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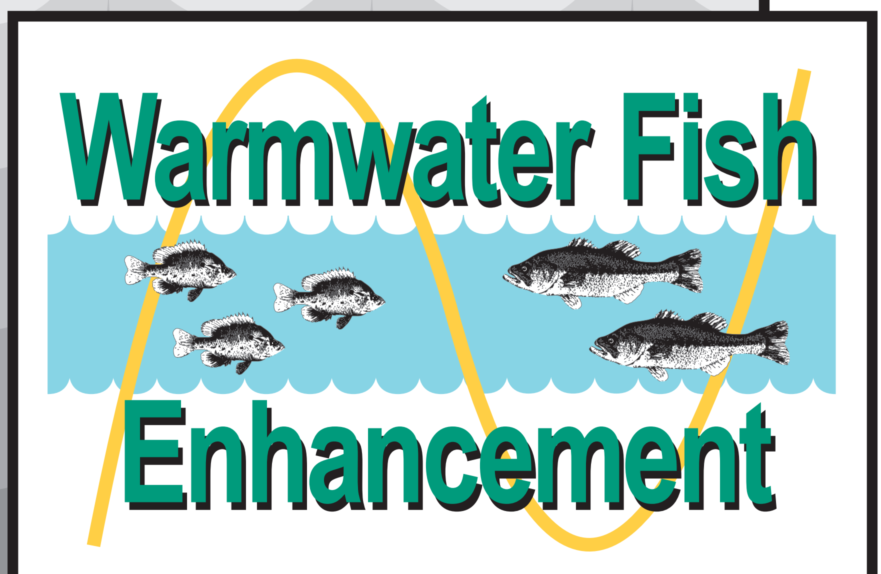
2005 Warmwater Fisheries Survey of Red Rock Lake, Grant County, Washington



by Michael R. Schmuck and Marc R. Petersen

Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

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2005 Warmwater Fisheries Survey of Red Rock Lake, Grant County, Washington

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Abstract

Red Rock Lake was surveyed by a three-person team June 14-22, 2005. Ninety-six percent of fish sampled were warmwater gamefish species. In addition, common carp *Cyprinis carpio*, northern pikeminnow *Ptychocheilus oregonensis* and lake whitefish *Coregonus clupeaformis* were collected. Yellow perch *Perca flavescens* were most abundant followed by largemouth bass *Micropterus salmoides*, pumpkinseed sunfish *Lepomis gibbosus*, and black crappie *Pomoxis nigromaculatus*. No tiger muskie *Esox lucius* × *E. masquinongy* were collected during this survey despite stocking in 1997 and 1999. Growth and relative weights were above average for all species; however, relative weights declined with increasing length for yellow perch. Black crappie, largemouth bass, and tiger muskie declined in abundance in our samples from 1999 to 2005. Declines in abundance of crappie and bass may be the result of ineffective sampling due to low water conditions, or may be due to biological changes driven by over harvest, changes in available prey, or entrainment into Red Rock Creek. Declines in abundance of tiger muskie are likely due to exploitation, no reproduction, and no subsequent stocking since 1999.

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Introduction and Background

Red Rock Lake (87.8 ha) is located in Grant County, approximately 4.8 km southeast of Royal City, Washington (Figure 1). Red Rock Lake was created in 1966 from water used for irrigation. From 1966 to 1982 Red Rock Lake existed as a natural corral lake and water flowed freely into Red Rock Creek. In 1982, the United States Bureau of Reclamation (BOR) constructed the Red Rock Lake Dike as part of the Columbia Basin Project. The dike was intended to be an emergency structure, capable of retaining water during high runoff and preventing the failure of the railroad dike immediately downstream (Willie Lowe, BOR - retired, pers. comm.). The dike was originally constructed of permeable rock-fill, which would allow gradual seepage during high water but has since sealed and acts as a dam. Water is supplied to the lake from the north and east via irrigation return canals. Water exits the lake from the west end through a cement culvert and flows approximately 0.8 km before joining Red Rock Creek. A vertical standpipe was attached to the culvert until approximately 1998, but was removed by the Quincy Irrigation District (QID) for two primary reasons: (1) The standpipe raised the water level and decreased the emergency storage capacity of the lake. (2) Water flowing through the standpipe created a vortex, which may have been hazardous to recreational users, thus creating liability issues for QID. Land surrounding Red Rock Lake is owned by Washington Department of Fish and Wildlife (WDFW), Washington Department of Natural Resources, and the BOR and is characterized by steep slopes and basalt cliffs.

The riparian area of Red Rock Lake hosts various mammals including beaver *Castor canadensis*, coyote *Canis latrans*, and raccoon *Procyon lotor*. Numerous species of waterfowl utilize the lake as a resting area during spring and fall. In addition, prairie falcon *Falco mexicanus* and sandhill crane *Grus canadensis* are also found in the area. Various aquatic (pondweed *Potamogeton spp.*), sub-aquatic (cattail *Typha latifolia* and bulrush *Scirpus spp.*), and terrestrial (Russian olive *Elaeagnus angustifolia*, sagebrush *Artemisia tridentata*, rabbitbrush *Ericameria spp.*, and wheatgrass *Agropyron spp.*) vegetation are common in the area.

The species assemblage in Red Rock Lake reflects multiple recent species introductions and an effort to manage for a mixed species fishery. Largemouth bass *Micropterus salmoides*, black crappie *Pomoxis nigromaculatus*, yellow perch *Perca flavescens*, and pumpkinseed sunfish *Lepomis gibbosus* became established in the lake through irrigation wasteway migration (WDFW 1997). Between 1968-1976, WDFW sporadically stocked the lake with rainbow trout *Oncorhynchus mykiss* (Jeff Korth, WDFW, pers. comm.). Common carp *Cyprinus carpio* first appeared in Red Rock Lake in 1969. In 1997, WDFW introduced tiger muskie *Esox lucius* × *E. masquinongy* in an attempt to reduce the number of carp and small yellow perch. In addition, smallmouth bass *M. dolomieu* were introduced so that the lake's rocky littoral habitat could be utilized more efficiently and more bass could be produced. Fishing is regulated under general statewide fishing regulations and fishing is allowed year-round.

