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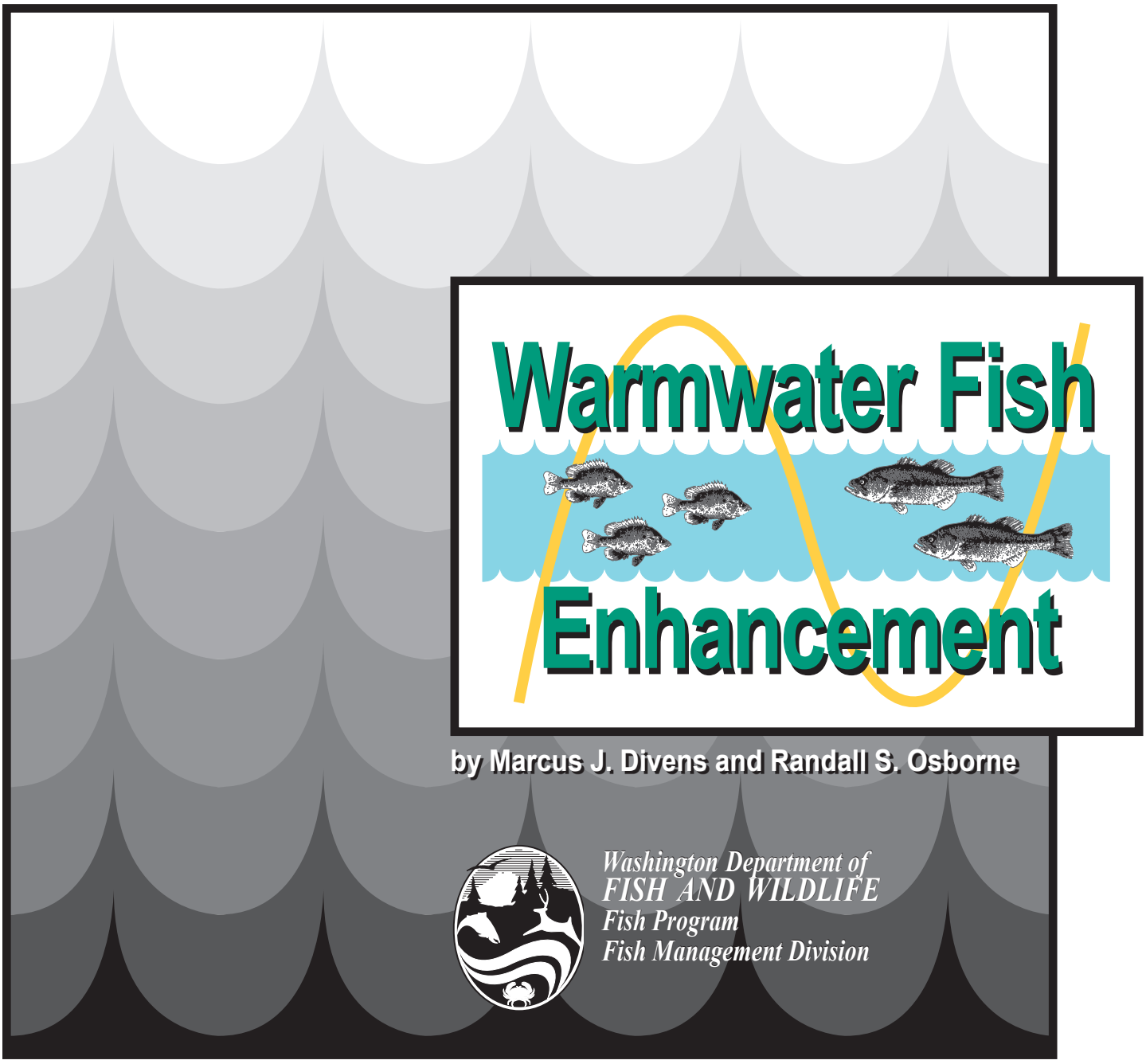
2004 Warmwater Fisheries Survey of Box Canyon Reservoir, Pend Oreille County, Washington



by Marcus J. Divens and Randall S. Osborne

Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

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By

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Abstract

Box Canyon Reservoir is an 88 kilometer stretch of the Pend Oreille River between Albeni Falls Dam near Newport and Box Canyon Dam near Metaline Falls in Washington State. On May 10-14, 2004 a warmwater fisheries survey was conducted through a joint effort by the Washington Department of Fish and Wildlife, the Kalispel Tribe of Indians' Natural Resources Department, and Eastern Washington University's fisheries program. During the weeklong effort, eight three-person crews sampled 128 of 644 available 400 meter shoreline sections by nighttime boat electrofishing, 56 by gillnetting, and 64 by fykenetting. Data collection included identifying all fish captured to species and recording total length (mm) and weight (g) from fish collected. Additionally, scales were collected from up to five fish per 10 mm length group for age and growth analysis. A total of 15,525 fish, comprised of 24 species, were collected. Pumpkinseed sunfish *Lepomis gibbosus* (28% by number), yellow perch *Perca flavescens* (27%), largemouth bass *Micropterus salmoides* (8%) and black crappie *Pomoxis nigromaculatus* (6%) were the most numerous warmwater game fish species sampled. Northern pikeminnow *Ptychocheilus oregonensis* (11% by number), peamouth *Mylocheilus caurinus* (7%), and tench *Tinca tinca* (6%) were also numerous. By weight, Tench (33%), largescale sucker *Catostomus macrocheilus* (12%), and largemouth bass (12%) accounted for the majority of the catch. Boat electrofishing catch rates were highest for pumpkinseed sunfish and yellow perch, followed by northern pikeminnow and largemouth bass; gill net catch rates were highest for peamouth and yellow perch; and fyke net catch rates were highest for pumpkinseed sunfish, yellow perch, and tench. The size ranges (mm; total length) of warmwater game fish sampled were: largemouth bass (52-534), smallmouth bass *M. dolomieui* (65-431), black crappie (35-280), yellow perch (45-246), pumpkinseed sunfish (29-199), brown bullhead *Ameiurus nebulosus* (72-324), and northern pike *Esox lucius* (267-860). Population indices, including proportional stock density, relative weight, and growth rates, all indicate a prey-crowded community. The results of this survey, when compared with previous work, indicate little change in the reservoir's fish community over the past 15 years. However, a recent increase in the occurrence of northern pike, in angler reports and fishery sampling efforts, warrants careful monitoring of the population. Managing the reservoir's warmwater fish populations for quality bass angling opportunity continues to be a viable option for fishery managers.

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Introduction

Box Canyon Reservoir (Pend Oreille County) is an 88-kilometer impoundment on the Pend Oreille River located in northeastern Washington State (Table 1, Figure 1). The 2,983 ha impoundment was created in 1955 following the construction of Box Canyon Dam at rkm 54. Historically, the Pend Oreille River supported runs of Chinook salmon *Oncorynchus tshawytscha* and steelhead *O. mykiss*, which were subsequently eliminated following the construction of Grand Coulee Dam downstream on the Columbia River (Bryant and Parkhurst 1950; Fulton 1968; Fulton 1970). The free flowing sections of the Pend Oreille River continued to support native coldwater fish populations such as Westslope cutthroat trout *O .clark lewisi*, rainbow trout *O. mykiss*, mountain whitefish *Prosopium williamsoni*, and bull trout *Salvelinus confluentus* after salmon and steelhead were no longer present. Following the construction of Box Canyon Dam, the slower flowing river, warmer water temperatures, and inundated backwater sloughs provided habitat more suitable to introduced warmwater species such as largemouth bass *Micropterus salmoides* and yellow perch *Perca flavescens*, which became more abundant.

The Pend Oreille River was a popular trout fishery in the early 1900's and both rainbow and cutthroat trout were stocked at times by the Washington Department of Game into the 1950's to enhance the recreational fishery (WDFW, unpublished data). With an increase in abundance of warmwater fish following dam construction, the majority of angler attention switched from trout to bass and panfish. Today, Box Canyon Reservoir is a popular warmwater fishery, which hosts several bass tournaments each year. All fish populations within the reservoir are managed under statewide general regulations, with no special regulations on warmwater game fish.

Box Canyon Reservoir's largemouth bass population has a history of attracting tournament anglers. Washington Department of Fish and Wildlife (WDFW) bass tournament permit records show a history of one to seven tournaments per year between 1987 and 2005 (WDFW, unpublished tournament data). Tournaments have typically taken place in May and June, but recently have started as early as April and have been held through August. The Inland Empire Bass Club has annually sponsored the largest tournament on Box Canyon Reservoir, which has been held the first weekend in June since at least 1996, awarded over $4,000 in prizes, and averaged over 90 participants each year. Smaller tournaments, sponsored by various other clubs, have typically drawn ten to fifty contestants who compete for prizes valued from $100 to $1,000. Overall, bass clubs have hosted from 107 to 252 anglers annually on the reservoir. Over the years, tournament anglers have reported catching from 687 to 1,316 bass per year. Largemouth bass were, by far, the most often caught species, although smallmouth bass *M. dolomieui* were reportedly caught during some events. Based on the number of participants and the total weight of all bass reported, the average size largemouth bass caught weighed 988 g – or 2.2 pounds. The largest tournament-caught bass have consistently weighed over 2.47 kg – or 5.5 pounds. In most years since 1996, tournament-winning bass weighed over 2.72 kg – or 6.0 pounds. The biggest largemouth bass reported caught during a tournament occurred in 2005 and weighed 3.05 kg – or 6.7 pounds.

Public and private boat access sites are readily available with a minimum of 14 boat launch facilities ranging from unimproved gravel-bar launch sites to well developed paved boat ramps

with accompanying boarding floats. A combination of city, county, state, federal, tribal and resort-owned access sites are distributed over the entire length of the reservoir.

