The 1999 Warmwater Fish Survey of Big Chambers Lake (Russell Lake), Thurston County

by

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Abstract

The warmwater fish population of Chambers Lake (Russell Lake) was sampled during the spring of 1999. The sampled biomass was dominated by largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), cutthroat trout (*Oncorhynchus clarki*) and bluegill (*Lepomis macrochirus*). Though none were captured during our survey, triploid grass carp (*Ctenopharyngodon idella*) are present and probably account for the majority of the biomass. Chambers Lake is currently involved in a channel catfish (*Ictalurus punctatus*) stocking program. No channel catfish were encountered in our survey, and it is unclear as to how successful these plants have been in creating a fishery. An angler creel survey, or some other method of monitoring harvest at Chambers Lake should be proposed to obtain information on the success of the channel catfish stocking program. Public access to the Chambers Lakes is limited to Big Chambers Lake. The area accessible to the angling public could be doubled by opening up the connecting channel between the two lakes.

Table of Contents

List of Tables

List of Figures

Introduction and Background

Big Chambers Lake, also known as Russell Lake is a small (24.3 ha) water body located in the towns of Olympia, and Lacey, Washington. Big Chambers Lake is connected to Little Chambers Lake by a small, overgrown channel during high water. There are no surface water inflows feeding either of the lakes, except that of runoff. Surface water exits through a creek at the east end of Little Chambers Lake and flows into the Deschutes River. Our survey was confined to Big Chambers Lake, so the majority of the following information will pertain only to that lake.

Big Chambers Lake has had an aquatic macrophyte problem throughout its history. It is a small, shallow lake, allowing good light penetration. There is abundant nutrient input through city, residential, and agricultural runoff, creating a habitat very hospitable to plant growth. In the beginning of July 1990, 6,000 grass carp were planted into Big Chambers Lake followed by an additional 6,622 at the end of July for a stocking rate of 13.7 grass carp per metric ton of vegetation (Pauley et al. 1998).

In September 1980, a total of 60 largemouth bass were salvaged from Clear Lake, which was scheduled for rehabilitation. These fish were tagged and planted into Chambers Lake to supplement the bass population.

Materials and Methods

Data Collection

Chambers Lake was surveyed by a four–person team during June 7-9, 1999. Fish were captured using three sampling techniques: electrofishing; gill netting; and fyke netting. The electrofishing unit consisted of a Smith-Root SR-16s electrofishing boat, with a 5.0GPP pulsator unit. The boat was fished using a pulsed DC current of 120 cycles/second at 3-4 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 size (1.3, 1.9, 2.5, and 5.1 cm stretch) monofilament mesh. Fyke (modified hoop) nets were constructed of five 1.2–m diameter hoops with two funnels, and a 2.4–m cod end (0.6 cm nylon delta mesh). Attached to the mouth of the net were two 7.6–m wings, and a 30.5–m lead.

In order to reduce the gear induced bias in the data, the sampling time for each gear was standardized so that the ratio of electrofishing to gill netting to fyke netting was 1:1:1. The standardized sample is 1800 seconds of electrofishing (3 sections), two gill net nights, and two fyke net nights. Sampling occurred during the evening hours to maximize the type and number of fish captured. Sampling locations were selected from a map (Figure 1) by dividing the entire

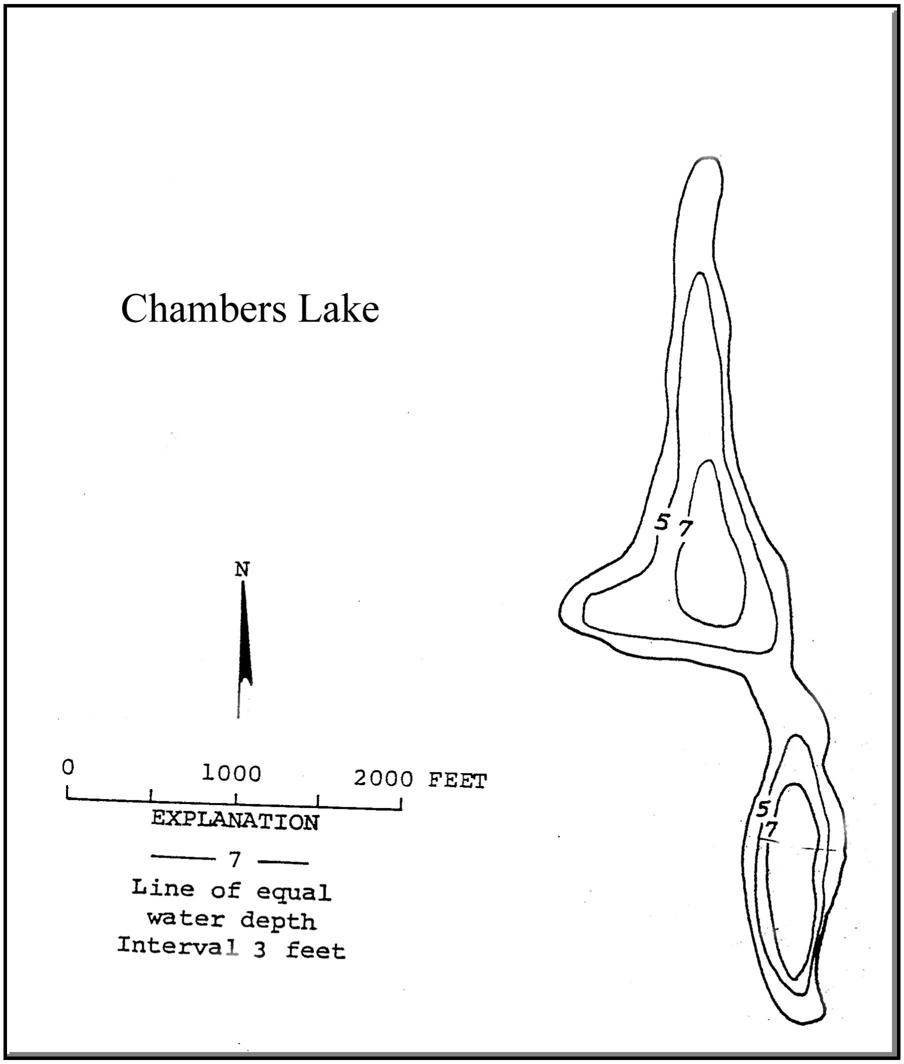

Figure 1. Bathymetric map of Big Chambers Lake, Thurston County, taken from Bortelson et al. (1976).