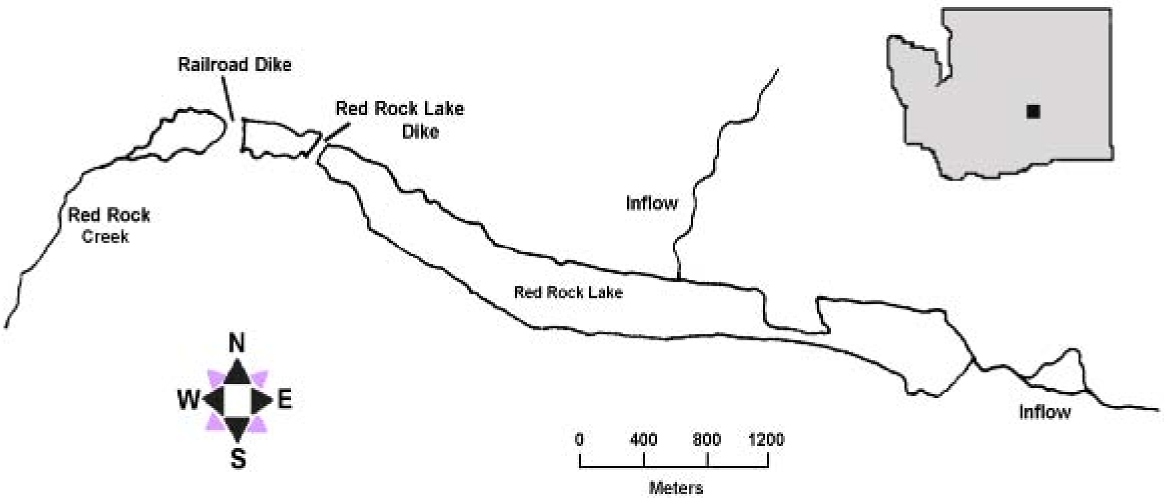

Figure 1. Map of Red Rock Lake, Grant County, Washington.

Methods and Materials

Red Rock Lake was surveyed by the Region Two Warmwater Team June 14-22, 2005. All fish were collected using a boat electrofisher, gill nets, and fyke nets. The electrofisher unit consisted of a 5.5 m (18 ft.) Smith-Root GPP electrofishing boat, supplying a DC current at a setting of 60 cycles/sec at 3 to 4 amps power. Experimental gill nets (45.7 m x 2.4 m) 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. All netting material was constructed of 13 mm nylon mesh.

Sampling locations were selected prior to sampling by dividing the shoreline into 400 m sections and randomly selecting 31 sections from the total. The 31 randomly selected sites were distributed between electrofishing (15 sites), gill nets (8 sites), and fyke nets (8 sites). 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 during nighttime hours when fish were 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) populations in the lake. Warmwater gamefish were assigned to a 10 mm size group based on total length, and scale samples were collected from the first five fish 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).

Species composition, by weight (kg) and number, was determined from fish captured. Fish less than one year old were excluded from all analyses. Eliminating fish less than one year of age, i.e., young-of-the-year (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 (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.

A relative weight (W_r) index was used to evaluate the condition of fish in Red Rock 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 $W_r = W/W_s \times 100$, 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 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.

Age and growth of warmwater gamefish in Red Rock Lake were evaluated using procedures described by Fletcher et al. (1993). All samples 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/or statewide averages.

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). 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 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 and Discussion

Species Composition

Nine fish species were collected during sampling efforts on Red Rock Lake (Table 2). Yellow perch was the most abundant species collected; however, yellow perch biomass ranked third behind common carp and largemouth bass. Common carp comprised 50 percent of the biomass collected; however this was represented by only 51 fish. Largemouth bass was second in terms of overall abundance as well as biomass. Species composition results from this survey were similar to those found during a 1999 survey with the exception of black crappie and tiger musky (Osborne et al. 2003). In 1999, black crappie was second in abundance, and three tiger musky were collected. Black crappie have declined 71 percent in our samples from 1999 and no tiger musky were collected (Figure 2).

Table 2. Species composition by weight, number, and size range of fish captured at Red Rock Lake during a warmwater fish survey June 14-22, 2004.

	Species Composition					
	Biomass		Abundance		TL Range (mm)	
Species	Kg	% of total	No.	% of total	Min.	Max
Warmwater gamefish						
Yellow perch	41.6	18.9	673	64.7	95	210
Pumpkinseed sunfish	3.2	1.5	113	10.8	61	161
Black crappie	7.7	3.5	65	6.3	98	345
Largemouth bass	51.4	23.4	120	11.5	120	541
Smallmouth bass	0.2	0.1	1	0.1	225	225
Brown bullhead	1.4	0.7	12	1.2	104	240
Non-warmwater gamefish						
Common carp	110.1	50.1	51	4.9	152	730
Northern pikeminnow	0.1	0.1	1	0.1	229	229
Lake whitefish	4.2	1.9	5	0.5	300	495
TOTALS	220.0	100.0	1041	100.0		

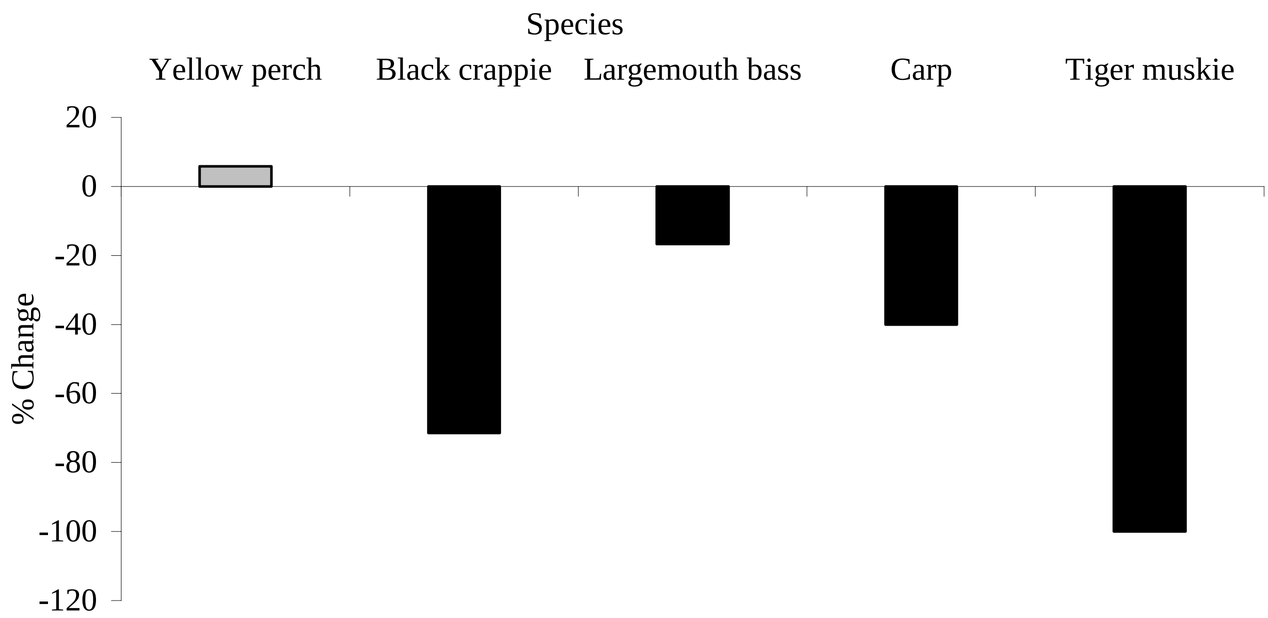

Figure 2. Percent change in fish species abundance sampled in Red Rock Lake from 1999 to 2005.