Two fish community surveys were conducted on Box Canyon Reservoir from 1989 through 1991: one by the University of Idaho's Department of Fish and Wildlife Resources (Bennett and Liter 1991) and one by Eastern Washington University's Fisheries Department (Ashe and Scholz 1992). Those surveys both found the fish community to be prey-crowded and dominated by overabundant forage species, including yellow perch and pumpkinseed sunfish, as well as non-game fish species such as northern pikeminnow *Ptychocheilus oregonensis* and tench *Tinca tinca*. Largemouth bass, the reservoir's primary predator species, were found to be at low density. Recommendations by both Bennett and Liter (1991) and Ashe and Scholz (1992) included that stocking age-one largemouth bass, to increase relative abundance and to take advantage of the extensive forage base observed in the reservoir, presented a viable management option to improve the recreational fishery opportunities. Following the findings of this research, and with general agreement among fishery managers including WDFW, the Kalispel Tribe of Indians Natural Resource Department (KNRD) built a hatchery facility in 1997 on reservation land adjacent to the reservoir. The goal of that rearing facility was to increase largemouth bass year-class strength through annual supplementation. The initial production goal was to produce and stock 150,000 age-1+ largemouth bass fingerlings (150 mm) annually (Maroney et al. 1996).

Due to its history of providing warmwater fishing opportunity and its reputation as a quality bass water, Box Canyon Reservoir was selected by WDFW fishery managers to be surveyed by the agency's Warmwater Fish Program in May 2004. The goal of the survey was to evaluate the reservoir's overall fish community, with special attention to the warmwater fish populations. Data collected in 2004 are compared with the two previous studies to determine if significant changes in the fish community have taken place and to identify ways to maintain or enhance recreational fishing opportunities for the coming years. The WDFW Warmwater Program conducted the joint survey effort with the KNRD and Eastern Washington University's fisheries program.

Table 1. Physical parameters of Box Canyon Reservoir (Pend Oreille County).

Physical Parameters	Box Canyon Reservoir
Surface Area (ha) @ 850 m^3/s	2,983
Maximum Depth (m) @ Box Canyon Dam	33
Mean Depth (m) varies by reach	3 - 13
Volume (ha-m) @ 850 m^3/s	8,610

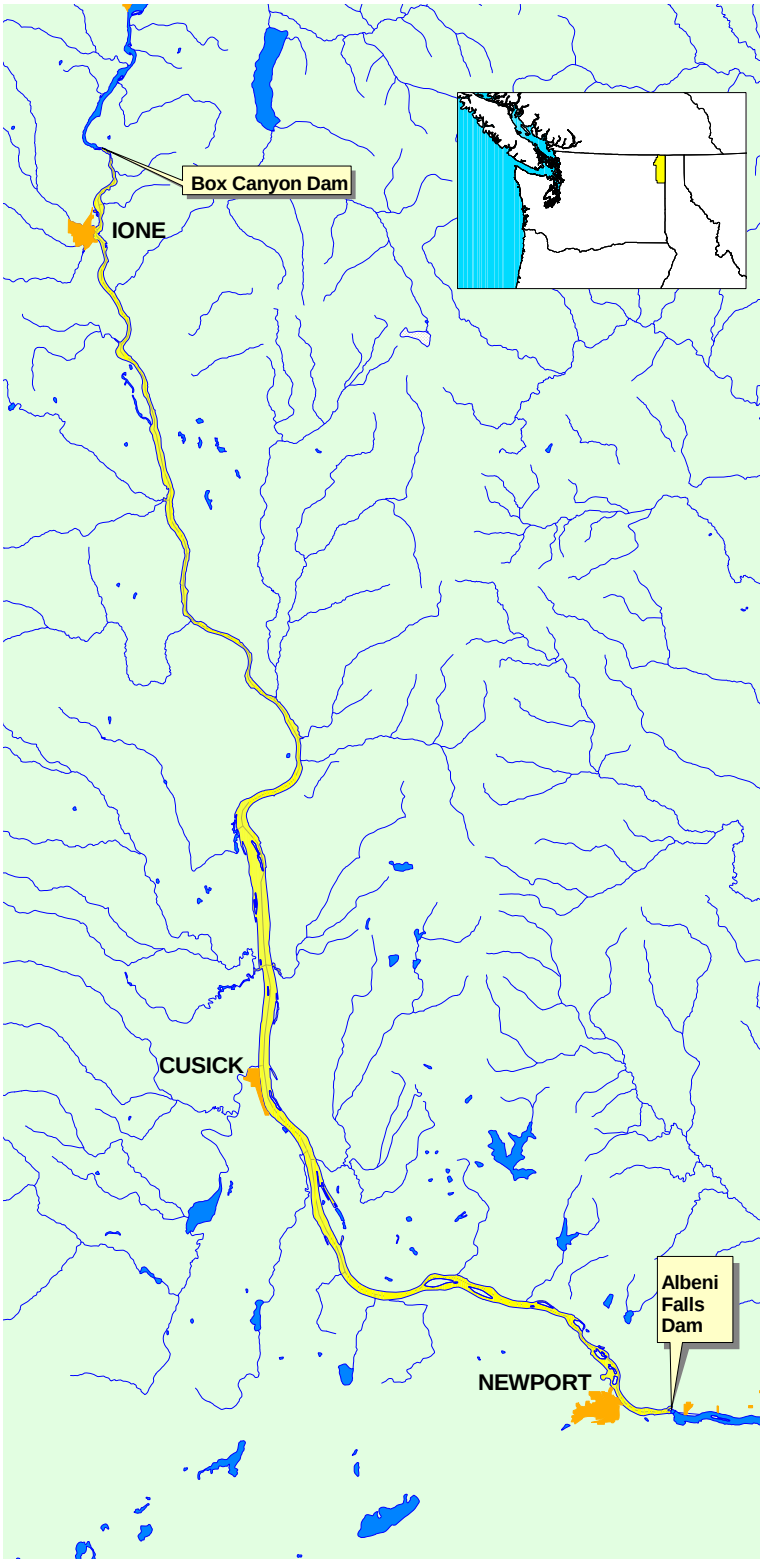

Figure 1. Box Canyon Reservoir (Pend Oreille County).

Methods

Box Canyon Reservoir was surveyed May 10 - 14, 2004, in accordance with WDFW standardized warmwater survey protocol (Bonar et al. 2000). During the survey, eight three-person crews sampled fish by boat electrofishing, gill netting, and fyke netting.

Sampling locations were randomly selected by dividing the available shoreline into sections of approximately 400 meters in length. This translated into a total of 644 available sections: 466 along the main river channel and 178 within off-channel sloughs. The number of sections sampled by each gear-type was proportional to those available within the main river and sloughs. Overall, 126 sections were sampled by nighttime boat electrofishing, 56 sections were sampled by gillnetting, and 64 sections were sampled by fykenetting.

Each fish captured was identified to species and then measured to total length (mm) and weighed to the nearest gram (g). Scales were collected for age and growth analysis from largemouth bass, smallmouth bass, northern pike *Esox lucius*, black crappie, yellow perch, and pumpkinseed sunfish. Scale samples (up to five per 10 mm length-class for each species) were mounted on adhesive scale cards, pressed onto acetate slides, and aged according to Jearld (1983) and Fletcher et al. (1993).

Data Analysis

Species composition by weight (kg) and number was calculated using all fish sampled during the survey. Species composition by number was calculated from fish collected by dividing the number of individuals of each species captured by the total number of individuals of all species captured, and multiplying by 100.

Catch-per-unit-of-effort (CPUE), by gear type, was determined for each fish species collected (number of fish/hour electrofishing, number of fish/gill net-night, and number of fish/fyke net-night). Eighty percent confidence intervals (CI) were calculated for each mean CPUE by species and gear type. Each CI was calculated as the mean $\pm t(N-1)\times SE$, where t=Student's t for confidence level with N-1 degrees of freedom (two tailed) and SE=standard error of the mean.

Length frequency histograms (percent frequency captured by each gear type) were created to evaluate the size structure of populations, for which sample size was greater than 25 individual fish.

Proportional stock density (PSD) and relative stock density (RSD) was calculated for each warmwater fish species collected that have established stock lengths (Anderson and Neuman 1996) (Table 2) for each gear type. Eighty percent confidence intervals were calculated, assuming a normal distribution, as an indication of precision (Conover 1980; Gustafson 1988).

Table 2. PSD/RSD standard length categories (mm; TL) for fish species sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004. Numbers in parentheses represent percentages of world record lengths (Gablehouse 1984).

Species	Standard Length Categories				
	Stock (20-26%)	Quality (36-41%)	Preferred (45-55%)	Memorable (59-64%)	Trophy (74-80%)
Black Crappie	130	200	250	300	380
Brown Bullhead	130	200	280	360	430
Brown Trout	150	230	300	380	460
Largemouth Bass	200	300	380	510	630
Pumpkinseed Sunfish	80	150	200	250	300
Smallmouth Bass	180	280	350	430	510
Yellow Perch	130	200	250	300	380

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). Using the direct proportional method, total length at annulus formation, L_n, was back–calculated as $L_n=(A\times TL)/S$, where 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 intercept from a scale radius-fish length regression. Mean back–calculated lengths at age n for each species were presented for comparison of growth between year classes, as well as between the lake average, and growth in other areas within the state of Washington (Fletcher et al. 1993) for the same species.

The relative weight (W_r) index was calculated for all species to evaluate condition (Anderson and Neuman 1996) . The index was calculated as,

$$W_r = \frac{W}{W_s} x100$$

where W is the weight (g) of an individual fish and W_s is the standard weight of a fish of the same length calculated with the standard weight (W_s) equation . The W_s equations were obtained from Andersen and Neuman (1996), Bister et al. (2000), Hyatt and Hubert (2001a), Hyatt and Hubert (2001b).

Results

Species Composition

We captured 15,525 fish, composed of 24 species. Tench was the most abundant species by weight, (33 percent of the sample), and yellow perch/pumpkinseed sunfish were the most abundant species by number (55 percent, combined) (Table 3). Largemouth bass was the most abundant game fish species by weight (12 percent and eight percent by number). Northern pikeminnow, largemouth bass, peamouth *Mylocheilus caurinus,* tench, and black crappie were also relatively numerous. Other species were present in lower numbers.

Table 3. Species composition by weight (kg) and number for all fish collected from Box Canyon Reservoir (Pend Oreille County) in May 2004.

