Tidal Chickahominy River
Supplemental Stocking Project
2009
Year 4

Concurrent with severe regional drought during the period 1999 – 2002, largemouth populations in the Chickahominy and other tidal rivers in the region experienced a period of poor or failed recruitment, which eventually resulted in reduced angler catches. Recruitment improved dramatically in the years following the drought, and tidal river largemouth bass populations, and fisheries, rebounded rapidly. However, concerns remained as to future periods of poor recruitment, given the dynamic nature of tidal systems

To determine the effectiveness of supplemental stocking fingerling largemouth in tidal river systems, oxytetracycline (OTC) marked F_1 (Florida X northern) fingerlings were stocked in the tidal Chickahominy River system over three consecutive years from 2005 – 2007 at a rate of 62 fish/ha (25 fish/ac). With available habitat estimated to be 1,856 ha (4,586 ac), approximately 114,000 fingerlings were stocked each of the three years. Determination of stocking success was based on two parameters: contribution of stocked fish to year-class strength, and boat electrofishing catch rates – catch per effort (CPE) – over time. Annual boat electrofishing surveys are conducted during October-November in this tidal river system, therefore, sampling events for this project were set to coincide with these surveys. The 2005 – 2007 year-classes to be sampled at age 0+, age 1+, and age 2+. Additional sampling was conducted in April of 2006, 2007, and 2008, to assess over-winter survival of the previous year's stocked fish. All sampling occurred at sites included in the annual fixed station fall electrofishing surveys (Figure 1).

In 2008, the forth year of the project was completed, with continued assessments of the three stocking events. In October-November 2008, VDGIF fisheries biologists conducted their annual boat electrofishing survey of the tidal Chickahominy, sampling 15 stations and expending a total of 4.2 hours of boat electrofishing effort. During the fall survey, a random sample of adult largemouth (n = 224) was aged, and a check was made for OTC marks

Assessment of 2005 Stocking

Approximately 40 months post-stocking, stocked fish accounted for just 6.4% of the 2005 year-class largemouth sampled (Table 1), with $CPE_{(natural\text{-}spawn)}$ = 13 fish/hour and $CPE_{(stocked)}$ = 1 fish/hour. Sample size of stocked 2005 year-class fish was too small for any analysis of growth, relative to natural-spawn fish from that year-class.

Although initial mortality was quite high for the 2005 cohort of stocked fish, at three-plus years post-stocking, these fish have persisted in the system at low relative

abundance levels, with fairly consistent contribution of stocked fish to the 2005 year-class (Table 1).

Assessment of 2006 Stocking

The contribution of stocked fish to the 2006 year class has remained remarkably stable over the assessment period. A check of OTC marks on otoliths from a random sub-sample (n = 50) of age 2+ fish collected by boat electrofishing in October 2008 (approximately 29 months after the June 2006 stocking) indicated that 70% of the 2006 year-class sampled were stocked fish. The estimated total catch per effort (CPE) of 2006 year-class largemouth was 16 fish/hr, with $CPE_{(stocked)}$ = 11 fish/hour and $CPE_{(natural\text{-}spawn)}$ = 5 fish/hour. Although stocked fish were significantly larger than natural-spawn fish (mean $TL_{(stocked)}$ = 383 mm and mean $TL_{(natural\text{-}spawn)}$ = 325 mm), no significant increase in the size difference between stocked and natural-spawn fish was detected in the period since October 2006 – stocked fish did not outperform natural-spawn fish in terms of growth in the interim between October 2006 and October 2008.

As opposed to the 2005 cohort, returns of the 2006 cohort of stocked fish have been outstanding – with consistent contribution of stocked fish to the year-class and robust catch rates (Table 2). As a result, rather than a below average year-class, the combined (stocked and natural-spawn) year-class was unusually strong – these fish have recruited to the adult population, and the fishery.

Assessment of 2007 Stocking

In April 2008, approximately 11 months post-stocking, biologists conducted a boat electrofishing survey targeting 2007 year-class largemouth bass, sampling 15 stations and expending a total of 3.5 hours of boat electrofishing effort. Given expected growth of largemouth in the tidal Chickahominy, only largemouth smaller than 28 cm were collected. Ages were determined and otoliths were checked for the presence of OTC marks. Of the fish sampled, 200 were from the 2006 year-class, 50% were stocked fish. Stocked fish (median TL = 236 mm) were significantly larger than natural-spawn fish (median TL = 182 mm) – Mann-Whitney Rank Sum Test ($p < 0.001$).

