STATE OF WASHINGTON July 2006

2005 Warmwater Fisheries Survey of Palmer Lake, Okanogan County, Washington

Warmwater Fish Enhancement

by Marc R. Petersen and Michael R. Schmuck

Washington Department of FISH AND WILDLIFE
Fish Program
Fish Management Division

FPT 06-10

2005 Warmwater Fisheries Survey of Palmer Lake, Okanogan County, Washington

By

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

July 2006

Acknowledgements

We thank Tammy Gish for his assistance with data collection. We would also like to thank Robert Jateff for his technical review, and David Bramwell for his tireless effort in compiling and preparing this report for publication. Appreciation is also extended to John Sneva and Lucinda Morrow for aging scales collected during this survey. The WDFW Warmwater Gamefish Enhancement Program funded this survey.

Abstract

Palmer Lake, Okanogan County, was surveyed September 12-15, 2005, using standard warmwater survey methods. A total of 13 fish species were collected during this survey. Yellow perch (*Perca flavescens*) was the most abundant warmwater gamefish collected followed by bluegill (*Lepomis macrochirus*) and smallmouth bass (*Micropterus dolomieu*). Largescale sucker (*Catostomus macrocheilus*) was the most abundant non-warmwater gamefish collected followed by northern pikeminnow (*Ptychocheilus oregonensis*) and peamouth chub (*Mylocheilus caurinus*). Warmwater gamefish comprised approximately 84.8 percent of the total fish collected, an increase of 17.5 percent from the 1999 warmwater survey. This change was attributed to increases in bluegill and yellow perch abundance of 508 and 355 percent, respectively, since 1999. The analysis of Palmer Lake fish species provided few changes since the 1999 survey. Yellow perch PSD increased along with catch rates. Length frequencies of most warmwater gamefish were similar to 1999, as were relative weights, which showed smallmouth bass and yellow perch being below the national average for most fish, and bluegill and black crappie being above the average.

We recommend the stocking of black crappie (*Pomoxis nigromaculatus*) continue on a yearly basis for 3 to 4 more years. Monitoring of black crappie should be conducted in 2 to 3 years to determine if adequate survival and maturation is occurring. A standard warmwater survey should be conducted in conjunction with black crappie monitoring to assess overall changes in the fish community of Palmer Lake.

Table of Contents

List of Tables ii

List of Figures iii

Introduction and Background 1

Materials and Methods 4
Results 6
Species Composition 6
Catch-Per-Unit Effort (CPUE) 7
Stock Density Indices 8
Water Chemistry 9
Largemouth Bass 10
Smallmouth Bass 13
Black Crappie 15
Bluegill 17
Yellow Perch 19

Discussion 21
Management Recommendations 22

Literature Cited 23

Glossary 24

List of Tables

Table 1. Fish stocked in Palmer Lake since 1980 2

Table 2. Minimum total length (mm) categories of warmwater fish used to calculate PSD and RSD values (Willis et al. 1993) 6

Table 3. Species composition by weight, number, and size range of fish captured at Palmer Lake during a warmwater fish survey during September 2005 7

Table 4. Mean catch per unit effort by sampling method (excluding YOY), including 80 percent confidence intervals, for fish collected from Palmer Lake during September 2005 8

Table 5. Stock density indices (+ 80 percent confidence interval) for warmwater fishes collected using boat electrofisher, gill nets, and fyke nets in Palmer Lake during September 2005 9

Table 6. Water chemistry data from Palmer Lake collected mid-day during September 2005 10

Table 7. Length at age of largemouth bass captured at Palmer Lake during September 2005. 11

Table 8. Length at age of smallmouth bass captured at Palmer Lake during September 2005 13

Table 9. Length at age of black crappie captured at Palmer Lake during September 2005 15

Table 10. Length at age of bluegill captured at Palmer Lake during September 2005 17

Table 11. Length at age of yellow perch captured at Palmer Lake during September 2005 19

List of Figures

Figure 1. Map of Palmer Lake (Okanogan County)... 3

Figure 2. Length frequencies of largemouth bass collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005. 12

Figure 3. Relative weights of largemouth bass collected in Palmer Lake, September 2005, compared to the national average (W_r = 100). 12

Figure 4. Length frequencies of smallmouth bass collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005. 14

Figure 5. Relative weights of smallmouth bass collected in Palmer Lake, September 2005, compared to the national average (W_r = 100). 14

Figure 6. Length frequencies of black crappie collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005. 16

Figure 7. Relative weights of black crappie collected in Palmer Lake, September 2005, compared to the national average (W_r = 100). 16

Figure 8. Length frequencies of bluegill collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005... 18

Figure 9. Relative weights of bluegill collected in Palmer Lake, September 2005, compared to the national average (W_r = 100). 18

Figure 10. Length frequencies of yellow perch collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005. 20

Figure 11. Relative weights of yellow perch collected in Palmer Lake, September 2005, compared to the national average (W_r = 100). 20

Introduction and Background

Located in the Okanogan National Forest approximately 5 miles north of Loomis, Washington, Palmer Lake drains approximately 767 square kilometers (296 square miles) of north-central Washington's Sinlahekin Valley (Figure 1). The lake has a surface area of 854 hectares (2,110 acres), a mean depth of 15.5 meters (m) (51 feet), Maximum depth of approximately 27.7 m (91 feet), and volume of 107,610 acre-feet. Water is supplied to the south end of Palmer Lake via Sinlahekin Creek. Between the months of March and July, water levels of the lake are governed by the flows of the Similkameen River (Joe Foster, Washington Department of Fish and Wildlife (WDFW), pers. comm.). Water exits Palmer Lake at the north end through Palmer Creek. Palmer Creek flows northerly for several miles before joining the Similkameen River. During periods of high water, the Similkameen River flows into Palmer Creek, which reverses its flow, thus elevating the level of Palmer Lake.

Most of the land surrounding Palmer Lake is privately owned. Portions of the land, such as Palmer Lake Campground and Split Rock boat launch, are operated by the Washington Department of Natural Resources (DNR) and the United States Bureau of Land Management (Linda Shaw, DNR, pers. comm.). During the 1980s, the Oroville-Tonasket Irrigation District (OTID) proposed to construct a water control structure on the outlet of Palmer Lake to provide a supplemental water supply and store approximately 10,500 acre-feet of additional water in case of inadequate water supplies from Lake Osoyoos and the Okanogan River (Tom Scott, OTID, pers. comm.). However, public opposition prevented the action.

Palmer Lake is managed as a mixed species fishery. Historical stocking records indicate that since 1972, WDFW has stocked the lake with rainbow trout *Oncorhynchus mykiss*, kokanee salmon (*O. nerka*), eastern brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), Lahontan cutthroat trout (*O. clarki henshawi*), and black crappie (*Pomoxis nigromaculatus*). Smallmouth bass (*Micropterus dolomieu*) were introduced to the lake by WDFW in 1982, and while they have inhabited the lake for many years, the first documented stocking of largemouth bass (*M. salmoides*) occurred in1984. Additional fish species found in Palmer Lake include burbot (*Lota lota*), bluegill (*Lepomis macrochirus*), northern pikeminnow (*Ptychocheilus oregonensis*), lake whitefish (*Coregonus clupeaformis*), peamouth (*Mylocheilus caurinus*), largescale sucker (*Catostomus macrocheilus*), and bridgelip sucker (*C. columbianus*). Moreover, yellow perch (*Perca flavescens*) have become established in the lake through unauthorized introduction. Anglers have reported catching walleye (*Sander vitreus*), the origin of which is unknown, although numbers were likely few.