	Species Composition					
	By Weight		By Number		Size Range (mm TL)	
Species	KG	% by W	#	% by #	Min	Max
Tench	637.769	33.24	1051	6.77	48	470
Largescale Sucker	239.089	12.46	448	2.89	82	622
Largemouth Bass	233.944	12.19	1232	7.94	52	534
Yellow Perch	149.422	7.79	4254	27.40	45	246
Northern Pikeminnow	149.079	7.77	1656	10.67	58	546
Peamouth	136.267	7.10	1110	7.15	61	340
Pumpkinseed Sunfish	135.794	7.08	4314	27.79	29	199
Brown Bullhead	74.580	3.89	278	1.79	72	324
Northern Pike	40.869	2.13	27	0.17	267	860
Longnose Sucker	38.722	2.02	82	0.53	70	521
Black Crappie	33.821	1.76	867	5.58	35	280
Brown Trout	15.168	0.79	42	0.27	102	579
Mountain Whitefish	13.683	0.71	64	0.41	126	480
Smallmouth Bass	10.362	0.54	31	0.20	65	431
Bridgelip Sucker	3.881	0.20	8	0.05	151	448
Walleye	1.546	0.08	1	0.01	544	544
Lake Whitefish	1.490	0.08	2	0.01	414	482
Eastern Brook Trout	0.900	0.05	6	0.04	112	395
Redside Shiner	0.682	0.04	24	0.15	57	170
Rainbow Trout	0.478	0.02	9	0.06	102	306
Unidentified Sucker	0.467	0.02	9	0.06	104	285
Chiselmouth	0.240	0.01	6	0.04	157	173
Cutthroat Trout	0.227	0.01	2	0.01	140	285
Sculpin Spp.	0.002	0.00	2	0.01	55	72

CPUE

Boat electrofishing catch rates were highest for pumpkinseed sunfish followed by yellow perch, northern pikeminnow, and largemouth bass (Table 4). Gill netting catch rates were highest for peamouth followed by yellow perch. Fyke netting catch rates were highest for pumpkinseed sunfish followed by yellow perch and tench.

Table 4. Mean catch-per-unit-effort by sampling method, including 80% confidence intervals, for all fish collected from Box Canyon Reservoir (Pend Oreille County) in May 2004.

	Gear Type					
	Electrofishing		Gill Netting		Fyke Netting	
Species	(#/hour)	Sites	#/Net Night	Net Nights	#/Net Night	Net Nights
Brown Bullhead	4.90 ± 1.31	126	0.21± 0.09	56	2.56 ± 1.11	64
Black Crappie	25.82 ± 5.94	126	4.43 ± 1.22	56	1.22 ± 0.58	64
Bridgelip Sucker	0.38 ± 0.38	126	0	56	0	64
Brown Trout	1.75 ± 0.56	126	0.09 ± 0.06	56	0.02 ± 0.02	64
Chiselmouth	0	126	0.11 ± 0.10	56	0	64
Sculpin spp.	0.10 ± 0.12	126	0	56	0	64
Cutthroat Trout	0.05 ± 0.06	126	0.02 ± 0.02	56	0	64
Eastern Brook Trout	0.19 ± 0.12	126	0.02 ± 0.02	56	0.02 ± 0.02	64
Largemouth Bass	56.63 ± 6.61	126	0.57 ± 0.18	56	0.05 ± 0.03	64
Longnose Sucker	3.04 ± 1.02	126	0.32 ± 0.12	56	0	64
Largescale Sucker	18.11 ± 2.93	126	1.20 ± 0.35	56	0.17 ± 0.07	64
Lake Whitefish	0.05 ± 0.06	126	0.02 ± 0.02	56	0	64
Northern Pike	0.05 ± 0.06	126	0.46 ± 0.36	56	0	64
Northern Pikeminnow	59.86 ± 10.00	126	6.80 ± 0.86	56	0.42 ± 0.15	64
Peamouth	15.97 ± 2.86	126	13.27 ± 2.29	56	0.53 ± 0.28	64
Pumpkinseed Sunfish	162.81 ± 18.07	126	7.32 ± 1.52	56	6.98 ± 1.68	64
Rainbow Trout	0.43 ± 0.18	126	0	56	0	64
Redside Shiner	0.56 ± 0.27	126	0.11 ± 0.08	56	0.02 ± 0.02	64
Smallmouth Bass	1.38 ± 0.46	126	0.04 ± 0.03	56	0	64
Unidentified Sucker	0.29 ± 0.26	126	0	56	0	64
Tench	18.55 ± 2.65	126	6.18 ± 1.28	56	4.78 ± 1.51	64
Walleye	0	126	0.02 ± 0.02	56	0	64
Mountain Whitefish	2.76 ± 1.14	126	0.11 ± 0.06	56	0	64
Yellow Perch	154.06 ± 21.07	126	11.54 ± 2.02	56	5.61 ± 2.41	64

Stock Density Indices

Electrofishing sample sizes were adequate to provide useful PSD and RSD values for black crappie, brown bullhead *Ameiurus nebulosus*, largemouth bass, pumpkinseed sunfish, and yellow perch (Table 5). With the exception of black crappie, pumpkinseed sunfish, and yellow perch, sample sizes were too low to provide useful PSD values for gill netting. Sample sizes of stock-length fish captured by fyke netting were adequate for black crappie, brown bullhead, pumpkinseed sunfish, and yellow perch. Yellow perch and pumpkinseed sunfish PSD values were low for all gear types. Largemouth bass and smallmouth bass collected by electrofishing had higher PSD values than those for panfish including yellow perch, pumpkinseed sunfish, and black crappie.

Table 5. Traditional stock density indices by sampling method, including 80% confidence intervals, for fish collected from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Species	# Stock Length	PSD	RSD-P	RSD-M	RSD-T
		Electrofishing			
Black Crappie	160	15 ± 4	2 ± 1	0	0
Brown Bullhead	102	92 ± 3	38 ± 6	0	0
Brown Trout	31	81 ± 9	65 ± 11	39 ± 11	16 ± 8
Largemouth Bass	361	42 ± 3	26 ± 3	1 ± 1	0
Pumpkinseed Sunfish	3355	2 ± 0.3	0	0	0
Smallmouth Bass	18	44 ± 15	33 ± 14	6 ± 7	0
Yellow Perch	2339	3 ± 0.5	0	0	0
		Gill Netting			
Black Crappie	148	4 ± 2	1 ± 1	0	0
Pumpkinseed Sunfish	409	0	0	0	0
Yellow Perch	634	6 ± 1	0	0	0
		Fyke Netting			
Black Crappie	53	36 ± 8	2 ± 2	0	0
Brown Bullhead	163	94 ± 2	39 ± 5	0	0
Pumpkinseed Sunfish	445	1 ± 0.5	0	0	0
Yellow Perch	279	8 ± 2	0	0	0

Largemouth Bass

Box Canyon Reservoir largemouth bass ranged from 52 to 534 mm TL (Table 3; Figure 3). The age of largemouth bass sampled ranged from young of the year to 12 years (Figure 2). Largemouth bass growth rates were similar to the Washington state average (Fletcher et al. 1993). Length frequency distribution indicates stable year-class strength (Figure 3). Largemouth bass relative weight varied from low to high and increased with total length (Figure 4).

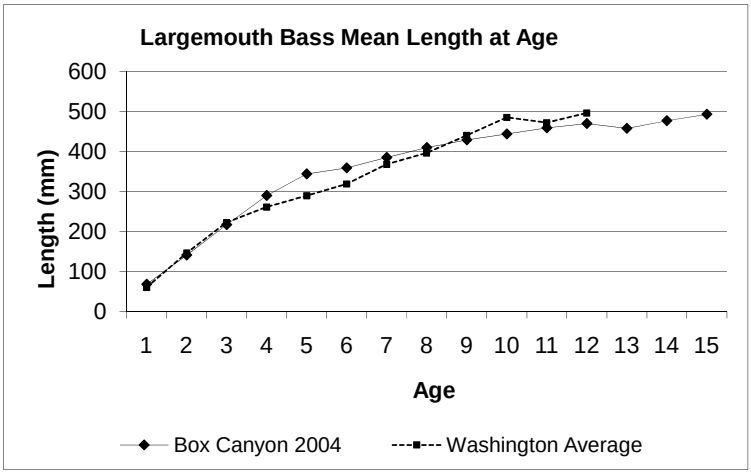

Figure 2. Age and growth of largemouth bass sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

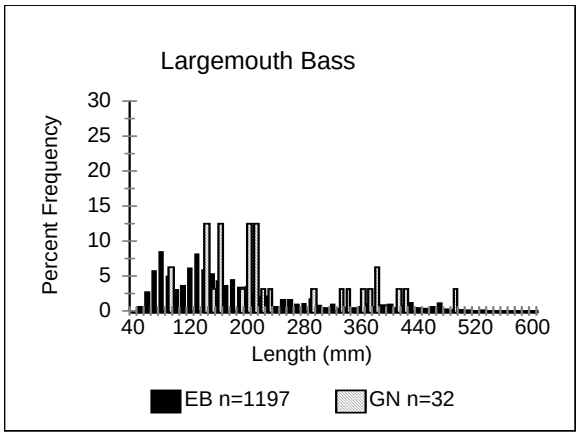

Figure 3. Length frequency distribution of largemouth bass sampled by boat electrofishing (EB) and gill netting (GN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

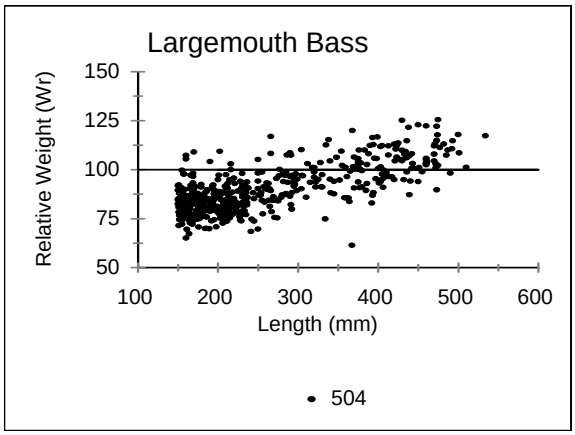

Figure 4. Relative weight (W_r) of largemouth bass sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Smallmouth Bass

Box Canyon Reservoir smallmouth bass ranged in length from 65 to 431 mm TL (Table 3). Smallmouth bass relative weight varied from below the national 75th percentile for smaller fish (<300 mm TL) to higher for larger fish (>300 mm TL) (Figure 5). Due to the low sample size, smallmouth bass were not aged for growth comparisons.

