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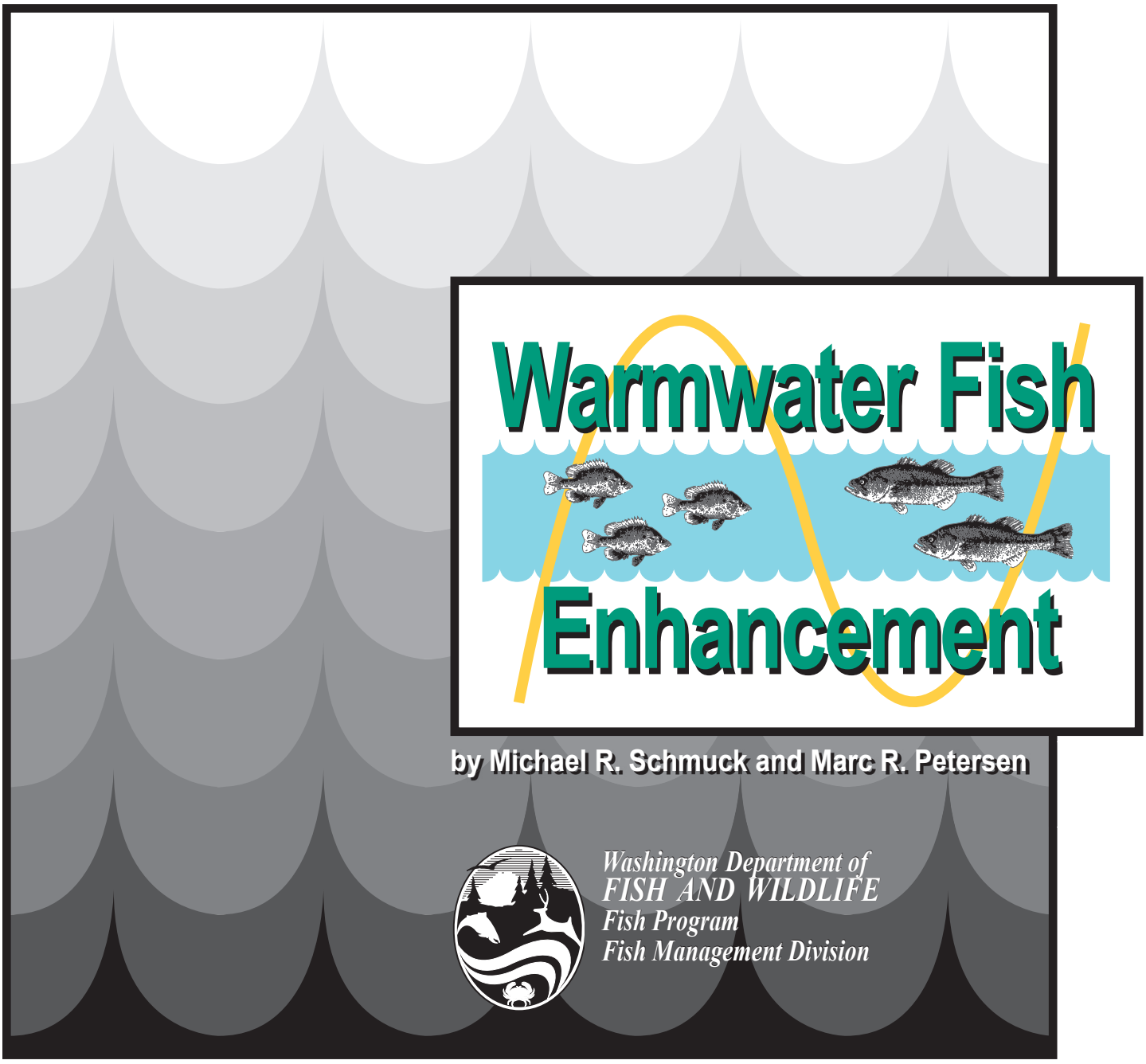
2005 Warmwater Fisheries Survey of Stan Coffin Lake, Grant County, Washington



by Michael R. Schmuck and Marc R. Petersen

Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

FPT 06-07

2005 Warmwater Fisheries Survey of Stan Coffin Lake, Grant County, Washington

A Five-Year Summary of the Fish Community in a Small Central Washington Lake Managed for Quality, Catch-and-Release Bass Angling

By

Michael R. Schmuck and Marc R. Petersen
Warmwater Fisheries Enhancement Program
Region Two
Washington Department of Fish and Wildlife
1550 Alder Street NW
Ephrata, WA 98823

Fish Program Report Number FPT 06-07

July 2006

Acknowledgements

We would like to thank Joe Miller, Jeff Korth, Patrick Verhey, and Tammy Gish from the Washington Department of Fish and Wildlife (WDFW) for their assistance during this survey. We are also grateful to the Moses Lake Fisheries Evaluation Project (Dave Burgess and Katrina Simmons) for donating supplies and equipment for this survey. We would also like to thank Lucinda Morrow, from the WDFW fish aging lab for aging fish collected during this survey. We are thankful to David Bramwell who formatted the final draft of this report. This project was funded through the WDFW Warmwater Enhancement Program.

Abstract

Stan Coffin Lake was surveyed by the Region Two Warmwater Team September 7-8, 2005 using standardized warmwater survey methods. This is the fifth year of surveys conducted to determine long-term trends in this fishery. The most abundant species collected was pumpkinseed sunfish (*Lepomis gibbosus*), closely followed by bluegill (*L. macrochirus*), and largemouth bass (*Micropterus salmoides*). Yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*M. dolomiteu*), and prickly sculpin (*Cottus asper*) comprised the remainder of the fish collected. Yellow perch, pumpkinseed sunfish, black crappie and largemouth bass increased in our samples since 2004, while bluegill, and channel catfish declined over the same period. Relative weights were near the national average (W_r = 100) for all species with the exception of yellow perch. From 2001-2004, yellow perch declined in relative abundance, while bluegill increased. Black crappie relative abundance remained relatively unchanged from 2001-2004, while largemouth bass decreased in our samples from 2001-2003, yet increased significantly in 2004.

A population estimate on largemouth bass $\geq$ stock length in Stan Coffin Lake was conducted in fall 2005 to establish baseline data for correlations between electrofishing catch-per-unit-effort, and population size, and to determine effects of predator densities on populations of panfish. The population of largemouth bass $\geq$ eight inches in Stan Coffin Lake was 1,597 (95% CI; 1,307- 2,136); resulting in a density of approximately 40 fish per acre.

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Introduction

Stan Coffin Lake is located in the Quincy Wildlife Area, Grant County, Washington (T19N - R23E, Sec 11) approximately 8.3 kilometers (5.2 miles) northwest of the city of George, Washington. This lake has a surface area of approximately 101 hectares (40.9 acres) and is approximately 6.1 meters (20 feet) at its deepest point. Stan Coffin Lake was formed in 1953 by drainage from the Columbia Basin Irrigation Project. It is now a permanent, year-round lake. The lake can be accessed from George, WA by traveling north on Road Q to Road 5 NW. Travel west on Road 5 NW approximately 3 miles to Road T NW. Turn left and follow a gravel road southeasterly approximately 1 mile to Stan Coffin Lake.