Catch Per Unit Effort (CPUE)

Whether using active (electrofisher) or passive (gill nets and fyke nets) techniques to sample a lake or reservoir, CPUE can be a useful index to monitor size structure and relative abundance (Hubert 1996). Electrofishing is typically the most effective sampling method for collecting large samples of centrarchid fishes; however, electrofisher catch rates during this survey were highest for yellow perch followed by largemouth bass and pumpkinseed sunfish (Table 3). This trend was likely due to the limited littoral habitat we were able to sample due to low water levels and excessive submergent vegetation (thick mats of filamentous algae, pond lily) close to shore. Gill nets are typically the most effective gear for capturing percids, and gill net catch rates from this survey were highest for yellow perch followed by common carp and black crappie. Fyke nets were ineffective at capturing significant samples of any fish species; however, fyke nets had the highest catch rate for black crappie. Trends in electrofishing CPUE from 1999 and 2005 (i.e. increases and decreases) correspond with changes in abundance of warmwater species in our samples with the exception of largemouth bass (Figure 3).

Table 3. Mean catch per unit effort by sampling method, including 80 percent confidence intervals (CI), for fish collected from Red Rock Lake June 14-22, 2004.

	Electrofisher			Gill Nets			Fyke Nets		
Species	No./ Hour	CI (+/-)	No. Sites	No./ Net Night	CI (+/-)	Net Nights	No./ Net Night	CI (+/-)	Net Nights
Yellow perch	215.2	69.9	15	16.9	6.9	8	0.1	0.2	8
Pumpkinseed sunfish	39.6	16.2	15	0.1	0.2	8	0.5	0.2	8
Black crappie	10.4	3.3	15	2.3	1.0	8	2.6	1.7	8
Largemouth bass	46.4	12.8	15	0.5	0.2	8	0	0	8
Smallmouth bass	0.4	0.5	15	0	0	8	0	0	8
Brown bullhead	3.2	1.7	15	0.3	0.2	8	0.1	0.2	8
Northern pikeminnow	0	0	15	0.1	0.2	8	0	0	8
Common carp	10.4	4.8	15	3.0	1.4	8	0	0	8
Lake whitefish	0	0	15	0.6	0.8	8	0	0	8

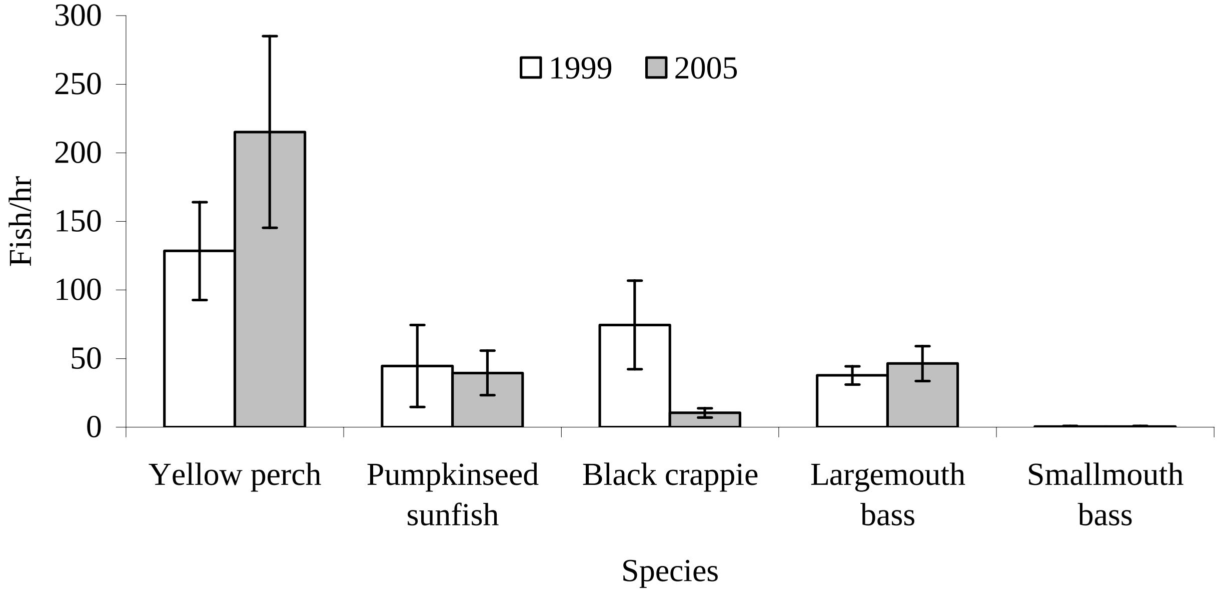

Figure 3 Relative mean electrofishing CPUE for warmwater species collected during 1999 and 2005 warmwater fisheries surveys (bars equal 80% confidence intervals).

Stock Density Indices

Electrofishing is considered an excellent method for collecting large samples of stock length and larger centrarchids (bass, crappie, bluegill), while gill nets are effective at collecting large samples of stock length and larger percids (perch, walleye). 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). The largemouth bass PSD (electrofishing) was 42, the RSD-P was 15, and the RSD-M was seven (Table 4). These indices show that seven percent of the 86 stock length largemouth bass collected were at least 510 mm (20 inches). The yellow perch PSD (gill nets) was six and was based on 135 stock length fish. Approximately six percent of the stock length yellow perch collected were 200 mm (~8 inches). Fyke nets did not provide adequate samples for PSD analysis.

Table 4. Stock density indices (± 80 percent confidence interval) for warmwater fishes collected using boat electrofisher, gill nets, and fyke nets in Red Rock Lake during June 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	Stock Length Fish (n)	PSD	RSD-P	RSD-M	RSD-T
		Electrofisher			
Yellow perch	429	1 (± 0.7)	0	0	0
Black crappie	26	31 (± 12)	15 (± 9)	15 (± 9)	0
Pumpkinseed sunfish	61	3 (± 3)	0	0	0
Largemouth bass	86	42 (± 7)	15 (± 5)	7 (± 4)	0
Smallmouth bass	1	0	0	0	0
		Gill Nets			
Yellow perch	135	6 (± 3)	0	0	0
Black crappie	15	20 (± 13)	0	0	0
Largemouth bass	4	25 (± 28)	0	0	0
		Fyke Nets			
Yellow perch	1	0	0	0	0
Black crappie	21	48 (± 14)	7 (± 4)	7 (± 4)	0
Pumpkinseed sunfish	4	25 (± 28)	0	0	0

Yellow perch

A total of 673 yellow perch were collected during this survey. Ages ranged from one to three years and growth was above the statewide average (Table 5). Most yellow perch were captured during electrofishing; however, yellow perch collected in gill nets were larger ($p < .001$) than those collected with the boat electrofisher (Figure 4). Relative weights were well above the national average ($W_r = 100$) for yellow perch less than stock length (130mm); however, relative weights were less for stock length (130-199mm; $p < .001$) and quality length (200-250mm; $p < .001$) yellow perch (Figure 5). Low relative weights are often an indication of inadequate food resources and these trends in relative weights are similar to those observed in 1999 (Osborne et al. 2003).

