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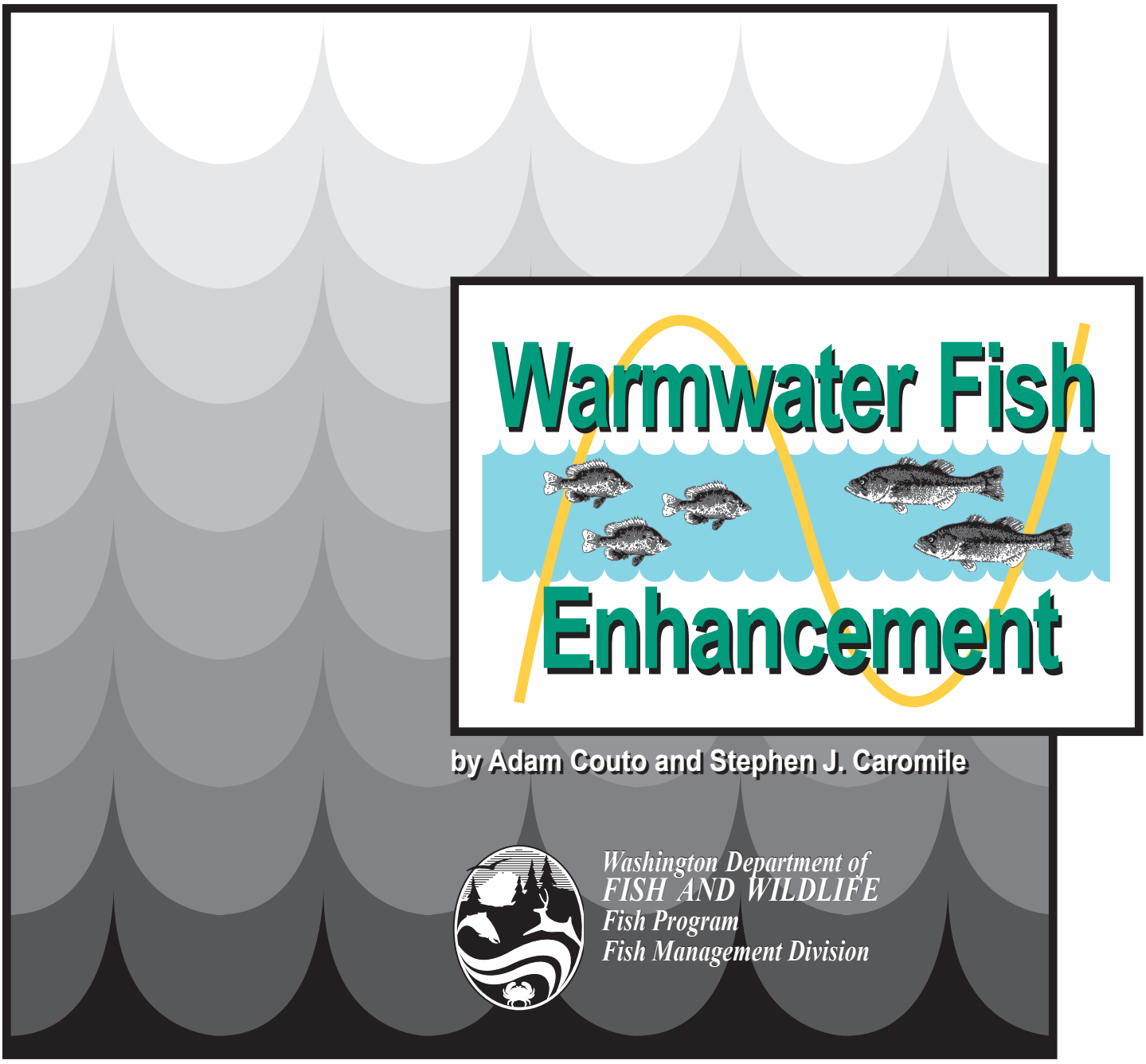
The Warmwater Fish Community of Pattison Lake, Thurston County, May 2005



by Adam Couto and Stephen J. Caromile

Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

FPT 07-02

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Abstract

Pattison Lake was surveyed from May 23rd to 26th, 2005 by a three person team using multiple gear types: electrofishing, gillnetting, and fyke-netting. Twelve fish taxa (11 species and one family) were collected: largescale sucker (*Catostomus macrocheilus*), largemouth bass (*Micropterus salmoides*), rainbow trout (*Oncorhynchus mykiss*), rock bass (*Ambloplites rupestris*), common carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), pumpkinseed sunfish (*Lepomis gibbosus*), brown trout (*Salmo trutta*), bluegill (*L. macrochirus*), sculpin (Cottidae family), and warmouth (*L. gulosus*). Data showed the warmwater game fish community to be balanced, with most PSDs ranging from 15 - 41, higher than average growth rates, relative weights at or near 100, and good relative abundances (as determined by catch rates). Compared to other western Washington lakes, Pattison Lake is a high quality warmwater fishery and may be one of the better warmwater fisheries in Thurston County. More survey work, creel data, and an evaluation of management options is warranted in order to maintain the value of this fishery.