Palmer Lake provides a myriad of outdoor opportunities throughout the year. Anglers are allowed to fish the lake year-round. All bass species in Palmer Lake are protected by a slotlength limit regulation which allows anglers to harvest five bass less than 12 inches to include no more than one bass over 17 inches in length. Anglers may harvest five burbot of any size from Palmer Lake. Additionally, anglers are allowed to harvest a combination of five trout (rainbow, Lahontan cutthroat, brook, brown) or kokanee (no minimum size limit) from Palmer Lake.

With the exception of those species mentioned previously, there is currently no minimum size or daily bag limit on the remaining fish species present in Palmer Lake. The public also uses the lake and its surrounding forest for hunting, camping, swimming, and hiking. In addition, wildlife enthusiasts occasionally utilize the lake for observing mountain goats (*Oreamnos americanus*) on near-by Grandview Mountain.

Table 1. Fish stocked in Palmer Lake since 1980. Species include rainbow trout (RB), smallmouth bass (SMB), eastern brook trout (EB), largemouth bass (LMB), kokanee (K), brown trout (BT), Lahontan cutthroat trout (LCT), and black crappie (BC). The size of fish stocked (excluding fry) were abbreviated as follows: F - fingerlings, A - adults, U – unknown, and SA – sub-adults.

Year	Species	Size	No. Stocked	Year	Species	Size	No. Stocked
1980	RB	F	38,788	1991	K	Fry	61,291
1981	RB	F	73,232		RB	F	48,000
1982	RB	F	37,400	1992	K	Fry	96,000
	SMB	A	34	1993	K	Fry	100,000
1983	SMB	A	75	1994	K	Fry	100,815
1984	EB	F	29,250	1995	K	Fry	100,100
	SMB	A	64		LCT	F	12,992
	LMB	A	58	1996	K	Fry	100,100
1985	K	Fry	71,145		LMB	SA	219
	BT	F	25,248	1997	K	Fry	100,000
	LCT	Fry	166,695	1998	K	Fry	115,416
	RB	F	40,050		LMB	A	1,057
	LMB	A/S	383	1999	LMB	A	574
1986	BT	U	12,400		BC	Fry	28,550
	LCT	Fry	218,290	2000	K	Fry	112,998
	K	Fry	115,700	2001	K	Fry	89,856
1987	K	Fry	120,625	2002	K	Fry	130,732
	LCT	Fry	157,300	2003	K	Fry	156,024
	RB	F	30,005	2004	K	Fry	163,877
1988	K	Fry	102,630	2005	K	Fry	161,354
1989	K	Fry	40,000		BC	F	25,000
1990	K	Fry	100,000				

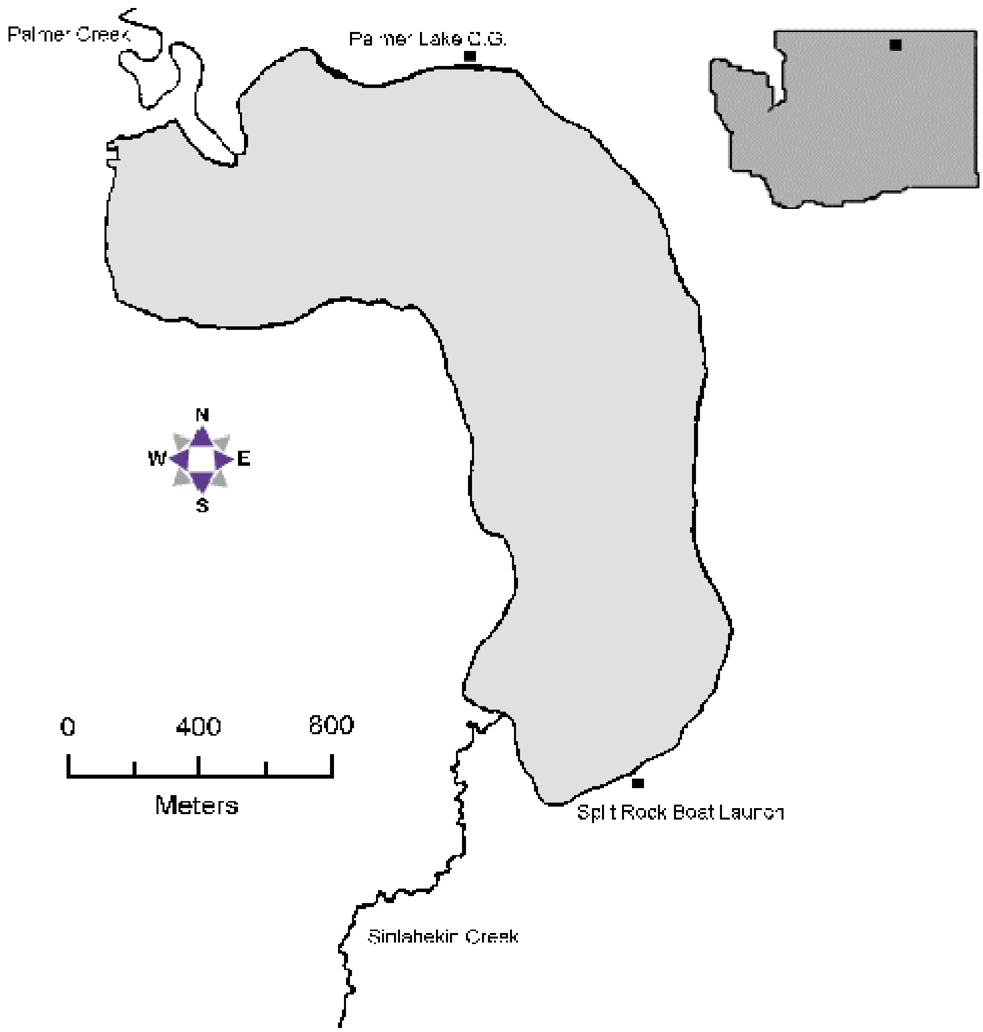

Figure 1. Map of Palmer Lake (Okanogan County).

Materials and Methods

Palmer Lake was surveyed by a three-person team September 12-15, 2005. All fish were collected using a boat electrofisher, gill nets, and fyke nets. The electrofisher unit consisted of a 5.5 m Smith-Root GPP electrofisher boat with a DC current of 60 cycles/sec at 3 to 4 amps power (Bonar et al. 2000). Experimental gill nets (45.7 m x 2.4 m) were constructed of variable size (13, 19, 25, and 51 mm stretched) monofilament mesh. Fyke nets were constructed of a main trap (four 1.2 m aluminum rings), a single 30.3 m lead, and two 15.2 m wings. Fyke net material was constructed of 13 mm nylon mesh.

Sampling locations were selected by dividing the shoreline into 400 m sections determined from a map. The number of randomly selected sections surveyed were as follows: electrofisher 15, gill nets 8, and fyke nets 8. Electrofishing occurred in shallow water (depth range: 0.2 - 1.5 m), adjacent to the shoreline at a rate of approximately 18.3 m/minute for 600-second intervals (Bonar et al. 2000). Gill nets were set perpendicular to the shoreline with the small mesh end attached on or near the shore and the large-mesh end anchored offshore. Fyke nets were set perpendicular to the shoreline with the wings extended at 70^{o} angles from the lead. 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 at night, when fish are typically found along the shoreline, thus maximizing the efficiency of each gear type.

Fish were identified to species, measured in millimeters (mm) to total length (TL) from the anterior most part of head to the tip of the compressed caudal fin, and weighed to the nearest gram (g). Total length data were used to construct length-frequency histograms and to evaluate the size structure of the warmwater species in the lake. Warmwater fish species were assigned to a 10 mm size group based on total length, and scale samples were collected from the first five fish collected in each size group (Bonar et al. 2000). Scale samples were mounted on adhesive data cards and pressed onto acetate slides using a Carver® laboratory press (Fletcher et al. 1993). Lucinda Morrow (WDFW Scale Lab) aged fish from this survey using scales that were collected.

