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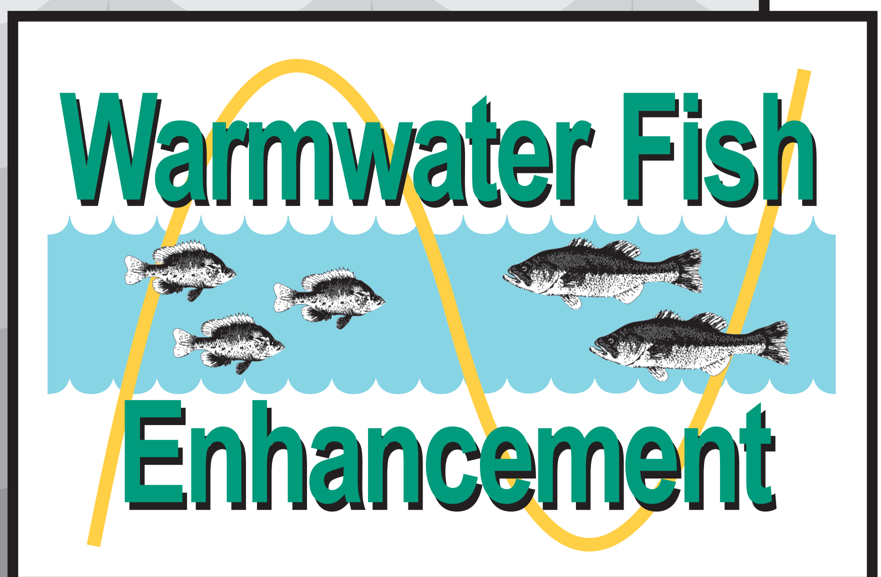
2001 Washburn Island Pond Warmwater Survey Okanogan County, Washington



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Washington Department of
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Fish Program
Science Division

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2001 Washburn Island Pond Warmwater Survey
Okanogan County, Washington

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Abstract

Washburn Island Pond, Okanogan County, Washington, was surveyed by a three person team between October 8 - 11, 2001. All fish were collected using boat electrofisher, gill nets, and fyke nets. Seven fish species, bluegill *Lepomis macrochirus*, black crappie *Pomoxis nigromaculatus*, pumpkinseed *L. gibbosus*, brown bullhead *Ictalurus nebulosus*, channel catfish *I. punctatus,* largemouth bass *Micropterus salmoides,* and tench *Tinca tinca* were collected. Bluegill were found in high density relative to all other fish species observed. Growth of bluegill was below the statewide average and relative weights were below average for most bluegill. Electrofisher catch rate of bluegill was nearly 2.5 times higher than observed during a 1998 electrofishing survey. Largemouth bass were found in low density. Growth of largemouth bass was found to be above average for most age classes, and relative weights were slightly below average but increased with length. Catch rate of largemouth bass by electrofisher was found to be approximately 50 percent of that observed during a 1998 electrofishing survey. Of the other fish species observed during the survey, all were found in low density, and only black crappie and channel catfish were actively being stocked. The management strategy for Washburn Island Pond is to provide a quality size (150 mm) and larger bluegill fishery, a largemouth bass fishery with an emphasis on catching more smaller-size fish with the occasional large bass, and to provide additional angling opportunities for black crappie and channel catfish. We recommend the following as possible strategies to achieve management goals: physical removal of bluegill by electrofisher or fyke netting, stocking of largemouth bass, conducting periodic creel surveys, and monitoring management actions with additional warmwater surveys.

Table of Contents

Acknowledgements i

Abstract ii

Table of Contents iii

List of Tables iv

List of Figures v

Introduction and Background 1

Methods and Materials 4

Results/Discussion 7
- Species Composition 7
- Catch per unit Effort (CPUE) 8
- Stock Density Indices 9
- Water Chemistry 10
- Largemouth Bass 11
- Bluegill 15
- Black Crappie 18
- Pumpkinseed Sunfish 20
- Channel Catfish 22

Summary and Management Strategies 23
- Strategy 1: Reduce bluegill density using non-regulatory means 24
- Strategy 2: Fish Stocking 24
- Strategy 3: Creel Census 25
- Strategy 4: Population Monitoring 25

Literature Cited 26

Glossary 28

List of Tables

Table 1 Fish stocked in Washburn Island Pond between from 1997 to 2001................................ 3

Table 2 Minimum total length (mm) categories of warmwater fish used to calculate PSD and RSD values (Willis et al. 1993) 6

Table 3 Species composition by weight, number, and size range of fish captured at Washburn Island Pond during a warmwater fish survey in October 2001. 7

Table 4 Species composition by weight, number, and size range of YOY fish captured at Washburn Island Pond during a warmwater fish survey in October 2001. 8

Table 5 Mean catch per unit effort by sampling method (excluding YOY), including 80 percent confidence intervals, for fish collected from Washburn Island Pond in October 2001..... 8

Table 6 Stock density indices, including 80 percent confidence interval, for warmwater fishes collected by an electrofisher, gill nets, and fyke nets from Washburn Island Pond during October, 2001.. 10

Table 7 Water chemistry data from Washburn Island Pond collected during a warmwater fish survey in October 2001.. 11

Table 8 Age and growth of largemouth bass captured at Washburn Island Pond during October 2001. 13

Table 9 Age and growth of bluegill captured at Washburn Island Pond during October 2001. .. 16

Table 10 Age and growth of black crappie captured at Washburn Island Pond during October 2001. 18

Table 11 Age and growth of pumpkinseed captured at Washburn Island Pond during October 2001.. 20

List of Figures

Figure 1 Map of Washburn Island Pond, Okanogan County. 2

Figure 2 Length frequency of largemouth bass captured by a boat electrofisher (EB) and gill nets (GN) in Washburn Island Pond during October 2001. 14