Stan Coffin Lake, as well as the surrounding uplands, is owned by the Bureau of Reclamation and managed by the Washington Department of Fish and Wildlife (WDFW) for wildlife and fisheries recreation. The WDFW operates a public boat launch on the west side of the Lake. In addition, there is also a toilet available that is accessible to persons with disabilities. This area is open to vehicle traffic between February 15 and October 1.

Stan Coffin Lake is managed as a bass and bluegill fishery. Current management calls for annual stocking of ~ 400 largemouth bass (*Micropterus salmoides*) > ten inches. In addition, anglers may not retain largemouth bass. This stocking regime and regulation were enacted to retain a high proportion of large, more piscivorous bass in the lake in order to control bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), pumpkinseed sunfish (*L. gibbosus*), and yellow perch (*Perca flavescens*) populations. Regional fisheries biologists identified Stan Coffin Lake as a body of water to be periodically surveyed under the WDFW Warmwater Enhancement Program. These surveys are conducted to monitor abundance, size, and condition of the fish species present in this lake. This information is used to monitor and evaluate WDFW management actions and to provide the public with status reports on this fishery.

We began this investigation in 2001, and have collected data on species assemblage and condition each fall since. This report is a summary of these data, with emphasis on trends in species composition, abundance, stock densities and thoughts on specific management goals. This report also summarizes results from a population estimate conducted one week prior to the warmwater survey.

Methods

Standard Warmwater Survey

Sampling Procedures

The Region Two Warmwater Assessment Team surveyed Stan Coffin Lake during September 7-8, 2005 in accordance with standardized warmwater sampling methodology. All fish were collected using a boat electrofisher, gill nets, and fyke nets. Sampling locations were selected by dividing the shoreline into 400 m sections determined from a map. The number of randomly selected sections surveyed are as follows: electrofisher (4), gill nets (2), and fyke nets (2). Electrofishing occurred in shallow water (0.2-5.5 m), adjacent to the shoreline at a rate of approximately 40 m/minute for 600 second intervals (Bonar et al. 2000). Gill nets and fyke nets were set overnight prior to electrofishing and were pulled the following morning (1 net night each). All sampling was conducted during nighttime hours when fish are most numerous along the shoreline, thus maximizing the efficiency of each gear type.

Once collected, fish were identified to species, measured (total length (TL)) and weighed (g). Total length data were used to construct length-frequency histograms and to evaluate the size structure of the warmwater gamefish (yellow perch, pumpkinseed sunfish, black crappie, largemouth bass, and smallmouth bass (*M. dolomieu*)) populations in the lake.

Species Composition

Species composition, by weight (kg) and number, was determined from fish captured. Fish less than one year old i.e., young-of-the-year (YOY) were excluded from analyses. Eliminating YOY prevents distortions in species composition that fluctuate between sampling locations, sampling method, and specific timing of hatches (Fletcher et al. 1993).

Catch Per Unit Effort

Catch per unit effort (CPUE, fish/hour or fish/net night) of each sampling gear was determined for each warmwater fish species collected. Electrofisher CPUE was determined by dividing the number of fish captured by the total amount of time that was electrofished. Similarly, CPUE of gill netting and fyke netting was determined by dividing the number of fish captured by the total time the nets were deployed.

Relative Weight

A relative weight (W_r) index was used to evaluate the condition of fish in Stan Coffin Lake. Relative weight of a fish is the relationship between the actual weight of a fish at a given length to the national average weight (standard weight W_s) of a fish of the same species and length. A W_r of 100 generally indicates that the fish is in a condition similar to the national average for that species and length (Anderson and Neumann 1996). The index is defined as:

$$Wr = \frac{W}{Ws} \times 100$$

where W is the weight (g) of an individual fish and W_s is the standard weight of a fish of the same total length (mm). The W_s was derived from a standard weight-length ($\log_{10}$) relationship, which was defined for each species of interest (Anderson and Neumann 1996). Only fish age one and older were used for calculations of W_r, as the variability can be significant for YOY. Relative weights less than (W_r = 50) were also excluded from our analysis as we suspected unreliable weight measurements.

Proportional Stock Density—Relative Stock Density

Stock density indices (PSD and RSD) are used to determine size distributions of fish populations, and are useful for evaluating predator-prey ratios. Samples that contain at least 55 stock length fish generate lower variability around the PSD estimate and are much more useful to managers than those that contain fewer fish (Gustafson 1988). Boat electrofishing is a highly regarded method for collecting large samples of stock length and larger centrarchid fishes (bass, crappie, bluegill), while gill nets are an excellent tool for collecting large samples of stock length and larger percids (perch and walleye) (Divens et al. 1996). The proportional stock density (PSD) of each warmwater gamefish species was determined following procedures outlined in Anderson and Neumann (1996). PSD used two measurements, stock length and quality length, to provide useful information about the proportion of various size fish in a population. Stock length was defined as the minimum size of a fish, which provides recreational value or the approximate length when fish reach maturity (Table 1). Quality length was defined as the minimum size of a fish that most anglers liked to catch and begin keeping. PSD was calculated using the number of quality size fish, divided by the number of stock size fish, multiplied by 100. Stock and quality lengths, which vary by species, are based on percentages of world-record lengths. Stock length was 20-26 percent of world record length, whereas quality length was 36-41 percent of world record length. Gustafson (1988) reported that at least 55 stock length fish are needed in order to calculate statistically valid PSD estimates. Electrofishing is a useful tool for collecting large samples of centrarchids (bass, panfish) and gill nets are effective for

collecting large samples of percids (perch, walleye (*Sander vitreum*)). Based on these trends, and in order to maintain consistency, we report electrofishing PSDs for centrachids and gill net PSDs for percids.

Relative stock density (RSD) of each warmwater gamefish species was examined using the five-cell model proposed by Gabelhouse (1984). In addition to stock and quality lengths, preferred, memorable, and trophy categories were added (Table 1). Preferred length (RSD-P) was defined as the minimum size of fish anglers preferred to catch. Memorable length (RSD-M) referred to the minimum size fish anglers remembered catching and trophy length (RSD-T) referred to the minimum size fish worthy of acknowledgment. Preferred, memorable, and trophy length fish were also based on percentages of world record lengths. Preferred length was 45-55 percent of world record length, memorable length was 59-64 percent of world record length, and trophy length was 74-80 percent of world record length. RSD differs from PSD in that it is more sensitive to changes in year class strength. RSD was calculated as the number of fish within the specified length category, divided by the total number of stock length fish, multiplied by 100. Eighty percent confidence intervals for PSD and RSD were selected from tables in Gustafson (1988).

Table 1. Minimum length categories of warmwater fish used to calculate PSD and RSD values (Willis et al. 1993).