shoreline into 400–m sections, and numbering them consecutively. Nightly sampling locations were randomly chosen (without replication) utilizing a random numbers table (Zar 1984). While electrofishing, the boat was maneuvered through the shallows at a slow rate of speed (~18 m/min, linear distance covered over time) for a total of 600 seconds of "pedal–down" time or until the end of the section was reached, whichever came first. Nighttime electrofishing occurred along nearly 100% of the available shoreline. Gill nets were fished perpendicular to the shoreline; the small–mesh end was tied off to shore, and the large–mesh end was anchored off shore. Fyke nets were fished perpendicular to the shoreline as well. The lead was tied off to shore, and the cod-end was anchored off shore, with the wings anchored at approximately a 45° angle from the net lead. We tried to set fyke nets so that the hoops were approximately 0.5 m below the water surface, this sometimes would require shortening the lead. Gill nets were set overnight at two locations around the lake, and fyke nets were set overnight at two locations as well.

With the exception of sculpin (Cottidae), all fish captured were identified to the species level. Each fish was measured to the nearest millimeter (mm) and assigned to a 10 mm size class based on total length (TL). However, if a sample included several hundred young–of–year (YOY) or small juveniles (<100 mm TL) of a given species, then a sub-sample (N ~100 fish) were measured, and the remainder were just counted. The frequency distribution of the subsample was then applied to the total number collected. At least ten fish from each size class were weighed to the nearest gram (g); in some instances, multiple small fish were weighed together to get an average weight. Scales were taken from five individuals per size class, mounted, pressed, and aged using the Fraser-Lee method. Members of the bullhead family (Ictaluridae), and non–game fish like carp (Cyprinidae), were not aged.

Water quality data (Table1) was collected during mid–day from one location on June 9, 1999. Using a Hydrolab® probe and digital recorder, dissolved oxygen, temperature, pH, and conductivity data was gathered in the littoral zone and in the deepest section of the lake at 1 m intervals through the water column.

Table 1. Water quality parameters collected from Chambers Lake, Thurston County, mid–day on June 9, 1999.

	Depth (m)	Temp (C)	pH	Oxygen mg / l	Conductivity µs / cm2
Location 1	0	16.97	5.71	7.7	35.9
	1	15.57	5.73	7.42	35.6

Data Analysis

Species Composition

The species composition by number of fish captured, was determined using procedures outlined by Fletcher et al.(1993). Species composition by weight (kg) of fish captured, was determined using procedures adapted from Swingle (1950). Percentage of the aggregate biomass for each species provided useful information regarding the balance and productivity of the community (Swingle 1950, Bennett 1962). Only fish estimated to be at least one year old were used to determine species composition. These were inferred from the length frequency distributions described below, in conjunction with the results of the aging process. Young–of–year or small juveniles were not considered because large fluctuations in their numbers may cause distorted results (Fletcher et al. 1993). However, most of these fish would be subject to natural attrition during their first winter, resulting in a different size distribution by the following year.

Catch Per Unit of Effort

The catch per unit of effort (CPUE) of electrofishing for each species was determined by dividing the total number in all size classes equal or greater than stock size, by the total electrofishing time (seconds). The CPUE for gill nets and fyke nets was determined similarly, except the number equal or greater than stock size was divided by the number of net nights for each net (usually one). An average CPUE (across sample sections) with 80% confidence interval was calculated for each species and gear type.

For fishes in which there is no published stock size (i.e., sculpins, suckers, etc.), CPUE is calculated using all individuals captured. Furthermore, since it is standardized, the CPUE is useful for comparing stocks between lakes.

Length Frequency

A length frequency histogram was calculated for each species and gear type in the sample. Length frequency histograms are constructed using individuals that are Age 1 and older (determined by the aging process, age 1 one standard deviation), and calculated as the number of individuals of a species in a given size class, divided by the total individuals of that species sampled. Plotting the histogram this way tends to flatten out large peaks created by an abundant size class, and makes the graph a little easier to read. These length frequency histograms are helpful when trying to evaluate the size and age structure of the fish community, and their relative abundance in the lake.

Stock Density Indices

Stock density indices are used to assess the size structure of fish populations. Proportional stock density (PSD and relative stock density RSD) are calculated as proportions of various size classes of fish in a sample. The size classes are referred to as minimum stock (S), quality (Q), preferred (P), memorable (M), and trophy (T). Lengths have been published to represent these size classes for each species, and were developed to represent a percentage of world–record lengths as listed by the International Game Fish Association (Gablehouse 1984). These lengths are presented in Appendix A.

The indices calculated here are described by Gablehouse (1984) as the traditional approach. The indices are accompanied by a 80% confidence interval (Gustafson 1988) to provide an estimate of statistical precision.