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Introduction

Pattison Lake is one of the three lakes in the Woodland Creek system of Lacey in Thurston County. Hicks Lake is the origin of the system and drains south into Pattison. Pattison Lake, the southernmost point in the system, empties north into Long Lake, which is due east of Hicks Lake. Long Lake then flows north into Woodland Creek, which enters Henderson Inlet in south Puget Sound. According to the WDFW SalmonScape web site (http://wdfw.wa.gov/mapping/salmonscape/index.html), anadromous fish access terminates at the Long Lake outflow.

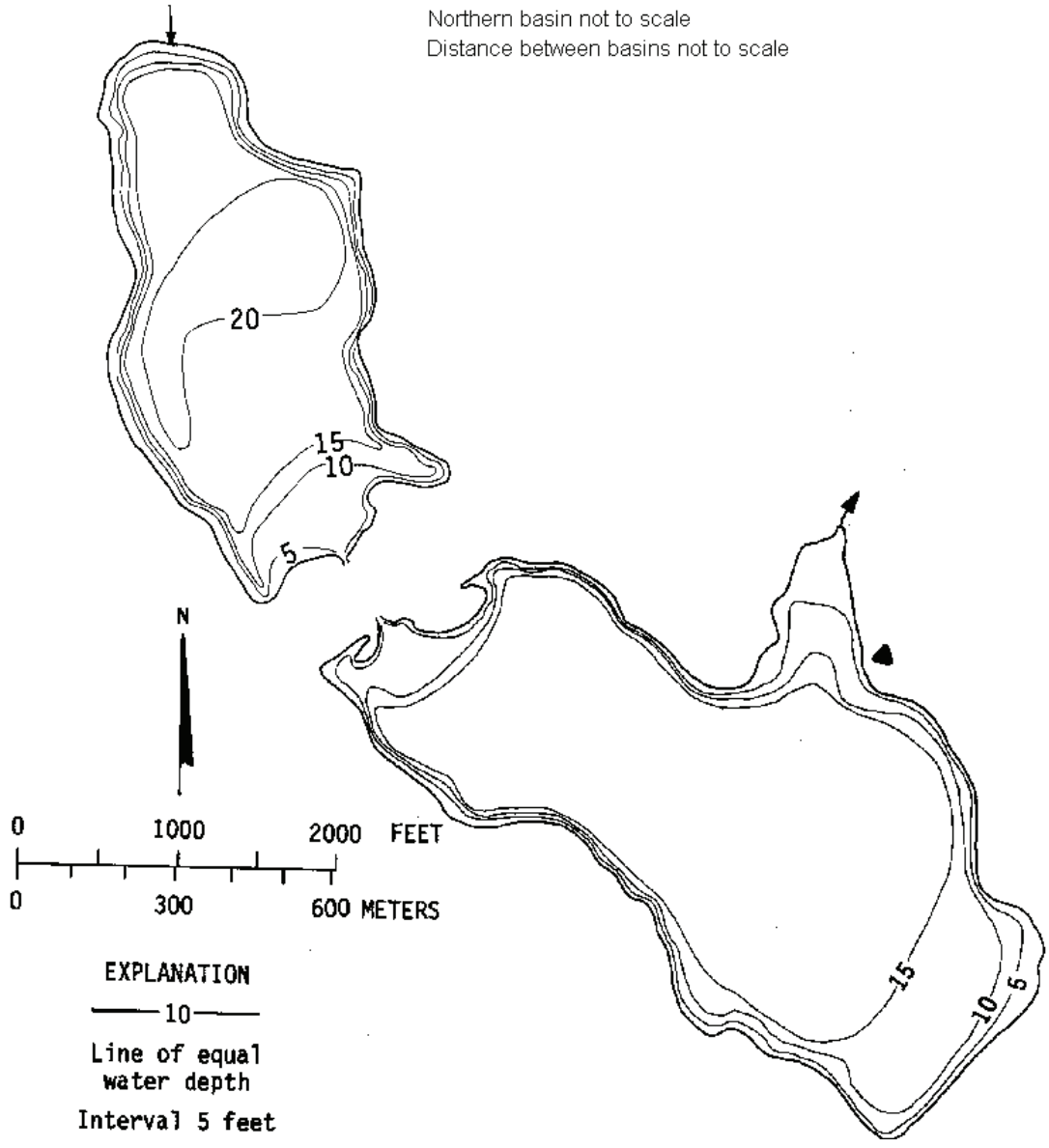

Figure 1. Topo map of Pattison Lake, Thurston County.

Pattison Lake is occasionally referred to as Patterson Lake, but the proper spelling is Pattison (US Board on Geographic Names - http://geonames.usgs.gov/). The lake is comprised of two distinct sections connected by a narrow channel under a Burlington Northern Railroad bridge; fill appears to have been placed either side of the bridge, and the connection between the two lake sections was probably much wider prior to railroad construction.