Species	Length Category (mm)				
	Stock	Quality	Preferred	Memorable	Trophy
Yellow perch	130	200	250	300	380
Bluegill	80	150	200	250	300
Black crappie	130	200	250	300	380
Largemouth bass	200	300	380	510	630
Smallmouth bass	180	280	350	430	510
Channel catfish	280	410	610	710	910

Mark - Recapture Population Estimate

Stan Coffin Lake was electrofished by two, three-person teams. Electrofishing occurred along the shoreline a rate of approximately 40 meters / minute. Largemouth bass > eight inches were collected and placed in a live-well. Total length (TL), and weight (g) were recorded, scales were removed for age analysis, a sequentially numbered FloyÓ t-bar anchor tag was implanted along the dorsal fin, and a portion of the upper caudal fin was clipped in order to later determine tag retention rates. Once all fish were measured and marked they were returned to the beginning of the section from where they were collected. This was done to reduce recapture of these fish in the subsequent section. After one week bass were collected using similar methods. Unmarked largemouth bass > eight inches were tagged, caudal fin clipped and data were recorded (i.e. length, weight). Marked (FloyÓ tagged) largemouth bass had length, weight, and tag number recorded. Effort was similar (in terms of shoreline shocked) to the mark-event. A population estimate N was generated using the adjusted Petersen method (Ricker 1975).

$$N = \frac{(M+1)(C+1)}{(m+1)}$$

where: M = The number of bass marked during the mark – event
C = The number of fish collected during the recapture – event
m = The number of fish marked in the recapture – event

Results

Warmwater Survey

Species Composition

Seven fish species were collected during this survey. Warmwater gamefish comprised 99 percent of the total number of fish collected and 99 percent of the biomass of fish collected (Table 2). The only non-gamefish collected was prickly sculpin (*Cottus asper*). Primary management species for this lake (largemouth bass, bluegill, and black crappie) comprised 55 percent of abundance and 66 percent of biomass collected during this survey. In 2004, these species comprised 77 percent of the fish collected and 66 percent of the biomass. This decline in abundance is attributed to a 66 percent decline in bluegill from 2004 to 2005, as well as ~150 percent increase in pumpkinseed sunfish and yellow perch (Figure 1,Figure 2). Yellow perch, while increasing 1.5-fold since 2004, showed no increase in biomass, indicating that this population is comprised of small fish. Largemouth bass showed an increase in abundance (> 100 %); however, biomass of this species remained unchanged from 2004 to 2005. Black crappie exhibited a slight increase in abundance; however, this population is comprised of very few fish. Channel catfish (*Ictalurus punctatus*) have declined steadily since 2003, when we collected 39 fish. One smallmouth bass was also collected during this survey.

Table 2. Species Composition, by weight (kg) and number (n), and size range of gamefish collected during Sept. 7 - 8, 2005 on Stan Coffin Lake (Grant County, WA)

		Species Composition					
	Change in abundance from 2004	Weight		Number		Size Range (mm)	
Species		Kg	%	n	%	Min	Max
Yellow perch	↑ 145 %	2.3	2.9	76	8.6	86	247
Bluegill	↓ 66 %	9.8	12.5	289	32.8	55	170
Pumpkinseed sunfish	↑ 151 %	7.5	9.5	301	34.2	56	161
Black crappie	↑ 40 %	1.9	2.5	35	4.0	92	204
Largemouth bass	↑ 114 %	40.3	51.5	152	17.3	52	520
Smallmouth bass		0.1	0.1	1	0.1	195	195
Channel catfish	↓ 25 %	16.3	21.0	15	1.7	423	535
Prickly sculpin		0.1	0.1	11	1.3	72	114
TOTAL		**78.2**	**100.0**	**876**	**100.0**		

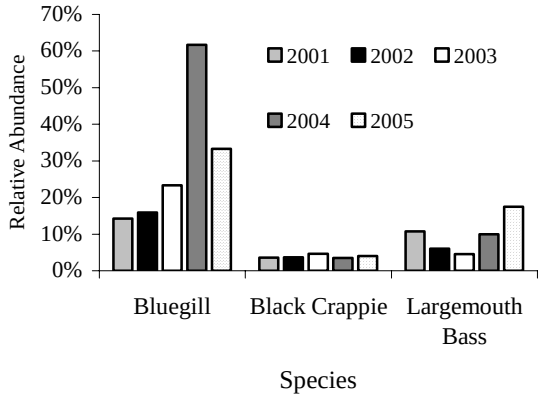

Figure 1. Trends in relative species abundance for primary management species from warmwater surveys conducted from 2001 to 2005.

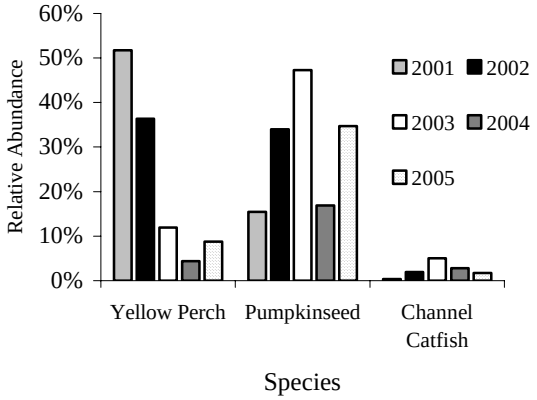

Figure 2. Trends in relative species abundance for secondary management species from warmwater surveys conducted from 2001 to 2005.

Catch Per Unit Effort (CPUE)

With the exception of channel catfish, more fish were captured with the boat electrofisher than by any other gear. Channel catfish were captured more effectively with gill nets. Boat electrofisher catch rates were highest for bluegill and pumpkinseed sunfish, although these rates had a high degree of variation (Table 3). Largemouth bass, yellow perch and black crappie had lower catch rates; however, black crappie and yellow perch had relatively high variation surrounding this estimate. Channel catfish and yellow perch had similar gill net catch rates; however, variation surrounding these estimates was as high as the estimate itself. Gill net catch rates for largemouth bass, pumpkinseed sunfish and black crappie were low, and no bluegill were collected in gill nets. Channel catfish was the only species collected during this survey not collected in fyke nets. Fyke net catch rates were highest for pumpkinseed, bluegill and yellow perch. These rates also had high variation. Trends in relative abundance (Figure 1,Figure 2,) correlate well with trends in electrofishing CPUE for bluegill and largemouth bass from 2001-2005 (Figure 3).

Table 3. Mean CPUE by sampling method, including 80% confidence intervals for warmwater fish species collected on Stan Coffin Lake, September 2005.