A check of OTC marks on otoliths from a random sub-sample (n = 114) of age-1+ fish collected by boat electrofishing in October, approximately 17 months after the May 2007 stocking, indicated that 47% of the 2007 year-class sampled were stocked fish. Total catch per effort (CPE) of 2007 year-class largemouth was 33 fish/hr, with $CPE_{(stocked)}$ = 15 fish/hour and $CPE_{(natural\text{-}spawn)}$ = 18 fish/hour. Although stocked fish collected during the survey were significantly larger than natural-spawn fish (mean $TL_{(stocked)}$ = 319 mm and mean $TL_{(natural\text{-}spawn)}$ = 286 mm), the size difference between stocked and natural-spawn fish was approximately half what is was in October 2007 (Figures 2 &3). Stocked fish had not outperformed natural-spawn fish in terms of growth in the interim between October 2007 and October 2008, and it may be natural-spawn fish are outperforming the F_1 stocked fish.

As with the 2006 cohort, catches of 2007 cohort of stocked fish have been outstanding (Table 3). While this was an average, to less than average, year-class for Chickahominy-spawned largemouth, given minimal compensatory mortality, the combined (stocked and natural-spawn) 2007 year-class is quite strong to-date. A more complete picture of the recruitment of this year-class will be available at the end of 2009, two-plus years post stocking and after this cohort has fully recruited to the fishery.

Summary

Results to-date indicate that, given appropriate stocking conditions and handling of stocked fish, supplemental stocking of fingerling largemouth bass is effective in the tidal Chickahominy system. Stocked fish augmented year-classes, with significant increases in the abundance of stock-size largemouth occurring in the population as these year-classes recruited to the size-class. Stocked fish have persisted to recruit to the fishery, the 2005 and 2006 fish have fully recruited, and the 2007 fish will have fully recruited by late 2009. Outstanding returns of the 2006 and 2007 cohorts have resulted in the production of two strong year-classes from what would have been a below average natural-spawn year class in 2006 and an average year class in 2007.

In 2006 and 2007, stocked fish were significantly larger than natural-spawn fish as YOY sampled in the fall. However, the size differential may not be due to differences in growth rates (stocked v. natural-spawn), but rather a function of an early stocking date – stocked fish getting a jump start on growth over natural-spawn YOY. The 2006-stocked fish did not increase their size differential over natural-spawn fish by October age 1+ sampling. For the 2007 year-class, the differential between stocked and natural-spawn and fish decreased by age 1+ October sampling. The 2005 stocked fish, were not significantly larger than natural-spawn fish as YOY, and have not grown significantly faster in the time since. Stocking occurred in July of 2005, as opposed to late May and early June in 2006 and 2007.

At this point, there is no evidence the F_1 fish are out performing (in terms of growth) Chickahominy-spawned fish. Unless F_1 fish out perform Chickahominy-spawned fish at older ages (beyond age-2+), there is no apparent advantage to stocking F_1 fingerlings, and use of brood stock collected from the tidal Chickahominy would be the obvious choice in future stocking efforts.

It remains undetermined whether supplemental stocking will be successful when recruitment failure is occurring in the system – while recruitment was below average in 2006, recruitment failure did not occur in the population during this study. In addition, the question remains as to whether the results observed in this system can be replicated elsewhere. However, the results of this study are positive indications that fisheries managers will be able to use supplemental stocking to augment weak or failed year-classes, resulting in more stable bass fisheries in these highly dynamic systems.

Table 1. Summary of the percent contribution of OTC-marked fish to the 2005 year-class, and catch per effort (CPE) of stocked, natural-spawn, and total 2005 year-class fish sampled. The number of 2005 year-class fish (stocked and total) sampled in parentheses.

	Percent		CPE (fish/hr)		
Sample Date	**Stocked Fish**		**Stocked**	**Natural**	**Total**
October 2005	**8.2%**	(8 of 97)	**2.0**	**22.6**	**24.6**
April 2006	**9.9%**	(14 of 142)	**3.0**	**27.3**	**30.2**
October 2006	**19.2%**	(15 of 78)	**9.5**	**39.8**	**49.3**
October 2007	**11.4%**	(8 of 70)	**2.2**	**17.5**	**19.7**
October 2008	**6.4%**	(3 of 47)	**0.9**	**12.7**	**13.6**

Table 2. Summary of the percent contribution of OTC-marked fish to the 2006 year-class, and catch per effort (CPE) of stocked, natural-spawn, and total 2006 year-class fish sampled. The number of 2006 year-class fish (stocked and total) sampled in parentheses.

	Percent		CPE (fish/hr)		
Sample Date	**Stocked Fish**		**Stocked**	**Natural**	**Total**
October 2006	**78.6%**	(158 of 201)	**35.6**	**9.7**	**45.2**
April 2007	**74.8%**	(80 of 107)	**23.0**	**7.8**	**30.8**
October 2007	**73.7%**	(84 of 114)	**22.9**	**8.2**	**31.1**
October 2008	**70.0%**	(35 of 50)	**11.2**	**4.8**	**16.0**

Table 3. Summary of the percent contribution of OTC-marked fish to the 2007 year-class, and catch per effort (CPE) of stocked, natural-spawn, and total 2007 year-class fish sampled. The number of 2007 year-class fish (stocked and total) sampled in parentheses.