Relative Weight

A relative weight index (W_r) was used to evaluate the condition (plumpness or robustness) of fish in the lake. A W_r value of 100 generally indicates a fish in good condition when compared to the national average for that species and size. Furthermore, relative weights are useful for comparing the condition of different size groups within a single population to determine if all sizes are finding adequate forage or food (ODFW 1997). Following Murphy and Willis (1991), the index was calculated as $W_r = W/W_s \times 100$, where W is the weight (g) for an individual fish from the sample and W_s is the standard weight of a fish of the same total length (mm). W_s is calculated from a standard log–weight, log–length relationship defined for the species of interest. The parameters for the W_s equations of many fish species, including the minimum length recommendations for their application, are listed in Anderson and Neumann (1996).

Age and Growth

Age and growth of warmwater fishes were evaluated according to Fletcher et al. (1993). Total length at annulus formation, L_n, was back–calculated using the Fraser-Lee method. Intercepts for the *y* axis for each species were taken from Carlander (1982). Mean back–calculated lengths at each age for each species were presented in tabular form for easy comparison between year classes. Mean back–calculated lengths at each age for each species were compared to averages calculated from scale samples gathered at lakes sampled by the warm water enhancement teams.

Results and Discussion

Water Quality and Habitat

Big Chambers Lake is a lowland lake, with a low gradient bottom. As such, it is very shallow, with a maximum depth of approximately 1.5 m, making the lake one large littoral zone. The lake is fed mainly by rainfall (runoff) and ground water. The outflow is through a small creek flowing from the southern end of Little Chambers Lake, and into the Deschutes River system.

Being shallow, Big Chambers Lake undoubtedly has an oxygen problem during periods of high water temperatures. Pauley et al. (1998) reported that bottom dissolved oxygen levels increased once grass carp started removing the vegetation. The reduced vegetation cover allows greater light penetration for photosynthesis and also allows better mixing of the water through wind action.

Species Composition and Relative Abundance

A total of nine species of fish were sampled at Chambers Lake: brown bullhead (*Ameiurus nebulosus*); black crappie (*Pomoxis nigromaculatus*); bluegill (*Lepomis macrochirus*); cutthroat trout (*Onchorynchus clarki*); largemouth bass (*Micropterus salmoides*); pumpkinseed (*Lepomis gibbosus*); warmouth (*Lepomis gulosus*); yellow perch (*Perca flavescens*); and grass carp (*Ctenopharyngodon idella*).

Largemouth bass and yellow perch were the two most abundant species, and accounted for almost 70% of the total biomass sampled (Table 2). Grass carp probably account for the most biomass, but none of these fish were actually taken aboard the boat and weighed, although quite a few were seen swimming in front of our electrical field while sampling.

Table 2. Species composition by weight (kg), and number of fish captured at Big Chambers Lake (Thurston County) during the spring 1999 warmwater fish survey.						
	Species Composition					
	by Weight		**by Number**		**Size Range (mm TL)**	
Species	**(kg)**	**(%w)**	**(#)**	**(%n)**	**Min**	**Max**
Brown bullhead	0.07	0.99	1	0.39	163	163
Black crappie	0.09	1.32	3	1.16	111	129
Bluegill	0.70	10.44	140	54.05	29	122
Cutthroat trout	1.07	15.87	3	1.16	250	334
Largemouth bass	2.85	42.26	17	6.56	19	372
Pumpkinseed	0.02	0.25	1	0.39	88	88
Warmouth	0.17	2.55	14	5.41	43	170
Yellow perch	1.77	26.30	80	30.89	35	189

Stock density indices (Table 3) show a fish community that is out of balance. Very few fish greater than stock size were sampled, and even fewer attained a quality size. The fact that the lake is one large, shallow, littoral zone made sampling difficult. It is possible that these stock density indices do not accurately reflect the true population composition.

Table 3. Stock density indices by gear type and length categories for the fish population at Big Chambers Lake during the spring 1999 warmwater fish survey.										
		Quality		**Preferred**		**Memorable**		**Trophy**		
Species	**# Stock Length**	**PSD**	**80% CI**	**RSD-P**	**80% CI**	**RSD-M**	**80% CI**	**RSD-T**	**80% CI**	
Electrofishing										
Bluegill	5	0	--	0	--	0	--	0	--	
Largemouth bass	8	38	22	0	--	0	--	0	--	
Yellow perch	23	0	--	0	--	0	--	0	--	
Gill net										
Cutthroat trout	2	0	--	0	--	0	--	0	--	

The average catch per unit of effort (CPUE) for all species is shown in Table 4. CPUE was highest for yellow perch, and largemouth bass, but still low overall. Fyke netting and gill netting did not prove to be efficient sampling techniques in Chambers Lake. The abundance of shallow habitat and aquatic vegetation spread across the entire lake means a large littoral zone, where fish could spread out and not be congregated along the shore line.

Table 4. Average catch per unit of effort (number of fish/hour electrofishing and number of fish caught/net night) for stock sized and larger fish sampled in Big Chambers Lake during the spring 1999 warmwater fish survey.

	Electrofishing			Gill Netting			Fyke Netting		
Species	**(# / hour)**	**80% CI**	**Sample Sites**	**#/net night**	**80% CI**	**# net nights**	**#/net night**	**80% CI**	**# net nights**
Brown bullhead	0.60	0.77	10	0.0	--	2	0.0	--	2
Bluegill	3.00	2.36	10	0.0	--	2	0.0	--	2
Cutthroat	0.60	0.77	10	1.0	1.28	2	0.0	--	2
Grass carp	0.60	0.77	10	0.0	--	2	0.0	--	2
Largemouth bass	4.80	3.77	10	0.0	--	2	0.0	--	2
Pumpkinseed	0.60	0.77	10	0.0	--	2	0.0	--	2
Warmouth	0.60	0.77	10	0.0	--	2	0.0	--	2
Yellow perch	14.37	7.60	10	0.5	0.64	2	0.0	--	2

Summary by Species

Largemouth Bass, (*Micropterus salmoides*)

The length frequency distribution of largemouth bass is shown in Figure 2. The low sample size (16 fish) is not nearly enough to create a useful or meaningful length frequency distribution. This figure is useful only to show the size range of fish we captured during electrofishing.