	Gear Type					
	Boat Electrofisher		Gill Nets		Fyke Nets	
Species	Fish / Hour ± CI	No. Sites	No. Net Night	Net Nights	No./ Net Night	Net Nights
Yellow perch	84 (± 33)	4	6 (± 6)	2	4 (± 5)	2
Bluegill	409 (± 107)	4	0	2	6 (± 7)	2
Pumpkinseed sunfish	390 (± 109)	4	2 (± 2)	2	16 (±17)	2
Black crappie	49 (± 32)	4	.5 (± .6)	2	.5 (± .6)	2
Largemouth bass	209 (± 24)	4	3 (± 0)	2	2 (± 2)	2
Channel catfish	5 (± 4)	4	6 (± 8)	2	0	2

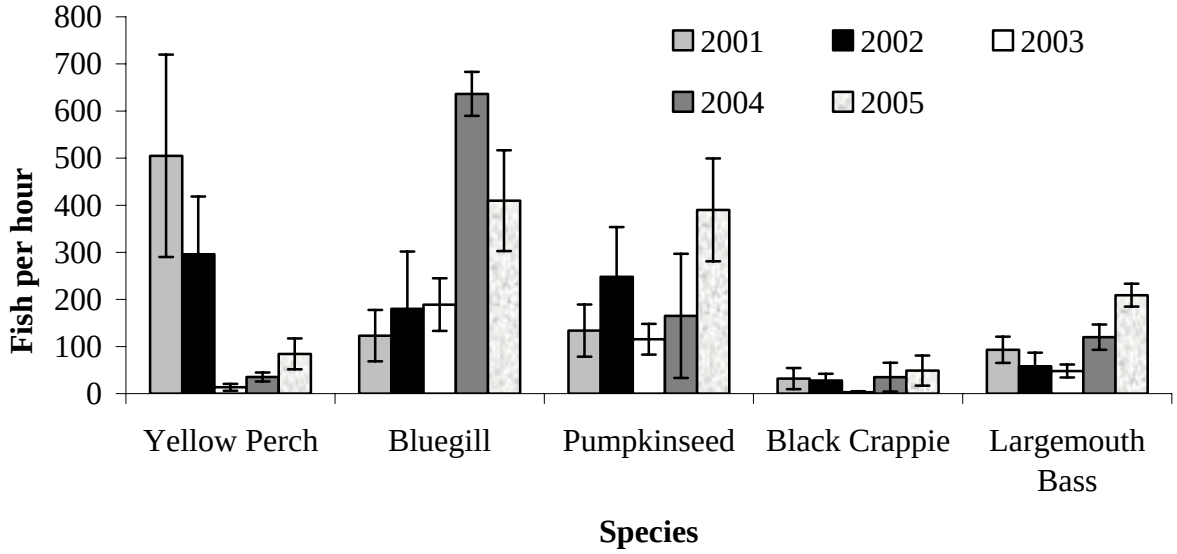

Figure 3. Electrofishing catch per unit effort (CPUE ± 80% CI) from fall warmwater fish surveys conducted on Stan Coffin Lake from 2001 to 2005.

Stock Density Indices

The PSD for bluegill collected during this survey was 15 (+ 3) and indicates that this population is primarily comprised of fish less than six inches (Table 4). The PSD for largemouth bass was 64 (+ 8) and indicates that most fish are between 12 and 15 inches. Relative stock density values (RSD-P and RSD-M), when combined with this PSD indicate bass stock densities are within the "balanced" management range described by Willis et al. (1993). The bluegill PSD has increased since 2004; however, it remains lower than desired for this fishery. Further predation by bass on bluegill will likely bring the bluegill PSD into the balanced management range (20 - 60). Bluegill PSD's decreased steadily from 2001 to 2004 while largemouth bass PSDs increased over the same interval. We found that largemouth bass PSD was inversely correlated with bluegill PSD (Figure 4). This is similar to trends seen by Guy and Willis (1990) and Novinger and Legler (1978). The increase of the largemouth bass PSD is attributed to the stocking of ~1200 adult largemouth bass during this time period; however it is probably too soon to make any management decisions based on current PSDs.

Table 4. Stock density indices (± 80 percent confidence interval) for warmwater fishes collected using boat electrofisher, gill nets, and fyke nets on Stan Coffin Lake during September 2005.

Species	Stock Length Fish (n)	PSD	RSD-P	RSD-M	RSD-T
		Boat Electrofisher			
Yellow perch	7	43 (± 24)	0	0	0
Bluegill	224	15 (± 3)	0		
Black crappie	29	3 (± 4)	0	0	0
Pumpkinseed sunfish	177	5 (± 2)	0	0	0
Largemouth bass	64	64 (± 8)	13 (± 5)	2 (± 2)	0
		Gill Nets			
Yellow perch	7	43 (± 24)	0	0	0
Largemouth bass	4	100 (± 0)	0	0	0
Channel catfish	12	100 (± 0)	0	0	0
		Fyke Nets			
Yellow perch	3	67 (± 35)	0	0	0
Pumpkinseed sunfish	11	0	0	0	0
Largemouth bass	2	50 (± 45)	0	0	0

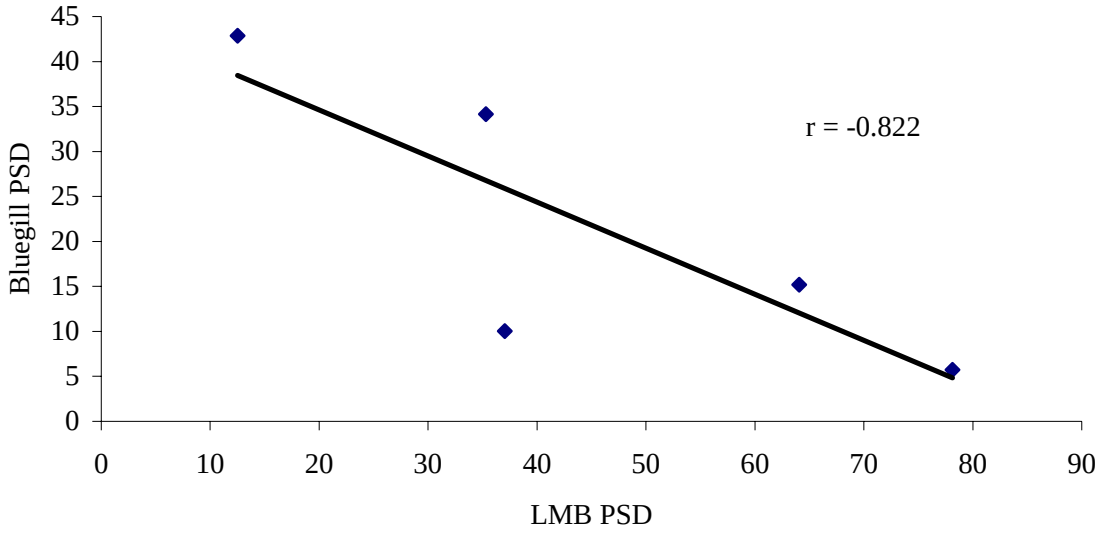

Figure 4. Correlation between bluegill PSD and largemouth bass PSD, 2001 to 2005.

Yellow Perch

A total of 76 yellow perch were collected during this survey. Yellow perch ranged from 86–247 mm (3-10 inches), and the majority of fish were collected with the boat electrofisher (Figure 5). Yellow perch abundance has increased 145 percent since 2004, yet biomass remains relatively unchanged. This indicates an increase in small yellow perch combined with a decrease in large fish. Relative weights varied greatly for small yellow perch and declined as yellow perch length increased (Figure 6). This trend in relative weight for larger yellow perch was also seen in 2004. While yellow perch increased in our samples, this species represents a small portion of this fish community. This increase could be an artifact of sampling since this was a one-night survey.

