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The Warmwater Fish Community of American Lake, Pierce County Fall 2002

Warmwater Fish Enhancement

by Adam Couto and Steve Caromile

Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

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Abstract

American Lake was surveyed in the fall of 2002 by a three-person team using multiple gear types: electrofishing, gill netting, and fyke netting. Ten taxa of fish (nine species and one family) were represented: rock bass (*Ambloplites rupestris*), kokanee (*Oncorhynchus nerka*), yellow perch (*Perca flavescens*), rainbow trout (*O. mykiss*), smallmouth bass (*Micropterus dolomieu*), cutthroat trout (*O. clarki*), pumpkinseed (*Lepomis gibbosus*), sculpin (Cottidae), largemouth bass (*M. salmoides*), and brown bullhead (*Ameiurus nebulosus*). The sample was numerically dominated by yellow perch and a stunted rock bass population, with the latter representing nearly half the lake biomass. Quality fishing opportunities exist for hatchery planted kokanee and rainbow trout, and for naturally reproducing yellow perch. Both largemouth and smallmouth bass were present in numbers too low to provide a quality fishery. It is hoped that changes to the black bass harvest regulations instituted in 2002 will improve this fishery. However, given the popularity and quality of the kokanee, rainbow trout, cutthroat trout, and yellow perch fisheries, the prudent management course would be to maintain the status quo and continue monitoring the warmwater community for changes.

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Introduction and Background

American Lake is a mid-sized (446 ha surface area), relatively deep (27 m) mesotrophic lake, located in southern Pierce County (Jacoby et al. 1993). Although smaller than several man-made reservoirs in the area, it is the largest naturally-occurring freshwater body in Pierce County. The lake has two basins, connected by a narrow channel. The larger, northern basin is 415 ha and has four islands within it; the southern basin is 31 ha (Jacoby et al. 1993). It is oriented from southwest to northeast and has an irregular shoreline.

A north-south line through the middle of the lake distinguishes the residential northeastern portion, located in the newly incorporated city of Lakewood, with the undeveloped areas of Fort Lewis, McChord Air Force Base, Camp Murray National Guard Installation, and the American Lake Veterans Hospital to the south. The shoreline within Lakewood city limits is densely developed, with numerous docks and approximately 15% of the lakeshore bulkheaded. The military installations, which encompass the southwest half of the lake, unite to form a virtual oasis of wilderness in Pierce County. The shoreline here is very natural, with only a few indications of development.

The principal water source for American Lake is groundwater, which flows from east to west. An intermittent stream, Murray Creek, is the second largest contributor, providing a quarter of water input. Precipitation accounts for the remainder. Groundwater also accounts for the vast majority of water loss, over 80%. An outflow (at high water only) and evaporation are the other two sources of loss. The lake is warm and stratified, with turnover occurring in late fall or early winter. While stratified, the hypolimnion becomes virtually anoxic (Jacoby et al. 1993).

Two public boat launches, one owned by the county and one Washington Department of Fish and Wildlife (WDFW), provide access for fishing and other water activities to this popular lake. The WDFW launch is located on land within Camp Murray and is operated by cooperative agreement between the military and WDFW. There are also two private launches and one boat ramp at the military-operated marina, which is exclusively for military personnel.

In 1993, KCM Inc. produced a report commissioned by the Tacoma-Pierce County Health Department to address the occurrence of a toxic blue-green algae bloom (Jacoby et al. 1993). Aquatic plant surveys have been conducted by WDOE in 1994, 1998, and 2002. A warmwater fish survey was conducted by WDFW in 1997 using different protocols than those standardized in 2000 (Bonar et al. 2000), so comparisons between those results and this survey will be limited to certain indices, e.g. relative weights and size-structure.

Materials and Methods

Data Collection

American Lake was surveyed by a three person team from October 7 - 10, 2002. Fish were captured using 3 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. Peak efficiency of the electrofishing unit is defined as producing a ¼ sine wave. The boat was fished using a pulsed DC current of 60 Hz at 2-4 amps power, as close to peak efficiency as possible. Experimental gill nets, 45.7 meters (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 (6 mm 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 sec of electrofishing (3 sections), 2 gill net nights, and 2 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 by dividing the entire shoreline into 400 m sections, numbering them consecutively, and randomly choosing them without replication. While electrofishing, the boat was maneuvered slowly through the shallows for a total of 600 seconds of "pedal-down" time. 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 on shore, and the cod-end was anchored off shore, with the wings anchored at approximately a 45° angle from the net lead. Fyke nets are fished with the hoops 0.3 - 0.5 m below the water surface, this sometimes requires shortening the lead. Twelve 400 m sections were electrofished; gill nets and fyke nets were each set overnight at eight locations around the lake.

With the exception of sculpin (family Cottidae), all fish captured were identified to the species level. Most fish were measured to the nearest millimeter (mm) and weighed to the nearest gram (g). Fish less than 70 mm were not weighed due to inadequate scale precision. In order to reduce handling stress on fish, where large numbers (>200) of obviously similar-sized fish were collected simultaneously, a subsample was measured to the nearest millimeter and weighed to the nearest gram. The remaining fish were counted and the subsampled data expanded. Weights were then assigned using a length-weight regression formula.

For aging purposes, scales were taken from five individuals of each warmwater game species per centimeter size class (greater than 70 mm). All fish providing scales were measured to the nearest millimeter and weighed to the nearest gram individually.

Water quality data was collected during midday from the deepest section of the lake on October 28, 2002. Using a Hydrolab® probe and digital recorder, dissolved oxygen (mg/l), temperature (C°), pH, turbidity (NTU), and conductivity (μsiemens/cm) data was gathered in the deepest section of the lake at 1 m intervals through the water column. Secchi disk readings, used to measure transparency, were taken by the methods outlined by Wetzel (1983).