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

Catch per unit effort (CPUE) of each gear type 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 electrofished. The CPUE for gill nets and fyke nets were standardized, and determined by dividing the total number of fish captured by the total number of nights each gear was deployed. Since CPUE is standardized, it can be useful in comparing catch rates between lakes, or between sampling dates on the same water.

A relative weight (W_r) index was used to evaluate the condition of fish. As presented by Anderson and Neumann (1996), a W_r of 100 indicates that the fish is in a condition similar to the national average for that species and length. The index is defined as $W_r = W/W_s \times 100$, 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 standard weight was derived from a standard weight-length ($\log_{10}$) relationship, which was defined for each species of interest in Anderson and Neumann (1996). Minimum lengths were used for each species, as the variability can be significant for small fish (YOY). Relative weights less than 50 were also excluded from our analyses as we suspected unreliable weight measurements.

Age and growth of warmwater fish species were evaluated using procedures described by Fletcher et al. (1993). Fish from which scales were taken were evaluated using both the direct proportion method (Fletcher et al. 1993) and Lee's modification of the direct proportion method (Carlander 1982). Mean back-calculated lengths-at-age for all warmwater species were then compared to those of eastern Washington and statewide averages (Fletcher et al. 1993).

Proportional stock density (PSD) of each warmwater fish species was determined following procedures outlined in Anderson and Neumann (1996). Proportional stock density uses two measurements, stock length and quality length, to provide information about the proportion of various size fish in a population. Stock length is defined as the minimum size of a fish that provides recreational value or approximates length when fish reach maturity (Table 2). Quality length is the minimum size of a fish that most anglers like to catch or begin keeping (Table 2). Proportional stock density is calculated using the number of quality sized fish, divided by the number of stock-sized fish, and multiplied by 100. Stock and quality lengths, which vary by species, are based on percentages of world-record lengths (Anderson and Weithman 1978). Stock length is 20-26 percent of the world record length, whereas quality length is 36-41 percent of the world record length.

Relative stock density (RSD) of each warmwater fish species was examined using the five-cell model proposed by Gabelhouse (1984). In addition to stock and quality lengths, the Gabelhouse model adds preferred, memorable, and trophy categories (Table 2). Preferred length (RSD-P) is defined as the minimum size of fish anglers would prefer to catch. Memorable (RSD-M) length refers to the minimum size fish anglers remember catching, and trophy length (RSD-T) refers to the minimum size fish worthy of acknowledgment. Preferred, memorable, and trophy length fish are also based on percentages of world record lengths (Anderson and Weithman 1978).

Preferred length is 45-55 percent of world record length, memorable length is 59-64 percent of world record length, and trophy length is 74-80 percent of world record length. Relative stock density differs from PSD in that it is more sensitive to changes in year class strength. Relative stock density is 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 2. Minimum total length (mm) categories of warmwater fish used to calculate PSD and RSD values (Willis et al. 1993).

	Length Category				
Species	Stock	Quality	Preferred	Memorable	Trophy
Black crappie	130	200	250	300	380
White crappie	130	200	250	300	380
Bluegill	80	150	200	250	300
Yellow perch	130	200	250	300	380
Largemouth bass	200	300	380	510	630
Smallmouth bass	180	280	350	430	510
Walleye	250	380	510	630	760
Channel catfish	280	410	610	710	910
Brown bullhead	150	230	300	390	460
Yellow bullhead	150	230	300	390	460

Results

Species Composition

Yellow perch was the most abundant fish species captured during the September 2005 warmwater survey (Table 3) Bluegill and smallmouth bass were second and third in abundance, respectively. Yellow perch, followed by smallmouth bass, contributed the highest fish biomass of warmwater gamefish captured during this survey. Largescale sucker was the most abundant non-game species collected, and while fourth in overall abundance, contributed the highest fish biomass of all species collected. Common carp represented a small portion of the number of fish collected as well as fish biomass. Warmwater gamefish comprised 84.8 percent by number and 46.6 percent of the total fish biomass collected during this survey.

Table 3. Species composition by weight, number, and size range of fish captured at Palmer Lake during a warmwater fish survey during September 2005

	Species Composition					
	Weight		Number		Size Range (mm)	
Species	kg	%	No.	%	Min	Max
Black crappie	6.2	1.9	157	6.2	95	310
Bluegill	14.9	4.6	641	25.4	51	191
Pumpkinseed sunfish	0.6	0.2	17	0.7	76	146
Largemouth bass	24.1	7.5	103	4.1	103	560
Smallmouth bass	40.2	12.5	231	9.2	94	466
Yellow perch	63.9	19.9	989	39.2	93	262
Burbot	0.5	0.2	1	0.0	435	435
Northern pikeminnow	34.6	10.8	146	5.8	137	589
Chiselmouth	0.8	0.3	7	0.3	212	252
Carp	22.5	7.0	29	1.1	114	546
Largescale sucker	107.0	33.3	169	6.7	155	558
Peamouth chub	6.4	2.0	31	1.2	200	315
Sculpin	0.0	0.0	1	0.0	69	69

Catch-Per-Unit Effort (CPUE)

Yellow perch, bluegill, and pumpkinseed sunfish were captured in highest rates by boat electrofisher (Table 4). Gill net catch rate was highest for yellow perch and black crappie catch rates were highest for fyke nets. Other fish species collected by gill and fyke nets were in lower abundance.

Table 4. Mean catch per unit effort by sampling method (excluding YOY), including 80 percent confidence intervals, for fish collected from Palmer Lake during September 2005.

	Gear Type								
	Electrofisher			Gill Nets			Fyke Nets		
Species	**No. Hour**	**CI (+-)**	**No. Sites**	**No. Night**	**CI (+-)**	**No. Night**	**No. Night**	**CI (+-)**	**Net Nights**
Black crappie	39.6	13.6	15	1.5	0.8	8	5.8	6.8	8
Bluegill	245.2	63.3	15	0.9	0.5	8	2.6	0.9	8
Pumpkinseed sunfish	6.0	3.4	15	0.1	0.2	8	0.1	0.2	8
Largemouth bass	39.6	13.6	15	0.4	0.2	8	0.1	0.2	8
Smallmouth bass	80.4	42.7	15	3.8	2.1	8	0.0	0.0	8
Yellow perch	200.4	56.7	15	56.3	38.1	8	4.8	4.3	8
Kokanee	12.8	11.1	15	3.8	1.2	8	0.0	0.0	8
Rainbow trout	8.0	3.0	15	0.3	0.2	8	0.0	0.0	8
Mountain whitefish	4.4	2.8	15	0.6	0.3	8	0.0	0.0	8
Burbot	0.4	0.5	15	0.0	0.0	8	0.0	0.0	8
Largescale sucker	42.4	13.4	15	7.9	2.7	8	0.0	0.0	8
Carp	6.0	2.6	15	1.0	0.5	8	0.0	0.0	8
Northern pike-minnow	17.2	6.2	15	12.8	4.2	8	0.1	0.2	8
Peamouth chub	5.2	3.2	15	2.3	1.0	8	1.6	1.9	8
Sculpin	0.4	0.5	15	0.0	0.0	8	0.0	0.0	8

Stock Density Indices

Bluegill, smallmouth bass, and yellow perch were collected in high enough numbers to generate a confident analysis of these species (Table 5). At least 55 stock length or larger fish must be collected for a given gear type in order for an individual species to meet the required minimum sample size for this analysis, (Bonar et al. 2000). All other species were collected in inadequate numbers; however, when viewed with caution, may be used to infer the number of large fish in the species sample. The PSD of bluegill captured with a boat electrofisher was 4, indicating 4 percent of the stock length or larger bluegill captured by boat electrofisher were at least 6 inches in length. The PSD of smallmouth bass and yellow perch captured by boat electrofisher was 4 and 7, respectively. Yellow perch was the only species captured by gill nets in high enough numbers to generate a confident stock density analysis. The PSD of yellow perch collected by gill nets was 54, indicating 243 of the total number of stock-length yellow perch collected by gill nets were at least 8 inches. Fyke nets did not capture enough stock-length or larger fish to generate valid stock density estimates. With the exception of yellow perch, stock density indices indicated the majority of warmwater fish species collected were smaller sized.