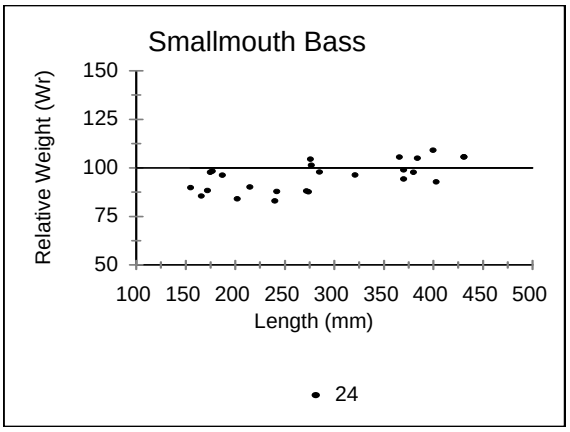

Figure 5. Relative weight (W_r) of smallmouth bass sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Walleye

A single 544 mm TL walleye was sampled at Box Canyon Reservoir (Table 3). The fish had a low relative weight (Figure 6).

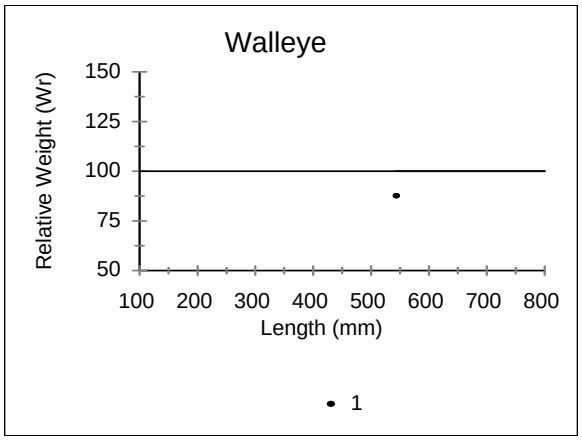

Figure 6. Relative weight (W_r) of walleye sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Black Crappie

Box Canyon Reservoir black crappie ranged in length from 35 to 280 mm TL (Table 3; Figure 8). The age of black crappie sampled ranged from young of the year to seven years (Figure 7). Black crappie growth rates were similar to the known Washington state average (WDFW unpublished data) through age five. Black crappie relative weight varied from high to low and generally decreased with total length (Figure 9). Condition of black crappie larger than 200 mm TL was generally below the national 75th percentile.

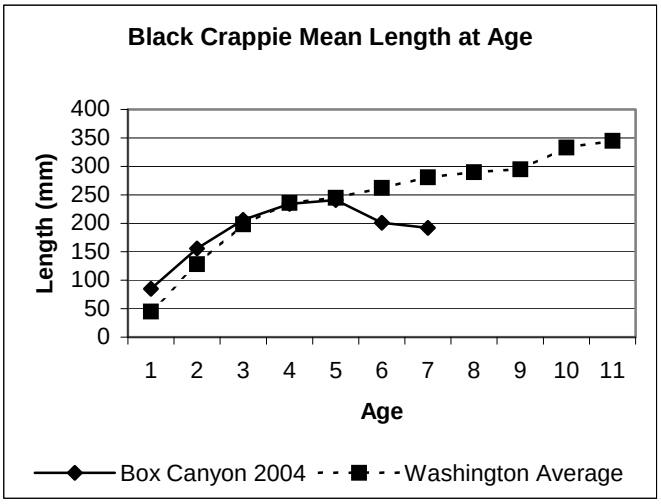

Figure 7. Age and growth of black crappie sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

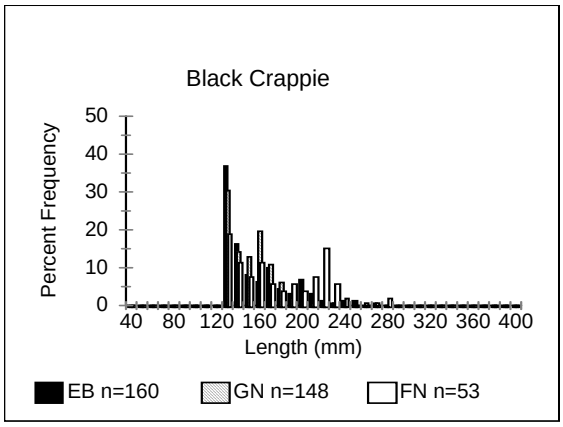

Figure 8. Length frequency distribution of black crappie sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

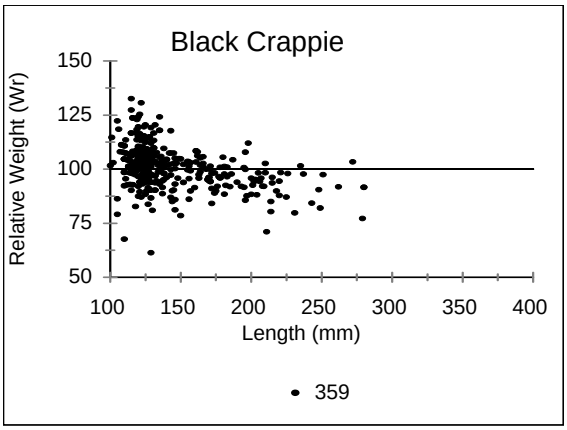

Figure 9. Relative weight (W_r) of black crappie sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004

Pumpkinseed Sunfish

Box Canyon Reservoir pumpkinseed sunfish ranged in length from 29 to 199 mm TL (Table 3; Figure 11). The age of pumpkinseed sunfish sampled ranged from young of the year to six years (Figure 10). Pumpkinseed sunfish growth rates were similar to the known Washington state average (Fletcher et al. 1993). Pumpkinseed sunfish relative weight varied equally above and below the national 75th percentile (Figure 12).

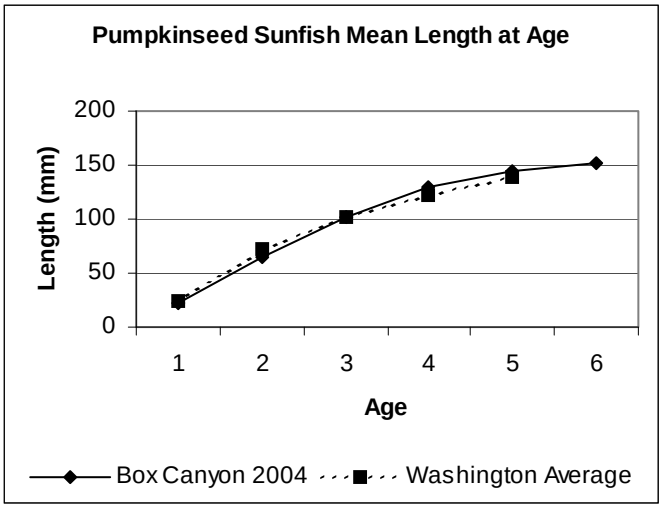

Figure 10. Age and growth of pumpkinseed sunfish sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

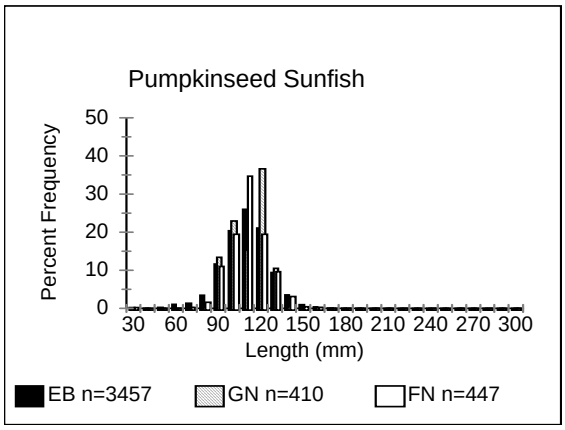

Figure 11. Length frequency distribution of pumpkinseed sunfish sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

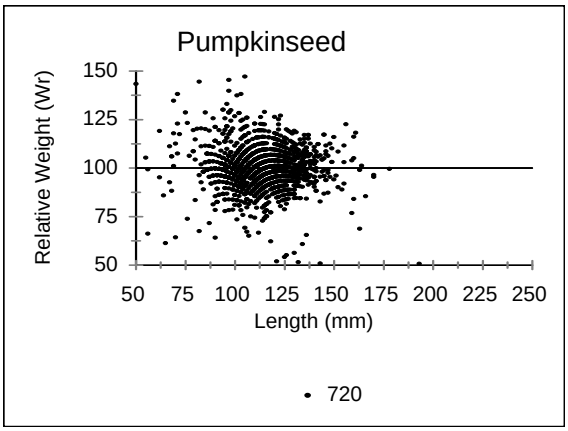

Figure 12. Relative weight (W_r) of pumpkinseed sunfish sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Yellow Perch

Box Canyon Reservoir yellow perch ranged in length from 45 to 246 mm TL (Table 3; Figure 14). The age of yellow perch sampled ranged from young of the year to eight years (Figure 13). Growth rates were similar to the known Washington state average. Length frequency indicates stable year-class strength (Figure 14). Yellow perch relative weight was generally below the national 75th percentile and generally decreased with total length (Figure 15).