Figure 3 Relative weights of largemouth bass captured by a boat electrofisher (EB) and gill nets (GN) in Washburn Island Pond during October 2001, as compared to the national average, Wr = 100 (Anderson and Neumann 1996). 14

Figure 4 Length frequency of bluegill captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001. 17

Figure 5 Relative weights of bluegill captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, Wr = 100 (Anderson and Neumann 1996). 17

Figure 6 Length frequency of black crappie captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001. 19

Figure 7 Relative weights of black crappie captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, Wr = 100 (Anderson and Neumann 1996). 19

Figure 8 Length frequency of pumpkinseed captured by a boat electrofisher (EB) and fyke nets (FN) in Washburn Island Pond during October 2001. 21

Figure 9 Relative weights of pumpkinseed captured by a boat electrofisher (EB) and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, Wr = 100 (Anderson and Neumann 1996). 21

Introduction and Background

Washburn Island Pond is located approximately 5 miles southeast of the town of Brewster, Washington in Okanogan County (Fig. 1). The pond, which is primarily used by hunters and fishers, has a surface area of approximately 57 hectares (140 acres) and a maximum depth of 6.3 meters (21 feet). At an elevation of 770 feet, the pond holds approximately 1140 acre feet of water (Heather Bartlett, WDFW, pers. comm.).

Constructed as a steelhead *Oncorhynchus mykiss* rearing pond in the mid-1960s as a mitigation facility for the construction and operation of Wells Dam, Washburn Island Pond was operated by Washington Department of Game until the mid-1970s when the steelhead program was relocated to the Wells Fish Hatchery (WDFW 1999a). Steelhead rearing in the pond was never satisfactory and the fish were plagued by pathogens endemic to the system (WDFW 1999b). To date, the Washburn Island Pond facility has not received any maintenance in over 20 years and many associated structures have been decommissioned. Access to the pond is provided by a low volume parking lot and boat ramp constructed by Douglas County Public Utility District, and by an existing gravel parking area via the north end dike.

Washburn Island Pond was rehabilitated in 1975, following use as a steelhead rearing facility, and again in 1985. Carp *Cyprinus carpio* were observed swimming in the pond following the 1975 rehabilitation, but were absent following the 1985 rehabilitation when tench *Tinca tinca* were first observed (Heather Bartlett, WDFW, pers. comm.). Currently, Washburn Island Pond is isolated from surface connection with the Columbia River to maintain its existing popular warmwater fishery, and to prevent the ingress of undesired fish species into the pond. The warmwater fish species observed in the pond include largemouth bass *Micropterus salmoides*, bluegill *Lepomis macrochirus*, pumpkinseed *L. gibbosis*, black crappie *Pomoxis nigromaculatus*, brown bullhead, *Ictalurus nebulosus* and channel catfish *I. punctatus*. The Warmwater Enhancement Program's management emphasis for Washburn Island Pond is to provide a quality size (150 mm) and larger bluegill fishery, a largemouth bass fishery with an emphasis on catching more smaller-size fish with the occasional large bass, and provide additional angling opportunities for black crappie and channel catfish.

Wildlife known to utilize the Washburn Island Pond area include: great blue heron *Ardea herodias*, black-crowned night heron *Nycticorax nycticorax*, double-crested cormorant *Phalacrocorax auritus*, pied-billed grebe *Podilymbus podiceps*, white pelican *Pelecanus erythrorhynchus*, common merganser *Mergus serrator*, common loon *Gavia immer*, Canada geese *Branta canadensis*, mallard *Anas platyrhynchos*, blue winged teal *A. discors*, cinnamon teal *A. cyanoptera*, northern shoveler *A. clypeata*, gadwall *A. strepera*, redhead *Aythya* *americana*, ruddy duck *Oxyura jamaicensis rubida,* American coot *Fulica americana*, canvasback *A. marila*, bufflehead *Bucephala albeola*, common goldeneye *B. clangula*, ring-necked pheasant *Phasianus colchicus*, California quail *Lophortyx californicus*, chukar *Alectoris graeca*, morning dove *Zenaida macroura*, red-winged blackbird *Agelaius phoeniceus*, meadowlark *Sturnella neglecta*, killdeer *Charadrius vociferus*, Virginia rail *Rallus limicola*, American bittern *Botaurus lentiginosus*, golden eagle *Aquila chrysaetos*, bald eagle *Haliaeetus leucocephalus*, red-tailed hawk *Buteo jamaicensis*, northern harrier *Circus cyancus*, American