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). All fish, including young-of-the-year, are used to determine biomass and species composition. Due to obvious differences in young-of-the-year presence from spring to fall, species composition data is not compared across seasons.

Catch Per of Unit 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 (defined in Appendix A), by the total electrofishing time (sec). 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. Because it is a standardized index, CPUE is useful for comparing stocks between lakes.

Length-Frequency

A length-frequency histogram was calculated for warmwater gamefish species by calculating the number of individuals of a species in a given size class divided by the total individuals of that species sampled, creating a percentage graph. Typically these graphs are constructed for each gear type and are limited to age-1 fish and above, as determined by the aging process. For this survey all gear types are combined on a single graph and all fish collected were included. Plotting the histogram by percentages tends to flatten out large peaks created by an abundant size class, and makes the graph 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

To assess the size structure of fish populations, stock density indices were calculated as described by Gablehouse (1984). 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.

Stock-density indices are accompanied by an 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 relative condition 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. Relative weights were calculated following Murphy and Willis (1991). The parameters for the standard weight (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 determination and annuli measurements from scales or other structures were determined by the Department of Fish and Wildlife Aging Unit. Total length at annulus formation was back-calculated using the Fraser-Lee method with *y*-axis intercepts specified by Carlander (1982). Mean back-calculated lengths at each age for each species were presented in tabular form for easy comparison between year classes. Results for each survey were compared to regional averages using the Student's *t*-test, one-tailed. Regional averages were developed from age data collected on other western Washington lakes in this same manner then calculated as a mean of means.

Results

Water Quality and Habitat

Table 1 shows the water quality data collected from American Lake (temperature, pH, turbidity, conductivity, and Secchi disk reading). Water depth at the survey site was 24.7 meters. The lake remained stratified at this late date (October 28, 2002), with the metalimnion between 11 and 15 meters. Water temperatures throughout the water column remained warm, and the hypolimnion was virtually anoxic, consistent with the KCM Inc.findings (Jacoby et al. 1993).

Secchi depth was 4.5 meters. Littoral areas were mostly gravel substrate and were notable for their lack of organic material. However, the two WDOE macrophyte surveys appear to support anecdotal observations that vegetation is increasing in the littoral zone.

Extensive habitat evaluations were conducted by KCM Inc. (Jacoby et al. 1993) the Washington Department of Ecology (DOE). DOE data can be found on their website at http://www.ecy.wa.gov/programs/eap/lakes/aquaticplants/index.html.

Table 1. Water Quality measurements taken from American Lake, Pierce County, October 28, 2002. Measurements taken at midday.

Depth (m)	Temp C°	pH	DO mg/l	Conductance µs/cm	Salinity
0	14.13	7.25	9.27	95.3	0.04
1	14.13	7.12	9.17	95.4	0.04
2	14.13	7.11	9.09	95.5	0.04
3	14.12	7.09	9.04	95.5	0.04
4	14.11	7.05	8.97	95.7	0.04
5	14.11	7.04	9.02	95.5	0.04
6	14.1	7.04	9.02	95.7	0.04
7	14.1	7.03	9.05	95.1	0.04
8	14.09	7.03	9.07	95.5	0.04
9	14.09	7.03	9.04	95.7	0.04
10	14.08	7.03	9.04	95.8	0.04
11	13.91	6.99	8.78	95.7	0.04
12	11.15	6.78	3.81	97.5	0.04
13	9.95	6.65	1.86	97.5	0.04
14	9.58	6.6	2.15	98.5	0.04
15	9.27	6.48	1.34	99.7	0.04
16	9.12	6.36	0.78	99.8	0.04
17	8.96	6.3	0.59	101.1	0.04
18	8.85	6.28	0.46	100.1	0.04
19	8.73	6.26	0.39	100.5	0.04
20	8.67	6.24	0.35	101.4	0.04
21	8.61	6.21	0.31	102.6	0.04
22	8.54	6.19	0.28	104.4	0.04

Depth (m)	Temp C°	pH	DO mg/l	Conductance µs/cm	Salinity
23	8.45	6.14	0.25	108.1	0.04
24	8.43	6.13	0.23	109	0.04
24.7	8.38	6.05	0.22	123.2	0.05

Species Composition and Relative Abundance

Ten different species of fish were collected at American Lake in 2002: rock bass (*Ambloplites rupestris*), kokanee (*Oncorhynchus nerka*), yellow perch (*Perca flavescens*), rainbow trout (*O. mykiss*), smallmouth bass (*Micropterus dolomieu*), cutthroat trout (*O. clarki*), pumpkinseed (*Lepomis gibbosus*), sculpin (Cottidae), largemouth bass (*M. salmoides*), and brown bullhead (*Ameiurus nebulosus*). The 1997 survey lacked both smallmouth bass and brown bullhead, but included all other fish species sampled in 2002. There were no species present in 1997 that were absent in 2002.

Yellow perch and rock bass dominated the sample numerically, combining for 88% of the catch (Table 2). Rock bass also comprised the greatest biomass, followed by kokanee. Although yellow perch outnumbered kokanee 20 to 1, most of the yellow perch were young-of-the-year, which kept the total weight for the species down.

Table 2. Species composition by weight and number for all fish sampled from American Lake, Pierce County, fall 2002.

