lanier, and lower average temperatures (literature suggests that trout growth increases with temperature up to approximately 68 °F). Population density is highest at the Buford Dam site (personal observation), and cannibalism possibly contributes to faster growth as this behavior was observed several times over

the course of the study. More analysis of the factors affecting growth at different sampling sites should be performed. Growth was lowest overall in the fall compared to all seasons. Again, more analysis should explore factors such as the effect of spawning activity and poor fall water quality (particularly immediately below Buford Dam). Growth in length decreased as fish grew larger, which is a typical condition among most fishes due to the greater energetic requirements to add mass on larger fish with each added inch.

There was no clear evidence for strong interspecific competition between stocked rainbow trout and wild brown trout in this study. While there was obvious diet overlap between the two species, rainbow trout were less effective overall at capturing the same diet items and were nearly three times as likely to have empty stomachs. Settles Bridge was used as a control site for rainbow trout stocking (closest stocking locations are approximately 2.5 miles upstream and 3.5 miles downstream). Despite holding smaller percentages of rainbow trout trout, condition factor of brown trout was usually lowest at Settles Bridge compared to the three stocked sites. Growth was third-lowest at Settles Bridge, only ranking higher than at Abbotts Bridge. Habitat availability and river productivity may have a much greater impact on growth and condition of brown trout than competition with stocked rainbow trout. The potential for density-dependent growth should be explored in greater detail. Macroinvertebrate data collected by the Chattahoochee Coldwater Fishery Foundation are currently being analyzed and will allow comparison of available vs. preferred forage to determine if lack of suitable food could be leading to density dependence. Additional analysis will attempt to determine if increased exploitation of brown trout could decrease density and allow greater growth of surviving individuals.

Conclusions

The data collected by this project will be highly valuable for future management of the Lanier Tailwater. Prior to this study, very little data existed to evaluate population dynamics factors for wild brown trout in the Chattahoochee River. Managers will be able to better understand both potential increases as well as limiting factors for this population when formulating management plans. Limiting factors for growth and/or abundance of this population appear to include some combination of food availability (resulting from river productivity), habitat availability (brown trout were highly localized within preferred habitats, personal observation), low water temperatures, and potential density dependence. Future analyses of this project and other future studies should concentrate on analyzing these limiting factors and exploring ways to mitigate their limiting influence.

This project also provided an excellent cooperative effort between agencies and non-governmental organizations with a major investment in the management and future of the Chattahoochee River. A large number of volunteers were able to participate in scientific research and learn about the river beyond their personal experiences. Georgia WRD will present the findings of this research to the study partners and other interested groups. The increase of available knowledge about the system should be a benefit in the future to all of the study partners, from the casual angler to the professional scientist.

Acknowledgements

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