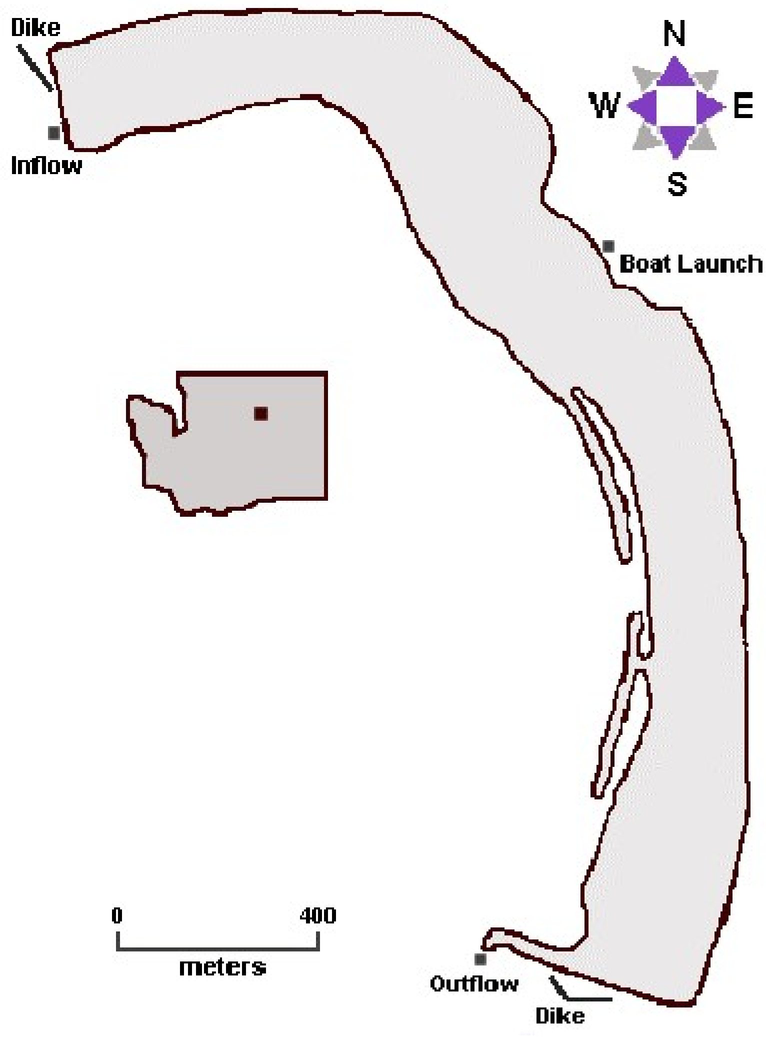

Figure 1 Map of Washburn Island Pond, Okanogan County

kestrel *Falco sparverius*, osprey *Pandion haliaetus*, tiger salamander *Ambystoma tigrinum*, bullfrog *Rana catesbeiana,* western rattlesnake *Crotalus viridis*, gopher snake *Pituophis melanoleucus deserticola*, and mammals including beaver *Castor canadensis,* muskrat *Ondatra zibethica*, raccoon *Procyon lotor*, cottontail *Sylvilagus auduboni*, vole *Microtus spp.*, pocket gopher *Thomomys spp.*, skunk *Mephitis mephitis*, mink *Mustela vison*, weasel *Mustela spp.*, porcupine *Erethizon dorsatum*, yellowbelly marmot *Marmota flaviventris*, coyote *Canis latrans*, and mule deer *Odocoileus hemionus*.

Various aquatic water milfoil *Myriophyllum spp.*, curly-leaved pondweed *Potamogeton crispus*, sub-aquatic cattail *Typha latifolia* and bulrush *Scirpus spp.*, and terrestrial Russian olive *Elaeagnus angustifolia*, sagebrush *Artemisia tridentata*, bluebunch wheatgrass *Pseudoroegneria spicatum*, cheatgrass *Bromus tectorum*, Sandberg's bluegrass *Poa sandbergii*, sand dock *Rumex spp*., needle and thread grass *Stipa comata*, bitterbrush *Purshia tridentata*, Canadian thistle *Cirsium arvense*, purple loosestrife *Lythrum salicaria*, diffuse knapweed *Centaurea diffusa*, reed canary grass *Phragmites spp.*, Russian knapweed *Centaurea picris*, and rabbitbrush *Ericameria spp.* vegetation are common in and around Washburn Island Pond.

Numerous shrubs and trees have been planted around Washburn Island Pond by Wells Wildlife Area personnel and include: black cottonwood *Populus trichocarpa*, Ponderosa pine *Pinus ponderosa*, Austrian pine *P. nigra*, blue spruce *Picea pungens glauca*, juniper *Juniperus scopulorum*, chokecherry *Prunus virginiana*, hawthorn *Crataegus douglasii*, water birch *Betula occidentalis*, black locust *Robinia pseudoacacia*, wood rose *Rosa woodsii*, caragana *Caragana arborescens*, serviceberry *Amelanchier alnifolia*, dogwood *Cornus stolonifera*, clematis *Clematis ligusticifolia*, and elderberry *Sambucus glauca*. Additionally, WDFW negotiated the purchase of the Washburn Island circle irrigation system, adjacent to the pond, and now irrigates 25 acres of winter wheat and 40 acres of permanent cover which is used extensively by waterfowl and upland game(Hallet 2001).

Table 1 Fish stocked in Washburn Island Pond between from 1997 to 2001.

Year	Species	Age	Number
1997	Black crappie	adults	100
	Channel catfish	fingerlings	3000
1999	Black crappie	fry	1,043
	Channel catfish	fingerlings	1,000
2000	Black crappie	sub-adults	250
	Black crappie	adults	250
	Channel catfish	juveniles	500
	Channel catfish	sub-adults	275
2001	Channel catfish	sub-adults	889

Methods and Materials

Washburn Island Pond was surveyed by a three-person team October 8 - 11, 2001. All fish were collected using a boat electrofisher, gill nets, and fyke nets. The electrofisher unit consisted of a 5.5 m (18 ft.) Smith-Root GPP electrofisher boat with a DC current of 60 cycles/sec at 3 to 4 amps power (Bonar et al. 2000). Experimental gill nets (45.7 m x 2.4 m) were constructed of variable size (13, 19, 25, and 51 mm stretched) monofilament mesh. Fyke nets were constructed of a main trap (four 1.2 m aluminum rings), a single 30.3 m lead, and two 15.2 m wings. All fyke net material was constructed of 13 mm nylon mesh.