	Species Composition					
	by Weight		by Number		Size Range (mm TL)	
Type of Fish	(kg)	(%w)	(#)	(%n)	Min	Max
Rock Bass	80.07	47.55	1625	42.02	30	276
Kokanee	33.26	19.75	92	2.38	100	415
Yellow Perch	23.63	14.04	1784	46.13	43	333
Rainbow Trout	18.19	10.80	94	2.43	73	391
Smallmouth Bass	6.38	3.79	13	0.34	63	445
Cutthroat Trout	1.97	1.17	7	0.18	271	333
Pumpkinseed Sunfish	1.66	0.99	80	2.07	41	129
Sculpin	1.64	0.97	163	4.22	34	165
Largemouth Bass	1.41	0.83	8	0.21	50	307
Brown Bullhead	0.17	0.10	1	0.03	228	228

Table 3 shows CPUE for each species, separated by gear type. Yellow perch, despite being the most abundant species in the sample, have an electrofishing CPUE of zero due to the lack of stock size fish encountered using that collection method. Rock bass had the highest catch rates for all three sampling techniques.

Table 3. Average catch per unit effort for stock-size fish sampled from American Lake, Pierce County, fall 2002.

	Electrofishing			Gill Netting			Fyke Netting		
		80%	Shock	#/net	80%	GN	#/net	80%	FN
Species	**(# / hour)**	**CI**	**Sites**	**night**	**CI**	**Nights**	**night**	**CI**	**Nights**
Rock Bass	161.87	37.97	12	120.63	13.87	8	8.38	3.58	8
Sculpin, Unknown	81.14	23.41	12	0.00	-	8	0.00	-	8
Rainbow Trout	12.48	5.14	12	5.88	2.05	8	0.13	0.16	8
Kokanee	3.50	1.76	12	10.50	4.09	8	0.13	0.16	8
Cutthroat	2.00	1.97	12	0.38	0.23	8	0.00	-	8
Pumpkinseed Sunfish	1.99	1.44	12	7.13	2.81	8	0.25	0.21	8
Smallmouth Bass	0.99	0.86	12	0.63	0.34	8	0.00	-	8
Largemouth Bass	0.99	0.86	12	0.13	0.16	8	0.00	-	8
Brown Bullhead Catfish	0.49	0.63	12	0.00	-	8	0.00	-	8
Yellow Perch	0.00	-	12	14.63	3.06	8	0.00	-	8

Stock density indices are shown in Table 4. With the exception of yellow perch sampled with gillnets, all species sampled had either a low quality size-structure or insufficient sample size to calculate a meaningful index. These data indicate an unbalanced predator-prey ratio, with insufficient predation resulting in overpopulated and stunted forage species.

Table 4. Stock density indices, by gear type, for fish sampled from American Lake, Pierce County, fall 2002.

		Quality		Preferred		Memorable		Trophy	
Species	**# Stock**		**80%**		**80%**		**80%**		**80%**
	Length	**PSD**	**CI**	**RSD-P**	**CI**	**RSD-M**	**CI**	**RSD-T**	**CI**
Electrofishing									
Cutthroat	4	-	-	-	-	-	-	-	-
Largemouth Bass	2	50	45	-	-	-	-	-	-
Pumpkinseed Sunfish	4	-	-	-	-	-	-	-	-
Rainbow Trout	25	-	-	-	-	-	-	-	-
Rock Bass	326	6	2	-	-	-	-	-	-
Smallmouth Bass	2	50	45	50	45	50	45	-	-
Gill Netting									
Cutthroat	3	-	-	-	-	-	-	-	-
Pumpkinseed Sunfish	57	-	-	-	-	-	-	-	-
Rainbow Trout	47	-	-	-	-	-	-	-	-
Rock Bass	965	2	1	-	-	-	-	-	-
Smallmouth Bass	5	60	28	60	28	60	28	-	-
Yellow Perch	117	82	5	8	3	1	1	-	-
Fyke Netting									
Pumpkinseed Sunfish	2	-	-	-	-	-	-	-	-
Rock Bass	67	19	6	1	2	-	-	-	-

Summary by Species

Rock Bass (*Ambloplites rupestris*)

Rock bass were the second most abundant species numerically, and represented the highest biomass in our sample (Table 2). They also had the highest CPUE (Table 3). Table 5 shows length-at-age data. Age-1 rock bass in American Lake were smaller at age than the western Washington average (P=.0481); no other age classes had a statistically significant difference. Relative weights were generally below the national 75th percentile (Figure 1), with a mean relative weight of 92.

Figure 2 shows the length-frequency distribution for all rock bass collected, separated by gear type. Although Figure 2 shows that a large portion of the population is stock size or larger (>100 mm), very few fish sampled reached quality length (180 mm).

The below average growth and relative weights, combined with high abundance (Table 4) and a size-structure absent sufficient numbers of quality or bigger fish indicate an overabundant and stunted population. Rock bass are well suited to the type of habitat available in American Lake (Whitney and Wydoski 2003) and the fish community lacks sufficient numbers of predators (e.g., black bass) to keep the population in balance.

Table 5. Mean length-at-age for rock bass collected from American Lake, Pierce County, October 2002.