Table 5. **Stock density indices (± 80 percent confidence interval) for warmwater fishes collected using boat electrofisher, gill nets, and fyke nets in Palmer Lake during September 2005. PSD = proportional stock density, RSD = relative stock density, RSD-P = relative stock density of preferred fish, RSD-M = relative stock density of memorable fish, and RSD-T = relative stock density of trophy fish.**

Species	No. Stock Length	PSD	RSD-P	RSD-M	RSD-T
		Electrofisher			
Black crappie	44	18 (± 7)	2 (± 3)	2 (± 3)	0
Bluegill	543	4 (± 1)	0	0	0
Largemouth bass	20	65 (+ 14)	55 (± 14)	5 (± 6)	0
Smallmouth bass	112	4 (± 2)	0	0	0
Pumpkinseed sunfish	14	0	0	0	0
Yellow perch	261	7 (± 2)	0	0	0
		Gill Nets			
Black crappie	3	33 (± 35)	0	0	0
Bluegill	7	0	0	0	0
Largemouth bass	3	100	33 (± 35)	0	0
Smallmouth bass	27	78 (± 10)	78 (± 10)	30 (+ 11)	0
Yellow perch	450	54 (± 3)	0	0	0
		Fyke Nets			
Black crappie	5	40 (± 28)	0	0	0
Bluegill	20	0	0	0	0
Yellow perch	27	11 (± 8)	0	0	0

Water Chemistry

Surface water temperatures within Palmer Lake were 18.4°C and ranged to a low of 7.3°C at the lake bottom (Table 6). A thermocline and chemocline existed between 8 and 9 meters at the time of this survey. A thermocline is defined as a change in temperature of 1°C or greater per meter of depth (Goldman and Horne 1983). The presence of a thermocline is an indication of resistance to vertical mixing and frequently causes a chemocline that traps and accumulates nutrients in cooler, denser water below the thermal barrier. Dissolved oxygen levels ranged from 12.9 ppm at the surface to 0.5 ppm at the lake bottom, and pH levels ranged from 8.8 to 7.0. Conductivity was 219 at the surface and 259 at the bottom. Dissolved oxygen, pH, and conductivity readings began to show significant changes at approximately 9 meters of depth, indicating the presence of a chemocline. Water chemistry parameters were found within desired levels for warmwater gamefish to a depth of approximately 10 meters, at which dissolved oxygen levels became to low to sustain fish species for long periods of time.

Table 6. Water chemistry data from Palmer Lake collected mid-day during September 2005.

Location	Depth	Temp (^oC)	pH	Dissolved O2	Conductivity
Center Lake	Surface	18.4	8.8	12.9	219
	1	18.4	8.9	12.7	219
	2	18.4	9.0	12.6	219
	3	18.3	9.0	12.5	219
	4	18.3	9.0	11.9	219
	5	18.1	8.9	11.8	219
	6	18.0	8.8	10.9	220
	7	17.9	8.8	10.6	220
	8	17.6	8.6	9.5	222
	9	16.1	7.9	6.0	229
	10	14.2	7.6	3.7	234
	11	12.1	7.3	1.9	237
	12	10.2	7.2	1.5	240
	13	9.3	7.1	1.3	243
	14	8.6	7.1	0.9	245
	15	8.0	7.1	0.6	249
	16	7.7	7.1	0.5	251
	17	7.5	7.1	0.5	254
	18	7.4	7.0	0.5	257
	19	7.3	7.0	0.5	259

Largemouth Bass

A total of 103 largemouth bass were collected during this survey. Ages of largemouth bass ranged from 1 to 8 with age-1 fish being the most abundant in our samples (Table 7). Growth of largemouth bass was above average at all ages except age 1, though 5 age classes were represented with only one fish per age-class. Largemouth bass ranged in length from 103 to 560 mm and most fish were collected using the boat electrofisher (Figure 2). Relative weights showed greater variation for largemouth bass less than 270 mm and were near the national average overall, while fish greater than 270 mm were found at or above the national average (Figure 3).

Table 7. Length at age of largemouth bass captured at Palmer Lake during September 2005. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993). Unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean total length (mm) at age							
Year class	No. Fish	1	2	3	4	5	6	7	8
2004	36	84.9							
		93.6							
2003	5	63.7	219.0						
		79.4	224.6						
2002	1	68.4	196.2	345.9					
		85.0	206.5	348.8					
2001	8	70.0	224.9	338.7	387.9				
		86.6	234.0	342.3	389.1				
2000	1	54.8	194.3	326.1	393.9	434.3			
		72.3	205.7	331.6	396.4	435.0			
1999	1	50.3	213.0	272.5	367.7	415.3	440.5		
		68.1	223.6	280.5	371.5	417.1	441.1		
1998	1	45.2	240.3	359.2	383.7	423.8	459.9	488.4	
		63.4	250.7	364.8	388.4	426.8	461.6	488.8	
1997	1	65.7	222.2	361.5	441.7	462.7	485.1	521.9	549.5
		83.4	234.2	368.6	445.9	466.2	487.7	523.2	549.9
Direct P. Means		62.9	215.7	334.0	395.0	434.0	461.8	505.1	549.5
Frazier L. Means		89.5	228.6	341.0	392.9	436.3	463.5	506.0	549.9
Eastern WA Ave.		68.8	135.6	189.2	248.9	300.0	351.5	421.6	437.6

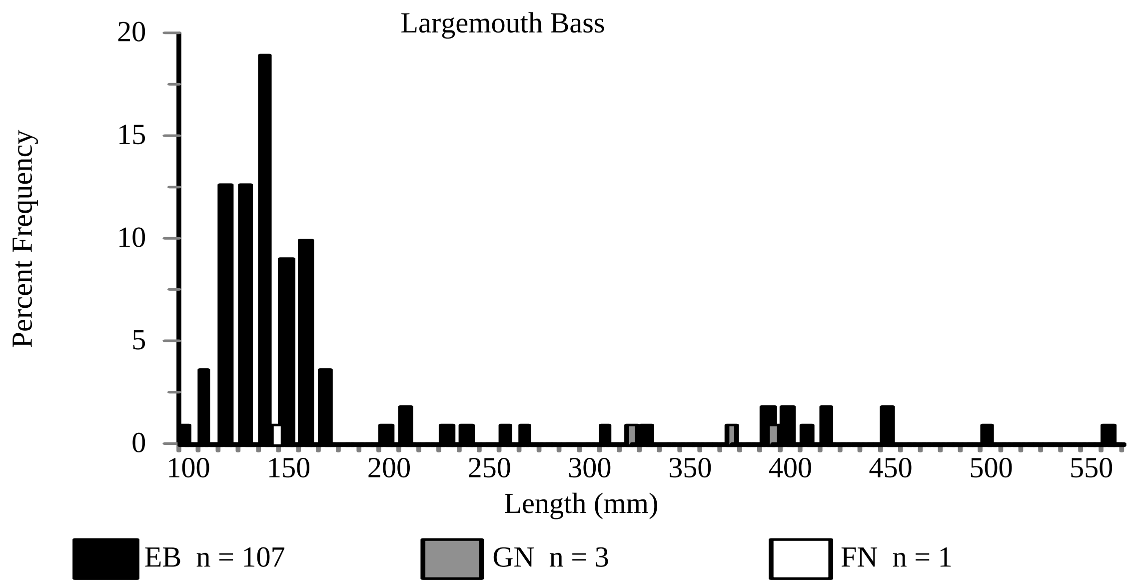

Figure 2. Length frequencies of largemouth bass collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005.