The lake has a surface area of 271 acres, a maximum depth of 22 feet (6.7 m) and a mean depth of 13 or 14 feet, depending on the section. The northern portion represents about 30% of the total surface area (81 acres), is the deeper section. The southern basin covers the remaining 190 acres. Surface water enters the lake in the northern basin via the tributary from Hicks Lake and exits the southern section through an outlet channel to Long Lake. A WDFW public access with boat launch is also located in the southern section.

Methods and Materials

Data Collection

Pattison Lake was surveyed from May 23rd to 26th, 2005 by a three-member crew using the methods described in the "Standard Fish Sampling Guidelines for Washington State Ponds and Lakes" (Bonar et al. 2000). Fish were captured using 3 sampling techniques: electrofishing, gillnetting, and fyke-netting. The electrofishing unit consisted of a Smith-Root SR-16s electrofishing boat, with a 5.0 GPP 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 gillnetting to fyke-netting was 3:2:2. The standardized sample is 1800 sec of electrofishing (3 sections), 2 gillnet 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 (12) 400 m sections were electrofished; gill nets and fyke nets were each set overnight at eight (8) 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 each lake on the last day of the survey. 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.

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 stock size 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 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 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

Water quality data are in Table 1. Washington Department of Ecology data from 1996 and 1997 indicate a eutrophic northern section and a meso-eutrophic southern section. Our observations, along with anecdotal reports from lakeside residents indicate a lake that may be less eutrophic now than it was 10 years ago.

Table 1. Water quality measurements taken from Pattison Lake, Thurston County, May 26, 2005. Measurements taken at midday.

Depth	Temp C°	pH	DO mg/l	Conductance µs/cm
0	18.92	8.00	10.06	122.2
1	18.43	8.14	10.65	122.5
2	18.09	8.18	11.09	122.2
3	17.47	8.11	11.33	122.3
4	16.47	7.49	10.44	122.3
5	15.9	6.79	4.85	129.4

Species Composition and Relative Abundance

Twelve fish taxa (11 species and one family) were collected in Pattison Lake: largescale sucker (*Catostomus macrocheilus*), largemouth bass (*Micropterus salmoides*), rainbow trout (*Oncorhynchus mykiss*), rock bass (*Ambloplites rupestris*), common carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), pumpkinseed sunfish (*Lepomis gibbosus*), brown trout (*Salmo trutta*), bluegill (*L. macrochirus*), sculpin (Cottidae family), and warmouth (*L. gulosus*).

Species composition data can be found in Table 2. Largescale suckers were the most abundant fish by biomass; rock bass were the most numerically abundant taxa. Table 3 shows the catch per unit effort (CPUE) of stock size fish for each gear type. These data give us a relative measure of abundance that can be compared to other surveys.

Table 2. Species composition by weight and number for all fish sampled from Pattison Lake, Thurston County, spring 2005.

	Species Composition					
	by Weight		by Number		Size Range (mm TL)	
Type of Fish	(kg)	(%w)	(#)	(%n)	Min	Max
Largescale sucker	41.1	31.5	29	4.8	468	593
Largemouth bass	34.0	26.0	92	15.2	77	648
Rainbow trout	11.3	8.7	55	9.1	81	443
Rock bass	10.9	8.4	163	26.9	51	210
Common carp	10.3	7.9	3	0.5	370	752
Yellow perch	9.6	7.4	111	18.3	103	235
Brown bullhead	5.7	4.4	14	2.3	204	365
Pumpkinseed	2.7	2.1	48	7.9	59	165
Brown trout	2.3	1.8	2	0.3	401	521
Bluegill	1.8	1.3	60	9.9	42	158
Sculpin	0.6	0.4	23	3.8	76	170
Warmouth	0.2	0.1	6	1.0	35	140

Table 3. Average catch per unit effort for stock size fish sampled from Pattison Lake, Thurston County, spring 2005.

	Electrofishing			Gill Netting			Fyke Netting		
Species	**no. per hour**	**80% CI**	**shock sites**	**no. per net night**	**80% CI**	**net nights**	**no. per net night**	**80% CI**	**net nights**
Brown bullhead	3.5	2.1	15	0.25	0.2	8	0.375	0.2	8
Bluegill	12.6	5.4	15	0		8	0		8
Brown trout	0.4	0.5	15	0.125	0.2	8	0		8
Sculpin, unknown	8.7	3.2	15	0.125	0.2	8	0		8
Common carp	1.2	1.5	15	0		8	0		8
Largemouth bass	15.4	3.9	15	0.625	0.5	8	0		8
Largescale sucker	5.9	4.4	15	1.75	1.0	8	0		8
Pumpkinseed	12.3	4.0	15	0.625	0.4	8	0.875	0.5	8
Rainbow trout	1.6	1.2	15	4.75	1.6	8	0		8
Rock bass	23.0	5.5	15	6.875	2.1	8	4	1.3	8
Warmouth	1.2	0.8	15	0.125	0.2	8	0		8
Yellow perch	16.6	4.5	15	6.875	2.6	8	0		8

Table 4 shows stock density data separated by gear type. Several of the samples with sufficient numbers of fish to evaluate (n > 30) have PSDs in (or close to) the preferred range of 20 – 40 (Novinger and Legler 1978). The primary predator, largemouth bass, has a electrofishing PSD of 41, while the predator species with sufficient sample sizes (bluegill, pumpkinseed, rock bass, and yellow perch) have an average PSD of 25. These data indicate a balanced community and the high likelihood of a quality largemouth bass fishery.