The relative weights of largemouth bass (Figure 3) show individuals to be in good condition, as compared to the standard. Again, the sample size is too low to draw good conclusions, but the general trend seems to be consistently above average. This would seem to suggest that prey items are not limiting, and that the environmental conditions are favorable. Back–calculated length at age (Table 5) supports these assumptions, as well. On average, western Washington largemouth bass reach 305mm (12 inches) during their sixth year. The largemouth bass population in Big Chambers Lake is a year ahead of that average, reaching 305mm in their fifth year. The averages in Table 5 do show erratic growth, as they are never consistently higher than the average. These average growth calculations are probably affected by a low sample size. More fish would smooth out the calculations, creating a better average.

Table 5. Back–calculated length at age (Fraser-Lee) for largemouth bass sampled from Big Chambers Lake, Thurston County, during the spring 1999 warmwater fish survey. Direct proportion averages are provided for comparison to historical data.

		Mean Length at Age (mm)					
Year Class	**n**	**I**	**II**	**III**	**IV**	**V**	**VI**
1998	5	70					
1997	0						
1996	6	84	144	191			
1995	2	69	115	219	283		
1994	1	71	160	214	306	339	
1993	1	67	131	186	272	300	344
Fraser-Lee	15	75	138	198	286	320	344
Direct Proportion		64	129	194	284	317	343
State Average (D.P.)		60	146	222	261	289	319

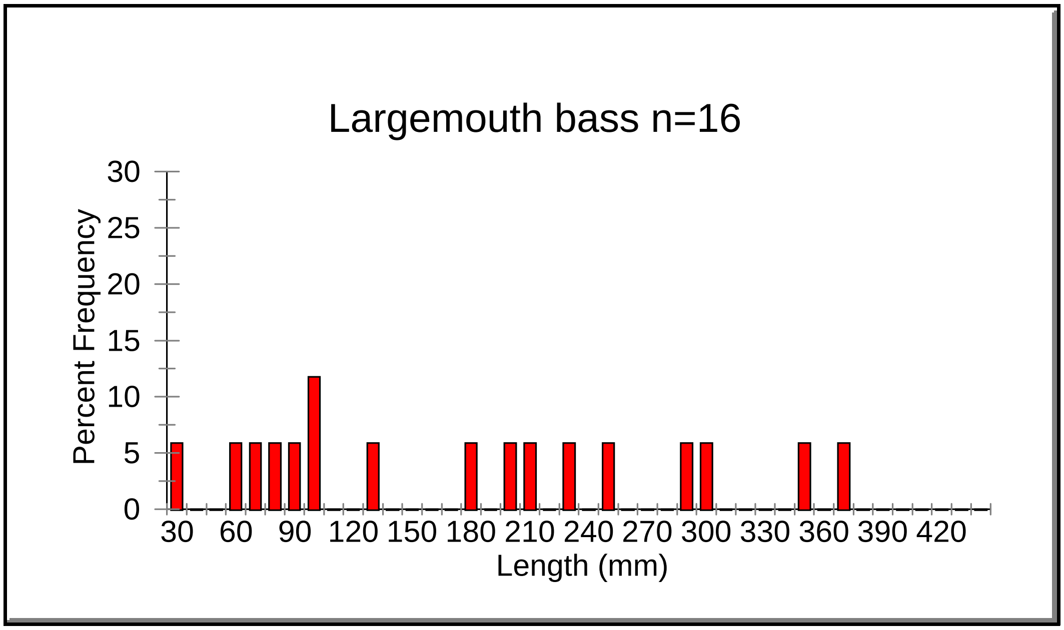

Figure 2. The length frequency distribution of largemouth bass from electrofishing during the spring 1999 warmwater fish survey of Big Chambers Lake, Thurston County.

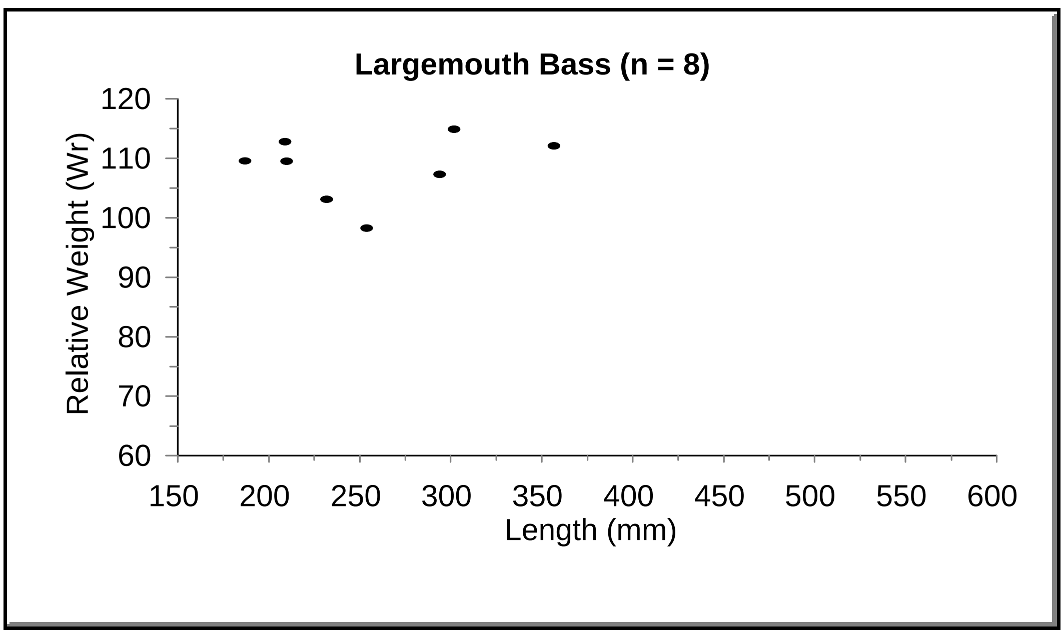

Figure 3. The relationship between total length and relative weight (Wr) for largemouth bass sampled at Big Chambers Lake during the spring 1999 warmwater fish survey.