Table 5. Length at age of yellow perch captured at red Rock Lake during June 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 length (mm) at age		
Year Class	(n) Fish	1	2	3
2004	19	76.2		
		87.1		
2003	21	80.3	151.5	
		96.2	154.8	
2002	12	74.8	141.1	190.4
		93.3	149.3	191.1
Direct Proportion mean		77.1	146.3	190.4
Fraser Lee mean		92.2	152.8	191.1
WA State Average (DP)		59.7	119.9	152.1

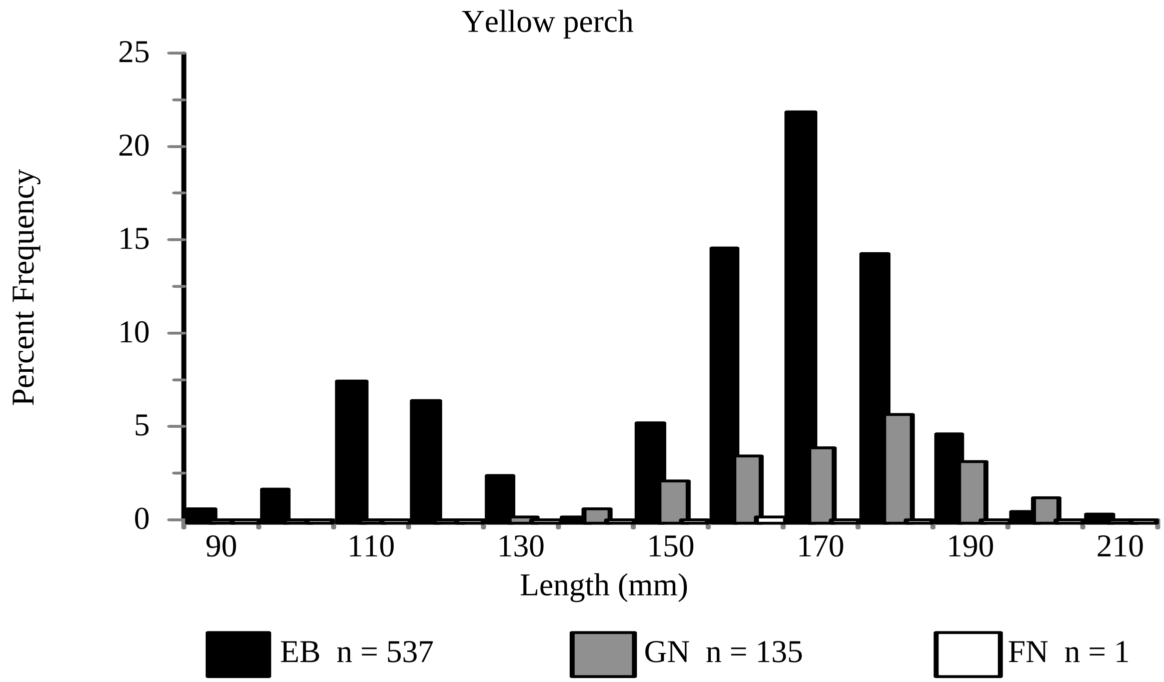

Figure 4. Length frequencies of yellow perch sampled using a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) on Red Rock Lake during June 2005.

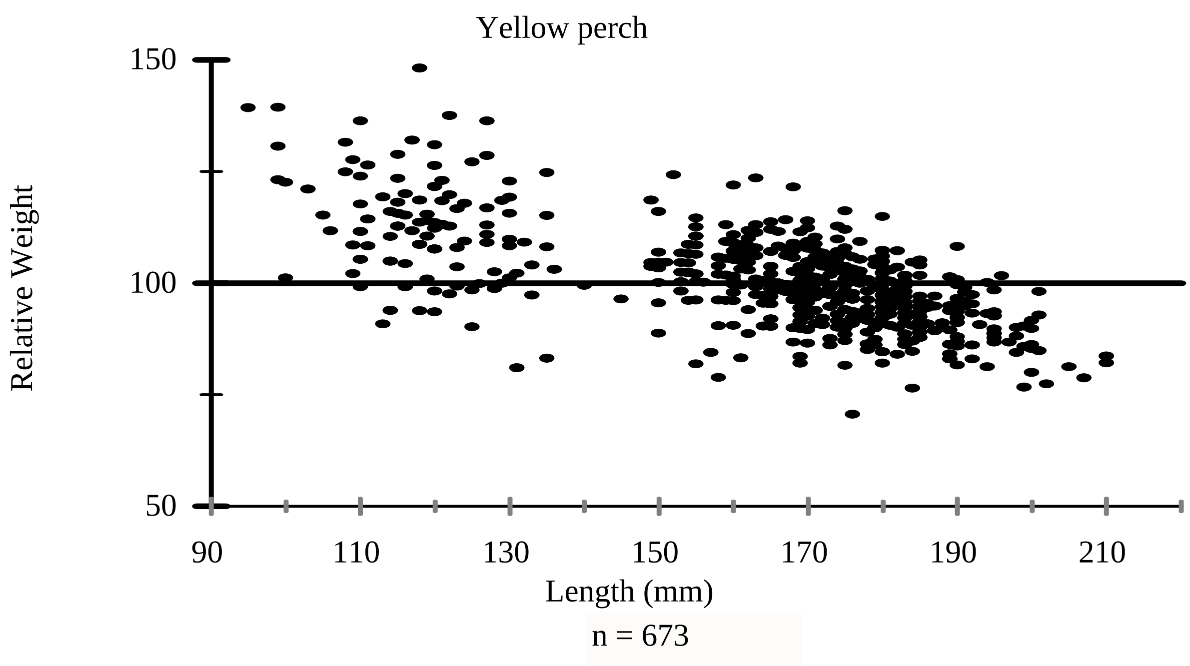

Figure 5. Relative weights for yellow perch sampled at Red Rock Lake, June 2005, compared to the national average W_r = 100 (Anderson and Neumann 1996).

Pumpkinseed sunfish

A total of 113 pumpkinseed sunfish ranging from 61-161 mm were collected during this survey. Ages ranged from one to four years and growth was well above the state average (Table 6). Pumpkinseed scales were not collected during the 1999 survey; consequently no growth comparisons are made between this survey and the 1999 survey. The majority of pumpkinseed sunfish collected were captured with the boat electrofisher (Figure 6). Relative weights averaged (W_r = 123) and were well above the national average (W_r = 100) for the majority of fish collected (Figure 7). The number of pumpkinseed in our samples is the same as that collected in 1999.