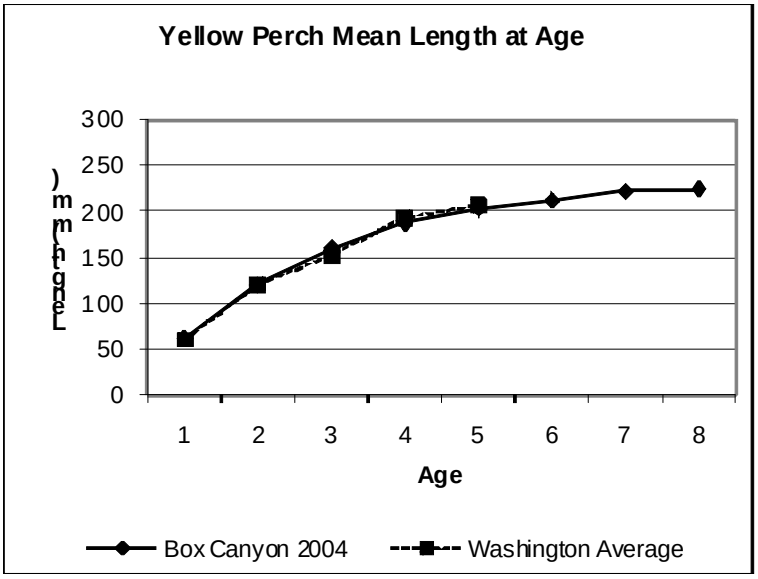

Figure 13. Age and growth of yellow perch sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

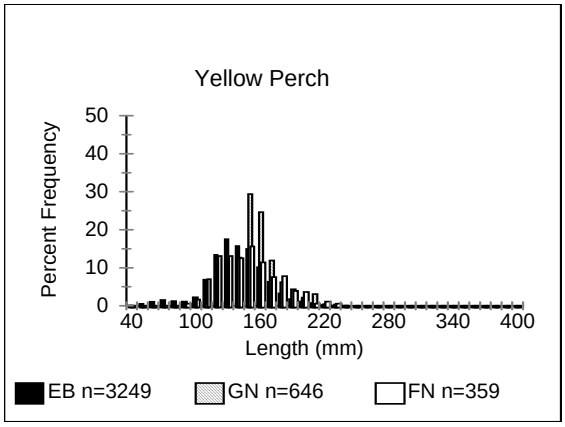

Figure 14. Length frequency distribution of yellow perch sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

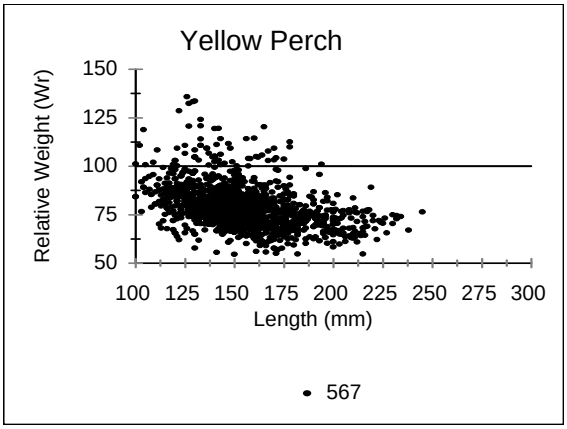

Figure 15. Relative weight (W_r) of yellow perch sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Northern Pike

Box Canyon Reservoir northern pike ranged from 267 to 860 mm TL (Table 3; Figure 17). The age of northern pike ranged from one to eight years (Figure 16). Although no average growth rate for northern pike populations in Washington is available, the Box Canyon Reservoir northern pike population growth rate was lower than that reported by Wydoski and Whitney (2003) for populations in Montana. Northern pike relative weight was generally above the national 75th percentile (Figure 18).

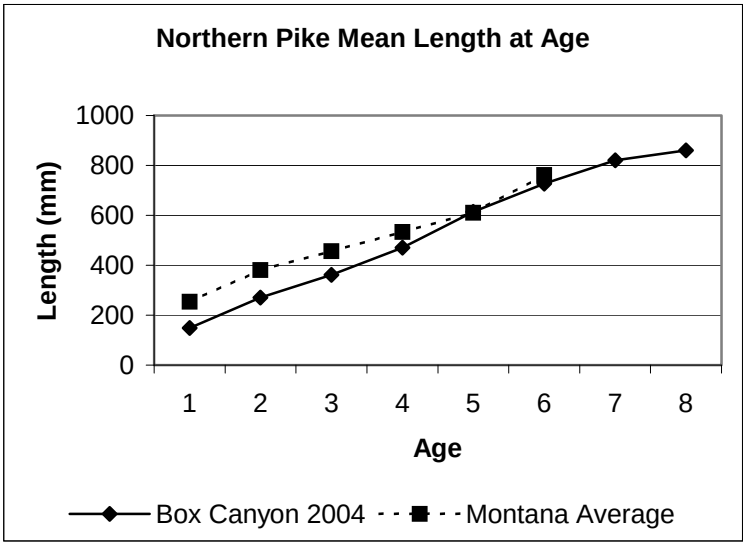

Figure 16. Age and growth of northern pike sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

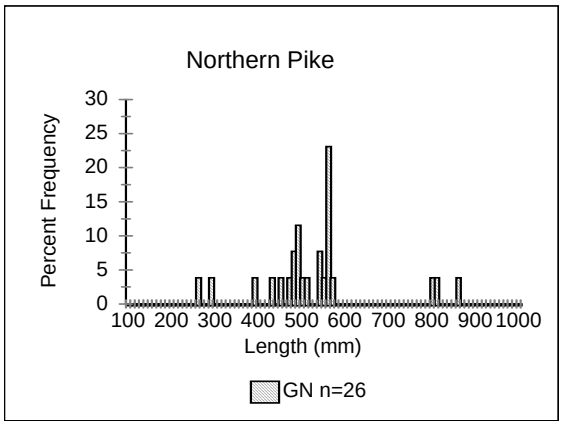

Figure 17. Length frequency distribution of northern pike sampled by gill netting (GN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

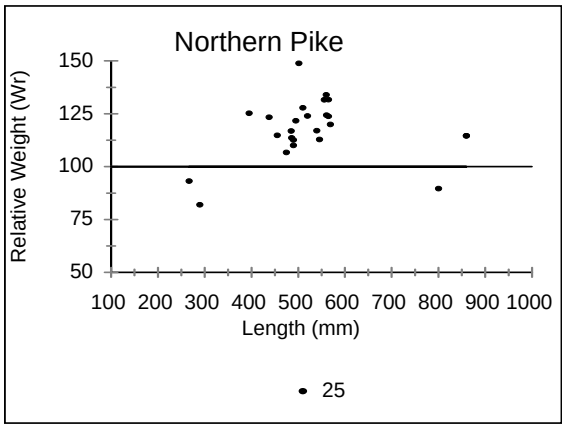

Figure 18. Relative weight (W_r) of northern pike sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Brown Bullhead

Box Canyon Reservoir brown bullhead sampled ranged from 72 to 324 mm TL (Table 3; Figure 19). No age analysis was done. Brown bullhead condition varied around the national 75th percentile Figure 20.

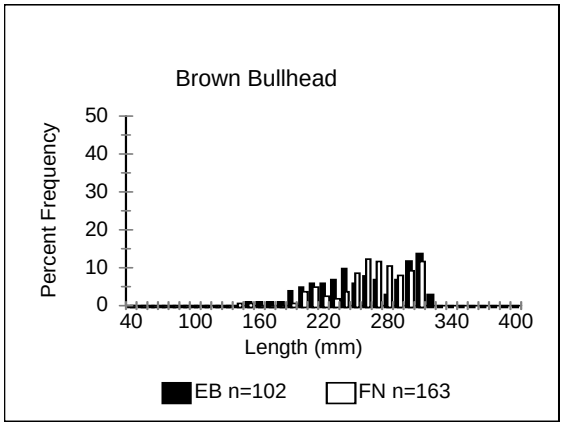

Figure 19. Length frequency distribution of brown bullhead sampled by boat electrofishing (EB) and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

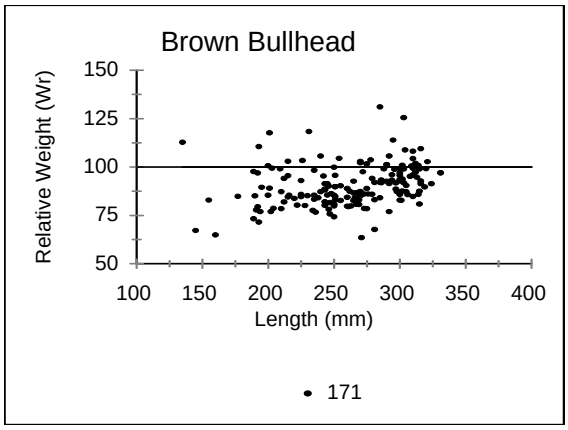

Figure 20. Relative weight (W_r) of brown bullhead sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Rainbow Trout

Box Canyon Reservoir rainbow trout sampled ranged in length from 102 to 306 mm TL (Table 3). The majority of fish in the sample were less than 200 mm TL. Rainbow trout relative weight was below the national 75th percentile (Figure 21).

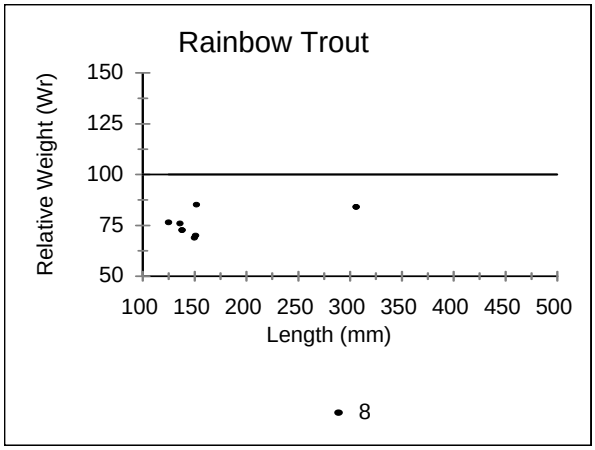

Figure 21. Relative weight (W_r) of rainbow trout sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Brown Trout

Box Canyon Reservoir brown trout *Salmo trutta* sampled ranged from 102 to 579 mm TL (Table 3; Figure 22). Brown trout relative weight was lower than the national 75th percentile at all sizes (Figure 23).