Bluegill, (*Lepomis macrochirus*)

The length frequency distribution of bluegill from the Big Chambers Lake survey (electrofishing) is shown in Figure 4. The bluegill population in Big Chambers Lake is dominated by smaller size classes.

The relative weights of bluegill at the time of capture (Figure 5) were high, but inconsistent. The back–calculated length at age (Table 6) shows that the bluegill are growing slower than the state average. Sometimes, fish that exhibit good condition but slow growth are considered to be stunted and in an over crowded situation. This is possible, as approximately 95% of our sample was smaller than 80mm. Also, the high abundance of aquatic vegetation provides an overabundance of cover for fish to hide from predators.

Table 6. Back–calculated length (Fraser-Lee)at age for bluegill sampled from Big Chambers Lake, spring 1999. Direct proportion averages are provided for comparison to historical data.

Year Class	Mean Length at Age (mm)		
	n	**I**	**II**
1997	1	53	
1996	4	33	80
Fraser-Lee	5	37	80
Direct Proportion		21	73
State Average (D.P.)		37	97

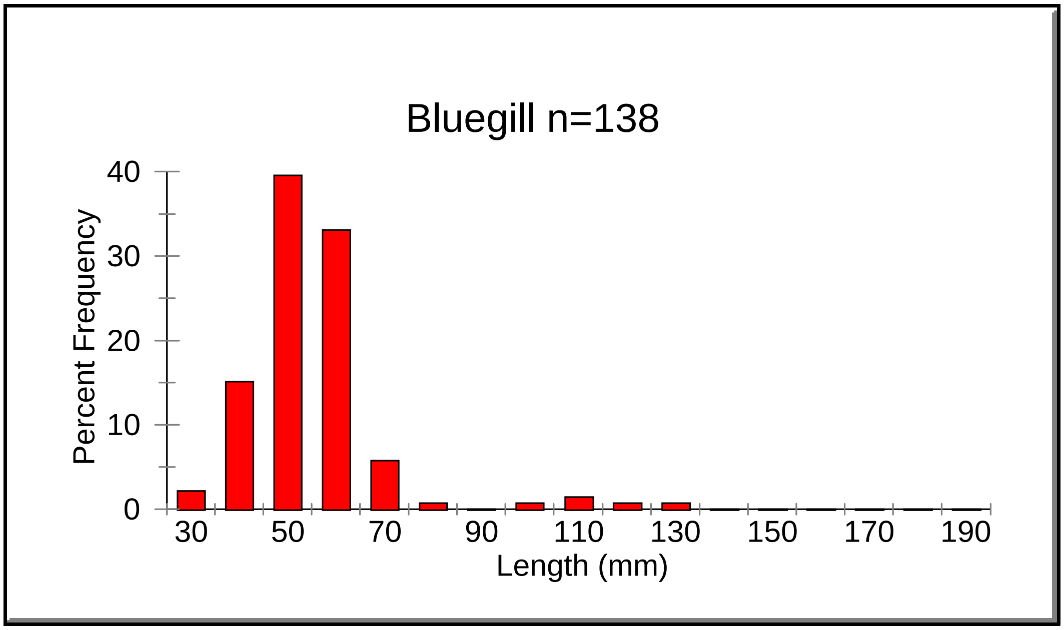

Figure 4. Length frequency distribution of bluegill from electrofishing during the spring 1999 warmwater fish survey of Big Chambers Lake, Thurston County.

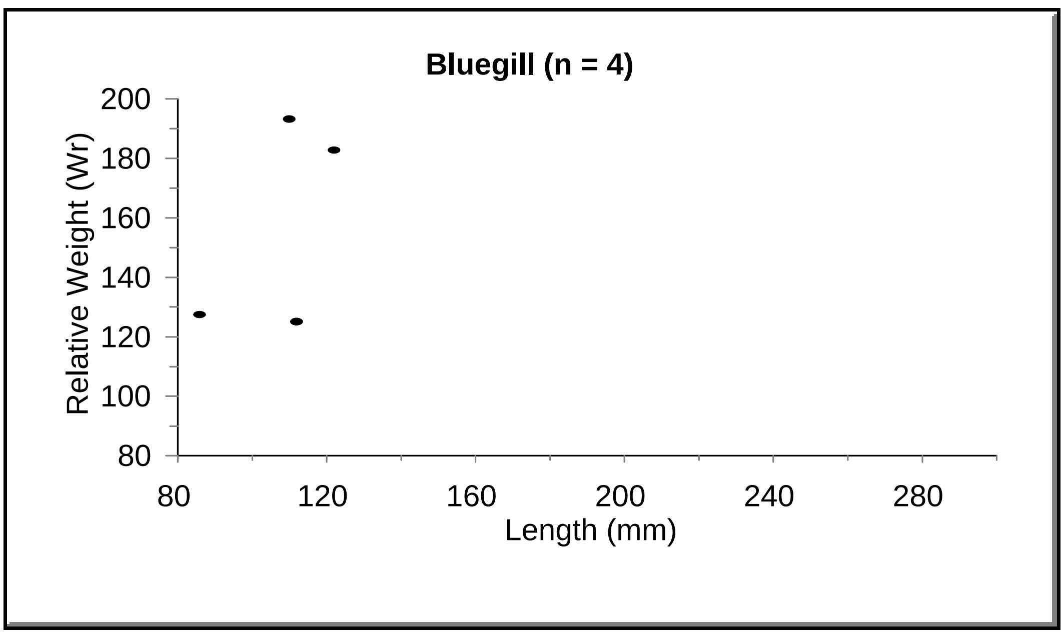

Figure 5. The relationship between total length and relative weight (Wr) for bluegill sampled at Big Chambers Lake during the spring 1999 warmwater fish survey.