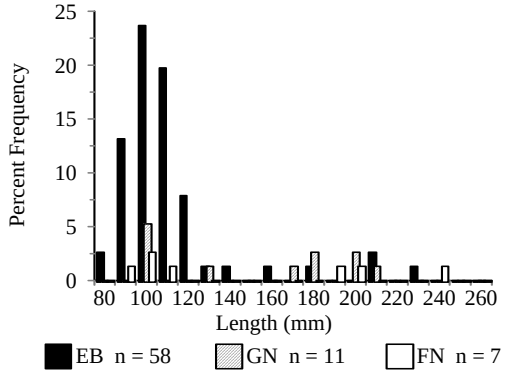

Figure 5. Length frequencies of yellow perch collected using a boat electrofisher (EB), gill nets (GN), and fyke nets on Stan Coffin Lake.

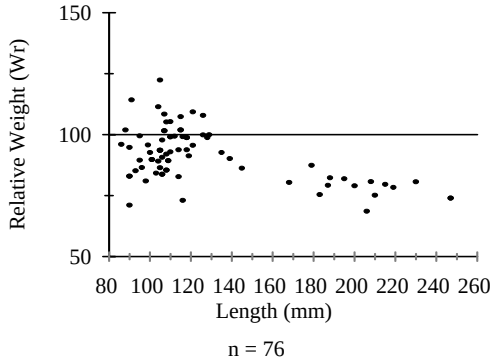

Figure 6. Relative weights of yellow perch collected at Stan Coffin Lake compared to the national average (W_r = 100) (Anderson and Neumann 1996)

Bluegill

A total of 289 bluegill were collected during this survey. Bluegill ranged in size from 55-170 mm (2-7 inches); however, most fish were less than six inches (Figure 7). The majority of bluegill were collected with the boat electrofisher, and this gear type collected larger sizes of bluegill than either gill or fyke nets. Relative weights for bluegill less than stock length (80 mm) were generally above average (W_r = 100); however these varied widely (Figure 8). Relative weights for bluegill stock length and larger were close to the national average and varied less than those of small fish. Bluegill reached peak abundance in 2004; since then we have seen a 66 percent decline in this species. Bluegill abundance in 2005; however, was higher than that seen from 2001 to 2003. The decline in abundance of bluegill has corresponded with an increase of 10-13 inch largemouth bass that were stocked in Stan Coffin Lake. Declines in small bluegill were expected due to predation by bass. Corresponding increases in bluegill PSD from 2004 to 2005 indicate this population contains a higher proportion of large fish; however, numbers of quality length bluegill have changed very little from 2001 (Figure 9).

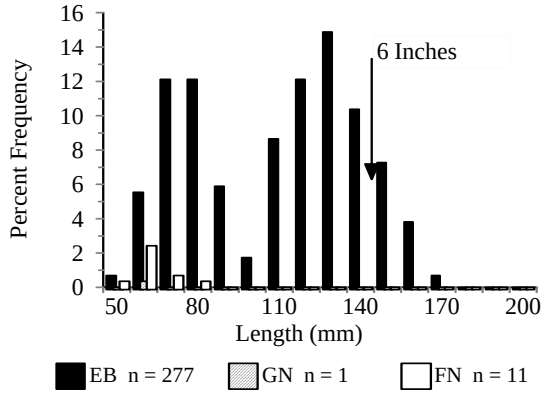

Figure 7. Length frequencies of bluegill collected using a boat electrofisher (EB), gill nets (GN) and fyke nets (FN) on Stan Coffin Lake.

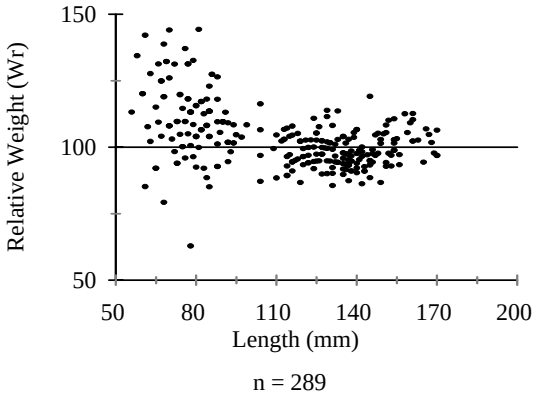

Figure 8. Relative weights of bluegill collected at Stan Coffin Lake compared to the national average (*Wr* = 100) (Anderson and Neumann 1996).

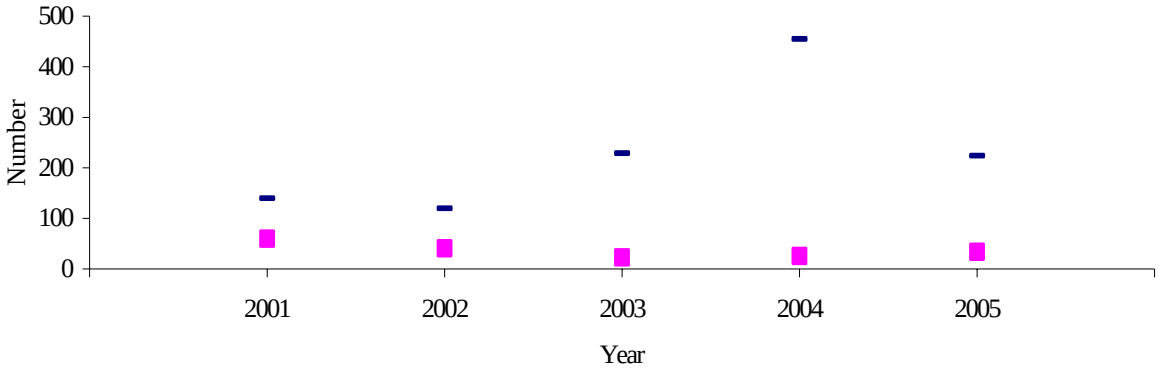

Figure 9. Number of stock length (dash), and quality length (box) bluegill collected from 2001 to 2005.

Pumpkinseed Sunfish

A total of 301 pumpkinseed sunfish were collected during this survey. Lengths ranged from 56 – 161 mm (2 – 7 inches) and nearly all fish were collected with the boat electrofisher (Figure 10). Pumpkinseed have doubled in both abundance and biomass since 2004. Relative weights of pumpkinseed varied widely for fish less than 100 mm; however relative weights were above the national average (W_r = 100) for most fish (Figure 11). Pumpkinseed sunfish provide forage for predatory fish; however, they compete with bluegill for food and space and limit the biotic potential of this desirable panfish. Pumpkinseed sunfish rarely grow to sizes anglers prefer to harvest and are not a desirable species in this lake. Largemouth bass are stocked into Stan Coffin Lake, in part, to reduce the pumpkinseed population. From 2001 to 2003 pumpkinseed declined significantly; however they increased measurably in 2004. Since 2004, pumpkinseed increased in abundance more than any other species collected.