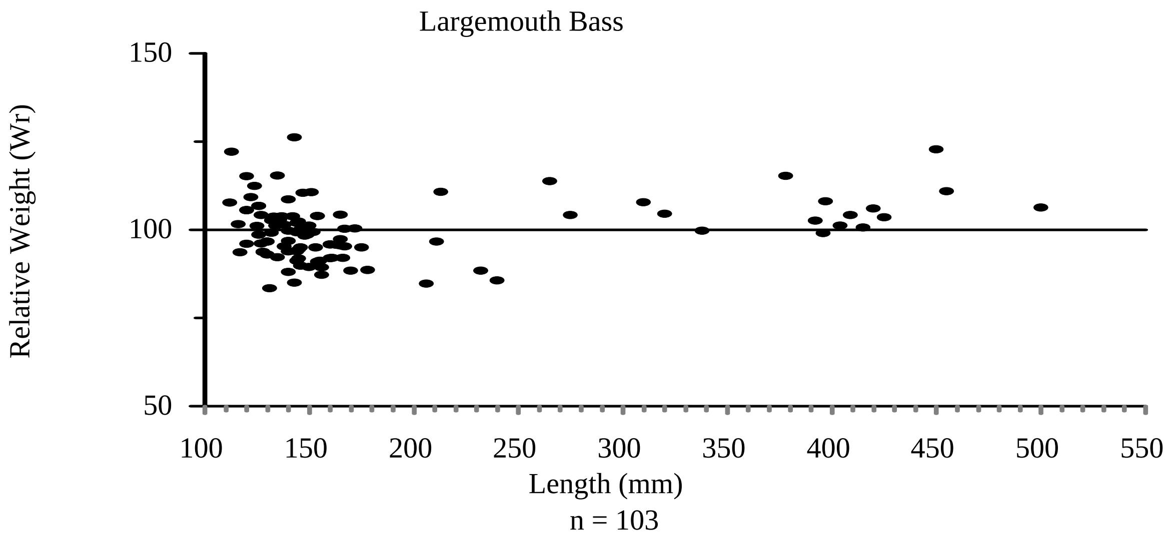

Figure 3. Relative weights of largemouth bass collected in Palmer Lake, September 2005, compared to the national average (W_r = 100).

Smallmouth Bass

A total of 231 smallmouth bass were collected during this survey. Ages of smallmouth bass ranged from 1 to 8 with age-3 fish being the most abundant in our samples (Table 8). Growth of smallmouth bass was below the statewide average for ages 1 through 3, and above average for age-4 and older fish. Smallmouth bass ranged in length from 94 to 466 mm and most fish were caught using the boat electrofisher (Figure 4). Relative weights of smallmouth bass less than 150 mm in length showed the most variation; approximately 50 percent were above and 50 percent were below the national average (Figure 5). Most smallmouth bass greater than 150 mm in length had relative weights below the national average.

Table 8. Length at age of smallmouth bass captured at Palmer Lake during September 2005. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993). Unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean total length (mm) at age							
Year class	No. Fish	1	2	3	4	5	6	7	8
2004	24	62.8							
		81.2							
2003	13	49.8	118.4						
		75.4	131.1						
2002	33	48.8	106.6	177.7					
		76.6	126.2	187.0					
2001	6	42.2	129.7	238.5	312.0				
		73.3	152.6	251.4	318.1				
2000	7	36.1	104.8	212.6	305.9	375.6			
		68.0	130.9	229.5	314.8	378.5			
1999	1	57.9	135.7	180.9	253.0	353.3	425.4		
		88.6	160.5	202.3	269.0	361.7	428.4		
1998	5	52.5	95.9	143.0	210.2	302.0	374.6	418.0	
		83.4	123.4	166.8	228.7	313.3	380.1	420.2	
1997	1	49.9	155.9	229.1	280.5	321.1	366.3	416.1	445.7
		81.1	179.1	246.9	294.5	331.9	373.7	419.9	447.3
Direct P. Means		50.0	121.0	197.0	272.3	338.0	388.7	417.1	445.7
Frazier L. Means		77.3	131.1	199.4	291.0	350.7	386.1	420.1	447.3
State Average		70.4	146.3	211.8	268	334	356.1	392.7	413.8

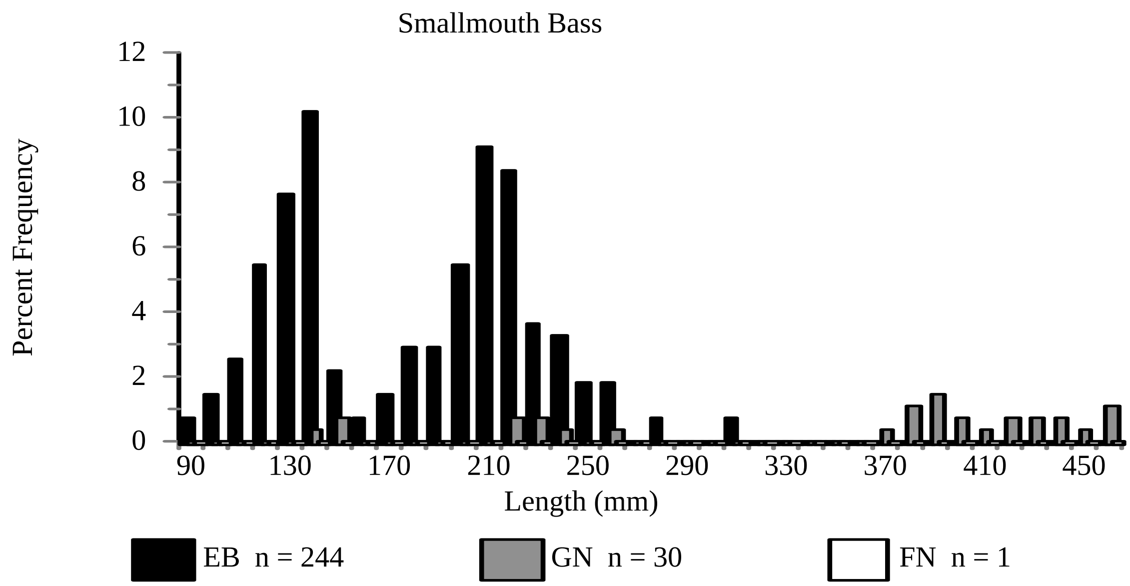

Figure 4. Length frequencies of smallmouth bass collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005.