Yellow Perch, (*Perca flavescens*)

Yellow perch were the second most abundant fish, in terms of biomass, in the sample (Table 2). The length frequency distribution of yellow perch from the electrofishing sample is shown in Figure 6. The gill netting sample closely resembled this distribution as well, although it had less of a sample size.

The relative weights of yellow perch are shown in Figure 7. Relative weights for yellow perch are higher than the national standard of 100 and higher than what is typically found in western Washington lakes. On average, yellow perch populations in western Washington lakes have W_r values less than 100. This suggests that prey items are abundant and probably not a factor limiting growth. Back–calculated length at age for yellow perch (Table 7) is less than the average for western Washington lakes. Yellow perch are another species that are prone to overpopulating a lake. Perch populations, when not held in check by a predator, can dramatically increase causing overabundance and lead to stunted growth. The high density of aquatic plants creates a condition favorable to this, as it reduces the visibility of predators, and increases the cover and spawning substrate for the perch. Individuals in stunted populations may also exhibit a high relative weights accompanied with poor growth.

Table 7. Back–calculated length at age (Fraser-Lee) for yellow perch sampled at Big Chambers Lake, during the spring 1999 warmwater fish survey. Direct proportion averages are provided for comparison to historical data.

	Mean Length at Age (mm)		
Year Class	**n**	**I**	**II**
1998	13	64	
1997	18	67	118
Fraser-Lee	31	66	118
Direct Proportion		48	110
State Average (D.P.)		60	120

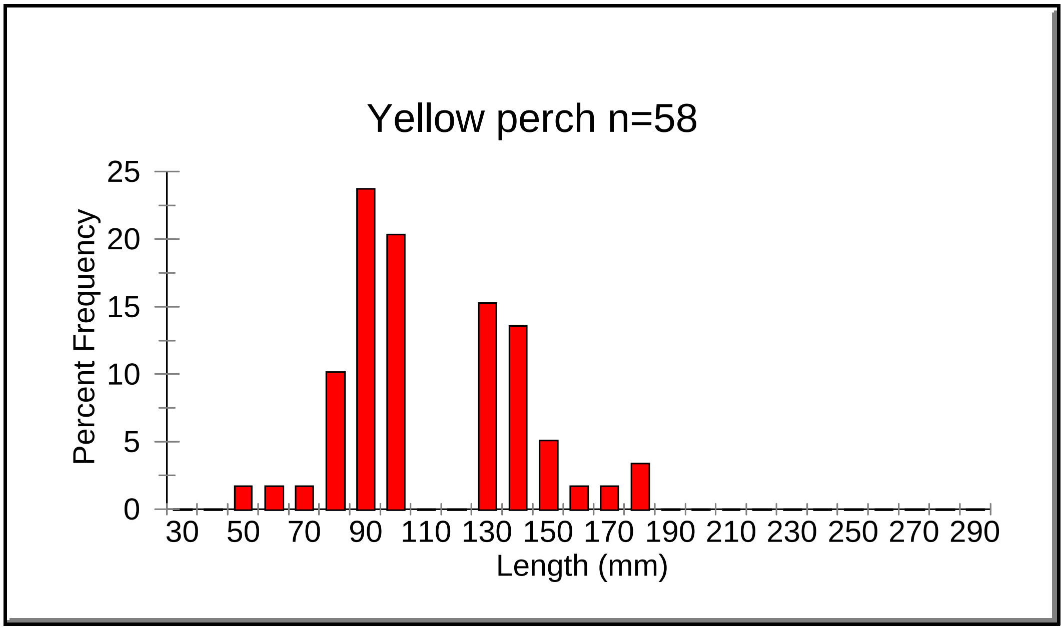

Figure 6. Length frequency distribution of yellow perch from electrofishing during the spring 1999 warmwater fish survey of Big Chambers Lake, Thurston County.

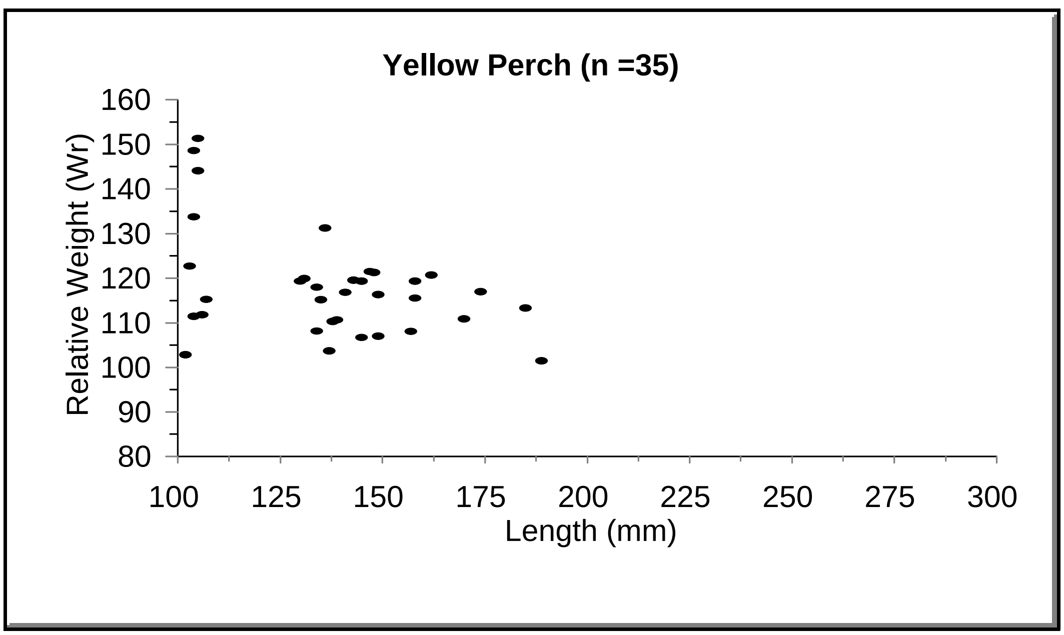

Figure 7. The relationship between total length and relative weight (Wr) for yellow perch sampled at Big Chambers Lake during the spring 1999 warmwater fish survey.