	Percent		CPE (fish/hr)		
Sample Date	**Stocked Fish**		**Stocked**	**Natural**	**Total**
October 2007	**65.8%**	(77 of 117)	**27.1**	**14.1**	**41.1**
April 2008	**50.0%**	(100 of 200)	**28.8**	**28.8**	**57.6**
October 2008	**46.5%**	(47 of 101)	**15.2**	**17.5**	**32.7**
October 2009					

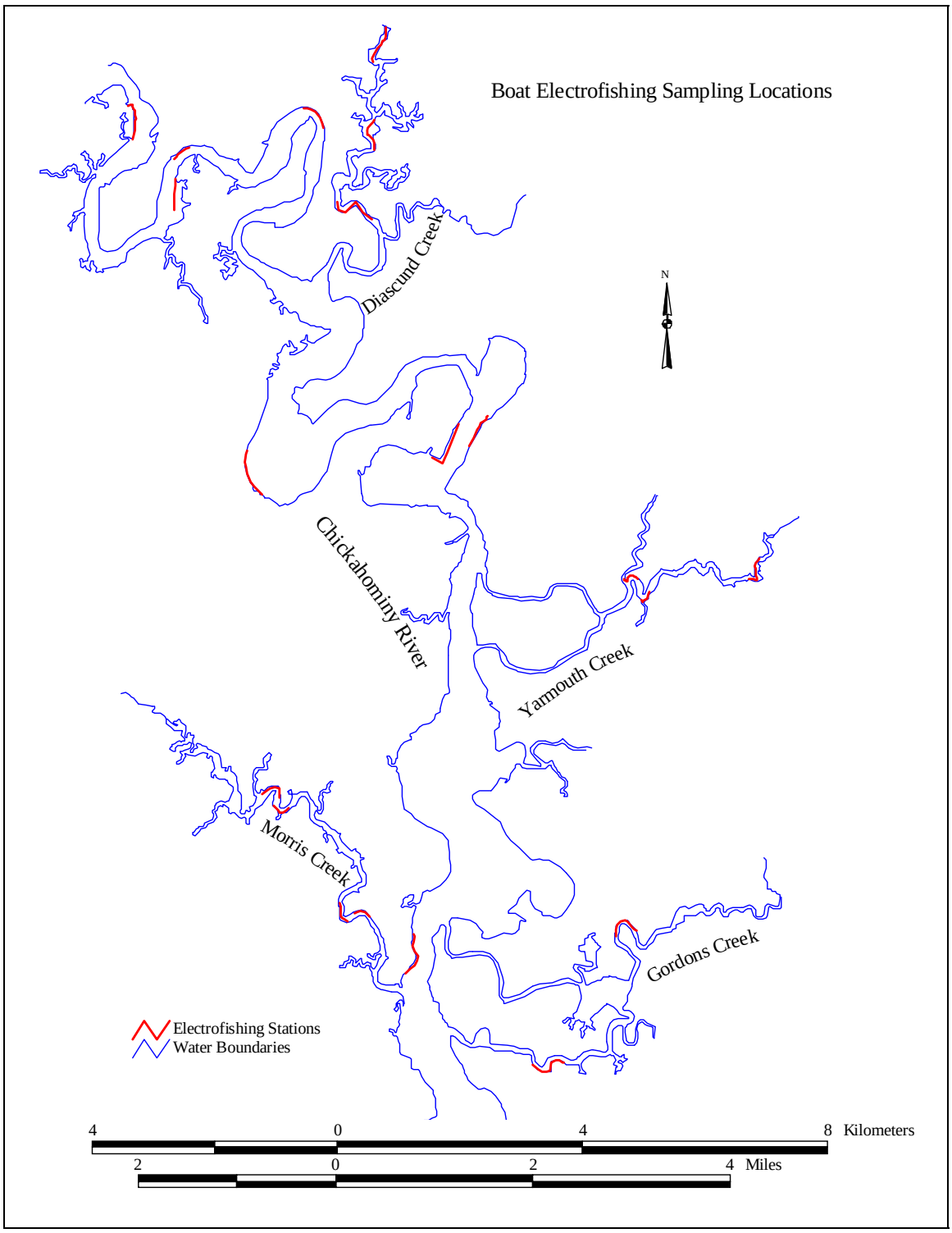

Figure 1. Distribution of sites sampled during boat electrofishing.