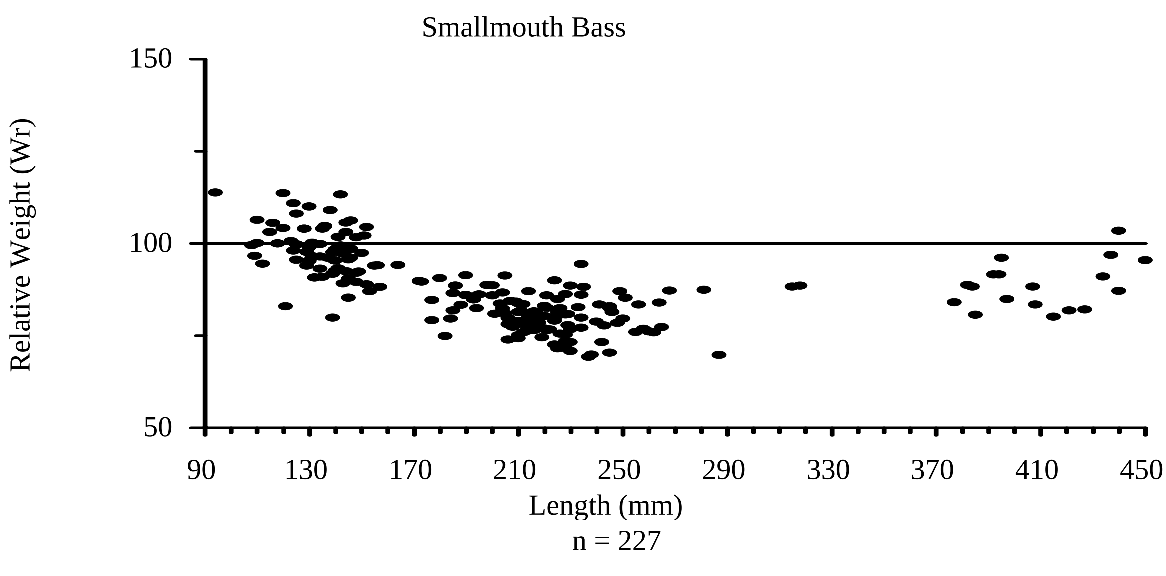

Figure 5. Relative weights of smallmouth bass collected in Palmer Lake, September 2005, compared to the national average (W_r = 100).

Black Crappie

A total of 157 black crappie were collected during this survey. Ages of black crappie ranged from 1 to 3 with age 1 being the most abundant in our samples (Table 9). Growth was below the statewide average for ages 1 and 2 black crappie, and above average for age-3 fish. Black crappie ranged in length from 95 to 319 mm and most were captured using the boat electrofisher (Figure 6). Relative weights of black crappie less than 150 mm in length were well above average for most fish, but slightly below average overall for fish greater than 150 mm (Figure 7).

Table 9. Length at age of black crappie captured at Palmer Lake during September 2005. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993). Unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean total length (mm) at age		
Year class	No. Fish	1	2	3
2004	30	54.0		
		73.3		
2003	16	37.8	122.1	
		65.7	134.4	
2002	5	27.1	95.2	179.7
		57.8	114.9	185.7
Direct P. Means		39.7	108.7	179.7
Frazier L. Means		69.4	129.8	185.7
State Average		46.0	111.2	156.7

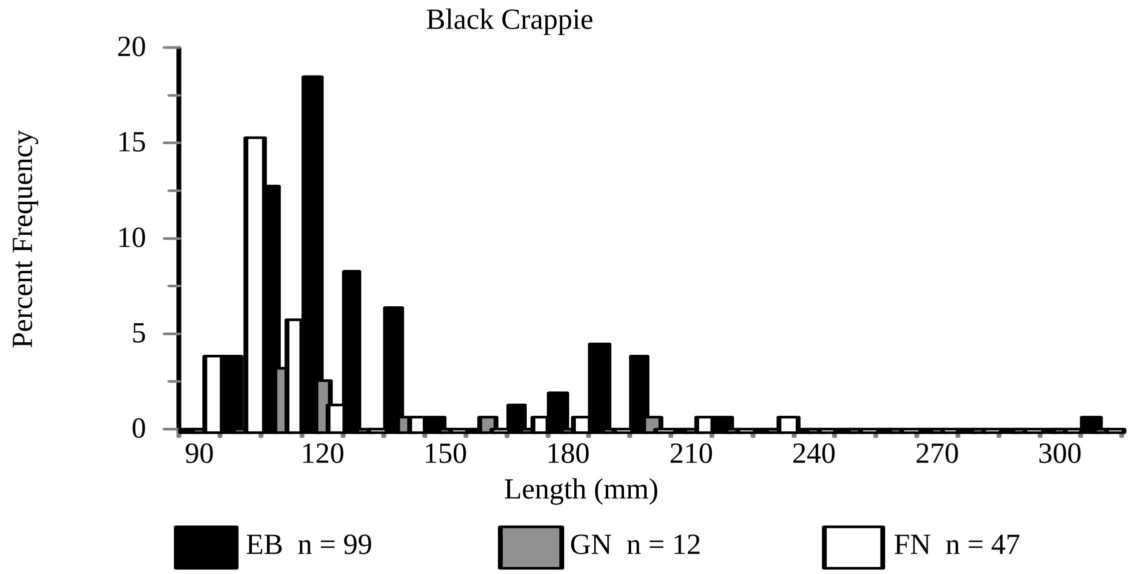

Figure 6. Length frequencies of black crappie collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005.

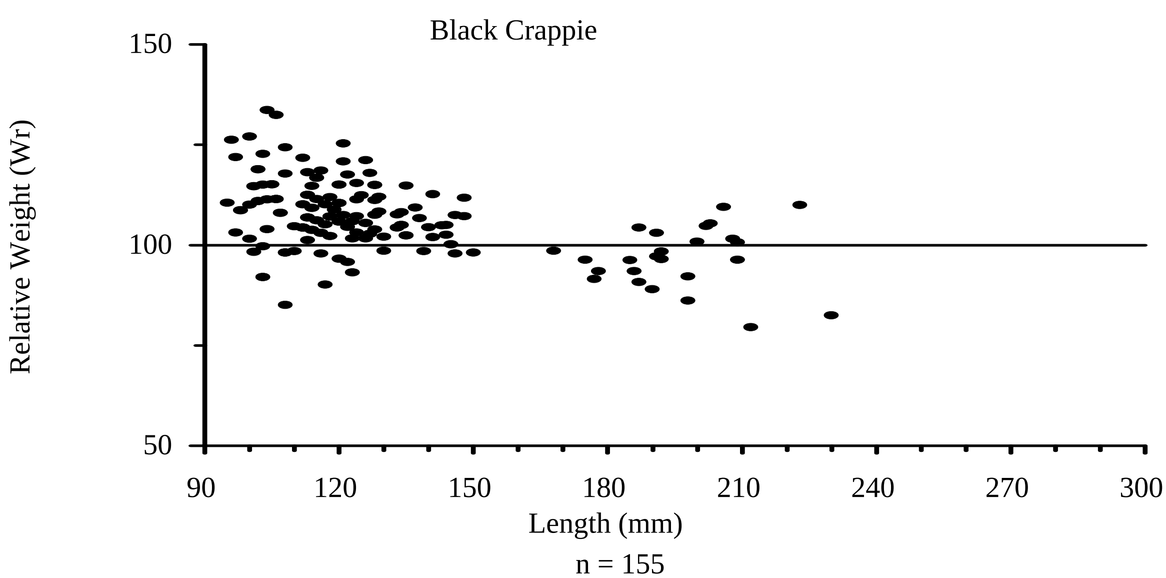

Figure 7. Relative weights of black crappie collected in Palmer Lake, September 2005, compared to the national average (W_r = 100).

Bluegill

A total of 641 bluegill were collected during this survey. Ages of bluegill ranged from 1 to 4 with age-1 fish being the most abundant in our samples (Table 10). Growth was below average for ages 1 and 2 bluegill, and above average for ages 3 and 4. Bluegill ranged in length from 51 to 191 mm and most were captured using the boat electrofisher (Figure 8). Relative weights of most bluegill were above the national average, and only a small percentage were below average (Figure 9).