Sampling locations were selected by dividing the shoreline into 400 m sections determined from a map. The number of randomly selected sections surveyed is as follows: electrofisher - 15, gill nets - 8, and fyke nets - 8. Electrofishing occurred in shallow water (depth range: 0.2 - 1.5 m), adjacent to the shoreline at a rate of approximately 40.0 m/minute for 600 second intervals (Bonar et al. 2000). Gill nets were set perpendicular to the shoreline with the small-mesh end attached on or near the shore and the large-mesh end anchored offshore. Fyke nets were set perpendicular to the shoreline with the wings extended at 70^o angles from the lead. Gill nets and fyke nets were set overnight prior to electrofishing and were pulled the following morning (1 net night each). All sampling was conducted during nighttime hours when fish are most numerous along the shoreline thus maximizing the efficiency of each gear type.

All fish were identified by species, measured in millimeters (mm) to total length (TL) from the anterior most part of head to the tip of the compressed caudal fin, and weighed to the nearest gram (g). Total length data was used to construct length-frequency histograms and to evaluate the size structure of the warmwater species in the lake. Warmwater fish species were assigned to a 10 mm size group based on total length, and scale samples were collected from the first five fish in each size group (Bonar et al. 2000). Scale samples were mounted on adhesive data cards and pressed onto acetate slides using a Carver® laboratory press (Fletcher et al. 1993).

Water chemistry data were collected at 1 meter (m) increments from the area of greatest depth. A Hydrolab® was used to collect information on dissolved oxygen (milligrams per liter)(mg/l), temperature (degrees Celsius)(°C), pH, conductivity (micro siemens per centimeter)(μS/cm), and turbidity (nephelometric turbidity units)(NTU).

Species composition, by weight in kilograms (kg) and number, was determined from fish captured. Fish less than one year old, i.e., young-of-the-year (YOY), were reported separately, but excluded from all analyses. Eliminating YOY fish prevents distortions in analyses that may occur due to sampling location, method, and specific timing of hatches (Fletcher et al. 1993).

Catch per unit effort (CPUE) of each sampling gear was determined for each warmwater fish species collected. Electrofisher CPUE was determined by dividing the number of fish captured by the total amount of time electrofished. Gill net and fyke net CPUE's were standardized, and were determined by dividing the total number of fish captured by the total number of nights each gear was deployed. Since CPUE is standardized, it can be useful in comparing catch rates between lakes or between sampling dates on the same water.

A relative weight (W_r) index was used to evaluate the condition of fish in Washburn Island Pond. As presented by Anderson and Neumann (1996), a W_r of 100 generally indicates that the fish is in a condition similar to the national average for that species and length. The index is defined as $W_r = W/W_s \times 100$, where W is the weight (g) of an individual fish and W_s is the standard weight of a fish of the same total length (mm). Standard weight was derived from a standard weight-length ($\log_{10}$) relationship that was defined for each species of interest in Anderson and Neumann (1996). Minimum lengths were used for each species as the variability can be significant for small fish (YOY). Relative weights less than 50 were also excluded from our analyses as we suspected unreliable weight measurements.

Age and growth of warmwater fish species in Washburn Island Pond were evaluated using procedures described by Fletcher et al. (1993). All samples were evaluated using both the direct proportion method (Fletcher et al. 1993) and Lee's modification of the direct proportion method (Carlander 1982). Mean back-calculated lengths-at-age for all warmwater species were then compared to those of Eastern Washington and/or statewide averages (Fletcher et al. 1993).

The proportional stock density (PSD) of each warmwater fish species was determined following procedures outlined in Anderson and Neumann (1996). PSD uses two measurements, stock length and quality length, to provide information about the proportion of various size fish in a population. Stock length is defined as the minimum size of a fish that provides recreational value or approximates length when fish reach maturity (Table 2). Quality length is the minimum size of a fish that most anglers like to catch or begin keeping (Table 2). PSD is calculated using the number of quality sized fish, divided by the number of stock sized fish, and multiplied by 100. Stock and quality lengths, which vary by species, are based on percentages of world-record lengths (Anderson and Weithman 1978). Stock length is 20-26 percent of the world record length, whereas quality length is 36-41 percent of the world record length.

Relative stock density (RSD) of each warmwater fish species was examined using the five-cell model proposed by Gabelhouse (1984). In addition to stock and quality lengths, the Gabelhouse model adds preferred, memorable, and trophy categories (Table 2). Preferred length (RSD-P) is defined as the minimum size of fish anglers would prefer to catch. Memorable (RSD-M) length refers to the minimum size fish anglers remember catching, and trophy length (RSD-T) refers to the minimum size fish worthy of acknowledgment. Preferred, memorable, and trophy length fish are also based on percentages of world record lengths (Anderson and Weithman 1978). Preferred length is 45-55 percent of world record length, memorable length is 59-64 percent of world record length, and trophy length is 74-80 percent of world record length. RSD differs from PSD in that it is more sensitive to changes in year class strength. RSD is calculated as the number of fish within the specified length category, divided by the total number of stock length fish, multiplied by 100. Confidence intervals of 80 percent were selected from tables in Gustafson (1988) for PSD and RSD.

Table 2 Minimum total length (mm) categories of warmwater fish used to calculate PSD and RSD values (Willis et al. 1993).

	Length Category				
Species	Stock	Quality	Preferred	Memorable	Trophy
Black crappie	130	200	250	300	380
White crappie	130	200	250	300	380
Bluegill	80	150	200	250	300
Yellow perch	130	200	250	300	380
Largemouth bass	200	300	380	510	630
Smallmouth bass	180	280	350	430	510
Walleye	250	380	510	630	760
Channel catfish	280	410	610	710	910
Brown bullhead	150	230	300	390	460
Yellow bullhead	150	230	300	390	460

Results/Discussion

Species Composition

A total of seven fish species were observed in Washburn Island Pond during this warmwater fish survey in October 2001 (Table 3). When combined, two of the species, bluegill and largemouth bass, comprised 95.5 percent of the total number of fish collected, and 75.9 percent of the fish biomass collected during the survey. Largemouth bass accounted for only 5.9 percent of the total number of fish collected, but contributed 32.7 percent of the total fish biomass. This was expected since largemouth bass were the largest of the fish species collected during the survey. Bluegill was by far the most abundant fish species observed (n = 2110) and contributed the largest percent biomass (43.2) of all species observed. Species composition in Washburn Island Pond during this 2001 survey is consistent with the observations of Jackson (1998) during an electrofishing survey.