Year Class	# Fish	1	2	3	4	5	6	7	8
2001	30	52							
2000	14	49	87						
1999	12	53	94	135					
1998	18	51	99	137	162				
1997	4	53	97	152	177	201			
1996	0	-	-	-	-	-	-		
1995	0	-	-	-	-	-	-	-	
1994	1	48	90	135	189	222	243	258	269
Fraser-Lee	**79**	**51**	**94**	**138**	**165**	**205**	**243**	**258**	**269**
W WA Ave		**56**	**108**	**156**	**188**	**210**	**224**	**230**	**269**

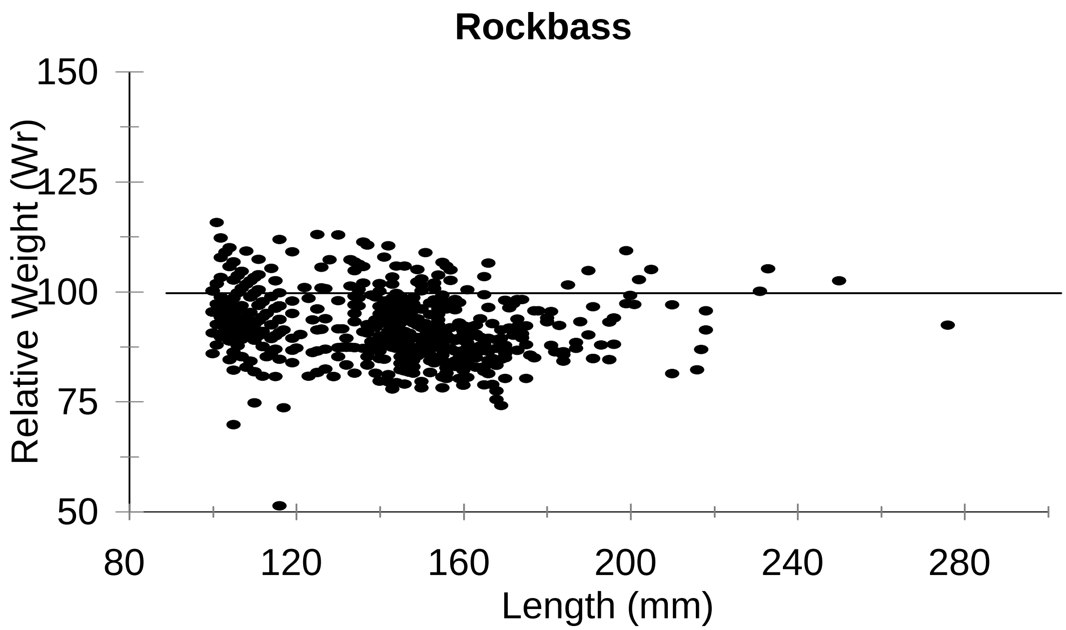

Figure 1. Relative weights of stock-size rock bass from the fall 2002 survey of American Lake, Pierce County. Horizontal line at 100 represents the national 75th percentile.

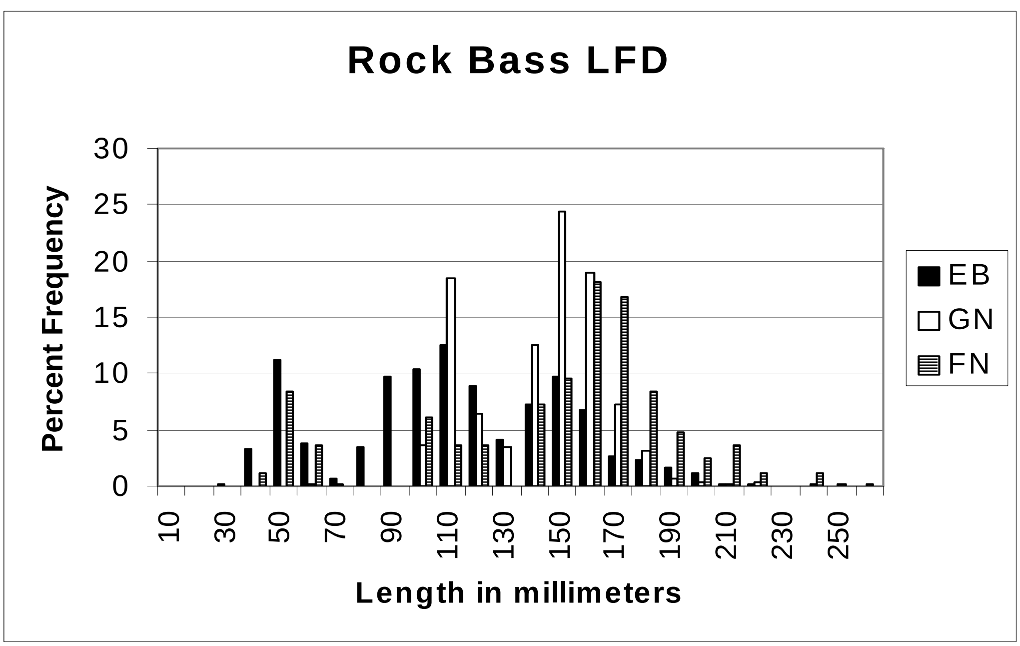

Figure 2. Length-frequency distribution for rock bass collected from American Lake, Pierce County, fall 2002. Separated by gear type.

Kokanee (*Oncorhynchus nerka*)

Table 6. Hatchery planting data for kokanee in American Lake, Pierce County, 1995-2002.

Date of Release	Species	Brood Year	Size	Number
May-95	kokanee	1994	fry	208000
May-96	kokanee	1995	fry	121965
June-97	kokanee	1996	fry	223938
June-97	kokanee	1996	fry	78440
April-98	kokanee	1997	fry	209405
May-98	kokanee	1997	fry	46944
June-99	kokanee	1998	fry	334634
April-00	kokanee	1999	fry	219457
June-00	kokanee	1999	fry	80000
May-01	kokanee	2000	fry	240000
June-01	kokanee	2000	fry	69290
May-02	kokanee	2001	fry	59000
May-02	kokanee	2001	fry	65000
May-02	kokanee	2002	fry	238000

From 1995 to 2002, an average of 156,720 kokanee fry have been planted annually in American Lake. The 92 fish kokanee in our sample ranged from 100 to 415 mm total length, and most were caught in gill nets. No age or growth analysis was conducted.