Table 10. Length at age of bluegill captured at Palmer Lake during September 2005. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993). Unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean total length (mm) at age			
Year class	No. Fish	1	2	3	4
2004	28	34.1			
		47.2			
2003	20	21.5	96.5		
		38.6	103.4		
2002	2	24.3	75.7	159.7	
		41.5	87.2	161.8	
2001	2	17.9	69.6	122.1	167.6
		35.9	82.1	128.8	169.4
Direct P. Means		24.4	80.6	140.9	167.6
Frazier L. Means		43.2	100.3	145.3	169.4
State Average		37.3	96.8	132.1	148.3

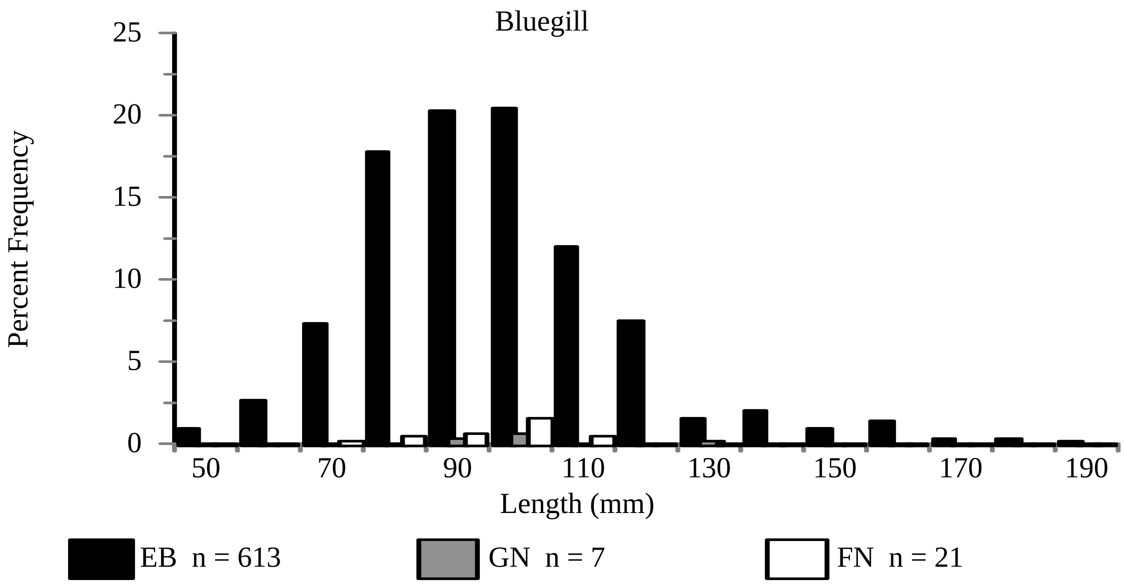

Figure 8. Length frequencies of bluegill collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005.

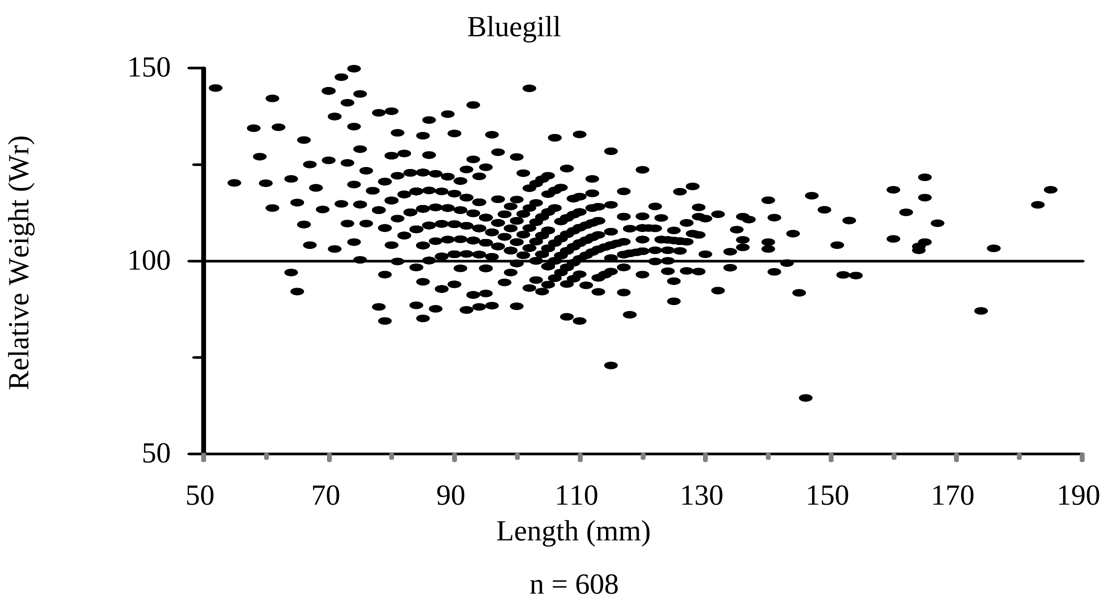

Figure 9. Relative weights of bluegill collected in Palmer Lake, September 2005, compared to the national average (W_r = 100).

Yellow Perch

A total of 989 yellow perch were collected during this survey. Ages of yellow perch ranged from 1 to 4 with age 3 being the most abundant in our samples (Table 11). Growth was above average for yellow perch at all ages except age 1. Yellow perch ranged in length from 93 to 262 mm, and more smaller-size fish were captured using the boat electrofisher, whereas larger fish were captured more often by gill nets (Figure 10). Relative weights of yellow perch less than 130 mm in length ranged higher above the national average than those larger than 140mm, but overall, most yellow perch were below average (Figure 11). These low relative weights are likely a result of intraspecific competition.

Table 11. Length at age of yellow perch captured at Palmer Lake during September 2005. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993). Unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean total length (mm) at age			
Year class	No. Fish	1	2	3	4
2004	20	54.2			
		70.1			
2003	22	55.2	119.7		
		74.9	127.4		
2002	30	60.4	126.3	179.8	
		81.4	137.8	183.5	
2001	1	56.1	127.6	164.1	206.2
		78.8	141.0	172.7	209.3
Overall mean		56.5	124.5	171.9	206.2
Weighted Mean		76.3	133.5	183.2	209.3
State Average		59.7	119.9	152.1	192.5

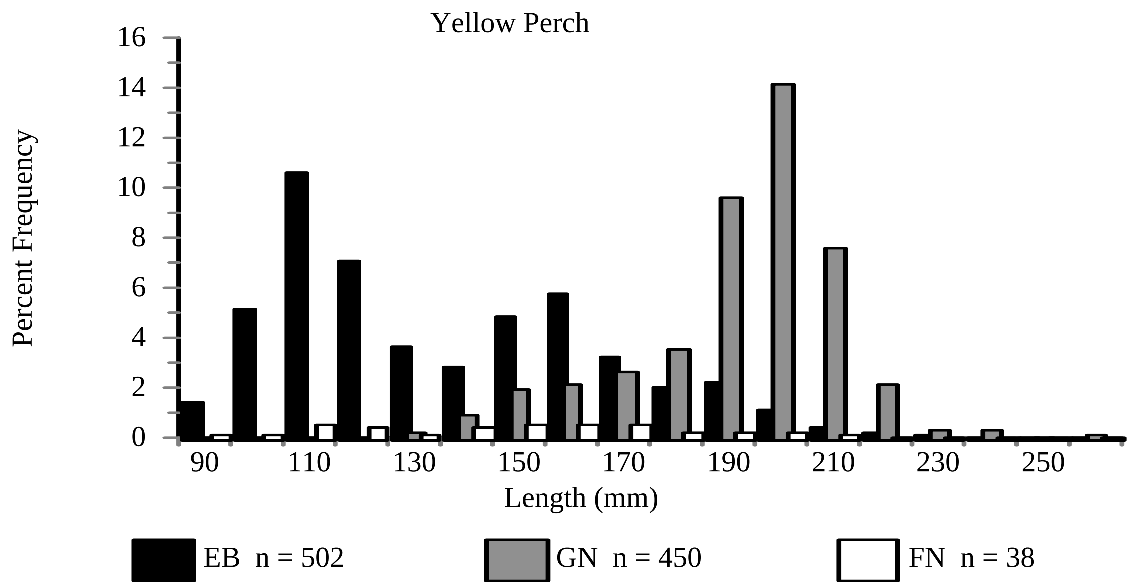

Figure 10. Length frequencies of yellow perch collected by boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Palmer Lake, September 2005.