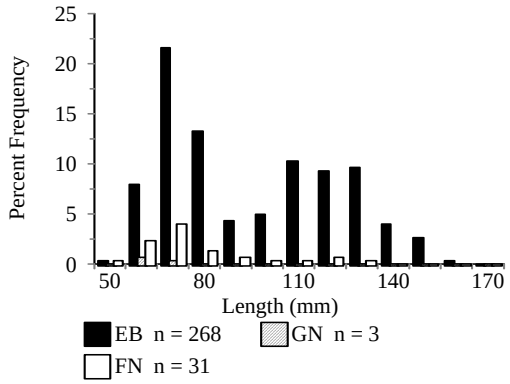

Figure 10. Length frequencies of pumpkinseed collected using a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) on Stan Coffin Lake.

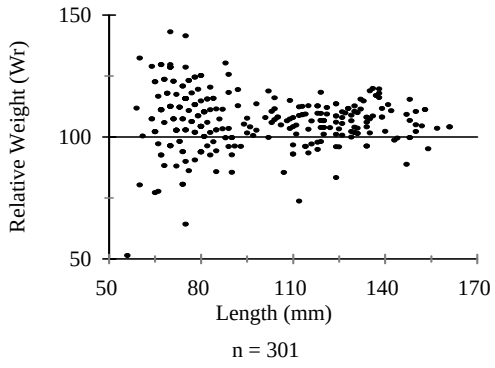

Figure 11. Relative weights of pumpkinseed collected at Stan Coffin Lake compared to the national average (W_r = 100) (Anderson and Neumann 1996)

Black Crappie

A total of 35 black crappie, ranging in size from 92 – 204 mm (4 – 8 inches) were collected during this survey – all but two were captured with our boat electrofisher (Figure 12). Black crappie abundance and size range is similar to that seen in 2004. This population is unique in that it remains relatively unchanged from 2001 – 2005. Relative weights were below the national average (W_r = 100) for most fish above 120 mm (Figure 13). This population fails to establish itself, likely due to competition with bluegill, largemouth bass (juveniles) and pumpkinseed sunfish for space and food.

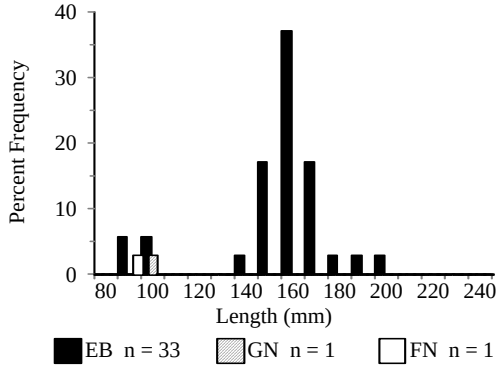

Figure 12. Length frequencies of black crappie collected using a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) on Stan Coffin Lake.

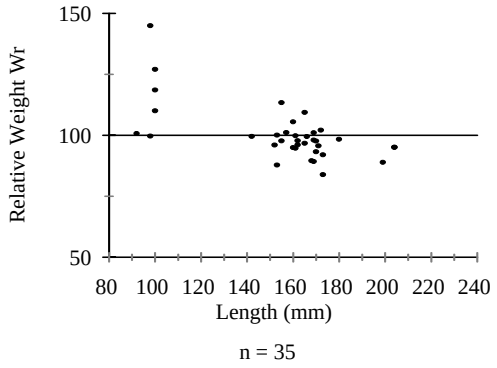

Figure 13. Relative weights for black crappie collected at Stan Coffin Lake compared to the national average (W_r = 100) (Anderson and Neumann 1996)

Largemouth Bass

A total of 159 largemouth bass were collected during this survey. Largemouth bass ranged from 52 – 520 mm (2 – 20 inches) and the majority were collected with the boat electrofisher (Figure 14). Unlike results seen in 2004, we collected many small largemouth bass (70 – 200 mm) in 2005. Largemouth bass have increased steadily since 2001, due mostly to stocking and the abundance of prey fish. Total biomass of largemouth bass remains unchanged from 2004, however, indicating the bass we collected in 2005 were smaller. Similar to bluegill, relative weights varied widely for largemouth bass less than stock length (200 mm) (Figure 15). Relative weights for larger bass were near the national average (W_r = 100) and varied much less than those of smaller fish. In 2001, relative weights for largemouth bass were below the national average; however, from 2002 to 2004, relative weights remained above the national average.

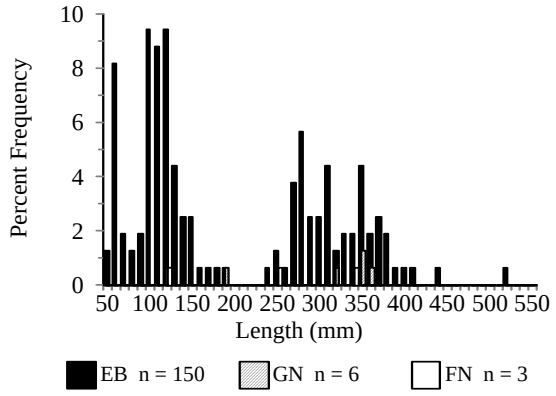

Figure 14. Length frequencies of largemouth bass collected using a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) on Stan Coffin Lake.

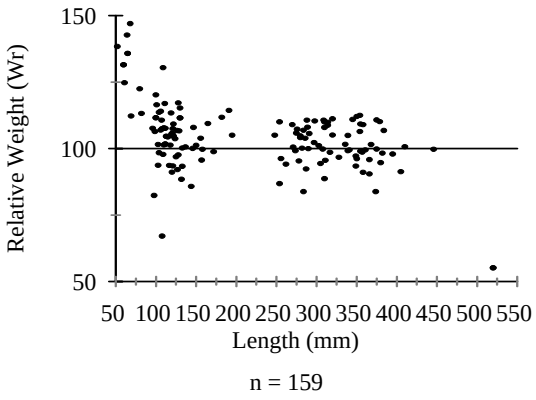

Figure 15. Relative weights of largemouth bass collected at Stan Coffin Lake compared to the national average (W_r = 100) (Anderson and Neumann 1996).

Channel catfish

Eleven channel catfish were collected during this survey; most of which were collected in gill nets (Figure 16). Catfish ranged in size from 423 – 535 mm (16 – 21 inches); however, catfish have declined in our samples steadily since 2003. Relative weights declined as length increased, yet most fish were above the national average (W_r = 100) (Figure 17). We have not collected any juvenile or YOY catfish during any of our surveys. This is a good indication that no spawning had occurred. Catfish lack suitable spawning habitat (e.g. hollow logs, undercut banks, etc.), and therefore likely do not reproduce in this lake. Future stocking of channel catfish should continue if we want to maintain this fishery.

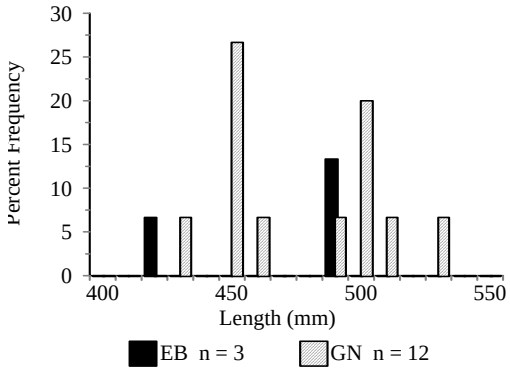

Figure 16. Length frequencies of channel catfish collected using a boat electrofisher (EB), and gill nets (GN) on Stan Coffin Lake.