Table 6. Length at age of pumpkinseed sunfish captured at Red Rock Lake during June 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 length (mm) at age			
Year Class	# Fish	1	2	3	4
2004	15	44.7			
		54.7			
2003	21	42.4	109.2		
		58.9	112.2		
2002	2	41.5	114.1	146.3	
		59.7	120.2	147.1	
2001	2	25.7	85.9	128.8	148.4
		46.5	96.7	132.5	148.8
Direct Proportion mean		38.6	103.1	137.6	148.4
Fraser Lee mean		56.7	111.6	139.8	148.8
WA State Average (DP)		24	72	102	123

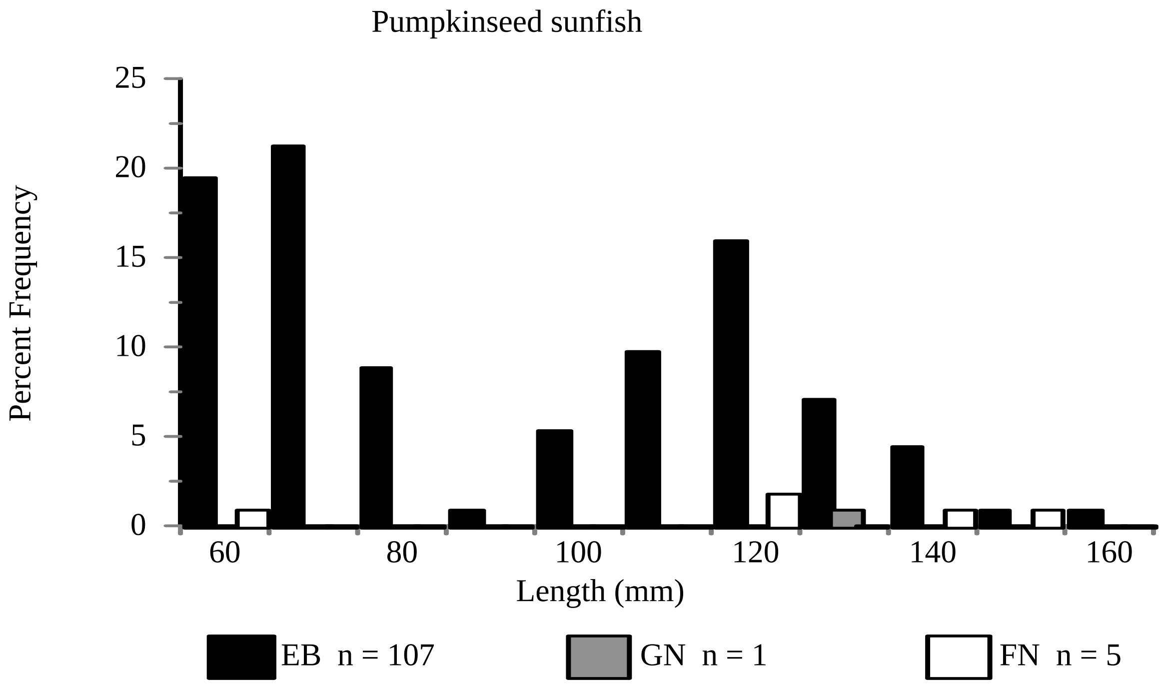

Figure 6. Length frequencies of pumpkinseed sunfish sampled using a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) on Red Rock Lake during June 2005.

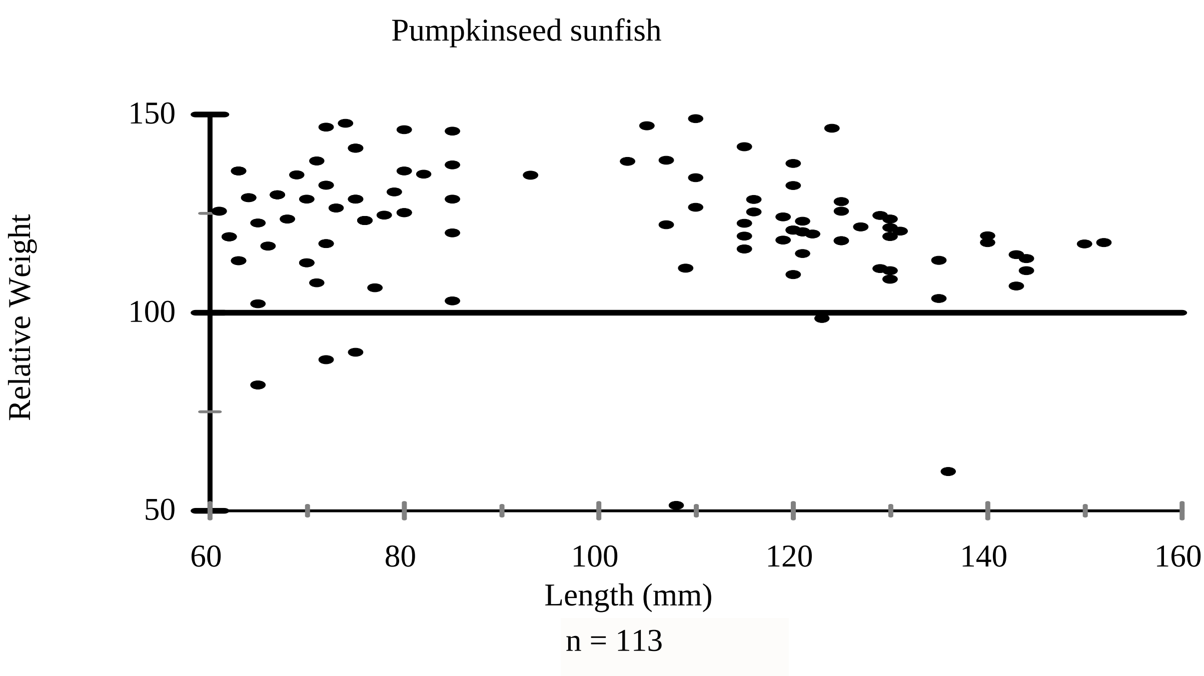

Figure 7. Relative weights for pumpkinseed sunfish sampled at Red Rock Lake, June 2005, compared to the national average W_r = 100 (Anderson and Neumann 1996).

Black crappie

A total of 65 black crappie, ranging in size from 98-345 mm were collected during this survey, which represents a 78 percent sample size decline from the 1999 survey (Osborne et al. 2003). Black crappie ranged in age from one to seven years and growth was above the state average for all age classes collected (Table 7). Black crappie were collected equally with all gear types and both preferred (250-299 mm) and memorable size (300-379 mm) black crappie were collected (Figure 8). Black crappie relative weights were above average for stock length (130-199 mm) fish. Relative weights were lower (p < .001) for quality (200-249 mm) and preferred length fish (Figure 9). This trend is similar to that seen in 1997 (Fletcher 1997). Overall, black crappie relative weights from the 2005 survey (W_r = 99) were slightly higher than that seen in 1999 (W_r = 97) (Osborne et al. 2003).