Table 4. Stock density indices, by gear type, for fish sampled from Pattison Lake, Thurston County, spring 2005.

		Quality		Preferred		Memorable		Trophy	
	# Stock		80%		80%		80%		80%
Species	**Length**	**PSD**	**CI**	**RSD-P**	**CI**	**RSD-M**	**CI**	**RSD-T**	**CI**
Electrofishing									
Bluegill	32	16	8	0		0		0	
Brown bullhead	9	100		67	20	0		0	
Common carp	3	67	35	67	35	33	35	0	
Largemouth bass	39	41	10	33	10	5	5	3	3
Pumpkinseed	31	19	9	0		0		0	
Rainbow trout	4	25	28	0		0		0	
Rock bass	58	38	8	0		0		0	
Warmouth	3	0		0		0		0	
Yellow perch	42	29	9	0		0		0	
Gillnetting									
Brown bullhead	2	100		50	45	50	45	0	
Largemouth bass	4	0		0		0		0	
Pumpkinseed	5	0		0		0		0	
Rainbow trout	35	0		0		0		0	
Rock bass	55	7	4	0		0		0	
Yellow perch	49	33	9	0		0		0	
Fyke-netting									
Brown bullhead	3	100		33	35	0		0	
Pumpkinseed	7	29	22	0		0		0	
Rock bass	32	9	7	0		0		0	

Summary by Species

Largemouth Bass (*Micropterus salmoides*)

Approximately 47% of the largemouth bass sampled at Pattison Lake were stock length fish. Length-at-age data is in Table 5. Largemouth bass in Pattison Lake grew faster at every age than the western Washington average ($P < .0001$, age-1 to -4; $P = .0012$ for age-5). The largest fish in our sample was a 25.5 inch, 8.3 pound female, a very big largemouth bass by western Washington standards. Relative weights (Figure 2) ranged from 66 to 140 and averaged 106.

Table 5. Mean back calculated length-at-age for largemouth bass collected from Pattison Lake, Thurston County, May 2005.

		Age Class							
Year Class	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2004	30	106							
2003	31	96	222						
2002	2	94	259	385					
2001	5	90	204	360	423				
2000	3	85	264	376	431	458			
1999	0								
1998	1	113	213	326	395	427	453	468	
1997	3	102	194	341	421	482	513	539	556
Fraser-Lee	**75**	**100**	**222**	**360**	**422**	**464**	**498**	**521**	**556**
W WA Ave		**83**	**184**	**284**	**344**	**389**	**423**	**449**	**461**

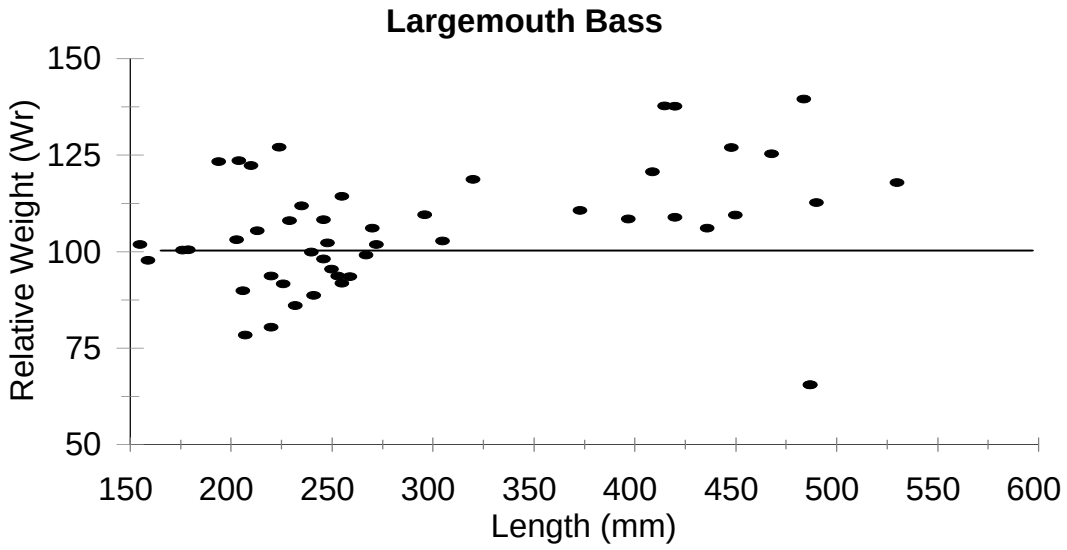

Figure 2. Relative weights of largemouth bass from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Rainbow Trout (*Oncorhynchus mykiss*)

Fifty-five rainbow trout were collected from Pattison Lake ranging in size from 81 – 443 mm. Rainbow trout in Pattison Lake are the result of hatchery plants. No age or growth analysis was conducted on these fish. Planting data can be found in Table 6.

