1998 Warmwater Fisheries Survey of Mesa Lake (Franklin County)

by

Marc Divens and Larry Phillips
Department of Fish and Wildlife
Fish Program
Warmwater Enhancement Program
600 Capitol Way North
Olympia, WA 98501-1091

August 2000

Acknowledgments

From the Washington Department of Fish and Wildlife (WDFW) we thank J. Pahutski, P. Round, and T. Nelson for data collection; C. Donley for assisting with data analysis; D. Fletcher for aging scales; S. Bonar, B. Bolding, S. Caromile, W. Meyer, K. Mueller, and M. Downen for technical advice; and J. Cummins, K. Divens, J. Easterbrooks, and S. Jackson for providing critiques of the manuscript. This project was funded through the WDFW Warmwater Enhancement Program in an effort to provide greater opportunities to fish for and catch warmwater fish in Washington State.

Abstract

Mesa Lake (Franklin County) was surveyed by a three person assessment team August 25-26, 1998. Fish were captured by boat electrofishing, gill netting and fyke netting. Yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) comprised the highest proportion of the catch by number. Common carp (*Cyprinus carpio*) and bridgelip sucker (*Catostomus columbianus*) comprised the highest proportion of the catch by weight. The current state of the fish community can be characterized as unbalanced with a variety of gamefish and non-gamefish species. Currently, the lake is likely to offer only marginal angling opportunity. The lakes connectivity to an extensive irrigation canal system limits fisheries management possibilities. It is very difficult to control the species composition and non-gamefish species densities due to immigration via the irrigation canal system. Management options include adopting the states current 12-17 inch slot-limit for largemouth bass in an effort to improve angling for both largemouth bass and panfish.

Table of Contents

List of Tables

List of Figures

Introduction

Mesa Lake (Franklin County) is located southwest of Mesa (surface area = 50 acres; mean depth = 2 m [5 ft]; max depth = 3.5 m [12 ft]) (Figure 1). Mesa Lake is fed mainly by an irrigation canal entering at the southern end of the lake. Additionally, the lake is fed intermittently by up to three smaller irrigation canals. Water exits the lake by an irrigation canal at the northern end of the lake. Land ownership around the lake is private and federal (Bureau of Reclamation). Development around the lake is limited to agriculture.

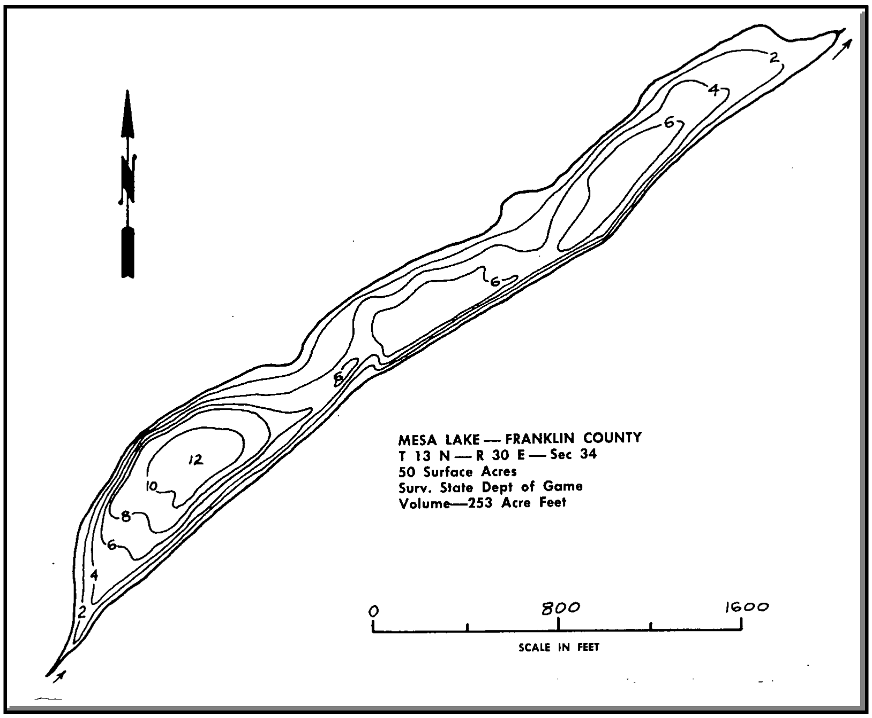

Figure 1. Map of Mesa Lake (Franklin County).

Historically, Mesa Lake has provided cutthroat trout (*Oncorhynchus clarki*), rainbow trout (*Oncorhynchus mykiss*) and warmwater fish angling opportunities. In 1961 the lake was rehabilitated with rotenone to eliminate common carp (*Cyprinus carpio*). Following the rehabilitation, the lake was stocked with smallmouth bass (*Micropterus dolomieui*) and cutthroat trout. No fishery developed from the smallmouth bass plants, but cutthroat trout provided a fair fishery for two years. Common carp reappeared in great numbers and in 1964 the lake was rehabilitated with toxaphene. The lake was restocked with rainbow trout which provided good angling for about two years. No stocking of Mesa Lake has occurred recently. Today, angling opportunities are the result of naturally reproducing warmwater fish populations and immigration of fish through irrigation canals. Statewide general regulations apply.

A Washington Department of Fish and Wildlife (WDFW) site provides parking, a boat launch, and limited shoreline access to the lake.

WDFW Warmwater Enhancement Program personnel conducted this survey of Mesa Lake in August 1998 to assess the state of the fish community.

Methods

Sampling

Mesa Lake (Franklin County) was surveyed by a three person assessment team August 25-26, 1998. Fish were captured using boat electrofishing, gill netting and fyke netting. The electrofishing unit consisted of a 5.5 m Smith-Root 5.0 GPP "shock boat" using a DC current of 120 cycles/sec $^{-1}$ at 5 to 6 amps power. Experimental gill nets (45.7 m long x 2.4 m deep) were constructed of four sinking panels (two each at 7.6 m and 15.2 m long) of variable mesh size (1.3, 1.9, 2.5, and 5.1 cm stretched mesh) monofilament. Fyke nets were constructed of a main trap net (4.7 m long and 1.2 m diameter), a lead net (30.5 m long x 1.2 m deep) and two wings (7.6 m long x 1.2 m deep).

Sampling locations were selected by dividing the shoreline into eight consecutively numbered sections. Three sections were randomly selected for sampling by boat electrofishing, two were selected for gill netting, and two were selected for fyke netting using a random number generator (Casio fx-991D scientific calculator). While electrofishing, the boat was maneuvered slowly through the shallows following the shoreline. Gill nets were set perpendicular to the shoreline with the small mesh end attached onshore and the large mesh end anchored offshore. Fyke nets were set perpendicular to the shore with the lead net anchored onshore and the wing nets set at a 45 degree angle to the trap. Length of the lead from shore and depths the fyke nets were set varied with the slope of the shoreline. Sampling was conducted during evening hours to maximize the type and number of fish captured. Samples were weighted so as to achieve a standardized 1:1:1 ratio of electrofishing to gill netting to fyke netting (1:1:1 - 1800 seconds boat electrofishing:24 gill net hours:24 fyke net hours). This methodology is employed to reduce bias between gear types (Fletcher et al. 1993). Total electrofishing time was 1801 seconds ("pedal-down" time), or one standard unit. Total gill net and fyke net time equaled one standard unit of two nets fished for one night.