Based on the size of fish encountered, it would appear that fry planting kokanee in American Lake is producing catchable carry-over fish.

Yellow perch (*Perca flavescens*)

Our sample included very large numbers of yellow perch young-of-the-year and a respectable number of stock-length fish caught in gill nets (Table 3, Table 4). The size range of yellow perch was 43 to 333 mm total length, the latter being a very large yellow perch for western Washington. The age data (Table 7) indicates slower than average growth for age-2 (P=.0021) and age-3 fish (P=.0046). Age-1 fish showed no statistically significant difference, and the sample sizes for age-4 and age-5 fish were too small for meaningful comparisons.

Table 7. Mean length-at-age for yellow perch collected from American Lake, Pierce County, fall 2002.

Year Class	# Fish	1	2	3	4	5
2001	13	96				
2000	5	71	146			
1999	27	78	134	180		
1998	2	76	130	176	221	
1997	1	107	190	268	297	316
Fraser-Lee	**48**	**83**	**137**	**183**	**246**	**316**
W WA Ave		**89**	**159**	**205**	**231**	**264**

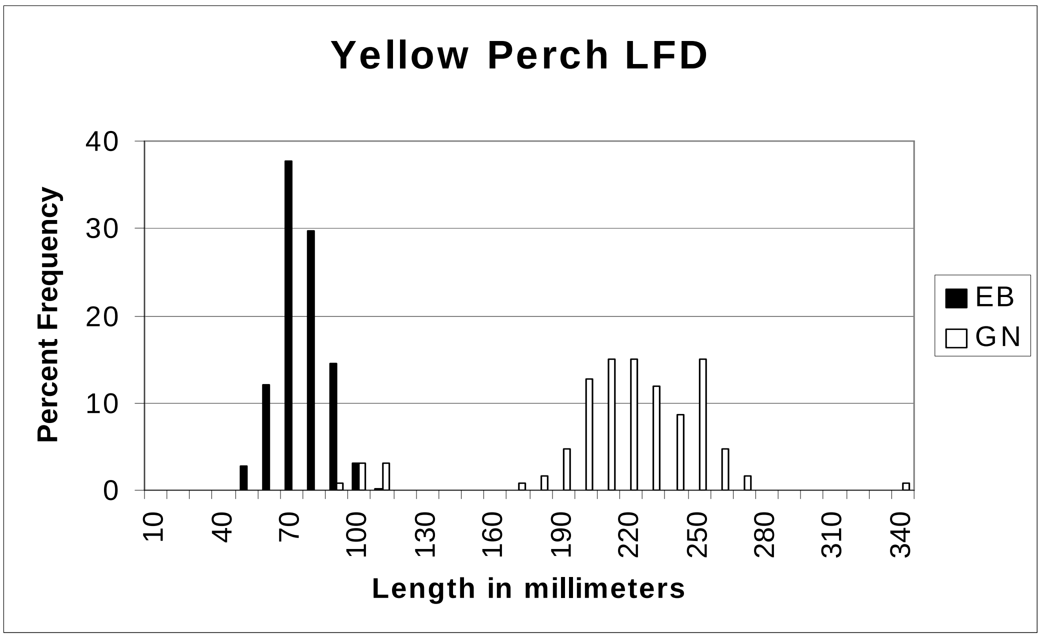

Figure 3. Length-frequency distribution for yellow perch collected from American Lake, Pierce County, fall 2002. Separated by gear type.

Figure 3 shows the length-frequency distribution for all yellow perch sampled, with two distinct groups; under 125 mm, and over 170 mm. This bimodal size distribution seems more a function of gear type than a reflection of the actual size structure. (Only one yellow perch was collected in the fyke nets, so that gear type was omitted from the graph.)

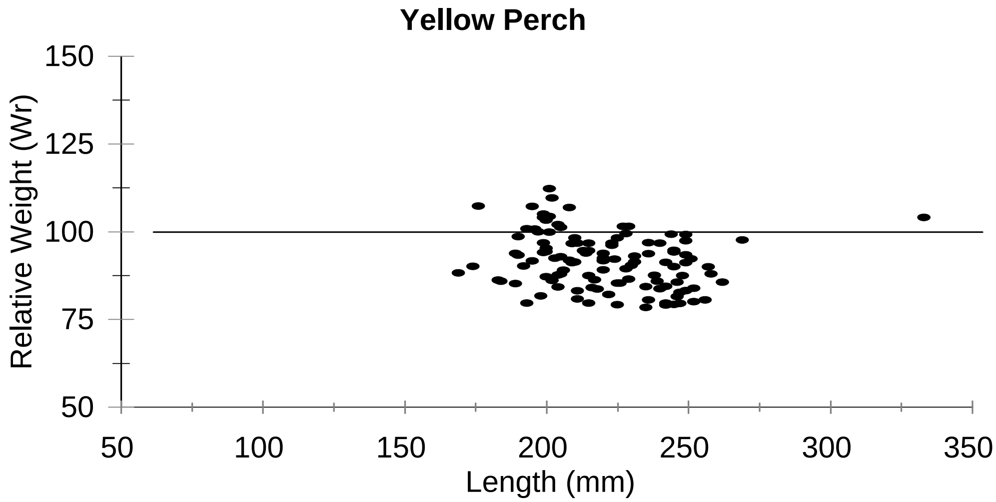

Figure 4. Relative weights of stock-size yellow perch from the fall 2002 survey of American Lake, Pierce County. Horizontal line at 100 represents the national 75th percentile.

Figure 4 shows the relative weights of stock sized yellow perch. The mean relative weight of stock sized fish is 92.