The number of YOY fish collected during this 2001 warmwater fish survey was low (Table 4). Bluegill YOY were most abundant (n = 166), but were much lower in abundance than anticipated given the number of adults collected in our samples. A total of 14 largemouth bass YOY were collected, also fewer than expected.

Table 3 Species composition by weight, number, and size range of fish captured at Washburn Island Pond during a warmwater fish survey in October 2001.

	Species Composition					
	Weight		Number		Size Range (mm TL)	
Species	kg	%	No.	%	Min	Max
Black crappie	3.4	3.3	30	1.3	100	300
Bluegill	43.7	43.2	2110	89.6	60	186
Pumpkinseed sunfish	0.9	0.9	41	1.7	71	169
Largemouth bass	33.1	32.7	139	5.9	128	511
Channel catfish	2.5	2.4	3	0.1	422	482
Brown bullhead	4.7	4.6	18	0.8	84	314
Tench	13.0	12.8	14	0.6	359	473

Table 4 Species composition by weight, number, and size range of YOY fish captured at Washburn Island Pond during a warmwater fish survey in October 2001.

	Species Composition					
	Weight		Number		Size Range (mm TL)	
Species	kg	%	No.	%	Min	Max
Black crappie	0.01	1.8	2	1.1	73	78
Bluegill	0.44	71.1	166	89.7	26	59
Largemouth bass	0.16	26.1	16	8.7	74	125
Pumpkinseed	0.01	1.0	1	0.5	71	71

Catch per unit Effort (CPUE)

Catch rates by boat electrofisher were highest for bluegill, largemouth bass, and brown bullhead (Table 5). Fyke nets captured pumpkinseed, black crappie, and tench more efficiently, while channel catfish were only collected with gill nets. Catch rates for bluegill were highest for all sampling methods. While this scenario is unusual, it is likely explained by the high percentage (89.6) of bluegill in the total survey collection. Utilizing different sampling methods such as an electrofisher, fyke nets, and gill nets, is an effective way to collect different sized or different species of fish. By utilizing these three sampling methods, we were effective in increasing the sample size and catch rates of black crappie, channel catfish, pumpkinseed, tench, and bullhead which were not found in high numbers during this survey. Jackson (1998) found catch rates of bluegill lower (227 fish/hour) and largemouth bass catch rates higher (133 fish/hour) during an electrofishing survey in May, 1998, when compared to the October, 2001 warmwater survey.

Table 5 Mean catch per unit effort by sampling method (excluding YOY), including 80 percent confidence intervals, for fish collected from Washburn Island Pond in October 2001.

	Gear Type								
	Electrofisher			Gill Nets			Fyke Nets		
Species	No. Hour	CI (+/-)	No. Sites	No. per Night	CI (+/-)	Net Nights	No. per Night	CI (+/-)	Net Nights
Black crappie	1.60	1.18	15	0.13	0.16	8	3.13	3.47	8
Bluegill	420.98	76.99	15	5.63	2.71	8	126.38	66.67	8
Pumpkinseed sunfish	3.58	1.80	15	0	0	8	4.0	1.75	8
Largemouth bass	54.64	15.98	15	1.0	0.54	8	0	0	8
Channel catfish	0	0	15	0.38	0.34	8	0	0	8
Brown bullhead catfish	1.20	1.11	15	0.38	0.34	8	1.13	0.51	8
Tench	1.20	0.82	15	0.50	0.48	8	12.63	9.68	8

Stock Density Indices

Proportional stock density (PSD) indices require at least 55 stock-sized fish per species be collected to develop a workable estimate (Gustafson 1988). Bluegill and largemouth bass were the only species captured in numbers high enough for a confident analysis of stock density (Table 6). Bluegill and largemouth bass PSD's were 23 (± 2) and 23 (± 7), respectively. The PSD of bluegill captured using fyke nets was 11 (±3). Additionally, the relative stock density (RSD) of preferred size largemouth bass collected by boat electrofisher was 18 (± 6) and of memorable size was 2 (± 2). No bluegill larger than quality length were observed during the warmwater survey.

Gabelhouse et al. (1984) described that largemouth bass and bluegill in small impoundments may be managed for balance, for a panfish option, or for a big bass option. In the panfish option, the quality size of largemouth bass is sacrificed to produce a higher quality bluegill population. A high-density, slow-growing largemouth bass population preys upon bluegill reproduction, and surviving bluegill have faster growth rates and reach sizes more desirable to anglers. In these communities, largemouth bass PSD should range from 20 to 40 and RSD-P should be 0 to 10; bluegill PSD should be 50 to 80 and RSD-P should be 10 to 30. Conversely, the big bass strategy is to produce fewer, larger largemouth bass, resulting in less predation on bluegills. Bluegill size structure shifts to smaller fish and PSD should range from 10 to 50 and RSD-P should be 0 to 10; largemouth bass PSD should be 50 to 80 and RSD-P should be 30 to 60. These scenarios assume that no angler overharvest is occurring. Bluegill PSD from Washburn Island Pond was found to be in the range of the big bass option described by Gabelhouse et al. (1984) (Table 6). While stock density indices of largemouth bass from Washburn Island Pond appeared shaped toward a big bass option, PSD and RSD values were found below the range of this option. One possible explanation for these lower values is that angler exploitation may have been higher on the larger bass due to the statewide daily bass regulation of 5 bass, no more than 3 over 15 inches, which allowed a greater harvest of quality size and larger fish. The statewide bass regulation will change in 2002 to a "slot length limit" of 5 bass, of which only bass less than 12 inches or greater than 17 inches may be kept with no more than 1 bass over 17 inches being retained. If angler exploitation was a causal factor for reducing PSD and RSD values, this new regulation may reduce angler exploitation on larger largemouth bass thereby increasing PSD and RSD values.