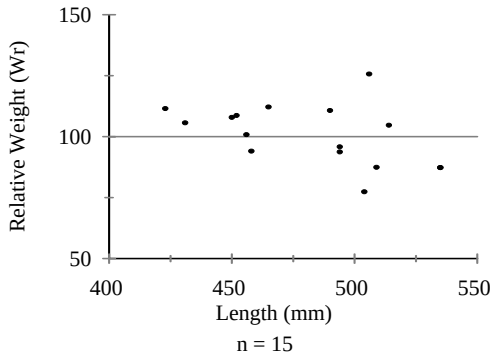

Figure 17. Relative weights of channel catfish collected at Stan Coffin Lake compared to the national average (W_r = 100) (Anderson and Neumann 1996)

Results

Population Estimate

A total of 289 largemouth bass ≥ 200 mm (~ eight inches) were collected and marked during the "mark–event" of the population estimate. During the "recapture–event", 258 largemouth bass were collected; of these, 46 were marked previously. This resulted in a population estimate of 1,597 largemouth bass (95% CI; 1307-2136) for Stan Coffin Lake. Stan Coffin Lake is approximately 40 acres, therefore, densities of largemouth range from 33–53 bass ≥ eight inches/ acre. The majority of fish collected were in the quality length (300–379 mm) category, and relative weights for all fish collected were near the national average (W_r = 100) (Figure 18). Average length at age (growth) for all age classes was above the Region Two average (Table 5; Figure 19).

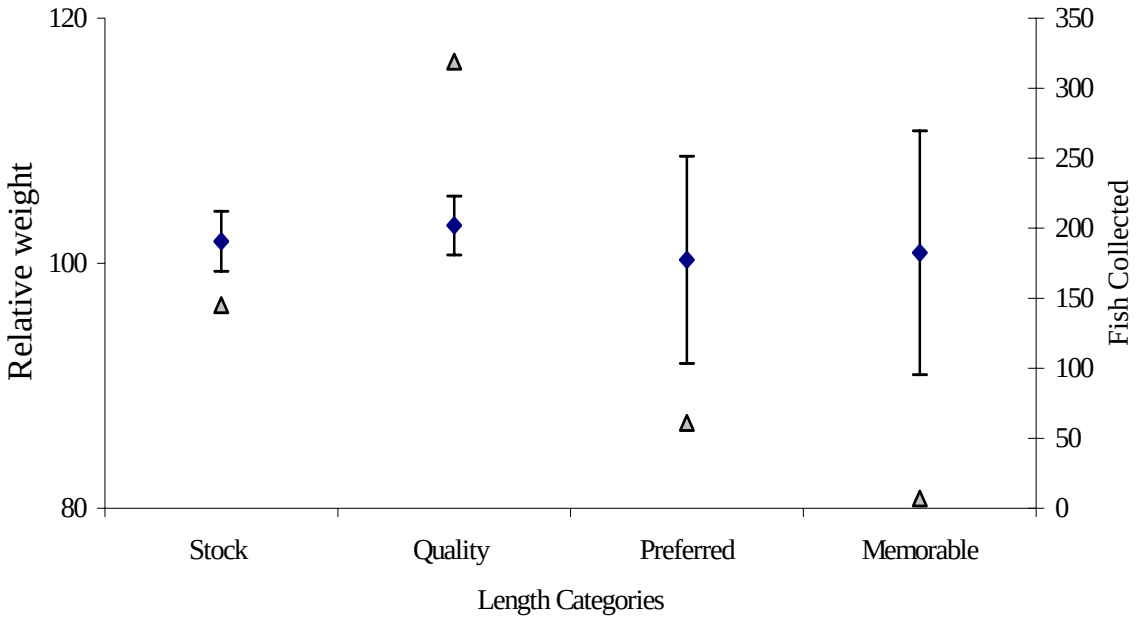

Figure 18. Mean relative weights ([diamond] including 95 % CI), and number (triangle) of stock (200–299 mm), quality (300-379 mm), preferred (380-509 mm), and memorable size (510-629 mm) largemouth bass collected during the 2005 population estimate.

Table 5. Age and growth of largemouth bass collected during the mark-recapture experiment at Stan Coffin Lake during September 2005. All lengths are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean length (mm) at age								
Year Class	# Fish	1	2	3	4	5	6	7	8	9
2004	0									
2003	115	105.5	206.0							
2002	215	115.8	231.1	297.7						
2001	53	99.9	206.1	292.4	335.1					
2000	3	85.1	175.4	244.1	288.4	330.6				
1999	3	84.9	190.7	252.7	329.1	369.0	255.8			
1998	3	130.1	230.9	305.8	357.7	396.2	426.7	451.8		
1997	1	132.4	207.8	296.8	352.4	401.8	429.0	447.5	461.1	
1996	1	146.1	255.6	340.2	391.4	408.1	427.5	452.4	471.8	485.7
Fraser Lee mean		110.4	219.7	295.9	334.8	372.5	362.9	451.1	466.5	485.7
Region Two Average		85.2	154.5	161.1	265.4	320.7	353.4	386.4	420.4	442.4

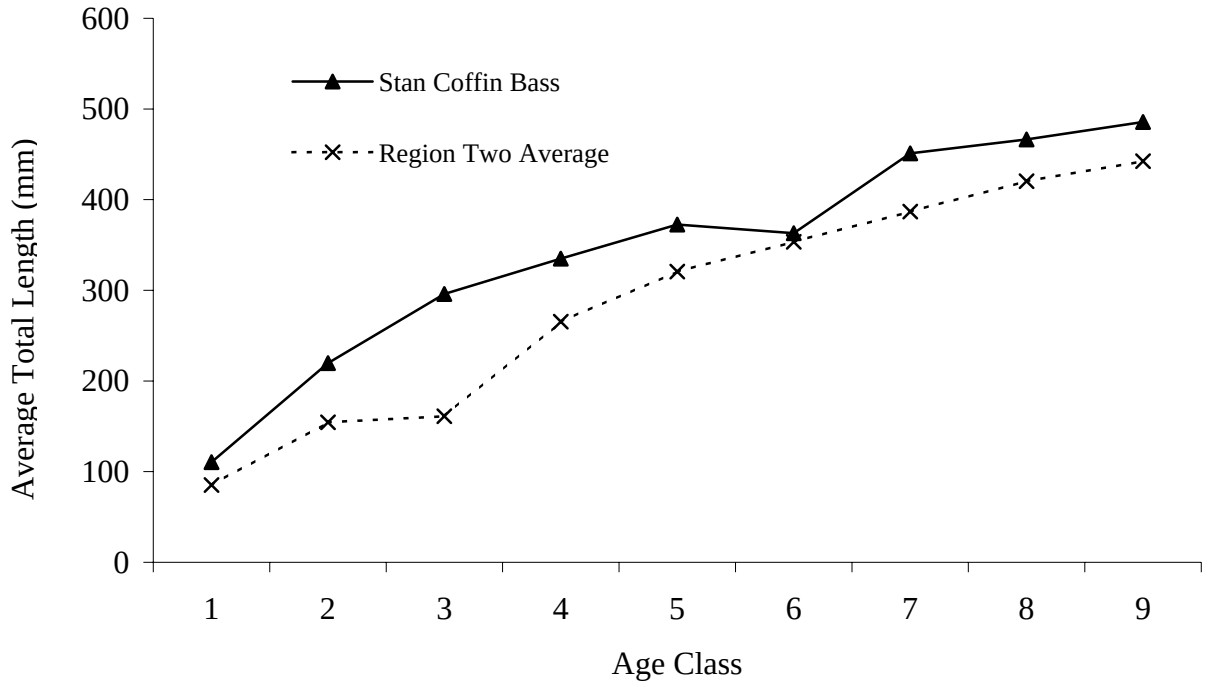

Figure 19. Average length at age for largemouth bass collected during a population estimate conducted on Stan Coffin Lake in September 2006.