Based on our survey results, the American Lake yellow perch population shows both balanced and unbalanced characteristics. The high abundance, below average growth, and slightly below average mean relative weight are all indicators of stunting. However the high gillnet PSD and respectable numbers of stock and quality-length fish point to a more balanced assemblage capable of producing a desirable sport fishery.

Rainbow trout (*Oncorhynchus mykiss*)

Table 8 shows the hatchery stocking data for American Lake from 1998 to 2002 for both rainbow and steelhead trout planted at various sizes (legal size, fingerlings, and fry). Because rainbow and steelhead are indistinguishable at the sizes encountered and are considered a single species, *Oncorhynchus mykiss* (Wydoski and Whitney 2003; Behnke 1992), they will be referred to jointly as rainbow trout.

Table 8. Hatchery planting data for rainbow in American Lake, Pierce County, 1998-2002.

Date of Release	Species	Brood Year	Size	Number
January-98	rainbow	1997	fry	9675
January-98	rainbow	1997	fry	121072
January-98	rainbow	1997	fry	136528
April-98	rainbow	1997	fry	9975
April-98	rainbow	1996	legals	51200
April-98	rainbow	1996	legals	11500
May-98	rainbow	1997	fry	20000
May-98	rainbow	1997	fry	30000
May-98	rainbow	1997	fry	38200
May-98	rainbow	1997	legals	8000
May-98	rainbow	1997	legals	7998
June-98	steelhead	1998	fry	44442
June-98	steelhead	1998	fingerlings	13200
August-98	rainbow	1997	legals	110
October-98	rainbow	1997	fry	12000
October-98	rainbow	1996	legals	151
October-98	rainbow	1995	legals	15
February-99	steelhead	1999	fry	370000
March-99	rainbow	1997	legals	2500
April-99	rainbow	1997	legals	15500
April-99	rainbow	1997	legals	23500
May-99	rainbow	1997	legals	10000
June-99	rainbow	1998	fry	65120
June-99	rainbow	1998	fry	11000
June-99	steelhead	1999	fry	29608
September-99	rainbow	1996	legals	25
September-99	rainbow	1997	legals	50
October-99	rainbow	1998	fry	1491
October-99	rainbow	1998	fry	2445
January-00	rainbow	1998	legals	17000
February-00	rainbow	1998	legals	500
March-00	steelhead	2000	fry	133000
April-00	rainbow	1998	legals	62000
May-00	rainbow	1998	legals	5000
June-00	rainbow	1999	fry	63500
July-00	rainbow	1999	fry	10000
May-01	rainbow	2000	fry	48150
May-01	rainbow	2000	fry	30000
May-01	rainbow	2000	fry	10000
July-01	rainbow	2000	fry	40000
January-02	rainbow	2001	fry	65185
April-02	rainbow	2000	legals	50000
April-02	rainbow	2000	legals	12000
April-02	rainbow	2001	legals	55000
May-02	rainbow	2001	fry	10000
September-02	rainbow	2000	legals	1400
October-02	rainbow	2000	legals	1400

From 1998 to 2002, rainbow plants into American Lake have averaged 67,000 legals and 245,000 fry. In addition, 13,000 fingerlings were planted in 1998, the only fingerling plant in the past five years.

Ninety-four rainbow trout were collected in our sample. No age or growth analysis was conducted.

Smallmouth bass (*Micropterus dolomieu*)

Smallmouth bass were planted in American Lake in the fall of 1998 in the following numbers: 8211 fry (average weight 6.5 g) and 179 adult fish (average weight 227 g). Thirteen smallmouth were collected in our sample; six age-0, three age-1, and four fish greater than age-1 (Table 9.) The older fish, 1997 and 1998 brood, were remnants of the original planting, while the 9 younger fish were progeny from that planting.

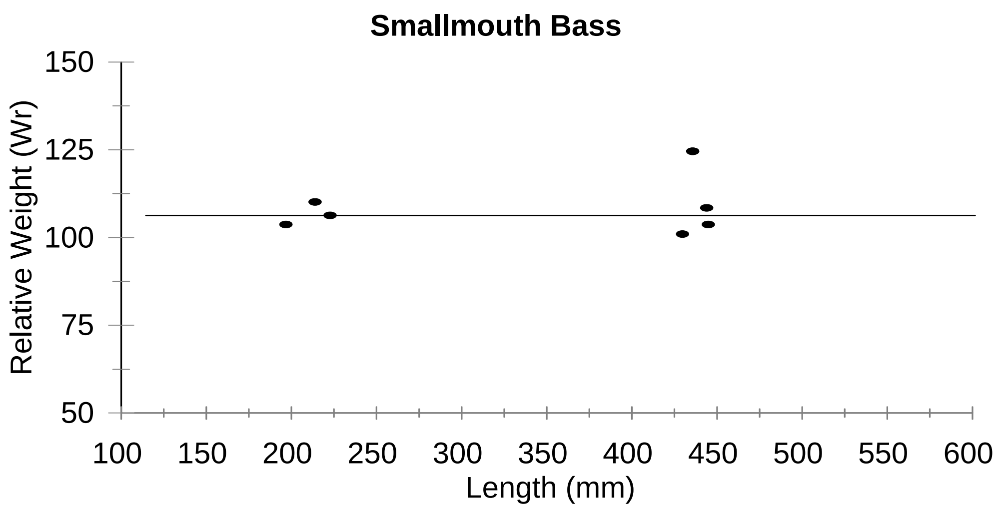

Figure 5. Relative weights of stock-size smallmouth bass from the fall 2002 survey of American Lake, Pierce County. Horizontal line at 100 represents the national 75th percentile.