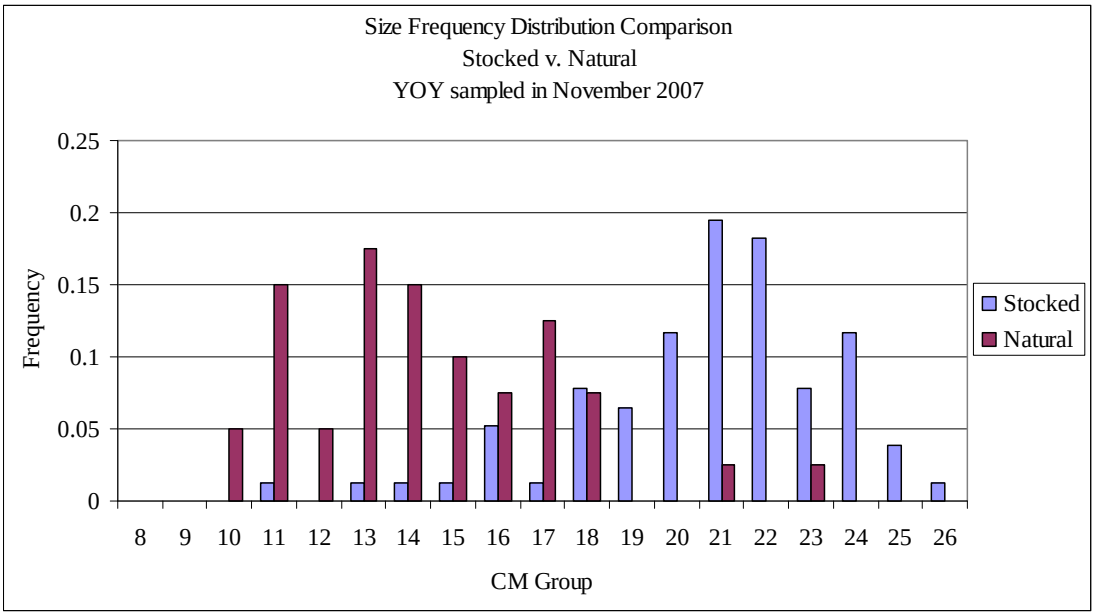

Figure 2. Comparison of the size distribution of stocked and naturally spawned 2007 year-class largemouth collected during boat electrofishing of the tidal Chickahominy River system in October-November 2007. Stocked fish were significantly larger than natural-spawn fish – t-test difference 62 mm; 95% C.I. (51 – 73 mm); p<0.001.

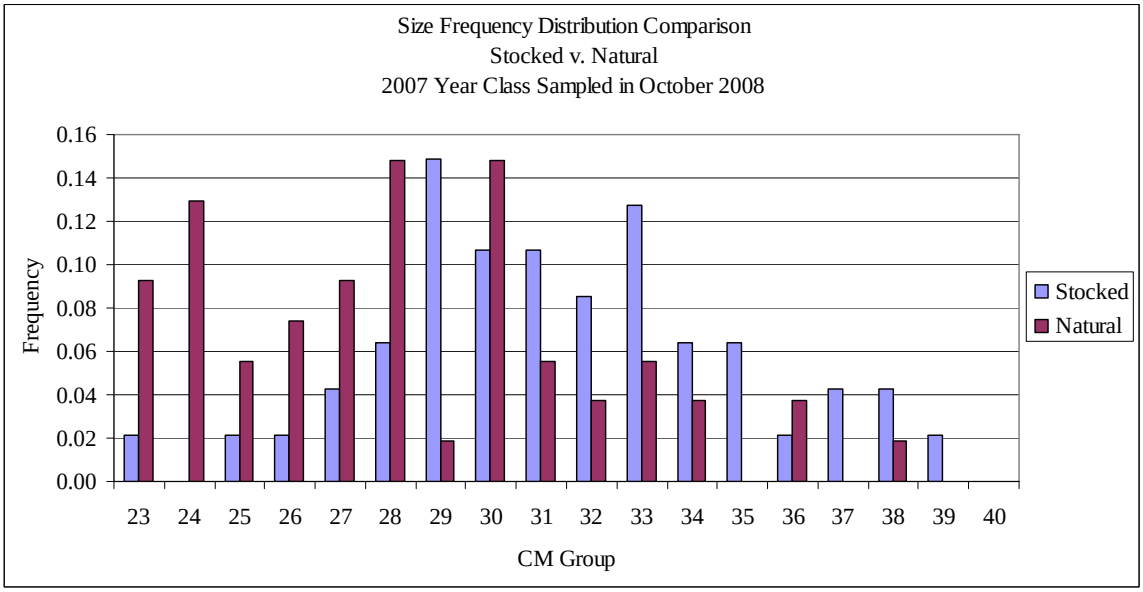

Figure 3. Comparison of the size distribution of stocked and naturally spawned 2007 year-class largemouth collected during boat electrofishing of the tidal Chickahominy River system in October 2008. Stocked fish were significantly larger than natural-spawn fish – t-test difference 33 mm; 95% C.I. (19 – 47 mm); p<0.001.

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