Table 7. Length at age of black crappie captured at Red Rock Lake during June 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 length (mm) at age						
Year Class	# Fish	1	2	3	4	5	6	7
2004	1	50.3						
		69.3						
2003	17	68.6	155.7					
		90.0	159.8					
2002	13	59.7	148.7	204.5				
		84.9	159.2	205.8				
2001	1	65.5	146.8	209.1	277.8			
		93.3	165.7	221.2	282.4			
2000	1	53.2	139.1	203.2	275.8	325.4		
		82.6	159.3	216.6	281.4	325.8		
1999	2	59.7	130.7	179.6	228.3	269.1	308.0	
		88.2	151.4	194.9	238.3	274.6	309.3	
1998	1	56.5	154.2	224.9	260.2	309.7	328.5	345.0
		85.8	173.6	237.1	268.8	313.3	330.2	345.0
Direct Proportion mean		59.1	145.9	204.3	260.5	301.4	318.3	345.0
Fraser Lee mean		87.3	159.6	207.8	261.9	297.0	316.2	345.0
WA Average (DP)		46	111.2	156.7	183.4	220.0	224.0	261.0

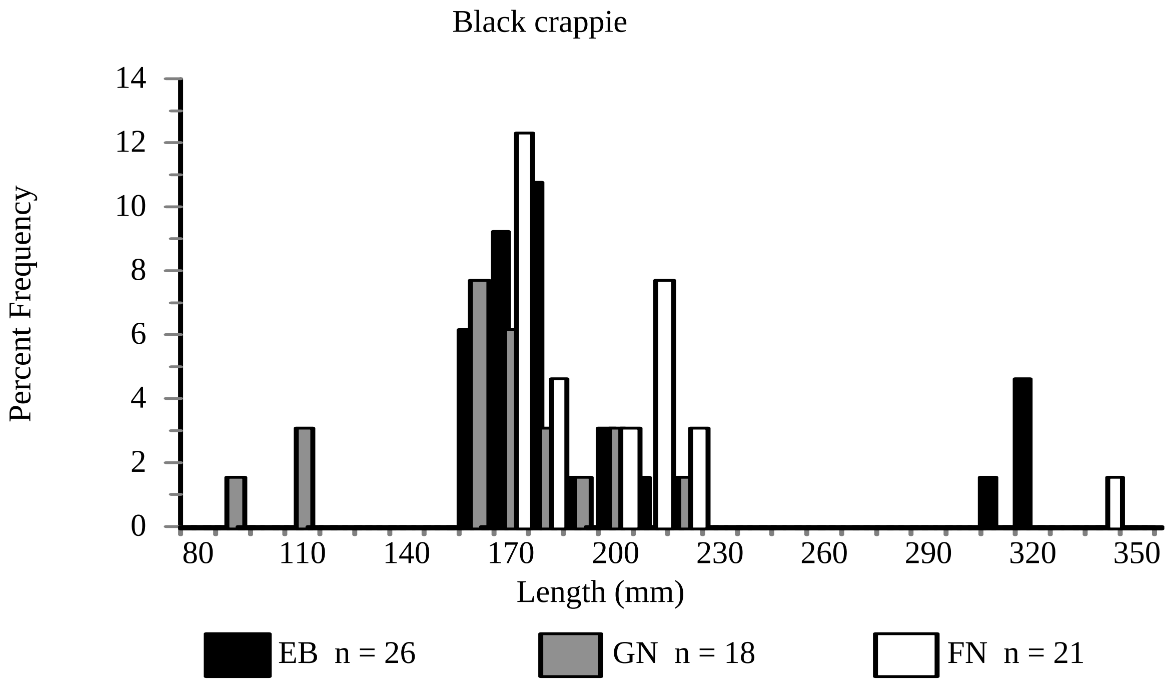

Figure 8. Length frequencies of black crappie sampled using a boat electrofisher (EB), gill nets (GN), and fyke nets on Red Rock Lake during June 2005.

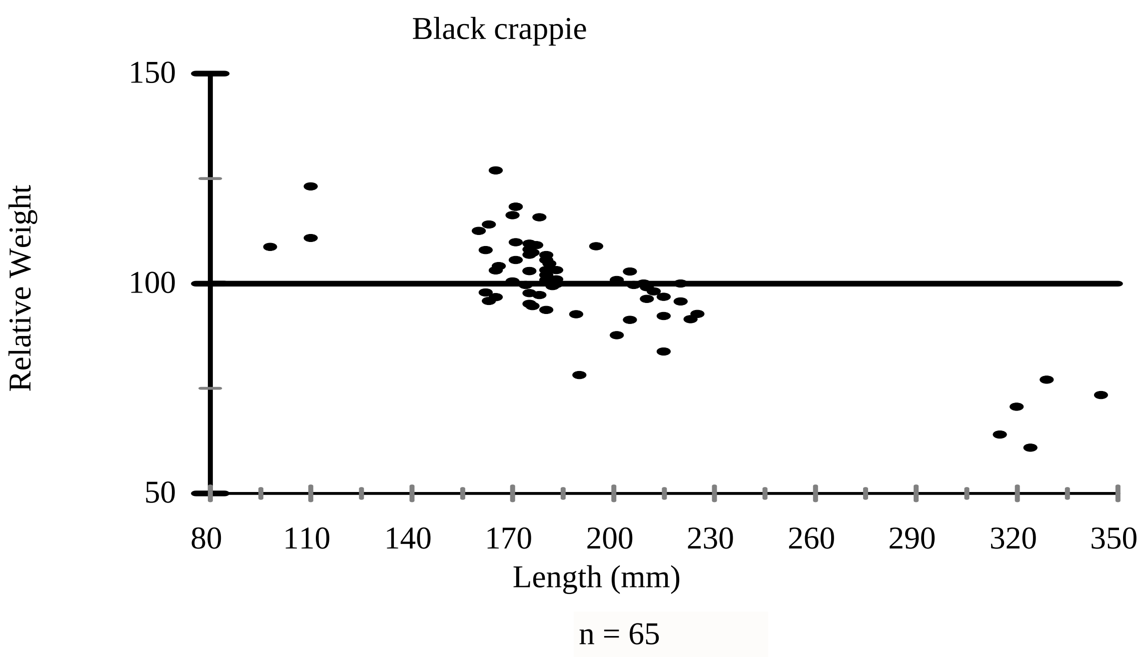

Figure 9. Relative weights for black crappie sampled at Red Rock Lake, June 2005, compared to the national average W_r = 100 (Anderson and Neumann 1996).