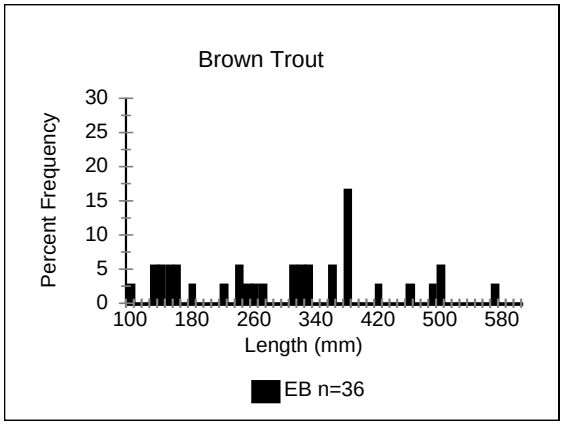

Figure 22. Length frequency distribution of brown trout sampled by boat electrofishing (EB) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

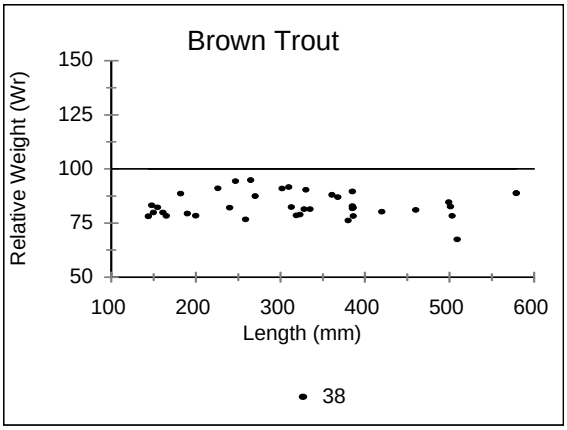

Figure 23. Relative weight (W_r) of brown trout sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Cutthroat Trout

Two cutthroat trout were sampled during the survey and they measured 140 and 285 mm TL (Table 3). The relative weight of these two fish was below the national 75th percentile (Figure 24).

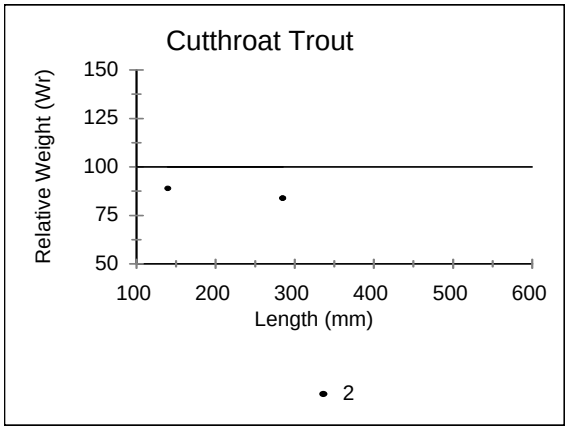

Figure 24. Relative weight (W_r) of cutthroat trout sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Eastern Brook Trout

Three eastern brook trout *Salvelinus fontinalis* were sampled during the survey and they ranged in length from 112 to 395 mm TL (Table 3). The condition of the fish under 300 mm TL was near the national 75th percentile, while the relative weight of the single fish sampled over 300 mm TL was below the national 75th percentile (Figure 25).

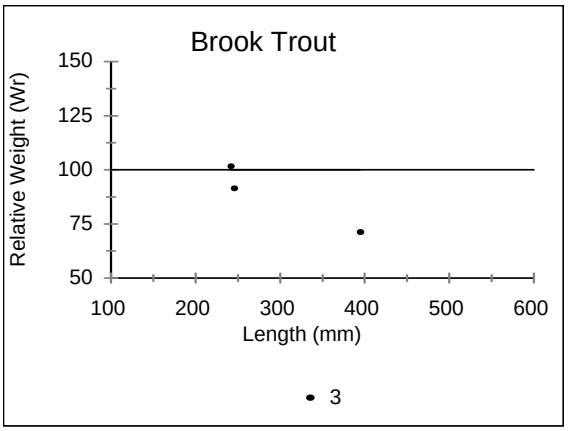

Figure 25. Relative weight (W_r) of brook trout sampled from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Mountain Whitefish

Box Canyon Reservoir mountain whitefish sampled ranged in length from 126 to 480 mm TL (Table 3; Figure 26).

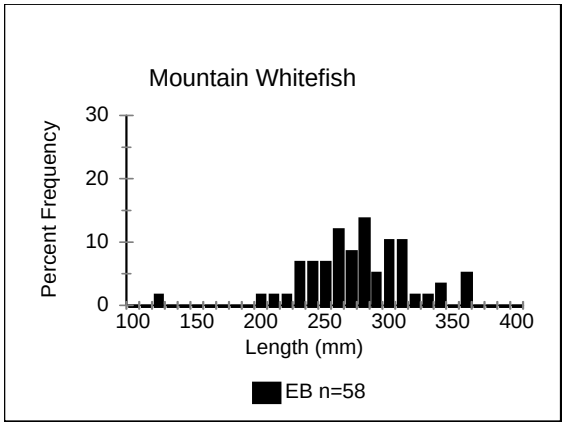

Figure 26. Length frequency distribution of mountain whitefish sampled by boat electrofishing (EB) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Lake Whitefish

Two lake whitefish *Coregonus clupeaformis* were sampled during the survey measuring 414 and 482 mm TL (Table 3).

Tench

Box Canyon Reservoir tench sampled ranged from 48 to 470 mm TL (Table 3; Figure 27).

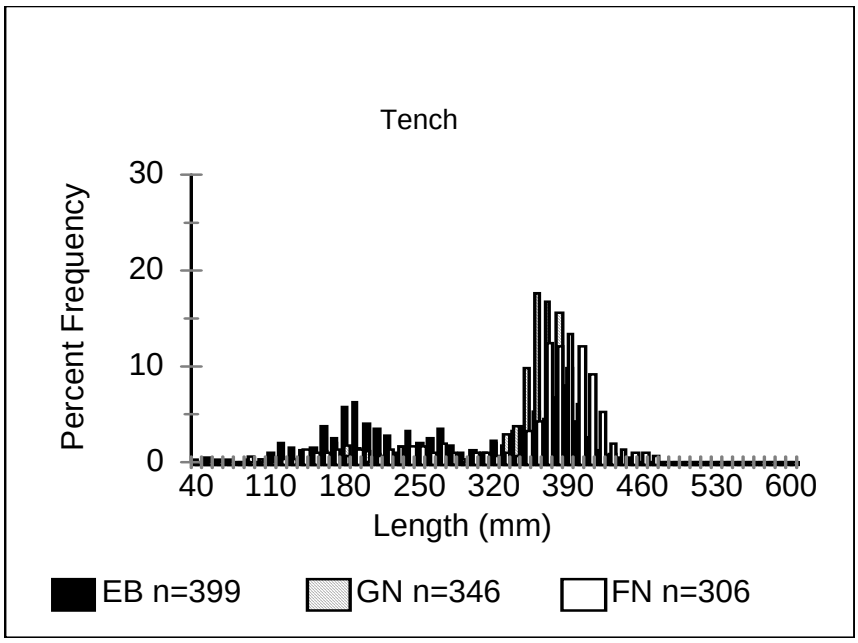

Figure 27. Length frequency distribution of tench sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Northern Pikeminnow

Box Canyon Reservoir northern pikeminnow sampled ranged from 58 to 546 mm TL (Table 3; Figure 28). No analysis of relative weight or age was done for this species.

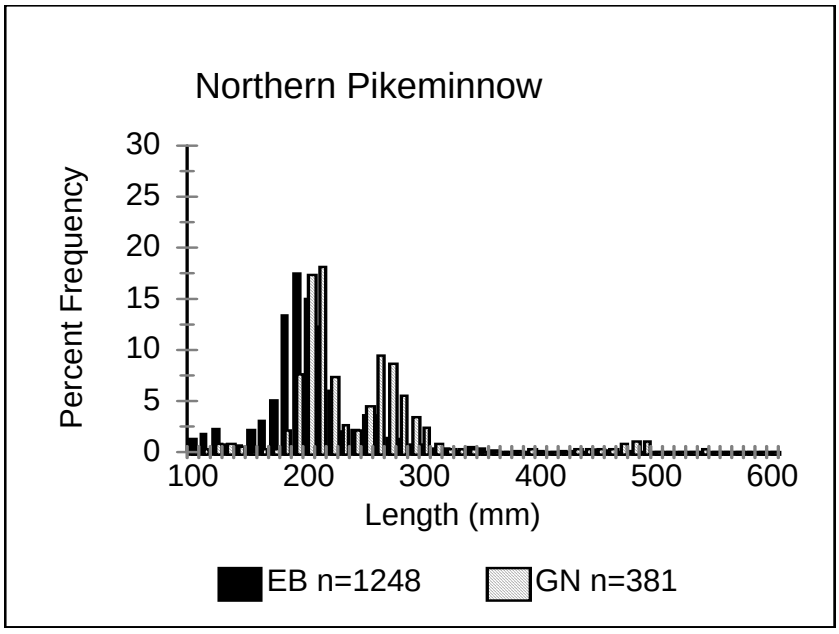

Figure 28. Length frequency distribution of northern pikeminnow sampled by boat electrofishing (EB) and gill netting (GN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Peamouth

Box Canyon Reservoir peamouth sampled ranged in length from 61 to 340 mm TL (Table 3; Figure 29).

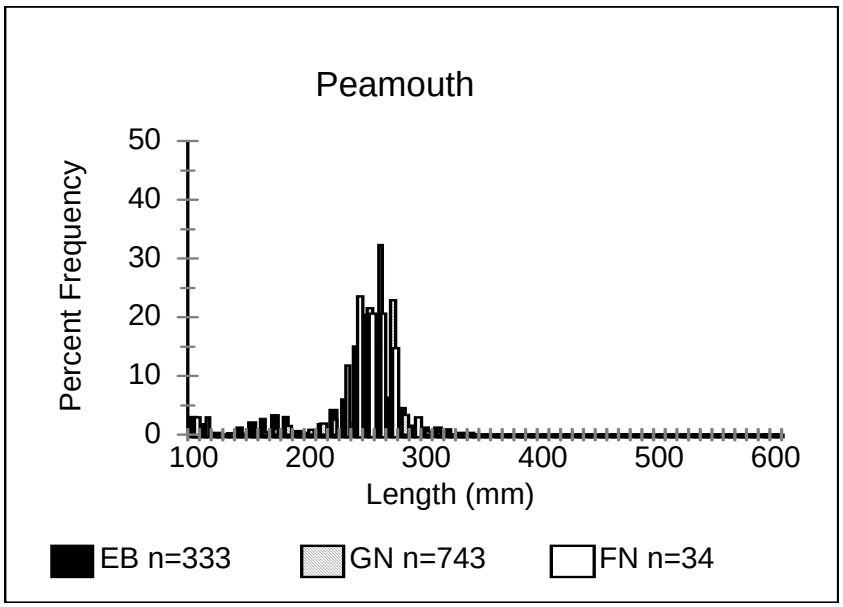

Figure 29. Length frequency distribution of peamouth sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) from Box Canyon Reservoir (Pend Oreille County) in May 2004

Largescale Sucker

Box Canyon Reservoir largescale sucker ranged in length from 82 to 622 mm TL (Table 3; Figure 30).