Each fish captured was identified to species, measured for total length (mm) and weighed (g). Scales were collected from largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), bluegill sunfish (*Lepomis macrochirus*), and pumpkinseed sunfish (*Lepomis gibbosus*) to analyze age and growth. Scale samples (up to five per 10 mm length class) were mounted, pressed, and aged according to Jearld (1983) and Fletcher et al. (1993).

Data Analysis

Percentages of the total biomass and number of fish collected for each species provides useful information regarding the balance and productivity of the community (Swingle 1950; Bennet

1962; Fletcher et al. 1993). Species composition by weight (kg) and number was calculated from data collected using boat electrofishing, gill netting, and fyke netting.

Catch per unit effort (CPUE) by sampling method was determined for each fish species collected (number of fish/hour electrofishing and number of fish/net night). The CPUE for each fish species was calculated using only stock length fish and larger. Stock length, which varies by species, is the size of a particular fish species that offers threshold recreational value to an angler (Anderson 1976). Randomly chosen sample sections can contribute to high variability among samples, therefore 80% confidence intervals (CI) were calculated for each mean CPUE by species and by sampling method. Each CI was calculated as the mean $\pm t(\propto, N-1) \times SE$, where t=Student's t for $\propto$ confidence level with N-1 degrees of freedom (two tailed) and SE=standard error of the mean. When standardized sampling is used, CPUE is a useful index that can be used to compare lakes within the state of Washington and to monitor changes in relative abundance over time.

Length frequency histograms (percent frequency captured by different sampling methods) were used to evaluate the size structure of all warmwater fish species collected.

Proportional stock density (PSD), calculated as the number of fish$\geq$quality length/number of fish$\geq$stock length$\times$100, was determined for each warmwater fish species collected (Anderson and Neuman 1996). PSD can provide information about the proportion of various size fish in a population and can be a useful tool when sample size is adequate (Willis et al. 1993; Divens et al. 1998). Stock and quality lengths used in the calculation of PSD are based on a percentage of world record catch size and vary depending on fish species (Table 1). Stock lengths (20-26% of the world record) refer to the minimum size fish with recreational value, and quality lengths (36-41% of the world record) refer to the minimum size fish anglers prefer catching. As an addition to stock and quality length, Gabelhouse (1984b) introduced preferred, memorable, and trophy length categories. Preferred length (45-55% of world record length) refers to the size fish anglers would prefer to catch when given a choice. Memorable length (59-64% of the world-record length) refers to the minimum size fish most anglers remember catching, whereas trophy length (74-80% of world record length) refer to the minimum size fish worthy of acknowledgment. Bister et al. (2000) developed and proposed additional length categories for 83 additional species including yellow bullhead catfish (*Ameiurus natalis*).

Table 1. Length categories for warmwater fish captured at Mesa Lake (Franklin County) August 1998. Measurements are minimum total lengths (mm) for each PSD and RSD category.

Species	Size				
	Stock	**Quality**	**Preferred**	**Memorable**	**Trophy**
Black Crappie	130	200	250	300	380
Bluegill Sunfish	80	150	200	250	300
Common Carp	280	410	530	660	840
Largemouth Bass	200	300	380	510	630
Pumpkinseed Sunfish	80	150	200	250	300
Walleye	250	380	510	630	760
Yellow Bullhead Catfish	100	180	230	280	360
Yellow Perch	130	200	250	300	380

Relative Stock Density (RSD), calculated as the number of fish$\geq$specific length/number of fish$\geq$stock length$\times$100, was also calculated for each game fish species. Like PSD, it can also provide useful information regarding population dynamics and is more sensitive to changes in year-class strength. For example, RSD-P was the percentage of stock length fish greater than or equal to preferred length, RSD-M, the percentage of stock length fish that are greater than or equal to memorable length, and so on. Eighty-percent confidence intervals for PSDs and RSDs are provided as an estimate of statistical precision and were calculated using normal approximation (Conover 1980; Gustafson 1988).

Age and growth of warmwater fishes sampled were evaluated using the direct proportion method (Fletcher et al. 1993) and Lee's modification of the direct proportional method (Carlander 1982). Although Lee's modification corrects for species-specific threshold length at the time of scale formation, direct proportion allows for comparison of growth with in-state survey averages previously calculated using direct proportion. We have chosen to present the results for calculations from both methods until survey averages can be developed using Lee's modification. Using the direct proportional method, total length at annulus formation, L_n, was back-calculated as L_n=(A$\times$TL)/S, were A is the radius of the fish scale at age n, TL is the total length of the fish captured, and S is the total radius of the scale at capture. Using Lee's modification, L_n was back-calculated as L_n=a+A$\times$(TL-a)/S, where a is the species-specific standard positive y-axis intercept from a scale radius-fish length regression. Mean back-calculated lengths at age n for each species were presented in tabular form for easy comparison of growth between year classes, as well as between the lake average and what has been found in other in Washington for the same species using the direct proportion method (Fletcher et al. 1993).

Relative weight (Wr) was used to evaluate the condition of fish in the lake. Relative weight is useful for comparing the condition of different size groups within a single population to determine if all sizes are finding adequate forage (ODFW 1997). A Wr value of 100 generally indicates average condition compared to the national average for a species. This index was calculated as Wr=W/Ws$\times$100, where W is the weight (g) of an individual fish and Ws is the standard weight of a fish of the same length (mm) (Murphy and Willis 1991). Ws is calculated from the standard log10 weight-log10 length relationship defined for the species of interest. Anderson and Neumann (1996) list the parameters for the Wr equations of many warmwater fish species, including the minimum length recommendations for their application. Wr values calculated from this survey were compared to the national average (Wr=100) for each species.

Results

Species Composition

Eleven species were collected at Mesa Lake in August, 1998 (Table 2). Bridgelip sucker (*Catostomus columbianus*) and common carp made up the majority of the catch by weight. Walleye (*Stizostedion vitreum*) were the most abundant gamefish species by weight. Yellow perch, largemouth bass, and black crappie (*Pomoxis nigromaculatus*) were the most abundant species by number. Lake whitefish (*Coregonus clupeaformis*), pumpkinseed sunfish, yellow bullhead (*Ameiurus natalis*), bluegill sunfish (*Lepomis macrochirus*), and sculpin (*Cottus* spp.) were sampled at lower numbers.

Table 2. Species composition by weight (kg) and number of fish captured at Mesa Lake (Franklin County) during August 1998.

	Species Composition					
Species	**by Weight**		**by Number**		**Size Range (mm TL)**	
	(kg)	**(%w)**	**(#)**	**(%n)**	**Min**	**Max**
Bridgelip Sucker	30.73	24.20	59	6.61	113	447
Common Carp	30.01	23.63	50	5.61	86	560
Walleye	20.44	16.10	16	1.79	445	620
Lake Whitefish	20.40	16.07	20	2.24	452	502
yellow Perch	17.00	13.39	488	54.71	74	321
Largemouth Bass	4.65	3.66	107	12.00	68	279
Black Crappie	2.38	1.88	115	12.89	62	354
Pumpkinseed Sunfish	0.70	0.55	31	3.48	47	192
Yellow Bullhead Catfish	0.52	0.41	2	0.22	255	255
Bluegill Sunfish	0.11	0.09	3	0.34	111	132
Sculpin	0.02	0.02	1	0.11	122	122

CPUE

Stock length yellow perch were captured at the highest rate by electrofishing at 114 fish per hour. Stock length common carp, pumpkinseed sunfish, and largemouth bass were sampled at a lower rate by electrofishing. Few fish were captured by gill netting except yellow perch. Bridgelip sucker were sampled at the highest rate by fyke netting. Yellow perch, common carp, lake whitefish, and black crappie were sampled at lower numbers by fyke netting (Table 3).