Cutthroat Trout, (*Oncorhynchus clarki*)

Few cutthroat trout were sampled, but they account for more than 15% of the sampled biomass (Table 2). The sample was insufficient to calculate any meaningful indices, and this listing is merely to acknowledge their presence.

Warmouth, (*Lepomis gulosus*)

Warmouth are not widely distributed in Washington; identified in only a few lakes in western Washington. These fish are capable of growth up to around 300mm when conditions are favorable. The length frequency distribution of warmouth in our sample at Big Chambers Lake is shown in Figure 8. Our sample was dominated by smaller size classes, though a single larger individual was sampled as well. It is possible that several weak year classes are responsible for the gaps in the length frequency distribution, or these fish may have been off shore, away from our sampling.

The back–calculated length at age for warmouth sampled from Big Chambers Lake is shown in Table 8. As previously indicated, scales are collected from fish 75mm and above; there were only two fish greater than 75mm. The average growth of these two fish is greater than the average for western Washington lakes, but this is not a valid sample size to make comparisons.

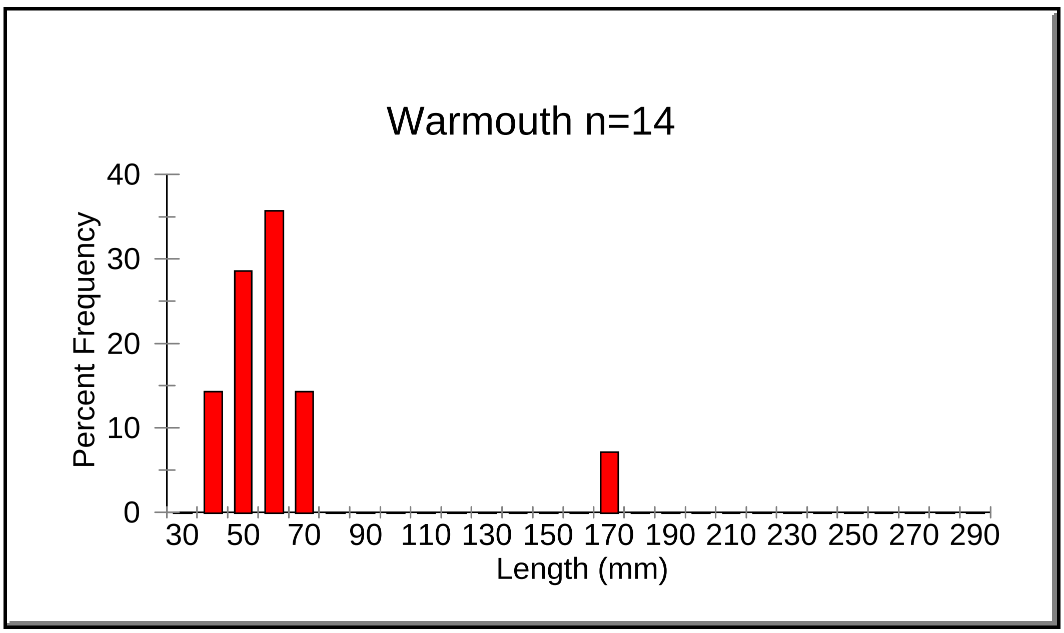

Figure 8. Length frequency distribution of warmouth from electrofishing during the spring 1999 warmwater fish survey of Big Chambers Lake, Thurston County.

Table 8. Back–calculated length at age (Fraser-Lee) for warmouth sampled from Big Chambers Lake, Thurston County, during the spring 1999 warmwater fish survey. Direct proportion averages are provided for comparison to historical data.

Year Class	n	Mean Length at Age (mm)				
		I	II	III	IV	V
1998	0					
1997	1	47	73			
1996	0					
1995	0					
1994	1	36	81	131	154	167
Fraser-Lee	2	42	77	131	154	167
Direct Proportion		28	71	125	152	167
State Average (D.P.)		23	58	89	116	131

Black Crappie, (*Pomoxis nigromaculatus*)

Black crappie were present in the sample at Big Chambers Lake. Although the entire shoreline of the lake was electrofished, we did not obtain an adequate sample size to calculate any meaningful stock density indices. Relative weights of the sampled individuals were all higher than the national standard. Scale samples revealed the three individuals to be one year old, with an average length of 91mm at Age 1.

Brown Bullhead, (*Ameiurus nebulosus*)

A single brown bullhead was sampled at Big Chambers Lake. Brown bullhead can be difficult to sample in lakes that have a lot of plant cover. Due to the fact that they are bottom dwellers, they often become entangled in vegetation or hidden in the substrate when sampling. There is undoubtedly a higher abundance of brown bullhead than is noted here, which could probably be shown by more directed sampling methods (baited traps, etc.).

Brown bullhead are not an important sport fish, but they can be an important food fish in some lakes in which they reside.

Pumpkinseed, (*Lepomis gibbosus*)

Pumpkinseed are present in Big Chambers Lake, but were not an abundant fish in our sample. Pumpkinseed are very prone to overpopulating lakes and small ponds with dense vegetation, but this does not seem to be the case in Big Chambers Lake, as only a single individual was sampled.