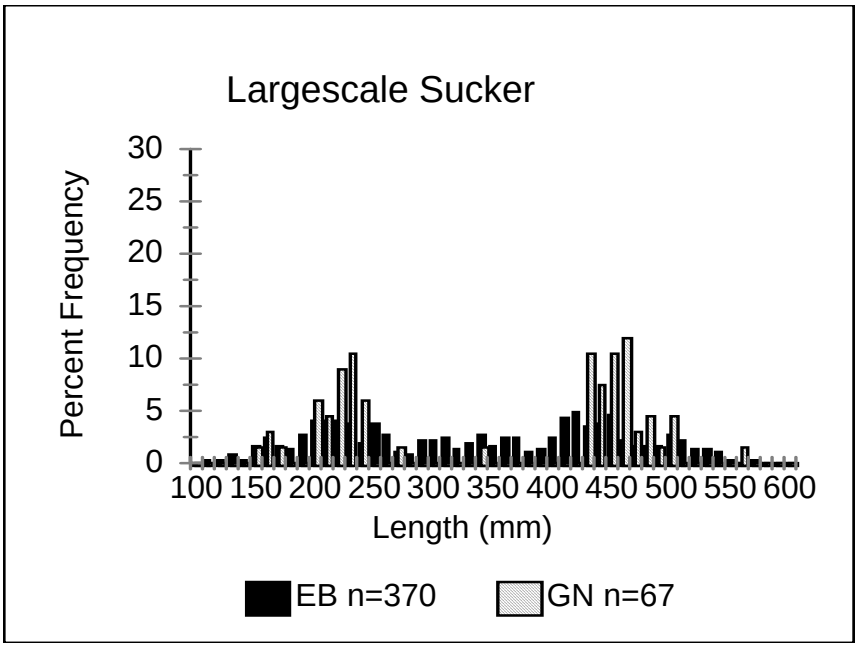

Figure 30. Length frequency distribution of largescale sucker sampled by boat electrofishing (EB) and gill netting (GN) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Longnose Sucker

Box Canyon Reservoir longnose sucker *Catostomus catostomus* sampled ranged in length from 70 to 521 mm TL (Table 3; Figure 31).

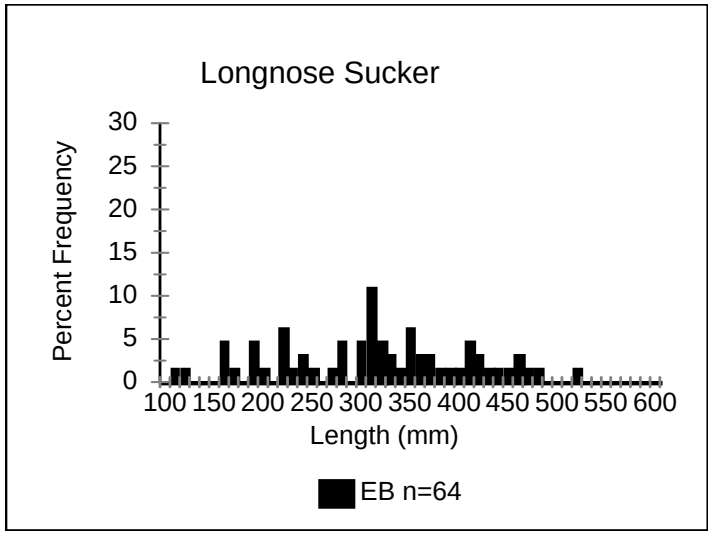

Figure 31. Length frequency distribution of longnose sucker sampled by boat electrofishing (EB) from Box Canyon Reservoir (Pend Oreille County) in May 2004.

Additional Species

Eight bridgelip sucker *Catostomus columbianus*, six chiselmouth *Acrocheilus alutaceus*, 24 redside shiner *Richardsonius balteatus*, two sculpin *Cottus* spp., and nine unidentified suckers *Catostomus* spp. were also caught during the survey (Table 3). Bridgelip suckers sampled ranged in length from 151 to 448 mm TL. Chiselmouth sampled ranged in length from 157 to 173 mm TL. Redside shiner sampled ranged in length from 57 to 170 mm TL. Sculpin sampled measured 55 and 72 mm TL.

Discussion

The 2004 WDFW Box Canyon survey demonstrated widespread distribution of both warmwater and nongame fish species throughout the reservoir. These results were similar to two previous surveys conducted in 1989-1991 (Bennett and Liter 1991; Ashe and Scholz 1992). Although these studies were conducted 15 years prior to our 2004 survey, and different protocols were used, a valuable comparison of the overall catch and indices of population structure for the fish community can still be made. In each study, largemouth bass, yellow perch and pumpkinseed sunfish were the most abundant game fish species sampled. The top three non-game fish species sampled were also the same, with tench, northern pikeminnow, and largescale sucker topping the list in all surveys. Conversely, black crappie and peamouth were more numerous in our survey; whereas, mountain whitefish were sampled at higher relative abundance by Ashe and Scholz (1992) and Bennett and Liter (1991). Cutthroat trout, rainbow trout, eastern brook trout, brown trout, and bull trout each accounted for less than 1% of the fish captured in all three surveys.

In Box Canyon Reservoir, the warmwater fish of primary interest to anglers are largemouth bass, yellow perch, and black crappie. Although many quality sized (≥ 300 mm TL) largemouth bass were sampled, the majority of yellow perch and black crappie were small; both species averaging only 150 mm (6 inches) in length. This size is considered too small by most anglers and is likely the result of their high numbers and competition for inadequate forage. Largemouth bass sampled ranged to 534 mm in length and weighing 2863 grams (21 inches; 6.3 pounds) with catchable largemouth bass (≥ 200 mm) averaging 306 mm (12 inches). Yellow perch sampled ranged to 246 mm (9.5 inches) with catchable yellow perch (≥ 130 mm) averaging 157 mm (6 inches). Black crappie sampled ranged to 280 mm (11 inches), but few (< 1 percent) were greater than 229 mm (9 inches). Catchable black crappie (≥ 130 mm) averaged 161 mm (6 inches) in length. These results are similar to those reported by Bennett and Liter (1991) and Ashe and Scholz (1992). Bennett and Liter (1991) reported sampling largemouth bass to 534mm (21 inches), yellow perch to 229 mm (9 inches) and averaging 165 mm (6.5 inches), and black crappie to 229 mm (9 inches), but most were small. They attributed this to dense aquatic vegetation and competition for available resources; conditions which likely continued into the present study. Ashe and Scholz (1992) reported sampling largemouth bass to 534 mm (21 inches) in length. Bass caught in tournaments during the late 1980's and early 1990's averaged 907 grams (2 pounds), with the largest fish weighing around 2722 grams (6 pounds). Yellow perch ranged to 280 mm (11 inches) and averaged 150 mm (6 inches), whereas black crappie ranged to 267 mm (10.5 inches) and averaged near 150 mm (6 inches).

Since no attempt was made to estimate population abundance during this survey, it is difficult to assess population numbers within Box Canyon Reservoir. However, when standardized sampling is used, catch-per-unit-effort provides a useful index to monitor relative abundance of populations over time. Although the WDFW sampling protocol for the 2004 survey was different than previous surveys, and many variables including gear type, timing, and crew efficiency are known to influence catch rates, valuable comparisons can be made. Comparing our electrofishing catch rates (fish per hour) with those of Ashe and Scholz (1992), we found that our catch rates were higher for the primary warmwater fish species (i.e., largemouth bass, yellow perch, pumpkinseed sunfish, and black crappie); however, when looked at proportionally by

species, catch rates ranked more similarly. This result is more likely an artifact of the timing of sampling efforts than a true reflection of population densities, especially considering the proportional similarities in overall species composition. By sampling within one week's time in spring, our standard sampling protocol maximizes the likelihood of adequate sample sizes for the most common warmwater fish species (Bettross and Willis 1998; Guy and Willis 1991). In contrast, sampling monthly throughout the year, as did Ashe and Scholz (1992), is likely to result in lower overall catch rates due to periods of less productive sampling. Considering this, it is our recommendation that future sampling be conducted following the same WDFW standardized warmwater survey protocols employed in this survey (Bonar et al. 2000) when attempting to monitor future trends in relative abundance.

Growth rates for largemouth bass, yellow perch, and black crappie were similar to those reported by Bennett and Liter (1991), but greater than those reported by Ashe and Sholz (1992). Reasons for the differences are uncertain. In general, largemouth bass averaged 200 mm (8 inches) at age 3, 300 mm (12 inches) at age 5, and 400 mm (16 inches) at age 7. Yellow perch averaged 150 mm (6 inches) at age 3 and 200 mm (8 inches) at age 5. Black crappie averaged 200 mm (8 inches) at age 3 and 250 mm (9 inches) at age 5. Future growth rates are likely to remain similar without a substantial change in population densities or shift in fish community balance. With an increase in predator numbers, growth rates of forage populations could improve if their numbers were reduced.

Warmwater fish condition in the reservoir was at or below the national 75^{th} percentile for young bass and panfish species of all ages, but high for adult predators like largemouth bass, smallmouth bass, and northern pike. This result is likely due to density dependent factors at work in the fish community. Overabundant yellow perch and pumpkinseed sunfish likely compete for limited food resources with young bass and each other, as well as non-game species within the reservoir. Ashe and Schulz (1992) reported high diet overlap between young largemouth bass, yellow perch, and black crappie following extensive diet analysis of many species within the reservoir. On the other hand, predators, like adult largemouth bass, smallmouth bass, and northern pike, and likely northern pikeminnow, appear to have abundant forage opportunities as exhibited by their high condition. Similar conditions were presented and discussed by Bennett and Liter (1991) and Ashe and Scholz (1992).