Relative weights for all smallmouth bass age-1 and above are shown in Figure 5. The average relative weight was 108, indicating the probability of a sufficient food supply. The small sample size limits our ability to make any conclusions about this population.

Table 9. Mean length-at-age for smallmouth bass collected from American Lake, Pierce County, fall 2002.

Year Class	# Fish	1	2	3	4	5
2001	3	80				
2000	0	-	-			
1999	0	-	-	-		
1998	3	105	225	314	391	
1997	1	77	172	309	384	419
Fraser Lee	**7**	**90**	**212**	**313**	**389**	**419**
W WA Ave		**90**	**209**	**337**	**401**	**433**

Cutthroat trout (*Oncorhynchus clarki*)

Seven cutthroat trout were collected from American Lake, ranging in size from 271 to 333 mm total length. These native fish have not recently been planted in American Lake. No age or growth analysis was conducted.

Pumpkinseed (*Lepomis gibbosus*)

Eighty pumpkinseed were collected in American Lake, and 25 were aged, but none were older than age-1 (Table 10). The comparatively small sample and lack of older age classes, combined with average growth (Table 10) and high relative weights (Figure 6; mean 108), indicates a population with high mortality rates.

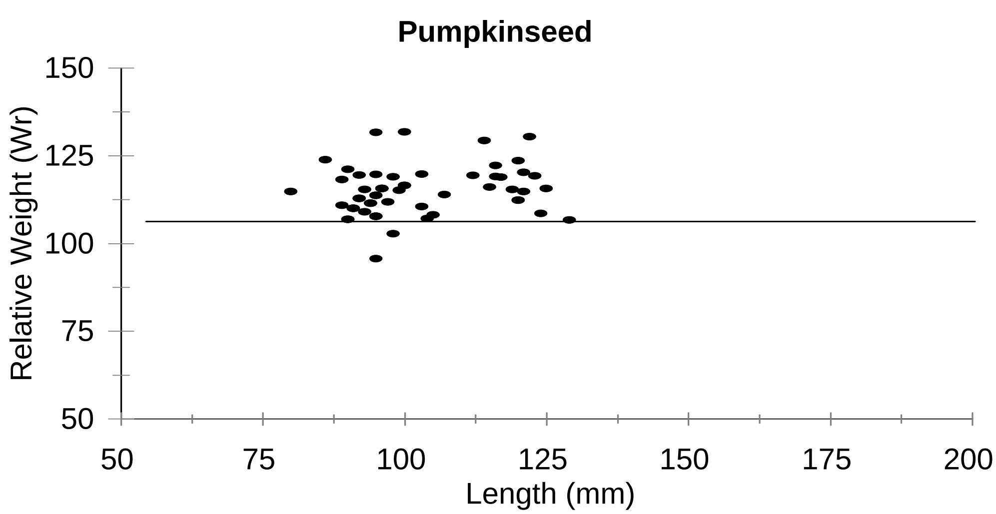

Figure 6. Relative weights of stock-size pumpkinseed from the fall 2002 survey of American Lake, Pierce County. Horizontal line at 100 represents the national 75th percentile.

Table 10. Mean length-at-age for pumpkinseed collected from American Lake, Pierce County, fall 2002.

Year Class	# Fish	1	2	3	4
2001	25	49			
2000	0	-	-		
1999	0	-	-	-	
1998	0	-	-	-	-
Fraser Lee	**25**	**49**			
W WA Ave		**48**	**100**	**136**	**137**

Sculpin (Cottidae)

One hundred and sixty three (163) sculpin were sampled at American Lake, ranging in size from 34 to 165 mm total length (Table 2). Sculpin were the only non-game fish in our sample. No age or growth analysis was conducted.

Largemouth Bass (*Micropterus salmoides*)

Eight largemouth bass were collected; six were aged (Table 11); three were age 1 and the rest were young-of-the-year. Growth rates and condition were extremely high; the average relative weight was 142 (Figure 7).

Table 11. Mean length-at-age for largemouth bass collected from American Lake, Pierce County, fall 2002.

Year Class	# Fish	1	2	3	4
2001	3	123			
2000	0	-	-		
1999	0	-	-	-	
1998	0	-	-	-	-
Fraser Lee	3	123			
W WA Ave		80	176	265	335

Largemouth bass in American Lake appear to be suffering from either high mortality or low recruitment, or some combination of both. There is clearly sufficient prey available, most likely rock bass. If this population could produce a significant year class it would likely do quite well in American Lake.

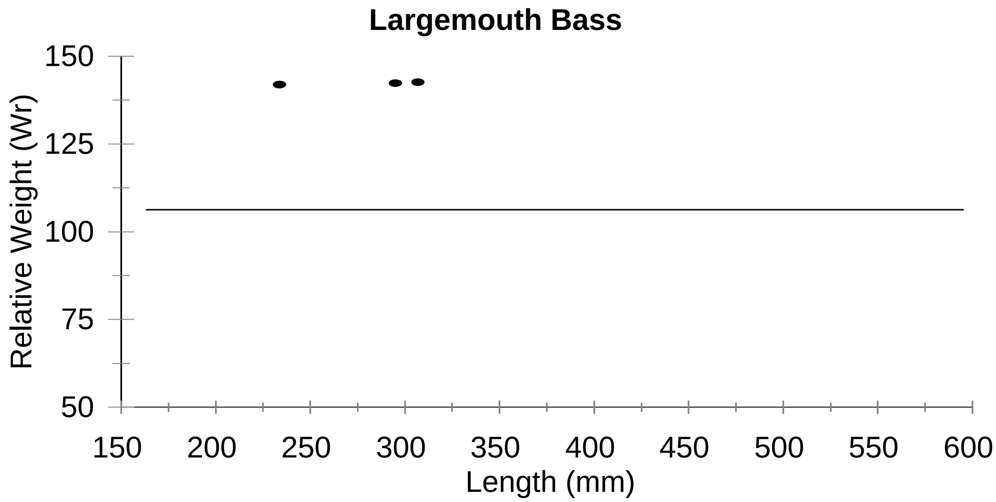

Figure 7. Relative weights of stock-size largemouth bass from the fall 2002 survey of American Lake, Pierce County. Horizontal line at 100 represents the national 75th percentile.