Table 3. Mean catch per unit effort by sampling method, including 80% confidence intervals, for stock length fish collected from Mesa Lake (Franklin County) during August 1998.

Species	Gear Type					
	Electrofishing		Gill Netting		Fyke Netting	
	(#/hour)	Sites	#/Net Night	Nights	#/Net Night	Nights
Yellow Perch	113.89 ± 58.09	3	36.50 ± 3.20	2	2.00*	2
Common Carp	35.94 ± 46.06	3	2.50 ± 3.20	2	0.50 ± 0.64	2
Pumpkinseed Sunfish	31.98 ± 15.59	3	5.50 ± 0.64	2	0.00	2
Largemouth Bass	21.96 ± 28.15	3	1.00 ± 1.28	2	0.00	2
Bluegill	9.99 ± 6.77	3	0.00	2	0.00	2
Sculpin, Unknown	8.00 ± 5.13	3	0.00	2	0.00	2
Bridgelip Sucker	4.00 ± 2.56	3	1.50 ± 0.64	2	26.00 ± 20.50	2
Walleye	0.00	3	8.50 ± 1.92	2	0.00	2
Lake Whitefish	0.00	3	9.50 ± 12.17	2	1.00 ± 1.28	2
Yellow Bullhead Catfish	0.00	3	0.50 ± 0.64	2	0.00	2
Black Crappie	0.00	3	1.00*	2	0.50 ± 0.64	2

Stock Density Indices

Stock density indicies were calculated and presented for species of which ten or more stock length fish were captured (Table 4). Except for yellow perch, sample sizes of stock length fish of all species were low allowing for only limited interpretation. The yellow perch PSD value of 37 ± 7 and RSD-P value of 5 ± 3 is indicative of a "balanced" population, or one that is not stunted. Similarly, pumpkinseed sunfish PSD and RSD-P values are not indicative of a stunted population. The 17 walleye captured by gill netting were all greater than quality length (510 mm) as indicated by RSD-P and RSD-M values.

Table 4. Traditional stock density indices, including 80% confidence intervals, of fish collected from Mesa Lake (Franklin County) August 1998 by sampling method.

Species	# ≥ Stock Length	PSD	RSD-P	RSD-M	RSD-T
		Electrofishing			
Common Carp	18	89 ± 9	6 ± 7	0	0
Largemouth Bass	11	0	0	0	0
Pumpkinseed Sunfish	16	0	0	0	0
Yellow Perch	57	14 ± 6	2 ± 2	0	0
		Gill Netting			
Pumpkinseed Sunfish	11	27 ± 17	9 ± 11	0	0
Walleye	17	100	35 ± 15	6 ± 7	0
Yellow Perch	73	37 ± 7	5 ± 3	0	0

Largemouth Bass

Mesa Lake largemouth bass sampled ranged in size from 68 to 279 mm TL (Table 2; Figure 2). No bass of quality length (≥ 300 mm) or larger were captured and resulting PSD was 0. The age of largemouth bass from which scales were collected for analysis were one and two years (Table 5). Largemouth bass growth rates for one and two year fish were higher than the known Washington average. Largemouth bass condition was high compared to the national 75th percentile and appeared to increase as length increased indicating adequate forage and limited intraspecific competition (Figure 3).

Table 5. Age and growth of largemouth bass sampled from Mesa Lake (Franklin County) August 1998. Unshaded values are mean back-calculated length at annulus using the direct proportion method (Fletcher et al. 1993). Shaded values are mean back-calculated lengths using the Lee's modification (Carlander 1982).

Year Class	# Fish	Mean length (mm) at age	
		1	2
1997	13	81	
		92	
1996	8	75	159
		89	166
Direct Proportion Overall Mean		78	159
Lee's Weighted Mean		91	166
Direct Proportion State Average		60	146

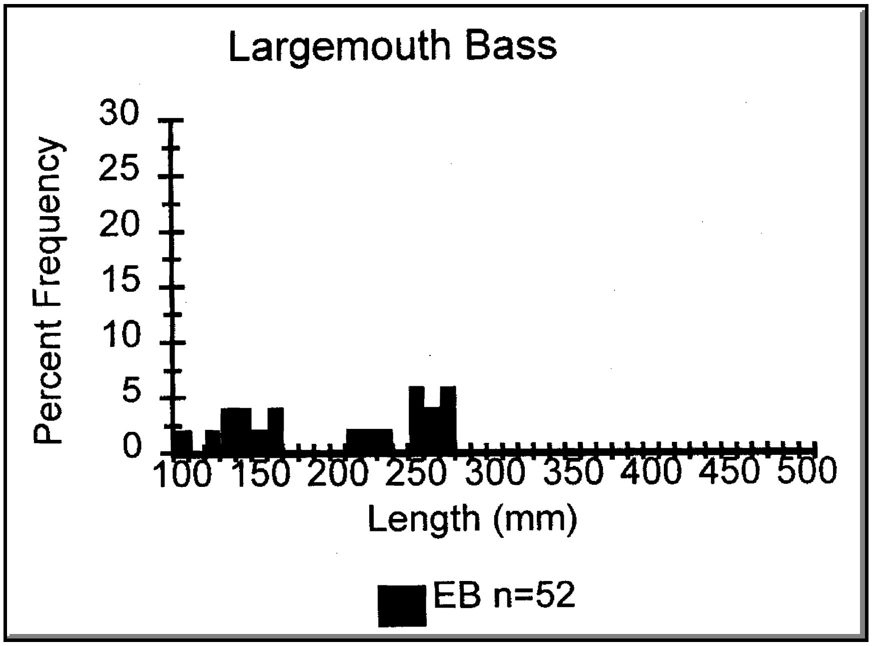

Figure 2. Length frequency distribution of largemouth bass sampled at Mesa Lake (Franklin County) August 1998 by electrofishing boat (EB).

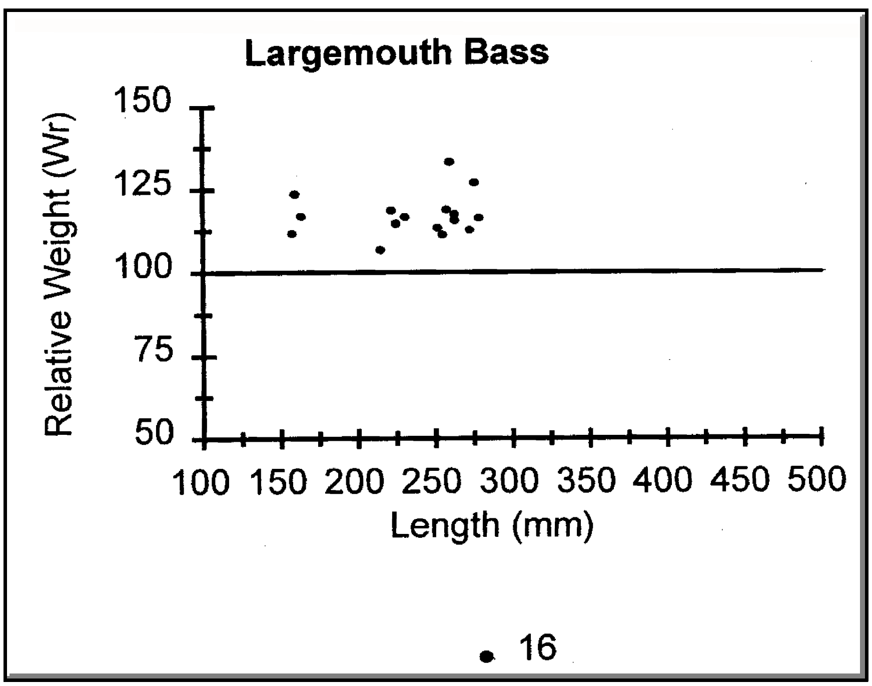

Figure 3. Relative weight (Wr) of largemouth bass sampled at Mesa Lake (Franklin County) August 1998 compared to the national 75th percentile.