Largemouth bass

A total of 120 largemouth bass ranging from 120-541 mm were collected during this survey. The majority of largemouth bass collected were age one to four; however, we also collected several fish up to age 15 (Table 8). These age ranges are similar to those observed in 1999 and are older than ages of largemouth bass collected from other lakes in the region. Most largemouth bass were captured with the boat electrofisher and no largemouth were collected in fyke nets (Figure 10). These data are similar to results found during the 1999 survey in terms of sample size and ratios of fish captured with each gear (Osborne et al. 2003). Average relative weights for largemouth bass were above the national average (W_r = 100) in both 1999 (W_r = 108) and 2005 (W_r = 109). The majority of largemouth bass collected were stock length (200-299 mm). These fish had lower (p < .05) relative weights than quality (300-379 mm) and preferred (380-509 mm) length largemouth bass (Figure 11).

Table 8. Age and growth of largemouth bass captured at Red Rock Lake during June 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 length (mm) at age														
Year Class	# Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	16	100														
		105														
2003	31	86	187													
		98	189													
2002	20	78	241	336												
		93	247	337												
2001	5	56	217	341	390											
		73	226	343	390											
2000	0															
1999	0															
1998	0															
1997	0															
1996	0															
1995	3	73	228	344	420	448	469	487	500	510	519					
		90	239	352	424	451	472	489	501	511	519					
1994	1	75	231	320	405	445	471	491	505	522	533	541				
		92	243	328	410	448	473	493	507	522	533	541				
1993	1	85	153	336	383	410	427	448	462	479	494	505	515			
		102	167	342	388	414	430	450	465	480	495	505	515			
1992	0															
1991	0															
1990	1	94	165	238	291	350	387	419	441	460	485	502	519	528	534	541
		111	179	250	301	357	393	424	445	463	487	503	520	529	534	541
Dir. Prop. mean		81	203	319	378	403	438	461	477	493	507	515	517	528	534	541
Fraser Lee mean		97	214	336	393	428	452	472	486	500	512	516	517	529	534	541
Eastern WA Average (DP)		69	135	189	249	300	351	421	437	N/A	N/A	N/A	N/A	N/A	N/A	N/A

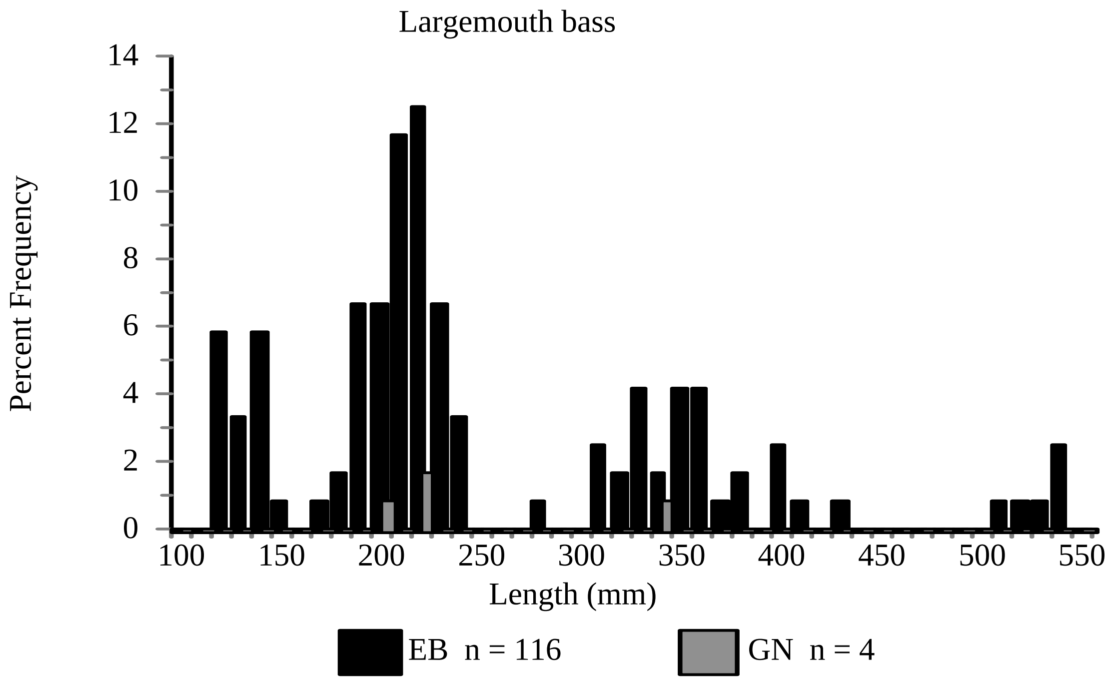

Figure 10. Length frequencies of largemouth bass sampled using a boat electrofisher (EB) and gill nets (GN) on Red Rock Lake during June 2005.

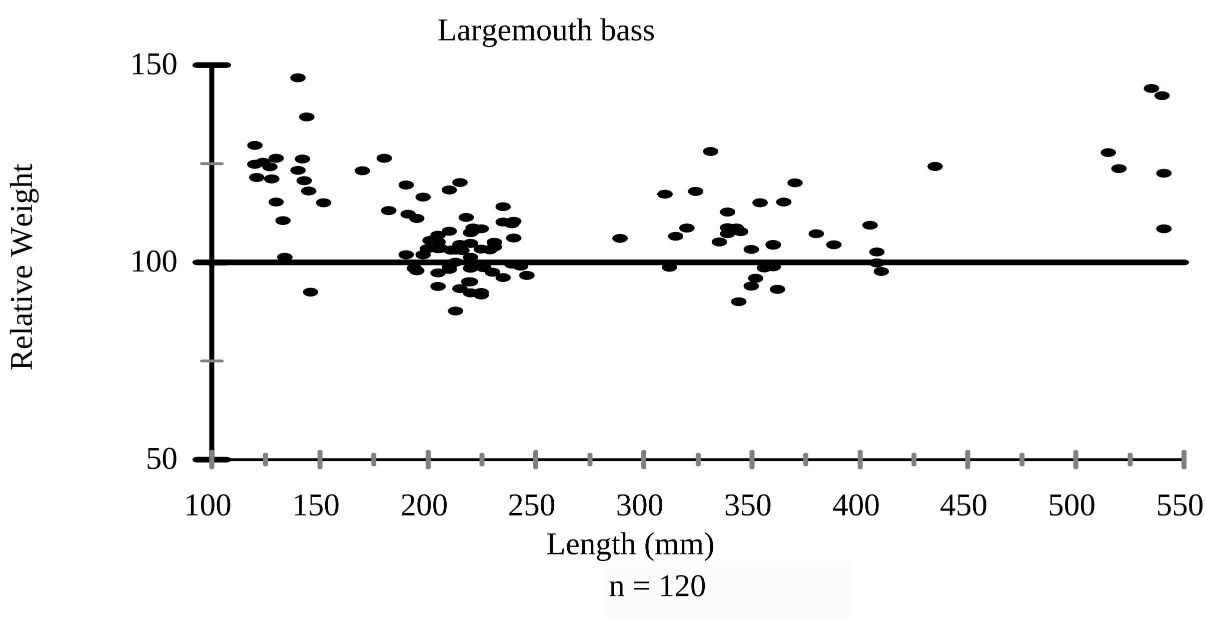

Figure 11. Relative weights for largemouth bass sampled at Red Rock Lake, June 2005, compared to the national average W_r = 100 (Anderson and Neumann 1996).