Table 6. Hatchery trout planting data for Pattison Lake, Thurston County, 1999-2005.

Date of Release	Species	Brood Year	Size	Fish Per Pound	Number Planted
Mar-99	Rainbow	1996	legals	0.5	150
May-99	Rainbow	1998	fry	93.0	41,385
Apr-99	Rainbow	1997	legals	3.6	24,025
Jun-99	Rainbow	1998	fry	84.0	25,200
Mar-00	Rainbow	1997	legals	0.5	150
Apr-00	Rainbow	1998	legals	3.9	19,033
Jun-00	Rainbow	1999	fry	95.0	70,000
Nov-00	Brown	1999	fry	18.0	5,000
Mar-01	Rainbow	1998	legals	0.5	501
Apr-01	Rainbow	1999	legals	3.9	20,839
May-01	Rainbow	2000	fry	105.0	70,000
Oct-01	Brown	2000	fry	20.0	5,000
Mar-02	Rainbow	1999	legals	0.4	202
Mar-02	Rainbow	1999	legals	0.6	105
Apr-02	Rainbow	2000	legals	3.7	20,149
May-02	Cutthroat	2002	fry	248.0	4,960
Jun-02	Rainbow	2001	fry	128.0	70,000
Oct-02	Brown	2001	fry	21.0	4,000
Mar-03	Rainbow	adult	adult	0.4	100
Mar-03	Rainbow	2001	legals	3.8	8,018
Apr-03	Rainbow	2001	legals	3.6	12,049
Jun-03	Rainbow	2002	fry	112.0	80,000
Jun-03	Cutthroat	2003	fry	245.0	5,022
Dec-03	Brown	2002	fry	11.0	6,000
Mar-04	Rainbow	2002	legals	3.5	3,220
Mar-04	Rainbow	adult	adult	0.4	203
Apr-04	Rainbow	2002	legals	3.5	21,789
Jun-04	Cutthroat	2004	fry	240.0	25,440
Jun-04	Rainbow	2003	fry	93.0	44,640
Jun-04	Rainbow	2003	fry	117.0	16,965
Oct-04	Brown	2003	fry	30.0	5,000
Apr-05	Rainbow	2003	legals	0.8	544
Apr-05	Rainbow	2003	legals	3.3	25,032
May-05	Rainbow	2004	fry	124.0	46,500
Oct-05	Brown	2004	fry	26.0	10,000

Rock Bass (*Ambloplites rupestris*)

Rock bass were the numerically dominant fish in our sample, which is often the case in lakes where they are found. 89% of the sample consisted of stock length fish. Length-at-age data can be found in Table 7. Age-1, -3, and -4 rock bass were larger than the western Washington average (P = .0370, .0130, and .0182, respectively), while age-2 fish were not significantly different (P = .0575). Figure 3 shows the relative weights for Pattison Lake rock bass. The mean relative weight was 92, with a range from 72 to 128.

Table 7. Mean back calculated length-at-age for rock bass collected from Pattison Lake, Thurston County, May 2005.

		Age Class			
Year Class	**n**	**1**	**2**	**3**	**4**
2004	6	64			
2003	28	60	121		
2002	15	55	109	169	
2001	7	64	120	166	196
Fraser-Lee	**56**	**59**	**117**	**168**	**196**
W WA Ave		**56**	**107**	**150**	**178**

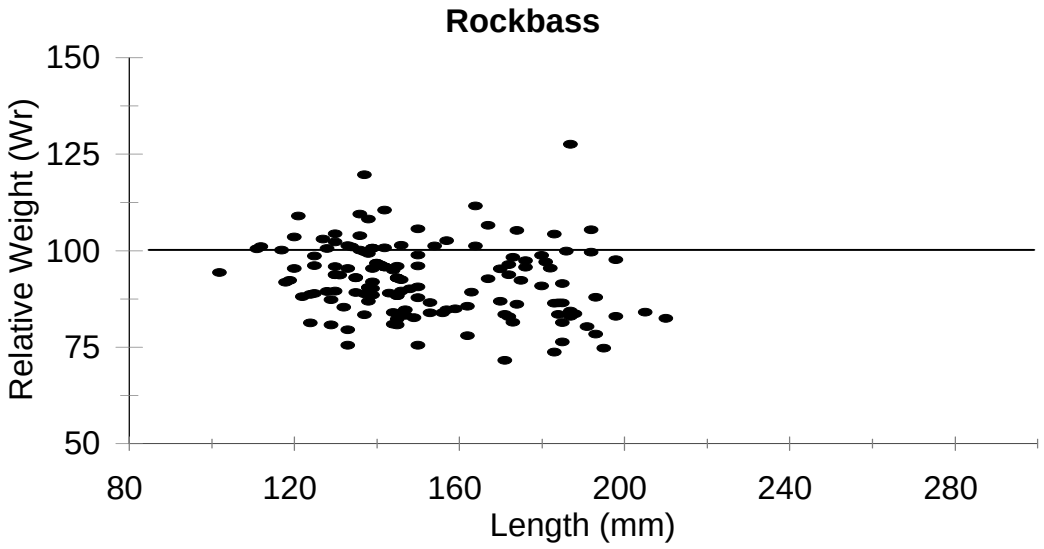

Figure 3. Relative weights of stock size rock bass from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Yellow Perch (*Perca flavescens*)

Stock length yellow perch represented 82% of the sample from Pattison Lake. Age-1 and age-2 yellow perch grew faster than the western Washington average ($P < .0001$ for both age classes). Length-at-age data is in Table 8. Figure 4 shows relative weight data, which ranged from 76 to 116 with a mean of 96.