Brown bullhead (*Ameiurus nebulosus*)

One brown bullhead was collected, 228 mm total length. No age or growth analysis was conducted.

Discussion

American Lake is an extremely popular fishing destination, with several accesses and a large urban population nearby. Creel data from the 1970s indicate that the lake received between 20,000 and 40,000 angler days per year (1 angler day = 1 angler fishing 3-4 hours), and subsequent observations suggest the fishing pressure has increased since then. The lake is also one of the few year-round lakes in the area, with a very active winter fishery.

Rainbow trout, kokanee, and yellow perch are all present in American Lake in sufficient size and numbers to provide excellent fishing opportunities. Rock bass, though abundant, are probably less sought after due to the lack of quality size fish and Washington anglers' unfamiliarity with the species. Cutthroat trout may be more available in the winter fishery than was apparent in our survey (John Long, pers. comm.) Although large largemouth and smallmouth bass were collected in our sample, neither species appears to have sufficient numbers to support any significant harvest pressure.

Except for the introduction of smallmouth bass in 1998, little appears to have changed in the American Lake warmwater fish community since the 1997 survey. Relative weights and PSD of rock bass have declined slightly, while the yellow perch, largemouth bass, and pumpkinseed populations remain virtually unchanged. It would appear that the fish community of American Lake has achieved a state of equilibrium, despite the apparent lack of a top predator.

Management Implications

Changes to the black bass harvest regulations designed to improve black bass size-structures in Washington lakes took effect in May 2002. The impacts of those changes are expected to be gradual and long-term, so our inability to measure improvements by the fall of 2002 is expected.

Both smallmouth and largemouth bass populations appear to be scarce in number, with electrofishing CPUEs of .99 fish per hour for each species. Smallmouth bass were planted four years before our study, but the number of transplanted fish was few (179 adults, 8,200 fry) and the process of establishing themselves is ongoing. Progeny from the initial plant were collected in our survey, and future surveys will tell us if those progeny were able to survive to reproductive age.

The largemouth bass data indicate a small population of young and very fast growing fish. These results are quite similar to those of the 1997 survey (Mueller and Downen 1999). Although a spring survey would be a better measure of large, older fish due to their presence on the spawning grounds (both WDFW surveys were conducted in fall), the absence of older fish is a key indication of high mortality rates. On the positive side, the strong growth and high relative weights indicate sufficient forage. With such a depressed population, even a moderate level of harvest pressure could keep abundance of reproductive fish below the minimum threshold to produce a healthy year class. If this is the case, the newly instituted black bass harvest regulations should have a positive impact on American Lake largemouth bass numbers and age-structure. Although harvest is not typically a significant factor in western Washington largemouth bass populations (Caromile unpublished data), given the robust growth and condition of sampled fish, harvest seems the most likely cause of mortality.

The other piscivore, cutthroat trout, was also few in number in our survey. Anecdotal information indicates a larger population than indicated by our data (John Long, pers. comm.) with an unknown impact on prey species.

The presence of an effective apex predator would likely benefit the over-abundant and undersized rock bass population. However it could also impact the popular kokanee fishery by reducing kokanee fry survival, and possibly unbalance the equilibrium currently established in the lake. Smallmouth and/or largemouth bass could eventually establish themselves as an effective predator in time, and changes to the black bass harvest regulations may facilitate that change.

Bibliography

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, Maryland.

Behnke, R. J. 1992. Native trout of western North America. Am. Fish. Soc. Monograph 6.

Bonar, S.A., B.D. Bolding, and M. Divens. 2000. Standard fish sampling guidelines for Washington State ponds and lakes. Wash Dept Fish Wildlife, Inland Fish Investigations. Report FPT 00-28. Olympia.

Carlander, K. D. 1982. Standard intercepts for calculating lengths from scale measurements for some centrarchid and percid fishes. Trans Amer Fish Soc 111:332-336.

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

Gablehouse, E. W. 1984. A length-categorization system to assess fish stocks. N Amer J Fish Mgmt. 4:273-285.

Gustafson, K. A. 1988. Approximating confidence intervals for indices of fish population size structure. N Amer J Fish Mgmt. 8:139-141.

Jacoby, J., and nine co-authors. 1993. American Lake phase 1 restoration project. Report of KCM, Inc., to Tacoma-Pierce County Health Dept. Tacoma, Washington.

Mueller, K. W., and M. R. Downen. 1999. 1997 Anerican Lake survey: the warmwater fish community before stocking smallmouth bass. Wash Dept Fish Wildlife, Technical Report Number FPT99-14. Olympia.

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

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

Wetzel, R. G. 1983. Limnology, 2nd edition. Saunders College Publishing, Philadelphia.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. University of Washington Press, Seattle.

Appendix A

Table 12. 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	6	15	9	23	12	30	15	38	18	46
Black crappie	5	13	8	20	10	25	12	30	15	38
Bluegill	3	8	6	15	8	20	10	25	12	30
Brook trout	5	13	8	20						
Brown bullhead	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	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