Walleye

Mesa Lake walleye sampled ranged in size from 445 to 620 mm (Table 2; Figure 4). Only a small number (17) of large sized walleye were sampled and no walleye less than quality length (380 mm) were captured. Resulting stock density indices were PSD (100), RSD-P (35±15) and RSD-M (6 ± 7). Analysis of relative weight showed walleye condition to be at or below the national average (Figure 5). No age analysis was done for walleye. Walleye were likely produced from outside Mesa Lake and either arrived via the irrigation canal or were illegally stocked as adults. There is no evidence from this survey that walleye are naturally reproducing in Mesa Lake.

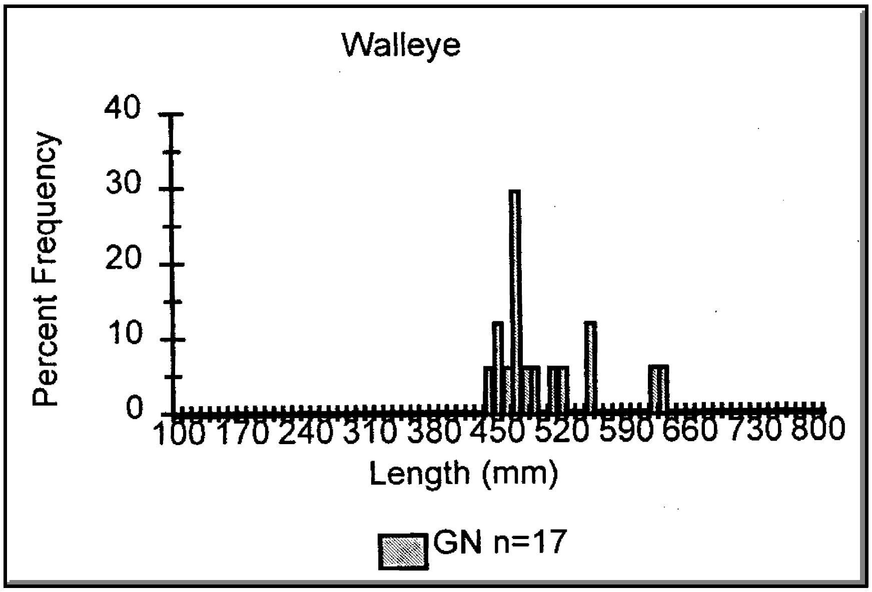

Figure 4. Length frequency distribution of Walleye sampled at Mesa Lake (Franklin County) August 1998 by gill net (GN).

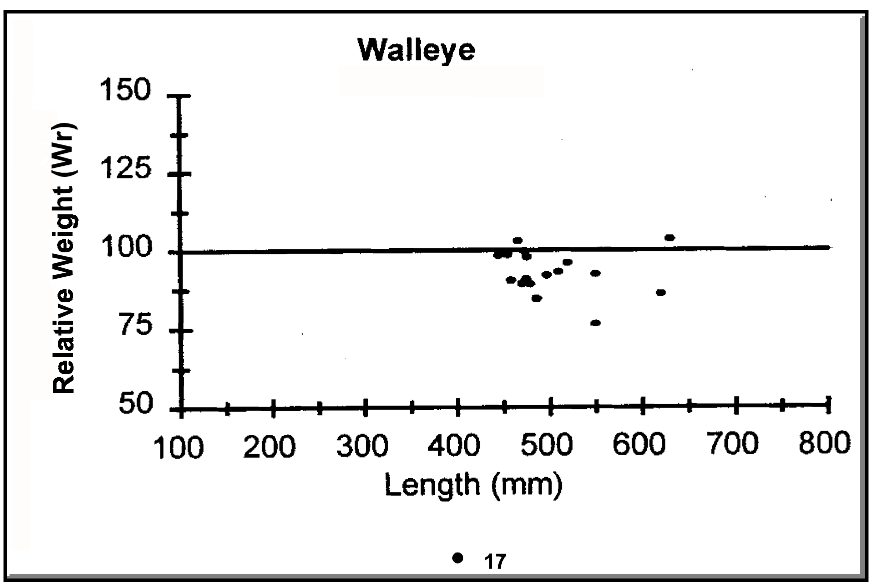

Figure 5. Relative weight (Wr) of walleye sampled at Mesa Lake (Franklin County) August 1998 compared to the national 75th percentile.

Yellow Perch

Mesa Lake yellow perch sampled ranged in size from 74 to 321 mm (Table 2; Figure 6). The age of yellow perch sampled ranged from 1 to 4 years (Table 6). Growth rates were higher than the known Washington. Condition was generally below the national average (Figure 7).

Table 6. Age and growth of yellow perch sampled from Mesa Lake (Franklin County) August 1998. Unshaded values are mean back-calculated length at annulus using the direct proportion method (Fletcher et al. 1993). Shaded values are mean back-calculated lengths using the Lee's modification (Carlander 1982).

Year Class	# Fish	Mean length (mm) at age			
		1	2	3	4
1997	9	98			
		112			
1996	9	93	182		
		111	189		
1994	2	95	185	223	
		114	193	227	
1994	1	72	134	177	283
		95	152	190	187
Direct Proportion Overall Mean		90	167	200	283
Lee's Weighted Mean		111	186	214	287
Direct Proportion State Average		60	120	152	193

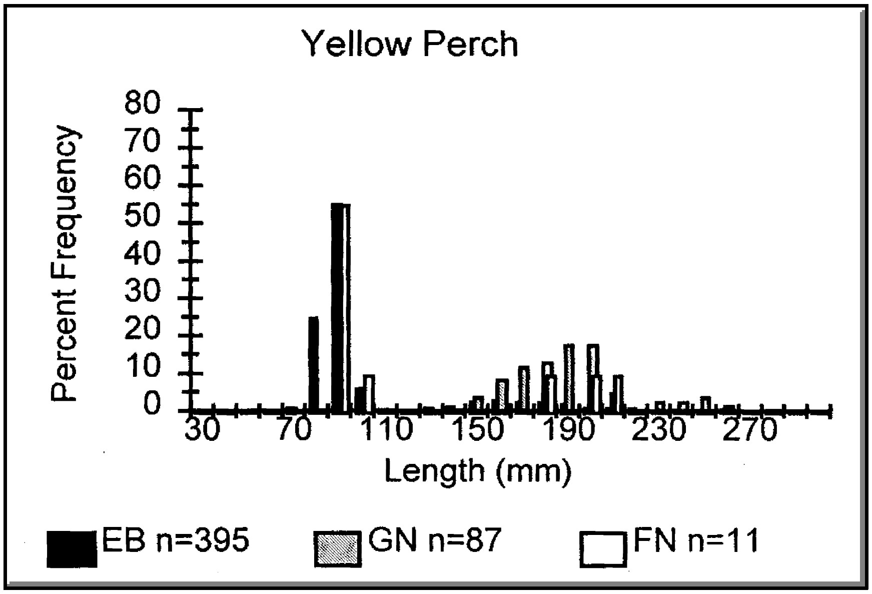

Figure 6. Length frequency distribution of yellow perch sampled at Mesa lake (Franklin County) August 1998 by electrofishing boat (EB), gill net (GN) and fyke net (FN).