Table 8. Mean back calculated length-at-age for yellow perch collected from Pattison Lake, Thurston County, May 2005.

		Age Class	
Year Class	**# Fish**	**1**	**2**
2004	12	100	
2003	36	107	193
Fraser-Lee	**48**	**105**	**193**
W WA Ave		**91**	**160**

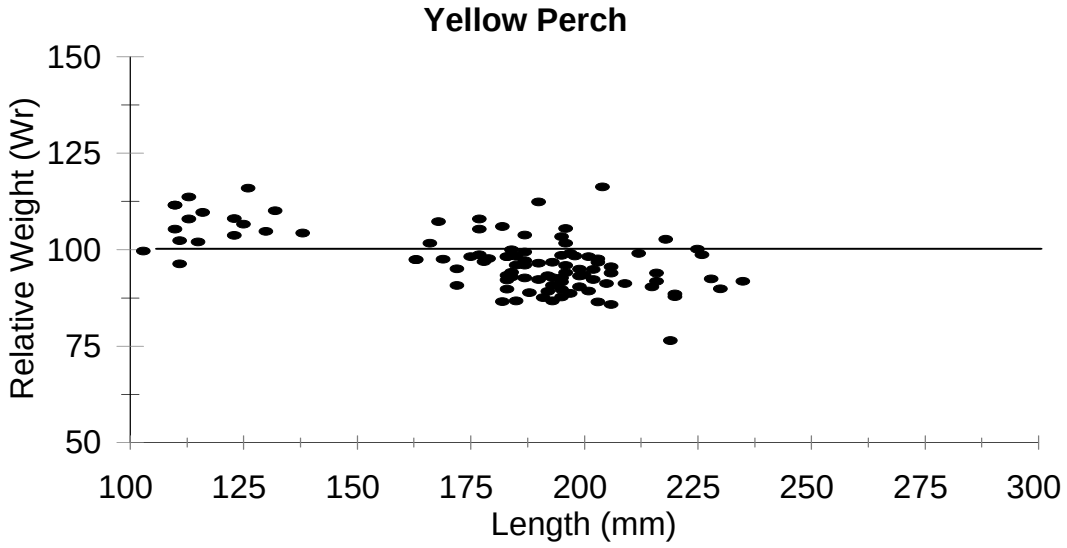

Figure 4. Relative weights of stock size yellow perch from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Brown Bullhead (*Ameiurus nebulosus*)

The entire sample of brown bullhead were not only stock length, they were all quality length fish, resulting in PSD of 100 for all three gear types. Relative weights are in Figure 5 and ranged from 95 to 133 with a mean of 109. No age or growth data were collected on these fish.

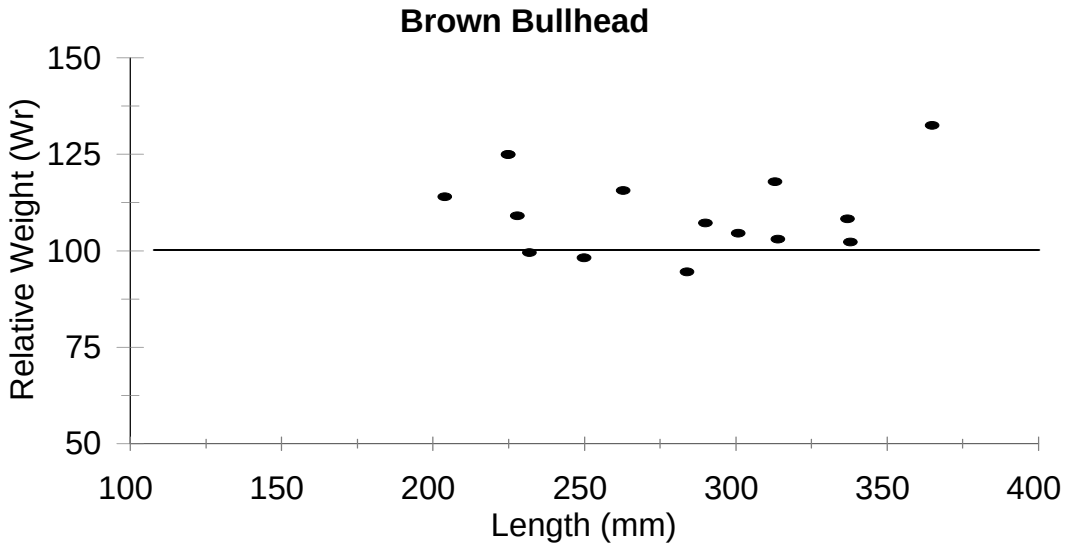

Figure 5. Relative weights of stock size brown bullhead from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Pumpkinseed (*Lepomis gibbosus*)