One difference between the work conducted previously and the results of this survey is evidence that northern pike abundance in Box Canyon Reservoir is increasing. We sampled 27 northern pike, whereas, no northern pike were reported sampled by either Bennett and Liter (1991) or Ashe and Scholz (1992). Bennett and Liter (1991) suggested that an increase in predator abundance (e.g. northern pike) might improve the predator/prey balance in the reservoir. However, at the time of our 2004 survey there was no apparent change in the overall predator/ prey balance of the fish community even though northern pike were sampled. The fact that the fish community proportions have not yet noticeably changed, may be due to the fact that northern pike numbers are still relatively low. As their population continues to increase in number and size of individual fish, it is likely that future surveys might show significant changes in the general fish community makeup. With northern pike constantly immigrating into the reservoir from Lake Pend Oreille, Idaho, and the apparent successful natural production within Box Canyon Reservoir, the population seems to be expanding. Considering this development,

continued monitoring of immigration, entrainment, spawning activity, relative abundance, and their effect on the fish community would be prudent.

In addition to northern pike, walleye is another potentially deleterious invasive predator. Although only one walleye was sampled in this survey, their presence in the reservoir should not be overlooked. Like northern pike, walleye numbers could increase within the reservoir by natural reproduction or by an influx of immigrants from upstream. Schoby et al.(2007) and Hanson and Tholl (2007) have recently documented expanding walleye populations in Lake Pend Orielle (Idaho) and the Clark Fork River (Montana), both of which drain into the Pend Oreille River in Washington. McMahon and Bennett (1996) cautioned northwest fisheries managers that managing top predators, such as walleye and northern pike can be difficult once they become established, because each of these species has the potential to significantly alter entire fish communities through predation.

Since the early 1990's, warmwater fisheries management on Box Canyon Reservoir has focused on enhancing the largemouth bass population in the reservoir to provide a quality sport and subsistence fishery. Following their research in the late 1980's and early 1990's, Bennett and Liter (1991) concluded that the primary factor affecting the warmwater fishes in the reservoir was limited recruitment of age-one largemouth bass. Low water temperatures, water level fluctuations, and bass tournament disturbance were all listed as possible contributing factors. Similarly, Ashe and Scholz (1992) suggested that the reservoir could support a larger population of largemouth bass considering habitat availability and an abundance of prey (e.g., yellow perch). They concluded that although recruitment of age-1 largemouth bass was limited and affected by annual variation, largemouth bass was the game fish species most likely to provide a substantial recreational fishery. Recommendations at that time included stocking age-one largemouth bass to supplement weak year-classes or the introduction of a large predator species, such as northern pike to take advantage of the extensive forage base observed in the reservoir (Bennett and Liter 1991) with the ultimate benefit of increased recreational opportunity and increased growth of the panfish species in the reservoir. In 1992, with general agreement among fishery managers, including the Washington Department of Fish and Wildlife and the Kalispel Tribe of Indians Natural Resource Department, Ashe and Scholz (1992) recommended two alternate strategies to expand the largemouth bass population in Box Canyon Reservoir: 1) natural expansion of the population, which involved changes in the flow regime of the reservoir, more restrictive fishing regulations for bass, and restricting bass tournaments during spawning season; or 2) supplementation of the natural bass population, which involved constructing a hatchery on the Kalispel Indian Reservation to produce 150,000 age-1+ largemouth bass fingerlings (150 mm) annually. Additionally, it was recommended that: 1) wetland refuge habitat be utilized to raise hatchery fry until release into the reservoir; 2) artificial structures be constructed and strategically placed to increase over-winter habitat for juvenile bass; 3) aquatic vegetation control techniques be modified to increase big-bass habitat; 4) no further introductions of exotic predator species be made into the reservoir; and 5) supplementation and habitat projects be monitored for three years after implementation. Following several recommendations from Ashe and Scholz (1992), the KNRD in conjunction with WDFW initiated the Kalispel Resident Fish Project in 1995 (Maroney et al. 1996). The warmwater fish component of the project involved the implementation of habitat and population enhancement for largemouth bass within the reservoir. Efforts to enhance largemouth bass habitat and population

size within the reservoir focused on two key areas: 1) construction of a tribal largemouth bass hatchery and rearing facility to supplement natural production within the reservoir and 2) increasing over-wintering habitat for juvenile largemouth bass through the installation of artificial structures in reservoir sloughs.

Since the completion of the KNRD hatchery in November 1997, largemouth bass production has progressed from only limited success to producing moderate numbers of fry by the time of this survey. Early setbacks resulting in fish loss due to factors including gas bubble disease, flooding of rearing sloughs, and predation, have apparently been overcome and production has recently increased. The first year production goal was to release 100,000 32 mm fry and 50,000 140 mm fingerling largemouth bass in the spring of 1998. However, no bass were produced the first year (Maroney et al. 1997). Although twenty-seven largemouth bass broodfish were collected from the reservoir in the fall of 1997, brought to the newly completed hatchery, and held over winter, no spawning occurred in the spring of 1998 (Maroney et al. 1997; Donley and Lockwood 1998; KNRD, 1998). The first successful spawn occurred in June 1999, which produced an estimated 144,000 fry. A second spawn in July 1999, produced an estimated 98,000 fry. Fry were then transferred to sloughs for rearing. Most fry were lost following their release into rearing sloughs due to high water and predation. It was believed that the majority of the fry were flushed out into the main reservoir over the slough dams by floodwaters. Following the spring flooding event, only 500 fry were recovered from the rearing sloughs. In the fall of 1999, all largemouth bass brood fish were lost due to a standpipe malfunction during fall maintenance activities. Twenty-seven adult largemouth bass were collected from the river to serve as brood fish for 2000 production (Bluff 2000). In early 2000, one brood fish died as the result of a fish hook lodged in its throat and the other 26 fish were lost to gas bubble disease. In 2001, 29 brood fish were again collected from the river (Bluff 2001). In 2002, approximately 150,000 eggs were incubated and hatched. In 2003, largemouth bass production goals were reduced from 100,000 fry and 50,000 fingerlings to 90,000 fry and 10,000 fingerlings. In 2004, largemouth bass spawned in July and the hatchery produced 9,116 50-100 mm fingerlings and approximately 25,000 fry. All fingerlings were marked prior to their release into four reservoir sloughs. Of the fingerlings, 2,748 fish were marked with coded wire tags and 6,358 were fin clipped (Gould 2005). During the same time period, 1997 to 2004, KNRD began a project to evaluate the use of two types of artificial structures (i.e., Berkley and Pradco) in two sloughs by monitoring largemouth bass utilization through electrofishing. The premise behind placement of artificial structures in the sloughs was to increase over-winter survival of age-0 largemouth bass. Monitoring efforts conducted from 2000 to 2003 indicate an increase in largemouth bass utilization of sloughs where structures were placed; however it is uncertain whether largemouth bass abundance within sloughs was actually higher or only appeared so due to increased concentration near the artificial structures (Anderson 2001; Andersen 2002; Andersen and Olson 2003; Olson and Andersen 2004).

The indices of population structure from the 2004 survey give no indication that largemouth bass supplementation efforts have, to date, increased the population within the reservoir. Factors resulting in low largemouth bass recruitment identified by Bennett and Liter (1991) and Ashe and Scholz (1992), which include: water level fluctuations affecting spawning success; low over-winter survival due to short growing season, competition for food, and insufficient cover, still persist. To date, production from the hatchery has been limited and no tagged bass released from

the hatchery have been recovered during any surveys on the reservoir (J. Connor, KNRD, personal communication).

Increasing the abundance of largemouth bass in self sustaining populations through hatchery supplementation in large reservoirs has rarely been an effective management tool (Keith 1986). Supplemental stocking has been used successfully to alter genetic composition with Florida largemouth bass (Buckmeier et al. 2003; Farquhar 2001; Maceina et al. 1988) and Jackson et al. (2002) reported that largemouth bass stocked into bays of a North Carolina Reservoir contributed to year-class strength and performed similarly to native fish, however, these results are not typical. More commonly, reported contributions to cohort abundance are short lived (Buynak and Mitchell 1999; Buckmeier and Betsill 2002; Buynak et al. 1999) and increases in angler harvest from supplemental stocking are not achieved (Boxrucker 1986; Hartman and Janney 2006). Researchers have attempted to improve largemouth bass stocking success, but the difficulties have yet to be overcome. Predator densities have long been reported to significantly affect stocking success (Hearn, M. C. 1977; Buckmeier et al. 2005) and habituating largemouth bass to predators, habitat, and/or live forage (Heidinger and Brooks 2002) prior to release has been suggested to improve stocking success (Buckmeier et al. 2005; Hoxmeier and Wahl 2002). The stocking of larger sub-adult yearling largemouth bass has been effective in some cases (Mesing et al. 2008; Powell 1975; Satterfield and Flickinger 1986; Smith and Reeves 1986; Kreiger and Putman 1983; Lawson and Davies 1979), but even stocking larger bass has been reported to have only short-lived success (Hartman and Janney 2006). High production costs have often deemed this approach cost prohibitive (Crawford and Wicker 1987; Hoffman and Bettoli 2005; Freund and Hartman 1999). Following extensive literature review, we found no study documenting an increase in harvest following largemouth bass hatchery supplementation.

Hatchery supplementation aside, managing the reservoir as a quality bass fishery remains a viable option for managers to consider. In general, the fish community in Box Canyon Reservoir can currently be described as prey-crowded. Overabundant panfish species including yellow perch, black crappie, and pumpkinseed sunfish, as well as a variety of non- game fish species, are all potential forage species for the low-density predator populations of largemouth bass, northern pike, and smallmouth bass, all of which provides for the high condition adult predatory fish. Considering the impending expansion of northern pike, walleye, and smallmouth bass within Box Canyon Reservoir, managers should reconsider the objective to increase the largemouth bass population through supplemental stocking. As each of these apex predators continue to increase in abundance, their impact on the prey base could be substantial. Although the quality of panfish populations would likely increase with increased predation pressure, the quality of the largemouth bass population could decline if the combined overall predation rates become too high. Considering this, the largemouth bass abundance of 2004 may have been appropriate if quality largemouth bass fishing opportunity was the goal of fisheries managers. Regardless, managing the balance of warmwater fish predator and prey populations within Box Canyon Reservoir is sure to be a challenge for fisheries managers in the years ahead.

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