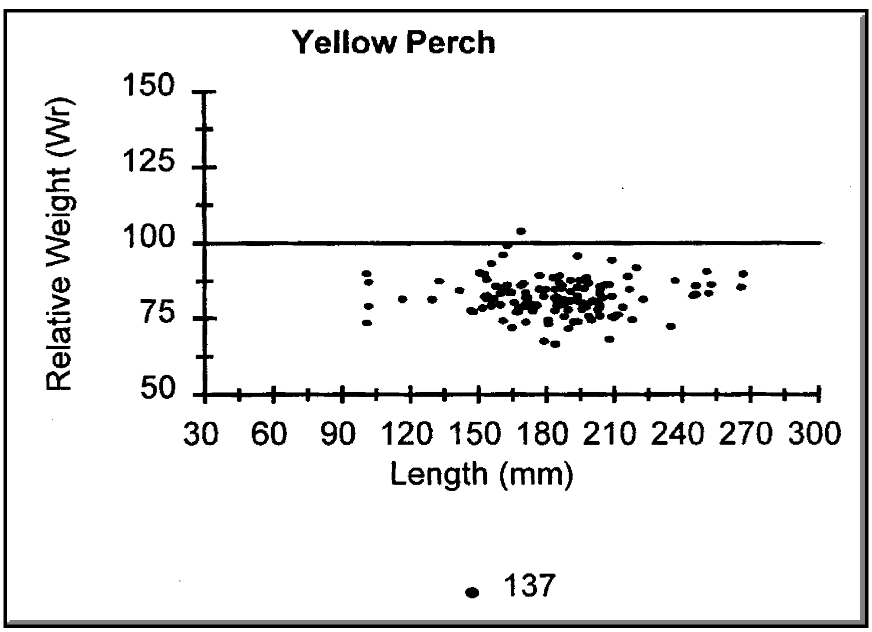

Figure 7. Relative weight (Wr) of yellow perch sampled at Mesa lake (Franklin County) August 1998 compared to the national 75th percentile.

Black Crappie

Mesa Lake black crappie sampled ranged in size from 62-354 mm (Table 2, Figure 8). Three black crappie were aged and ranged from one to seven years suggesting variable year-class strength (Table 7). The limited number of black crappie captured and aged limits comparison with other populations in Washington. The three adult black crappie caught showed average condition by relative weight compared to the national average (Figure 9).

Table 7. Age and growth of black crappie sampled from Mesa Lake (Franklin County) August 1998. Unshaded values are mean back-calculated length at annulus using the direct proportion method (Fletcher et al. 1993). Shaded values are mean back-calculated lengths using the Lee's modification (Carlander 1982).

Year Class	# Fish	Mean length (mm) at age						
		1	2	3	4	5	6	7
1997	1	62						
		82						
1996	0							
1995	0							
1994	1	73	142	185	260			
		100	161	199	266			
1993	0							
1992	0							
1991	1	63	164	216	247	282	307	330
		92	183	230	258	289	311	333
Direct Proportion Overall Mean		66	153	201	253	282	307	330
Lee's Weighted Mean		92	172	215	262	289	311	333
Direct Proportion State Average		46	111	157	183	220	n/a	n/a

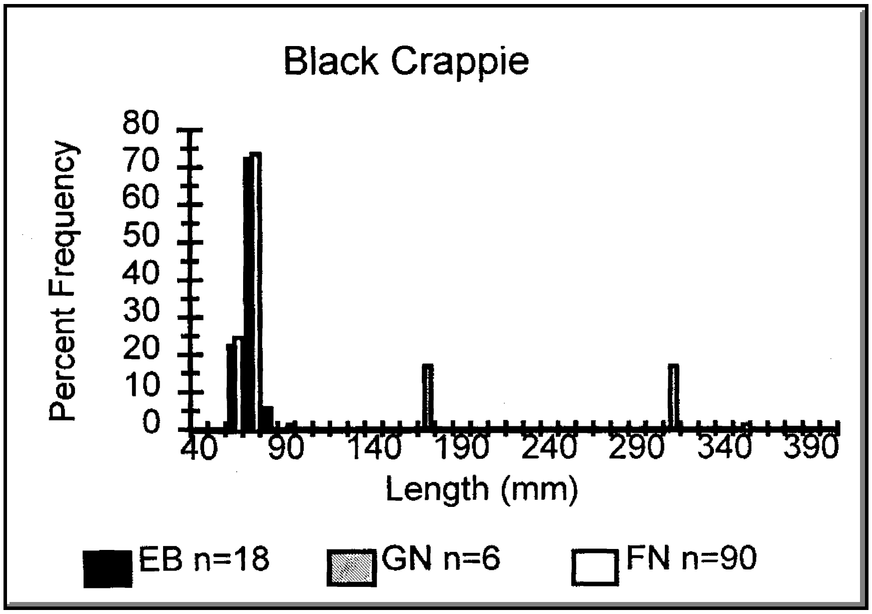

Figure 8. Length frequency distribution of black crappie sampled at Mesa Lake (Franklin County) August 1998 by electrofishing boat (EB), gill net (GN), and fyke net (FN).

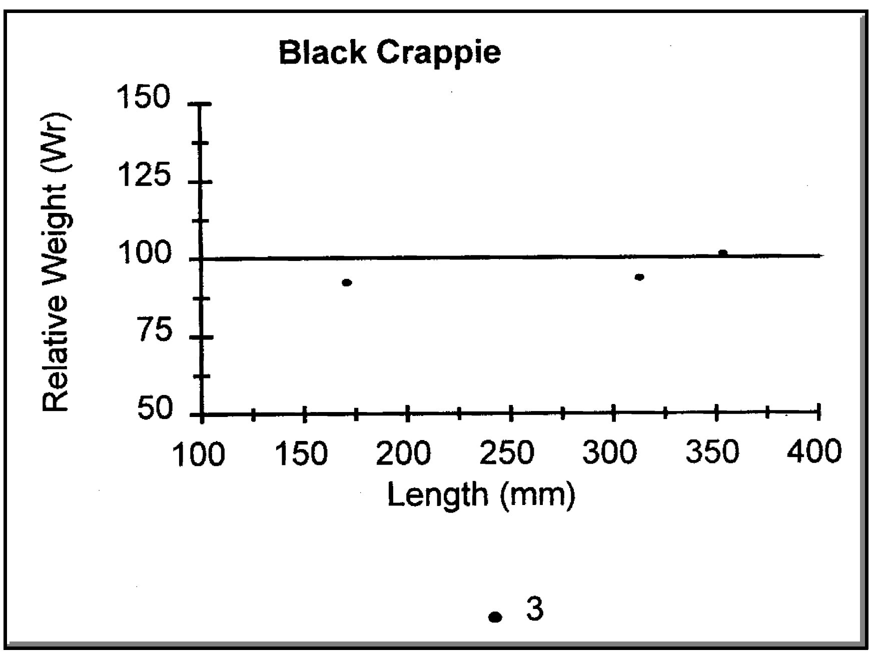

Figure 9. Relative weight (Wr) of black crappie sampled at Mesa lake (Franklin County) August 1998 compared to the national percentile.