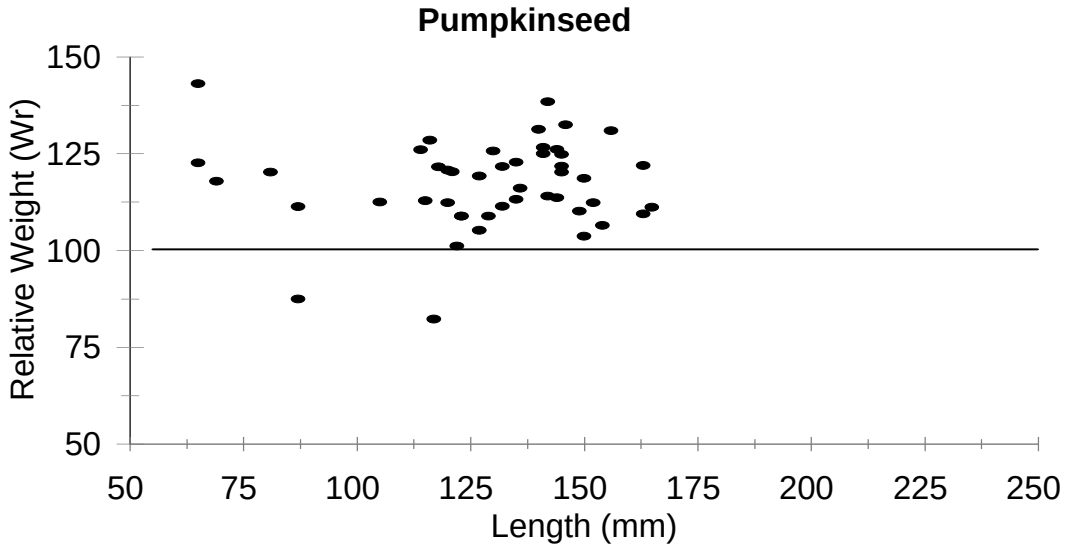

Figure 6. Relative weights of stock size pumkinseed from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Ninety percent of the pumpkinseed from Pattison Lake were stock length fish. Length-at- age data can be found in Table 9. Age-1 and age-2 yellow perch grew faster than the western Washington average (P = .0036 and P = .0001, respectively). Relative weights (Figure 6) ranged from 82 to 139 and averaged 117.

Table 9. Mean back calculated length-at-age for pumpkinseed collected from Pattison Lake, Thurston County, May 2005.

		Age Class		
Year Class	**n**	**1**	**2**	**3**
2004	4	62		
2003	27	53	123	
2002	1	83	123	157
Fraser-Lee	**32**	**55**	**123**	**157**
W WA Ave		**48**	**102**	**137**

Brown Trout (*Salmo trutta*)

Two brown trout were collected from Pattison Lake, 401 and 521 mm. No age or growth analysis was conducted on these fish. They are likely the result of hatchery fry plants (Table 6).

Bluegill (*Lepomis macrochirus*)

Just over half (53%) of the bluegill sampled were stock size. Table 10 shows length-at-age data. Bluegill from Pattison Lake grew faster than the western Washington average (age-1 *P* = .0335; age-2 *P* = .0036). Figure 7 shows relative weight data. Relative weights ranged from 84 to 130 and averaged 115.

Table 10. Mean back calculated length-at-age for bluegill collected from Pattison Lake, Thurston County, May 2005.

		Age Class	
Year Class	**n**	**1**	**2**
2004	11	55	
2003	25	36	110
Fraser-Lee	**36**	**42**	**110**
W WA Ave		**38**	**88**