Grass Carp, (*Ctenopharyngodon idella*)

In early July 1990, Big Chambers Lake was stocked with 6,000 grass carp. Subsequently, an additional 6,622 grass carp were stocked in late July 1990, for a total stocking rate of 13.7 grass carp per metric ton of vegetation (Pauley et al. 1998).

Quite a few large grass carp were seen swimming away from our electrical field, but none were actually captured. The exact status of the grass carp population is unclear, as the annual mortality rate is not known.

Channel Catfish, (*Ictalurus punctatus*)

Channel catfish stocking began in Big Chambers Lake in 1995. Fish were purchased from Chico, California, and 246 were stocked at 8.5 fish/pound (8-10 inches), in 1996, 1005 Chico stock were again planted at 15/pound (about 4-5 inches). The latest planting was in November 1999; 31 fish at 0.5/pound (10-18inches) and 800 at 15.5/pound (4-5 inches) were stocked. No channel catfish were captured in our survey, and we have no information on fish returning to the creel. More directed sampling efforts may be needed to determine the status of the population.

Management Options

Big Chambers Lake proved to be a difficult lake to sample. Although we sampled the entire shoreline by electrofishing, our sampling effort was probably inadequate to accurately describe the fish community. Big Chambers Lake, being a shallow lake, allows for equal distribution of fishes across the entire surface acreage of the lake; there is probably not a diurnal offshore/ onshore migration as there would be in larger lakes with more steeply sloped banks. In the future, we may need to think of alternative sampling methods; including more net nights, beach seines, or possibly electrofishing around weed beds in the center of the lake. By utilizing these other sampling strategies, we can be assured of sampling more segments of the population.

Access

The access area at Big Chambers Lake was recently updated with a new parking lot and restroom facilities. There is a single boat ramp. The access area was once owned by the Department of Fish and Wildlife, but was deeded to Thurston County Parks with the agreement that they would improve and maintain the area. The parking area is also used as a trail head for the Chehalis Western Trail, a paved walking trail built by the Thurston County Parks department on an old railroad grade. The access to Little Chambers Lake is limited to a walk–in area through a stormwater overflow area in a residential subdivision. There is no boat access to Little Big Chambers Lake. The two lakes were once connected by a small stream, but over the years this connection has become overgrown. Now the connection only appears seasonally with higher water.

Access to Little and Big Chambers Lake can be increased two ways. First, reopening the channel that once was present between the two lakes will nearly double the surface acreage open to anglers. If the necessary permits are obtained, a crew could remove brush and shrubs to allow a channel to be dredged. Second, the Chehalis Western Trail bisects the two lakes. Shore access could be increased by cutting walking trails off of this main trail to each lake shore, provided this land is owned by the public. Current access for shore anglers is limited to the boat launch area at Big Chambers Lake, and at private residences

Channel Catfish Stocking

Channel catfish have been stocked into Big Chambers Lake for the past few years, but channel catfish survival and fishery contributions are unknown. To better manage this fishery and ensure the success of this stocking program, we need to obtain information on the performance of these fish within the warmwater fishery. Our recommendation is to continue with stocking at the current levels and sizes, and develop a plan to monitor harvest and angler effort.

Creel Survey

As with most of our lakes, we have very limited information that pertains to the harvest of our warmwater fish populations. A well designed angler creel survey can provide useful information to the manager such as angler pressure, harvest, satisfaction, and species preference. This kind of information is needed when developing management plans. Other methods, such as sport reward tags may also be utilized to get an estimate of exploitation. In either case, this information is essential to the management of the channel catfish fishery. This type of information cannot be obtained during one of our standard population surveys.

Literature Cited

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Appendix A

Table A1. Length categories that have been proposed for various fish species. Measurements are for total lengths (updated from Neumann and Anderson 1996).

	Category									
	Stock		Quality		Preferred		Memorable		Trophy	
Species	**(in)**	**(cm)**	**(in)**	**(cm)**	**(in)**	**(cm)**	**(in)**	**(cm)**	**(in)**	**(cm)**
Black bullhead [a]	6	15	9	23	12	30	15	38	18	46
Black crappie	5	13	8	20	10	25	12	30	15	38
Bluegill [a]	3	8	6	15	8	20	10	25	12	30
Brook trout	5	13	8	20						
Brown bullhead [a]	5	13	8	20	11	28	14	36	17	43
Brown trout	6	15	9	23	12	30	15	38	18	46
Burbot	8	20	15	38	21	53	26	67	32	82
Channel catfish	11	28	16	41	24	61	28	71	36	91
Common carp	11	28	16	41	21	53	26	66	33	84
Cutthroat trout	8	20	14	35	18	45	24	60	30	75
Flathead catfish	11	28	16	41	24	61	28	71	36	91
Green sunfish	3	8	6	15	8	20	10	25	12	30
Largemouth bass	8	20	12	30	15	38	20	51	25	63
Pumpkinseed	3	8	6	15	8	20	10	25	12	30
Rainbow trout	10	25	16	40	20	50	26	65	31	80
Rock bass	4	10	7	18	9	23	11	28	13	33
Smallmouth bass	7	18	11	28	14	35	17	43	20	51
Walleye	10	25	15	38	20	51	25	63	30	76
Warmouth	3	8	6	15	8	20	10	25	12	30
White catfish [a]	8	20	13	33	17	43	21	53	26	66
White crappie	5	13	8	20	10	25	12	30	15	38
Yellow bullhead	4	10	7	18	9	23	11	28	14	36
Yellow perch	5	13	8	20	10	25	12	30	15	38

[a] As of this writing, these new, or updated length classifications have yet to go through the peer review process, but a proposal for their use will soon be in press (Timothy J. Bister, South Dakota State University, personal communication).