Bluegill Sunfish

Mesa Lake bluegill sampled ranged in size from 111 to 132 mm (Table 2; Figure 10). The four bluegill aged were one and two years old and were below average growth compared to the known Washington average (Table 8). Analysis of relative weight showed at or above average condition compared to the national average (Figure 11).

Table 8. Age and growth of bluegill sunfish sampled from Mesa Lake (Franklin County) August 1998. Unshaded values are mean back-calculated length at annulus using the direct proportion method (Fletcher et al. 1993). Shaded values are mean back-calculated lengths using the Lee's modification (Carlander 1982).

Year Class	**# Fish**	**Mean length (mm) at age**	
		1	**2**
1997	2	31	
		46	
1996	2	32	95
		47	100
Direct Proportion Overall Mean		31	95
Lee's Weighted Mean		46	100
Direct Proportion State Average		37	97

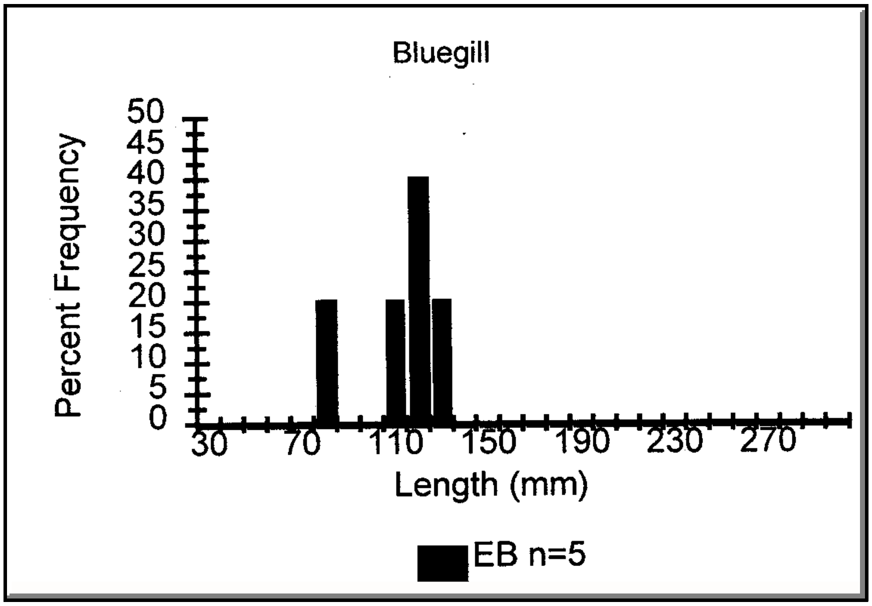

Figure 10. Length frequency distribution of bluegill sampled at Mesa Lake (Franklin County) August 1998 by electrofishing boat (EB).

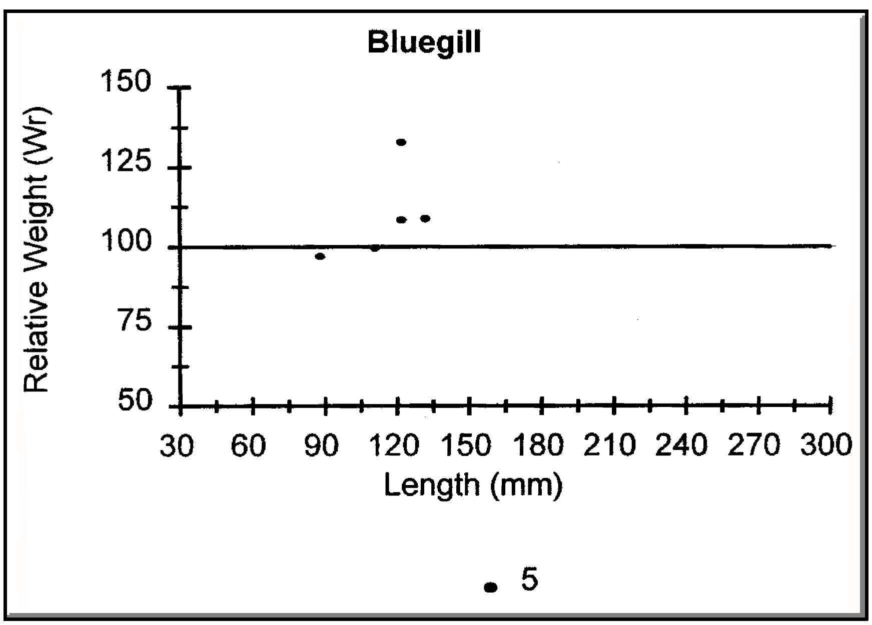

Figure 11. Relative weight (Wr) of bluegill sampled at Mesa Lake (Franklin County) August 1998 compared to the national 75th percentile.

Pumpkinseed Sunfish

Mesa Lake pumpkinseed sunfish sampled ranged from 47 to 192 mm (Table 2; Figure 12). The fourteen fish aged were one and two years and showed above average growth compared to the known Washington average (Table 9). Analysis of relative weight showed average condition for smaller fish and below average condition for larger fish compared to the national average (Figure 13). Considering the limited relative abundance of large pumpkinseed sunfish sampled, low condition of larger specimens likely indicates extensive interspecific competition for available resources.

Table 9. Age and growth of pumpkinseed sunfish sampled from Mesa Lake (Franklin County) August 1998. Unshaded values are mean back-calculated length at annulus using the direct proportion method (Fletcher et al. 1993). Shaded values are mean back-calculated lengths using the Lee's modification (Carlander 1982).

Year Class	# Fish	Mean length (mm) at age	
		1	**1**
1997	7	21	
		41	
1996	7	33	77
		50	83
Direct Proportion Overall Mean		27	77
Lee's Weighted Mean		45	83
Direct Proportion State Average		24	72