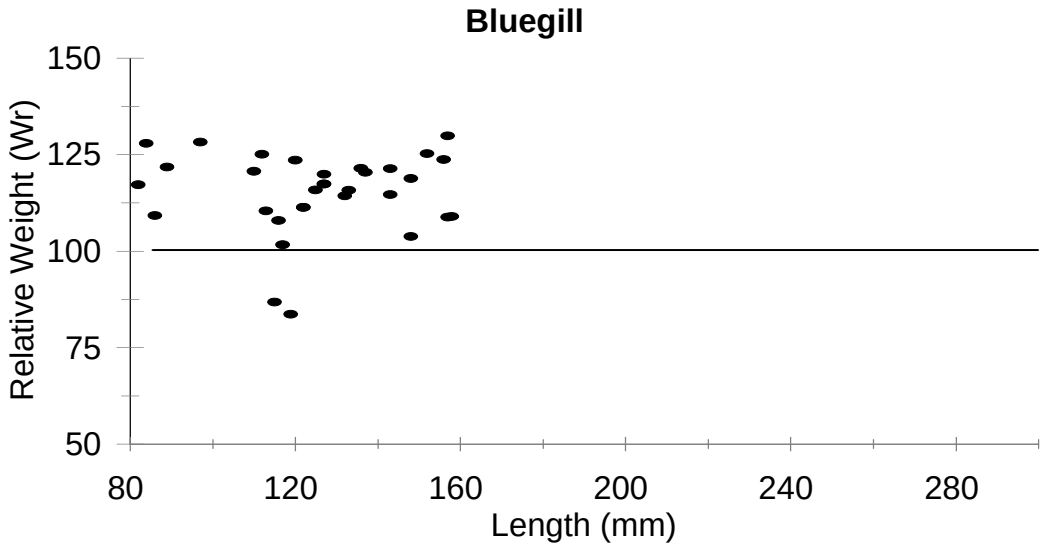

Figure 7. Relative weights of stock size bluegill from the spring 2005 survey of Pattison Lake, Thurston County. Horizontal line at 100 represents the national 75th percentile.

Warmouth (*Lepomis gulosus*)

Six warmouth were collected at Pattison Lake, three of which were stock length. Four fish were aged, all of which were age-2 with an average length of 43 mm at age-1 and 101 mm at age-2. Relative weights ranged from 101 to 148 and averaged 117. Warmouth are uncommon in Washington and insufficient data are available to calculate a meaningful length-at-age average for western Washington.

Non-Game Fish

In addition to the game fish listed above, the Pattison Lake sample included largescale suckers (*Catostomus macrocheilus*), common carp (*Cyprinus carpio*), and sculpin (Cottidae). These fish combined to represent nearly 40% of the sample biomass, but less than 10% of the total number collected. No age or growth analysis was conducted on these fish.

Discussion

Pattison Lake has seven different species of warmwater fish, all of which appear to be in good condition. All of the aged species demonstrated faster than average growth. Relative weights were all at or close to the national 75th percentile. Most PSDs were in or close to the 20 – 40 range, which is considered ideal for angling opportunity (Novinger and Legler 1978). PSDs also indicate a predator – prey ratio that appears to be in balance. The one potential negative indicator is the shortened lifespans of virtually every warmwater species (lifespans of aged Pattison Lake fish were a combined 24% shorter than the western Washington mean).

Comparing Pattison Lake to Hicks Lake reveals the benefits of increased lake productivity to the warmwater fish community, with Pattison being downstream and thus more productive due to a larger drainage area. Hicks Lake was surveyed the week before Pattison, and despite their proximity and connection via Woodland Creek, the differences in our samples were marked. Despite similar effort, the Hicks Lake sample lacked two species (bluegill and pumpkinseed) found in Pattison, had half as many total fish as Pattison (301 to 606), and catch rates were lower for most warmwater game fish. PSDs for Hicks could not even be calculated with any confidence due to insufficient sample size.

The other lake in the system, Long Lake, was last surveyed in the spring of 2000 (Jackson and Caromile 2002). That report describes the warmwater fish community as poor, and suggested the long-term aquatic plant removal program (which continues to this day) may be to blame. However, a close look at the data shows a population very similar to Pattison Lake. The two sets of species composition data look nearly identical, and catch rates and PSDs are quite similar. (Rock bass were more abundant in Long Lake, likely a result of aquatic plant removal which would improve rock bass habitat, while bluegill were caught almost four times more frequently in Pattison.) Although neither lake would rate as a destination warmwater fishery on a national or even state-wide level, both lakes probably have above average warmwater fisheries when compared to other western Washington lakes.

Management Considerations

Identifying, protecting, and promoting high quality warmwater fisheries, particularly those close to urban areas, is one of the means available to the Warmwater Enhancement Program to achieve its goals. Although the data set for Thurston County lakes is small (most lakes have been surveyed only once since the inception of the program in 1997), the available data suggest that Pattison Lake may be one of the highest quality warmwater fisheries in the county. (Other candidates are Black Lake, McIntosh Lake, and Long Lake.) As such, it is deserving of increased attention from managers in the form of more frequent surveys and the collection of creel data. Due to its proximity to urban areas and its relatively small size, the potential for increased angling pressure to unbalance this fishery is significant, yet no creel data has ever been collected. Baseline harvest information should be collected as soon as feasible, and a schedule of creel and lake surveys should be developed to establish a long-term data set. In addition, the role of hatchery trout plants on the fish community and on the level of harvest pressure should be considered and evaluated in cooperation with regional fish management staff.

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.

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.

Jackson, C. S., and S. J. Caromile. 2000. An assessment of the warmwater fish community in Long Lake (Thurston County) June 2000. Wash Dept Fish and Wildlife, Report #FPT 02-06, 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.

Novinger, G. D., and R. E. Legler. 1978. Bluegill population structure and dynamics. Pages 37-49 *in* G. D. Novinger and J. G. Dillard, editors. New Approaches to the Management of Small Impoundments. NCD-AFS Spec. Publ. 5, Bethesda, MD.

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

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

Appendix A

Table 11. Length Categories that have been proposed for various fish species. Measurements are for total lengths (updated from Anderson and Neumann 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
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 crappie	5	13	8	20	10	25	12	30	15	38
Yellow bullhead	6	15	9	23						
Yellow perch	5	13	8	20	10	25	12	30	15	38

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