While the PSD of bluegill and largemouth bass was found shaped toward the big bass option, the warmwater management strategy of Washburn Island Pond concerning largemouth bass and bluegill is that of the panfish option. Active management (removal) may be required to reduce the number of small, slow growing bluegill. Removal of enough bluegill may allow those that remain the opportunity to grow to larger sizes by reducing the intra-specific competition for food. Additionally, diminished inter-specific competition for food between bluegill and largemouth bass young, combined with the newly implemented "slot length limit" for largemouth bass, should improve survival of bass, thereby increasing their numbers. Future measurements of stock density between Washburn Island Pond bluegill and largemouth bass should provide useful in monitoring the progress of these populations as management techniques are applied.

Table 6 Stock density indices, including 80 percent confidence interval, for warmwater fishes collected by an electrofisher, gill nets, and fyke nets from Washburn Island Pond during October, 2001. PSD = proportional stock density, RSD = relative stock density, RSD-P = relative stock density of preferred fish, RSD-M = relative stock density of memorable fish, and RSD-T = relative stock density of trophy fish.

Species	#Stock Length	PSD	RSD-P	RSD-M	RSD-T
		Electrofisher			
Black crappie	4	75 (± 28)	25 (± 28)	0	0
Bluegill	812	23 (± 2)	0	0	0
Brown bullhead	3	100	67 (± 35)	0	0
Pumpkinseed sunfish	6	17 (± 20)	0	0	0
Largemouth bass	61	23 (± 7)	18 (± 6)	2 (± 2)	0
		Gill Nets			
Bluegill	20	0	0	0	0
Brown bullhead	3	100	67 (± 35)	0	0
Channel catfish	3	100	0	0	0
Largemouth bass	2	50 (± 45)	0	0	0
		Fyke Nets			
Black crappie	22	59 (± 13)	9 (± 8)	5 (± 6)	0
Bluegill	171	11 (± 3)	0	0	0
Brown bullhead	9	78 (± 18)	56 (± 21)	0	0
Pumpkinseed sunfish	28	4 (± 4)	0	0	0

Water Chemistry

Water chemistry data collected from Washburn Island Pond were relatively homogeneous throughout the water column with respect to temperature, pH, dissolved oxygen and conductivity (Table 7.). Water temperatures ranged from 14.5 to 15.6^{o} C and dissolved oxygen ranged from 7.5 to 8.49 mg/l. The pH levels in Washburn Island Pond ranged from 9.06 to 9.16; slightly above the desirable range for warmwater fish (6.5 to 9.0) reported by Swingle (1969). In general, water chemistry parameters were found to be within ranges expected to promote vigorous growth and good health of the Washburn Island Pond warmwater fish community.

Table 7 Water chemistry data from Washburn Island Pond collected during a warmwater fish survey in October 2001.

Location	Depth (m)	Temp (^oC)	pH	Dissolved O2	Conductivity	Secchi (m)
Center of Lake	Surface	15.6	9.06	7.50	327	2.6
	1	15.1	9.11	8.14	325	
	2	14.9	9.16	8.39	324	
	3	14.9	9.14	7.62	324	
	4	14.8	9.12	7.55	324	
	5	14.8	9.11	7.67	325	
	6	14.6	9.16	8.49	324	
	6.3	14.5	9.10	7.51	324	

Largemouth Bass

Largemouth bass ranged in age from 1 to 11 years with ages one and two being the most abundant of those analyzed for age and growth (Table 8). Age seven largemouth bass were absent from our samples, and the number of age five and older bass analyzed for age and growth were inadequate for a confident analysis. All age classes of largemouth bass analyzed were above the eastern Washington average for growth except age nine and older fish where no state average has been developed. Lengths of largemouth bass collected from Washburn Island Pond ranged from 128 mm to 511 mm (Table 3; Fig. 2). Relative weights were slightly below average for largemouth bass less than 400 mm in length, and average or better for those larger than 400 mm (Fig. 3). The slightly below average weights of largemouth bass less than 400 mm in length is likely a result of food competition. While food competition likely exists, it appears slight and has not restricted bass growth.

By comparison, catch rates of largemouth bass (54.6 fish/hr) collected by an electrofisher were approximately 50 percent of those observed by Jackson (1998) (103 fish/hr) during a May, 1998 electrofishing survey. Additionally, catch rates of bluegill captured by an electrofisher were nearly 2.5 times (420.9 fish/hr) that found by Jackson (1998) (175 fish/hr). Some variation in findings between 1998 and 2001 surveys was expected due to sampling dates occurring in different seasons (spring vs. fall); however, the extent of the increase in bluegill abundance, combined with poor growth and condition, indicates predation on bluegill by largemouth bass was inadequate for achieving desired management goals.