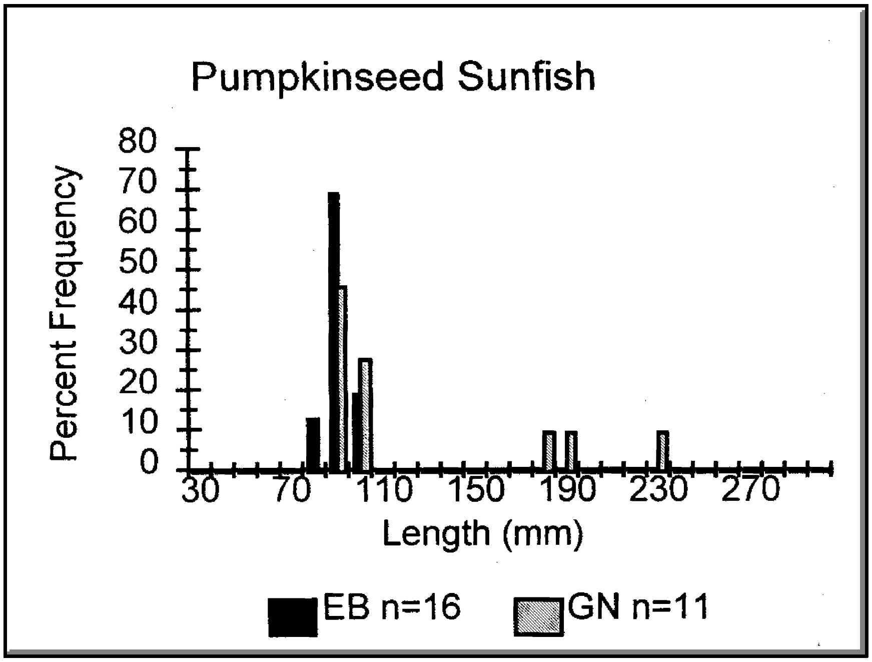

Figure 12. Length frequency distribution of pumpkinseed sunfish sampled at Mesa Lake (Franklin County) August 1998 by electrofishing boat (EB) and gill net (GN).

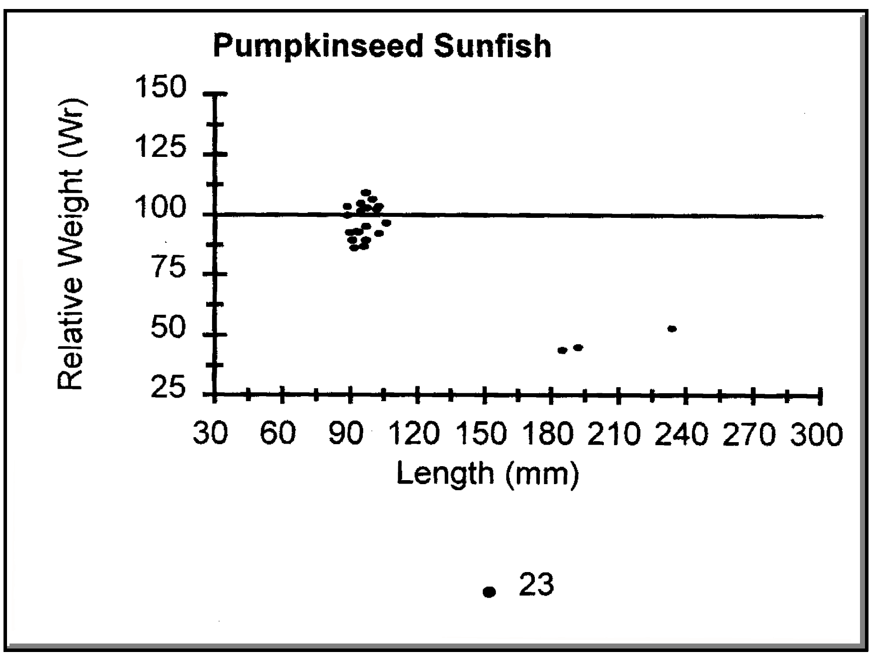

Figure 13. Relative weight (Wr) of pumpkinseed sunfish sampled at Mesa Lake (Franklin County) August 1998 compared to the national 75^{th} percentile.

Lake Whitefish

Mesa Lake lake whitefish sampled ranged from 452 to 502 mm (Table 2; Figure 14). No analysis of growth or condition was done for lake whitefish. The few large lake whitefish sampled at Mesa Lake likely immigrated to the lake via the irrigation canal system.

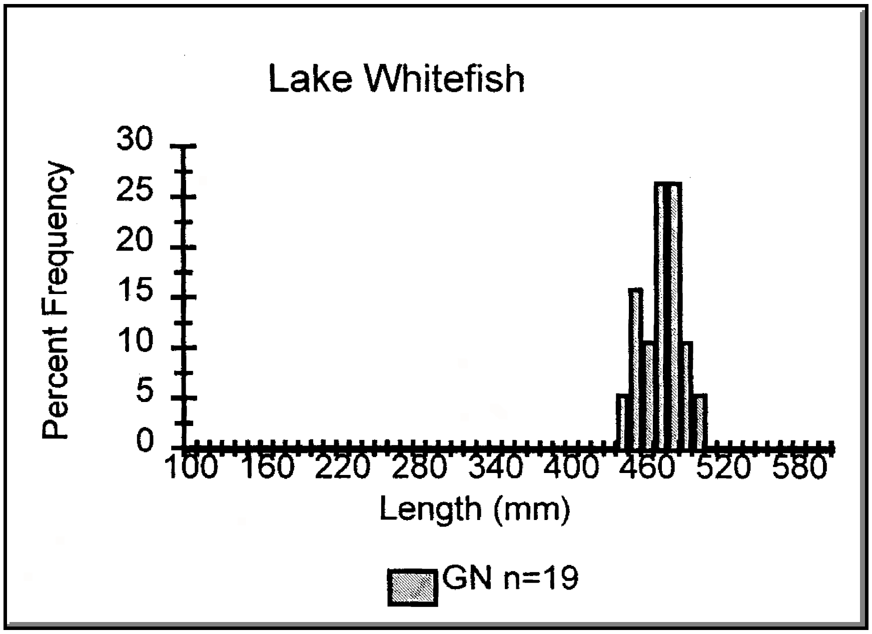

Figure 14. Length frequency distribution of lake whitefish sampled at Mesa Lake (Franklin County) August 1998 by gill net (GN).

Common Carp

Mesa Lake common carp sampled ranged from 113-447 (Table 2; Figure 15). No analysis of growth or condition was done for common carp. The broad size range of common carp collected suggests natural reproduction of common carp in Mesa Lake or recruitment to the population from an outside source.

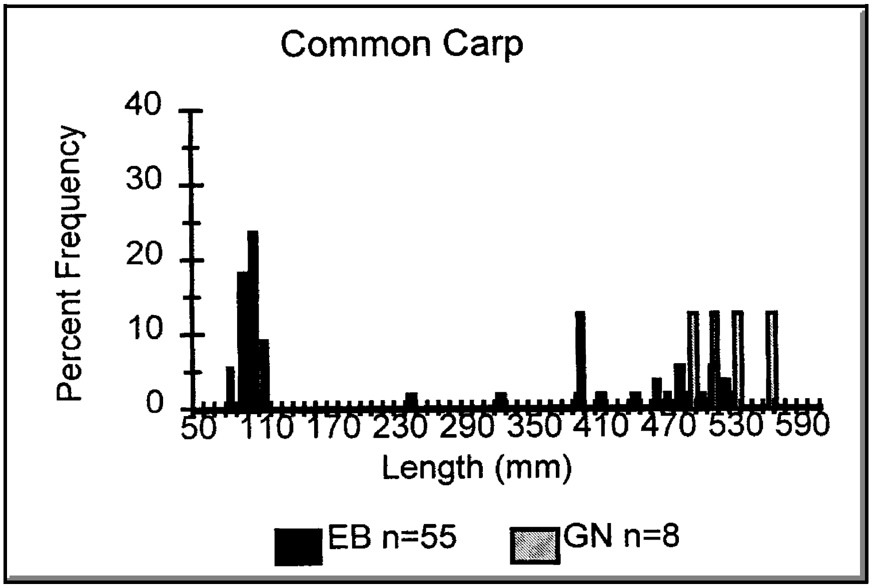

Figure 15. Length frequency distribution of common carp sampled at Mesa Lake (Franklin County) August 1998 by electrofishing boat (EB) and gill net (GN).