Conclusions and Recommendations

Largemouth bass are often stocked to control panfish populations or to increase panfish stock densities (Willis et al. 1990; Gabelhouse 1984). Largemouth bass were stocked into Stan Coffin Lake to reduce abundance of pumpkinseed sunfish and yellow perch, and to increase stock densities of bluegill. The current stocking regime (~400 LMB $\geq$ eight inches/ year) began in 2003, and during the 2004 survey we found that yellow perch and pumpkinseed declined in abundance in our samples, while bluegill increased in abundance. In 2005, we found that both yellow perch and pumpkinseed increased more than 100 percent from 2004, while bluegill decreased nearly 70 percent. We have observed measurable changes in panfish abundance and stock densities; however, we are unsure what impact largemouth bass are having on individual populations (e.g. bluegill, pumpkinseed, yellow perch). In addition, the effects largemouth bass have on panfish populations may not have had adequate time to manifest. An examination of bass diets would provide data to help determine whether largemouth bass select prey based on abundance, or another factor. Data from diet analyses would also help us determine the size of bass best suited for control of panfish populations.

Bluegill decreased in relative abundance since 2004. The bluegill PSD reached a high of 43 in 2000, and a low of six in 2004. Largemouth bass and bluegill PSDs are in the "Balanced" management range described by Willis et al. 1993. If managers want to manage for the panfish option (i.e. bluegill PSDs 50-80), largemouth bass stocking needs to continue in order to create a high density, slow growing bass population. This population would prey heavily on panfish, and resulting panfish PSDs and relative weights would increase due to reduced competition for food. In 2005, relative weights for bluegill were above the national average (W_r = 100) for most fish. It appears that the bluegill population is at an acceptable density based on relative weights. We feel stocking should be temporarily halted for at least one year so that we can determine if the present bass population is adequate for achieving our management goals.

Largemouth bass appear to be effective at reducing numbers of panfish in Stan Coffin Lake. Densities of bass $\geq$ eight inches range from 33-53 per acre, and relative weights were above the national average (W_r = 100). Growth information, coupled with relative weight data indicate that bass in Stan Coffin Lake are not undergoing food competition. Unfortunately, many bass collected were likely stocked in the lake within the last two years, therefore, growth is not completely attributable to conditions in Stan Coffin Lake. In subsequent surveys, scales should be taken on all species in order to more effectively make management decisions about this community.

Pumpkinseed sunfish have increased in abundance since 2004, and relative weights are above the national average (W_r = 100). High relative weights are likely the result of bass predation and abundant prey due in part, to high bass densities (i.e. abundant bass fry in spring and summer). One of our management goals was to reduce the pumpkinseed population through bass stocking. Without an understanding of how largemouth bass select prey, (i.e. size, availability, location, etc.), we can only speculate on whether bass are effective at specifically reducing pumpkinseed. If pumpkinseed can be controlled through predation we should see an increase in average size of fish in this population. If so, anglers targeting panfish will not likely be concerned with catching an occasional large pumpkinseed.

Black crappie remain at low densities and this population will likely remain low as long as bluegill and pumpkinseed are the dominant panfish in this lake. Several lakes in central Washington contain black crappie, yet very few of these have sizable populations. This may be due to species interactions with other panfish, a lack of available forage, or predation on YOY black crappie by other fishes. We feel that a lack of prey fish is the leading cause of low crappie abundance in Washington waters. In the eastern and central US shad (*Dorosoma spp*.) are an important prey item for crappie (McConnel and Gerdes 1964; Bartholomew 1966). In Washington waters species such as black crappie rely on YOY gamefish for forage, since many of our waters lack small cyprinids and shad.

Channel catfish have declined in our samples since 2003. These declines are likely due to little or no reproduction. Catfish are either limited by suitable spawning habitat or water temperature for spawning. If Stan Coffin Lake lacks suitable spawning habitat, artificial spawning structures could be placed and monitored to determine usage.

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Glossary

Catch Per Unit Effort (CPUE): Is defined as the number of fish captured by a sampling method (i.e., electrofisher, gill nets, or fyke nets) divided by the amount of time sampled.

Confidence Interval (CI): Is defined as an estimated range of values which is likely to include an unknown population parameter with a percentage or degree of confidence.

Memorable Size: Is defined as fish anglers remember catching, and also identified as 59-64 percent of the world record length. Memorable length varies by species.

Preferred Size: Is defined as the size fish anglers preferred to catch when given a choice, and also identified as 45-55 percent of world record length. Preferred length varies by species.

Proportional Stock Density (PSD): Is defined as the number of quality length fish and larger, divided by the number of stock sized fish and larger, multiplied by 100.

Quality Length: Is defined as the length at which anglers begin keeping fish. Also identified as 36-41 percent of world record length. Quality length varies by species.

Relative Stock Density (RSD): Is defined as the number of fish of a specified length category (preferred, memorable, or trophy) and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Preferred Fish (RSD-P): Is defined as the number of fish in the preferred size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Memorable Fish (RSD-M): Is defined as the number of fish in the memorable size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Trophy Fish (RSD-T): Is defined as the number of fish in the trophy size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Weight (W_r): The comparison of the weight of a fish at a given size to the national average weight (W_r = 100) of fish of the same species and size.

Standard Weight (W_s): Is defined as a standard or average weight of a fish species at a given length determined by a national length-weight regression.

Stock Length: Is defined by the following: 1) approximate length of fish species at maturity, 2) the minimum length effectively sampled by traditional sampling gears, 3) minimum length of fish that provide recreational value, and 4) 20-26 percent of world record length. Stock length varies by species.

Total Length (TL): Length measurement from the anterior most part of the fish to the tip of the longest caudal (tail) fin ray (compressed).

Trophy Size: Minimum size fish worthy of acknowledgment, and identified as 74-80 percent of world record length. Trophy length varies by species.

This program receives Federal financial assistance from the U.S. Fish and Wildlife Service Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972. The U.S. Department of the Interior and its bureaus prohibit discrimination on the bases of race, color, national origin, age, disability and sex (in educational programs). If you believe that you have been discriminated against in any program, activity or facility, please write to:

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