As discussed earlier in this report, the PSD 23 ($\pm$ 7) and RSD-P 18 ($\pm$ 6) of largemouth bass collected by boat electrofisher was similar, but slightly lower than the range of the big bass strategy described by Gabelhouse et al. (1984). The big bass strategy is to produce fewer, larger largemouth bass, resulting in less predation on panfish, but is not the desired management strategy for this pond. The number of stock length or larger largemouth bass (n = 61) and CPUE (54.6 fish/hr) of fish collected by electrofisher indicate this largemouth bass population is in low density (Tables 5 and 6). The Washburn Island Pond largemouth bass population was likely shaped by angler exploitation, natural mortality, food or space competition with bluegill, or any combination of these aforementioned conditions. Since largemouth bass relative weights were found slightly below average for smaller bass and improved as the bass grew, it's probable that competition with bluegill for available food resources did exist, at least for smaller-sized bass. Additionally, the abundance of stock length and smaller largemouth bass were found in low density which indicates survival of largemouth bass young may be limited, possibly due to egg or fry predation from the higher density bluegill population. Competition for food and space may result in not only poor condition of juvenile largemouth bass, but also a lower survival rate, that in turn can lead to low recruitment of largemouth bass to larger sizes. A total of 16 YOY largemouth bass were collected during the October survey (Table 4).

Table 8 Age and growth of largemouth bass captured at Washburn Island Pond during October 2001. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993), and unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean length (mm) at age										
Year Class	# Fish	1	2	3	4	5	6	7	8	9	10	11
2000	24	77.0										
		86.5										
1999	24	83.9	158.2									
		96.0	163.5									
1998	20	88.6	157.8	206.9								
		102	166.1	211.6								
1997	5	72.3	171.5	228.5	286.8							
		87.9	181.8	235.5	290.5							
1996	1	61.8	177.0	207.9	233.2	257.1						
		77.4	184.4	213.1	236.6	258.8						
1995	3	66.4	159.8	258.8	350.6	415.1	446.8					
		83.6	173.0	267.8	355.7	417.4	447.8					
1994	0											
1993	1	58.7	124.4	205.4	259.9	318.6	391.3	426.3	447.2			
		76.1	138.9	216.4	268.6	324.7	394.2	427.6	447.6			
1992	1	84.7	156.0	259.5	338.9	412.8	434.4	453.2	474.7	493.5		
		101.	169.9	269.4	345.6	416.7	437.4	455.4	476.1	494.2		
1991	2	60.5	112.8	212.6	282.9	347.9	395.1	428.9	453.9	473.8	484.3	
		78.0	128.2	223.9	291.4	353.7	399.0	431.3	455.3	474.4	484.5	
1990	2	68.6	139.5	226.1	300.6	350.6	388.7	414.5	433.1	449.0	461.0	471.0
		85.7	153.7	236.7	308.0	356.0	392.5	417.2	435.0	450.3	461.8	471.3
Weighted Means		80.2	156.8	217.4	299.0	363.1	414.8	427.7	449.3	467.7	472.7	471.0
		92.7	164.9	223.8	304.6	367.2	417.5	430.0	450.7	468.7	473.1	471.3
Eastern WA Average		68.8	135.6	189.2	248.9	300.0	351.5	421.6	437.6	NA	NA	NA

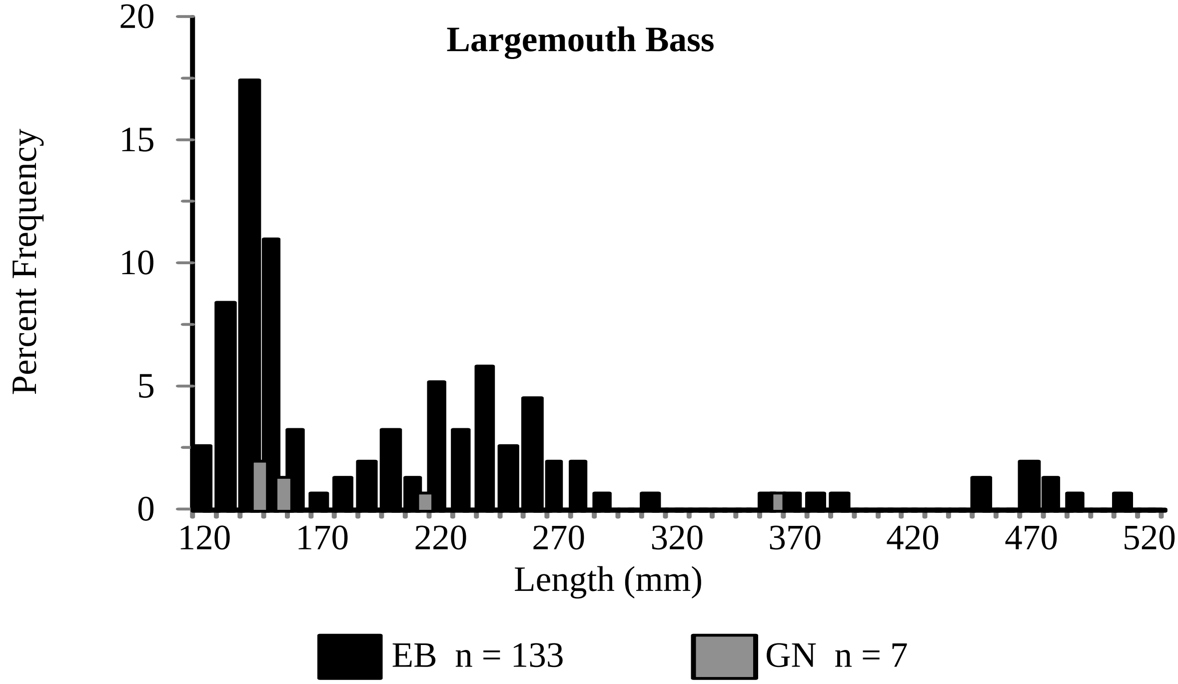

Figure 2 Length frequency of largemouth bass captured by a boat electrofisher (EB) and gill nets (GN) in Washburn Island Pond during October 2001.