Bridgelip Sucker

Mesa Lake bridgelip sucker ranged from 113-447 mm (Table 2; Figure 16). No analysis of growth or condition was done for bridgelip sucker. The relatively high proportion of bridgelip sucker larger than 300 mm may be an artifact of gear bias.

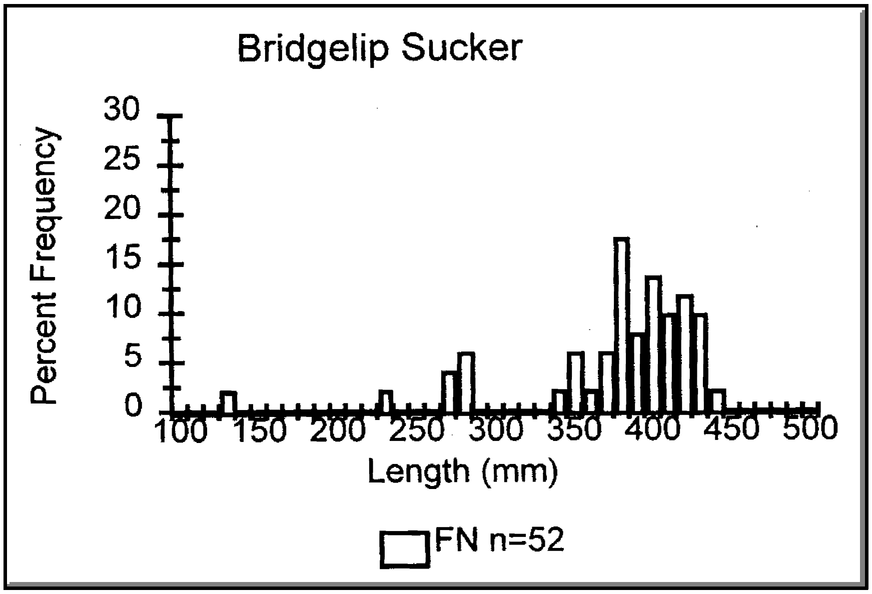

Figure 16. Length frequency distribution of bridgelip sucker sampled at Mesa Lake (Franklin County) August 1998 by fyke net (FN).

Discussion

Warmwater fisheries managers typically consider the “balance” between predator and prey fish populations when assessing warmwater fish communities. The term balance is used loosely to describe a system in which omnivorous prey fish maximize food resources to produce harvestable-size fish stocks for anglers and an adequate forage base for piscivorus fish (Bennett 1962). Fish communities may otherwise typically be described as being prey-crowded or predator-crowded. To provide quality warmwater fishing opportunities, predatory gamefish species such as largemouth bass must be able to reproduce and grow to control overpopulation of both prey and predator species.

Due to the limited duration and number of fish sampled in this survey, the results are less than conclusive and their interpretation limited. However, some inferences can be made from analysis of the data collected. In August 1998, Mesa Lake showed indications of having an unbalanced fish community. The high number of gamefish and non-gamefish species sampled in Mesa Lake typically results in extensive interspecific competition for limited resources. This likely reduces the quality of all fish populations. The high condition of largemouth bass indicates that they are effectively foraging on panfish. Four panfish species may offer some angling opportunity. However, except for yellow perch, the current quality of the panfish fishery would likely be considered poor.

The high proportion of biomass tied up in common carp and bridgelip sucker at Mesa Lake may be causing a reduction in the production of more desirable gamefish species. Common carp and bridgelip sucker abundance should be monitored in future surveys. However, controlling undesirable species in Mesa Lake would likely prove difficult considering the Lake’s connection to the irrigation canal system.

Management Options

The fact that Mesa Lake is connected to an extensive irrigation canal system limits fishery management options available. However, it is our opinion that the quality of warmwater fishing opportunities offered at Mesa Lake might be improved by adopting the states general slot-limit regulation for largemouth bass. This regulation consists of a five fish limit, fish 12"-17" are to be released, and only one fish over 17" may be retained. The intent of this regulation would be to increase the number of quality size ($\geq$300mm, 12") largemouth bass in the lake, which would then be available for catch and release angling opportunities. Slot-limits have been used successfully in other states and some lakes in Washington to provide both quality bass and panfish angling (Rasmussen and Michaelson 1972; Eder 1984; Wilde 1997).

Literature Cited

Anderson, R. O. 1976. Management of small impoundments. Fisheries (Bethesda) 1(6):5-7.

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.

Bennet, G. W. 1962. Management of Artificial Lakes and Ponds. Reinhold Publishing Corporation, New York, NY.

Bister, T. J., D. W. Willis, and M. L. Brown. 2000. Proposed Standard Weight (Ws) Equations and Standard Length Categories for 18 Warmwater Nongame and Riverine Fish Species. In press. North American Journal of Fisheries Management.

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

Conover, W. J. 1980. Practical nonparametric statistics, 2nd Edition. John Wiley and Sons, Inc., New York.

Divens, M. J., S. A. Bonar, B. D. Bolding, E. Anderson, and P. W. James. 1998. Monitoring warm-water fish populations in north temperate regions: sampling considerations when using proportional stock density. Fisheries Management and Ecology 5:383-391.

Eder, S. 1984. Effectiveness of an imposed slot limit of 12.0 - 14.9 inches on largemouth bass. North American Journal of Fisheries Management 4:469-478.

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. 1984b. A length categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

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

Jearld, A. 1983. Age determination. Pages 301-324 *in* Nielsen, L. A., and D.L. Johnson (eds.), Fisheries Techniques. American Fisheries Society, Bethesda, MD.

Murphy, B. R., and D. W. Willis. 1991. Application of relative weight (Wr) to western warmwater fisheries. Pages 243-248 in Proceedings of the Warmwater Fisheries Symposium I, June 4-8, 1991, Scottsdale, Arizona. USDA Forest Service, General Technical Report RM-207.

ODFW (Oregon Department of Fish and Wildlife). 1997. Fishery biology 104-Body condition. Oregon Department of Fish and Wildlife, Warmwater Fish News 4(4):3-4.

Rasmussen, J. L. and S. M. Michaelson. 1972. Attempts to prevent largemouth bass overharvest in three northwest Missouri lakes. Symposium on overharvest and management of largemouth bass in small impoundments. American Fisheries Society, Special Publication Number 3.

Swingle, H. S. 1950. Relationships and dynamics of balanced and unbalanced fish populations. Auburn University, Alabama Agricultural Experiment Station Bulletin No. 274.

Wilde, G. R. 1997. Largemouth fishery responses to length limits. Fisheries 22(6):14-23.

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

The Washington Department of Fish and Wildlife will provide equal employment opportunities to all potential and existing employees without regard to race, creed, color, sex, sexual orientation, religion, age, marital status, national origin, disability, or Vietnam Era Veteran's Status. The Department is subject to Title VI of the Civil Rights Act of 1964 and Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination on the basis of race, color, national origin or handicap. If you believe you have been discriminated against in any Department program, activity, or facility, or if you want further information about Title VI or Section 504, write to: Office of Equal Opportunity, U.S. Department of Interior, Washington D.C. 20240, or Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091.