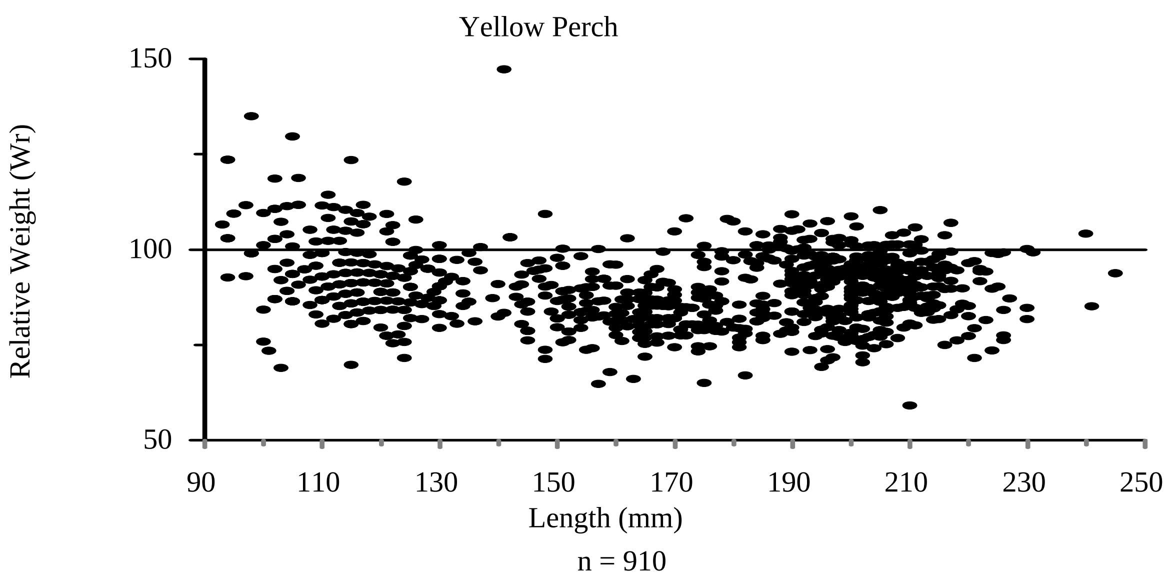

Figure 11. Relative weights of yellow perch collected in Palmer Lake, September 2005, compared to the national average (W_r = 100).

Discussion

Warmwater gamefish comprised 84.8 percent by number and 46.6 percent of the total fish biomass collected during this survey. By comparison, warmwater gamefish comprised 67.3 percent by number and 25.4 percent of the total fish biomass collected during September 1999 (Osborne et al. 2003). The increase of warmwater gamefish collected during 2005 was attributed primarily to bluegill and yellow perch, which increased 508 and 355 percent since 1999, respectively.

Order of species abundance changed since the 1999 survey. Smallmouth bass was the most abundant warmwater gamefish collected during 1999, followed by black crappie and yellow perch. During 2005, yellow perch followed by bluegill and smallmouth bass were the warmwater gamefish collected in highest abundance. Most significant was the decrease in smallmouth bass abundance and increase in yellow perch. The most abundant non-gamefish management species collected during 1999 was peamouth chub, followed by largescale sucker and northern pikeminnow, whereas during 2005, largescale sucker, northern pikeminnow, and peamouth chub were most abundant. The most notable change in abundance of these species between surveys was the decrease in number of peamouth chub from 227 in 1999 to 31 in 2005. Changes in the abundance of species observed within Palmer Lake commonly occurs naturally in most waterbodies over time. Natural mortality, angler exploitation, and predation are common causes of changes within fish communities. Since Palmer Lake receives inflow and reverse flow through the Similkameen River, some species, especially peamouth chub and northern pikeminnow, may move into and out of the lake each spring during high flows.

While changes in abundance of fish species occurred since 1999, relatively few differences were found with other indices. Yellow perch PSD by boat electrofisher increased since 1999, as did the gill net PSD that was too low for an accurate analysis during 1999. Bluegill and yellow perch catch rates were higher relative to the increases in the numbers of each species sampled during 2005. Relative weights during 2005 were similar to 1999 findings, with smallmouth bass and yellow perch being below the national average for most fish, and bluegill and black crappie being above the average.

Yellow perch collected during 2005 showed signs of intraspecific competition for fish larger than 130 mm in length. Stock length for yellow perch is 130 mm, and the majority of yellow perch collected were stock length or larger. The relative weight index showed most yellow perch greater than 130 mm in length to be below average in condition. The density of fish in this size category may be indicative of competition for the available food resource.

Most warmwater gamefish collected during the 2005 survey were smaller, relative to the 1999 survey. Ages of most species collected during 2005 were comprised of younger fish, and when older age fish were present in samples, were few in number. This likely indicates the fish community in Palmer Lake was comprised mostly younger, smaller-size fish. It is unknown why the Palmer Lake fish community contained mostly younger aged fish, but excessive angler harvest or ineffective sampling (e.g. fish were in deep water) may be possible explanations.

Water chemistry parameters were found within desirable ranges during 2005, similar to 1999. Surface water temperatures and dissolved oxygen were higher during 2005, and the thermocline was approximately 1 meter higher than in 1999.

Management Recommendations

Black crappie were stocked for the first time in Palmer Lake since 1999. Black crappie are a desirable panfish in Palmer Lake and we recommend stocking continues on a yearly basis for 3 to 4 more years. Monitoring of black crappie should be conducted in 2 to 3 years to determine if adequate survival and maturation is occurring. If reproduction occurs at a high enough level to sustain this population at higher densities than currently exist, stocking may be reduced or eliminated in the future. A standard warmwater survey should be conducted in conjunction with black crappie monitoring to assess overall changes in the fish community of Palmer Lake.

Literature Cited

Anderson, R. O., and R. M. Neumann. 1996. Length, weight and associated structural indices. Pages 447-482 in Murphy, B. R., and D. W. Willis (eds.), Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, MD.

Anderson, R.O. and A.S. Weithman. 1978. The concept of balance for coolwater fish populations. American Fisheries Society Special Publication 11:371-381.

Bonar, S. A., B. D. Bolding, and M. Divens. 2000. Standard fish sampling guidelines for Washington State pond and lake surveys. Report No. FPT 00-28, Washington Department of Fish and Wildlife, Olympia, Washington. 24 pp.

Carlander, K. D. 1982. Standard intercepts for calculation lengths from scale measurements for centrarchid and percid fishes. Transactions of the American Fisheries Society 111:332-336.

Fletcher, D., S. Bonar, B. Bolding, A. Bradbury, and S. Zeylmaker. 1993. Analyzing warmwater fish populations in Washington State. Washington Department of Fish and Wildlife, Warmwater Fish Survey Manual,

Gabelhouse, D.W., Jr. 1984. A length categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Goldman, C.R. and A.J. Horne. 1983. Limnology. McGraw-Hill, Inc. New York, New York. 464 pp.

Gustafson, K. A. 1988. Approximating confidence intervals for indices of fish population size structure. North American Journal of Fisheries Management 8:139-141.

Willis, D.W., B.R. Murphy, and C.S. Guy. 1993. Stock density indices: development, use, and limitations. Reviews in Fisheries Science 1(3):203-222.

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 that 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, and 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, and 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, and 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, and 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.