Smallmouth bass

Similar to results of the 1999 warmwater survey (Osborne et al. 2003), only one smallmouth bass (254 mm; age two) was collected during this survey. The smallmouth bass collected during the 1999 survey was likely from the 1997 stocking. There is either some natural reproduction of smallmouth bass occurring in Red Rock Lake, or these fish are moving into the lake from Red Rock Creek through the outflow culvert. However, our sampling efforts have failed to collect significant numbers of this species. This could be due to small population size and limited distribution of this population since we are able to sample smallmouth bass effectively in other lakes and reservoirs.

Northern pikeminnow

Only one northern pikeminnow was collected during this survey. No pikeminnow were collected during the 1999 survey (Osborne et al. 2003), and this fish may have entered Red Rock Lake via the outflow culvert that flows into Red Rock Creek. Red Rock Creek connects with the Columbia River via Crab Creek.

Brown bullhead

Twelve brown bullhead were collected during this survey. Lengths ranged from 104-240 mm and bullhead were collected with all gear types. Only three brown bullhead were collected during the 1999 survey and it doesn't appear that this population has become established and become problematic. Juvenile brown bullhead provide forage for largemouth bass which may be controlling the bullhead population and preventing significant population growth. Brown bullhead is a popular gamefish in waters where they are abundant and exhibit good growth; however, it is unlikely that brown bullhead will become a species targeted by anglers in Red Rock Lake.

Lake whitefish

Only five lake whitefish were collected during this survey, which is similar to the number collected in 1999. All fish collected in both 1999 and 2005 were adults and lengths ranged from 300-495 mm. Lake whitefish likely arrived in Red Rock Lake via migration from irrigation return canals that connect with Potholes Reservoir and Moses Lake. Lake whitefish are probably not targeted by anglers in Red Rock Lake and likely have little impact on warmwater gamefish.

Common carp

Carp comprised the majority of biomass sampled during this survey, which is similar to results of the 1999 survey (Osborne et al. 2003). Carp can become problematic in lakes and reservoirs due to their feeding and spawning behavior, which reduces water clarity and uproots aquatic vegetation. Carp control measures are often time consuming, costly, and of little benefit if migration barriers are not installed to prevent re-infestation. Carp are able to migrate into Red Rock Lake from irrigation return canals; therefore, carp control should not be considered until this population expands to the point where carp are limiting gamefish populations.

Tiger Muskie

Tiger muskie were stocked in Red Rock Lake 1997 and 1999. During a 1999 warmwater survey three tiger muskie were collected; none were collected during this survey. The fate of these fish is unknown; however, Red Rock Lake may not be well suited for tiger muskie due to extreme water level fluctuations and a lack of available cover during low water conditions.

Conclusions and Management Options

Species Summaries

Yellow perch was the most abundant species collected during this survey and samples of this species have increased approximately six percent since 1999. Tiger muskie were stocked in Red Rock Lake in part, to control the yellow perch population. In 1999, three tiger muskie were sampled and several more were observed; however, no tiger muskie were collected or seen during this survey. A lack of predators in Red Rock Lake may allow panfish populations to expand beyond acceptable levels and will likely result in declining relative weights and slow growth. Low relative weights may also be due to turbidity, which reduces feeding efficiency. Red Rock Lake was extremely turbid during this survey due to low water conditions that occur in spring. Yellow perch was the only species that increased in abundance from 1999 to 2005, which may be due to declines in predators such as largemouth bass and tiger muskie.

Black crappie declined in our samples 78 percent from 1999 to 2005. Only two age classes (age two and three) contained more than two fish. Due to varying irrigation uses water levels fluctuate significantly in Red Rock Lake. Excessive low water conditions may inhibit feeding to the point that relative weights are negatively impacted. The most notable result was the lack of age one black crappie collected during this survey. Black crappie often exhibit high variations in year class strength (Swingle and Swingle 1967); however, small populations are more significantly affected by inconsistent recruitment and this population may be headed for a significant decline if this trend in low recruitment continues.

As with black crappie, largemouth bass have declined in abundance in our samples since 1999. Age 5-9,13,14 largemouth bass were missing from our samples and contained sizes of fish available for harvest (>340mm; 17 inches). Approximately 30 percent of the largemouth bass collected were within the protective slot (12-17 inches); however, this population should provide excellent opportunity for catch and release angling due to the abundance of large fish in the population. Declines in largemouth bass may be due to exploitation of large fish, a lack of available forage fish, or the result of sampling variation due to low water levels. Low water levels, as seen during this survey, change the areas we are able to sample (i.e. sampling open water vs. littoral zone) and effort is different than when water levels are high. Without more frequent surveys and at least minimal creel data we can only speculate as to the cause of this observed decline.

Growth of all species was above the eastern Washington or statewide average. This attribute is not surprising when it is coupled with declines in abundance for nearly all species sampled.

Growth is density dependant, and high growth rates in these populations are likely due to the fact that competition for food and space is low.

Population Monitoring

This survey was conducted in spring when water levels were low and much of the shoreline was inaccessible to our electrofishing boat. The 1999 survey was conducted in fall when water conditions were higher. There were many areas we could not sample during the 2005 survey and this likely affected our results in terms of abundance and CPUE. We recommend sampling Red Rock Lake when water levels are higher in order to reduce sampling variability caused by limited sampling sites.

Warmwater surveys should be conducted more frequently (e.g. 2-3 yr. intervals) in order to monitor changes in abundance and detect trends in warmwater fish populations to allow managers to make timely decisions. Managers should make an effort to visit Red Rock Lake in order to monitor angling pressure at whatever interval is feasible. While this will not serve as a statistically sound "creel survey", it will provide managers with an idea of this lake's popularity with anglers.

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Glossary

Catch Per Unit Effort (CPUE): Is defined as the number of fish captured by a sampling method (ie. 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 proportion of fish of a specified length category (quality, 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 proportion 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 proportion 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 proportion 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): Is defined as the length measurement from the anterior most part of the fish to the tip of the longest caudal (tail) fin ray (compressed).

Trophy Size: Considered a trophy, and also identified as 74-80 percent of world record length. Trophy length varies by species.