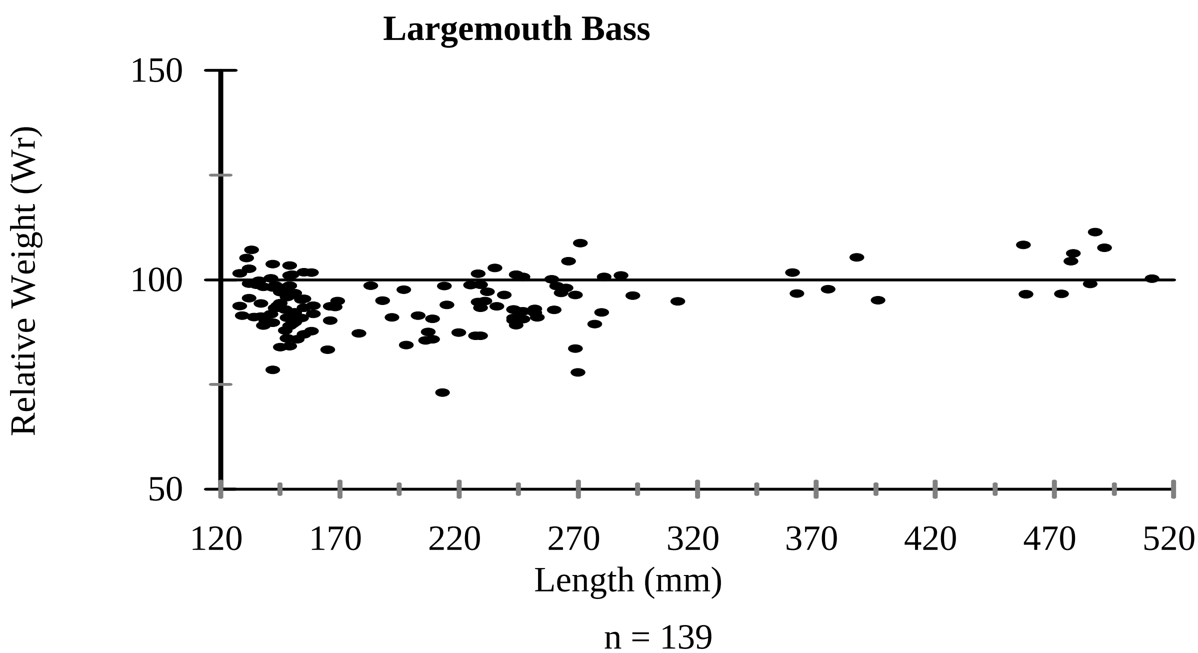

Figure 3 Relative weights of largemouth bass captured by a boat electrofisher (EB) and gill nets (GN) in Washburn Island Pond during October 2001, as compared to the national average, W_r = 100 (Anderson and Neumann 1996).

Bluegill

Bluegill ranged in age from one to eight years with age three being the most abundant of those analyzed for age and growth (Table 9). All age classes of bluegill analyzed were below the statewide average for growth, with the exception of age eight in which no statewide average has been developed. Lengths of bluegill collected from Washburn Island Pond ranged from 60 mm to 186 mm (Table 3; Fig. 4). Relative weights varied greatly for fish less than 100 mm in length, and were below average for most bluegill greater than 100 mm in length (Fig. 5). A much higher density of bluegill was observed in the ranges where most relative weights fell below average. The below-average relative weights of bluegill greater than 100 mm in length was likely a result of intra-specific food competition among bluegill feeding on similar size prey. A total of 166 YOY bluegill were collected during the October survey (Table 4).

As discussed previously, catch rates of bluegill (420.98 fish/hr) collected by an electrofisher were nearly 2.5 times that found by Jackson (1998) (175 fish/hr) during a May, 1998 electrofishing survey, indicating a much higher density than previously observed. Some variation in findings between 1998 and 2001 surveys was expected due to sampling dates occurring in different seasons (spring vs. fall), but the extent of the increase in bluegill abundance indicates predation by largemouth bass or angler exploitation was not sufficient enough to slow the expansion of this high density bluegill population. While largemouth bass most likely prey upon bluegill in Washburn Island Pond, dense aquatic macrophytes found along the shoreline may have contributed to the overpopulation of bluegill. Dense aquatic vegetation may reduce the ability of predators to effectively forage (Bettoli et al. 1992; Olson et al. 1998) which may ultimately lead to stunted prey populations, reduced panfish feeding efficiency, and below average condition (Crowder and Cooper 1982). Active management techniques may need to be employed for reducing the density of this population in order to achieve the Washburn Island Pond warmwater management goal.

Table 9 Age and growth of bluegill captured at Washburn Island Pond during October 2001. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993), and unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean length (mm) at age							
Year Class	# Fish	1	2	3	4	5	6	7	8
2000	6	31.0							
		43.2							
1999	10	16.3	51.2						
		32.9	60.4						
1998	15	19.3	47.7	89.8					
		36.1	59.9	95.2					
1997	8	19.0	53.5	89.8	120.4				
		36.5	66.3	97.8	124.3				
1996	7	17.4	47.1	86.7	120.7	144.1			
		35.2	61.1	95.5	125.2	145.6			
1995	4	20.1	49.0	80.5	114.1	143.9	160.7		
		37.8	63.4	91.2	121.0	147.4	162.2		
1994	3	16.1	41.7	76.7	106.9	138.9	161.3	172.2	
		34.3	57.0	88.1	114.9	143.3	163.2	172.8	
1993	3	16.0	35.9	67.0	92.4	120.1	136.1	149.7	158.4
		34.0	51.6	79.0	101.4	125.8	139.9	151.9	159.5
Weighted Means		19.5	48.3	85.6	114.5	138.9	153.5	160.9	158.4
		36.2	60.8	93.6	120.2	142.1	155.8	162.3	159.5
WA State Average		37.3	96.8	132.1	148.3	169.9	200.9	195.8	-

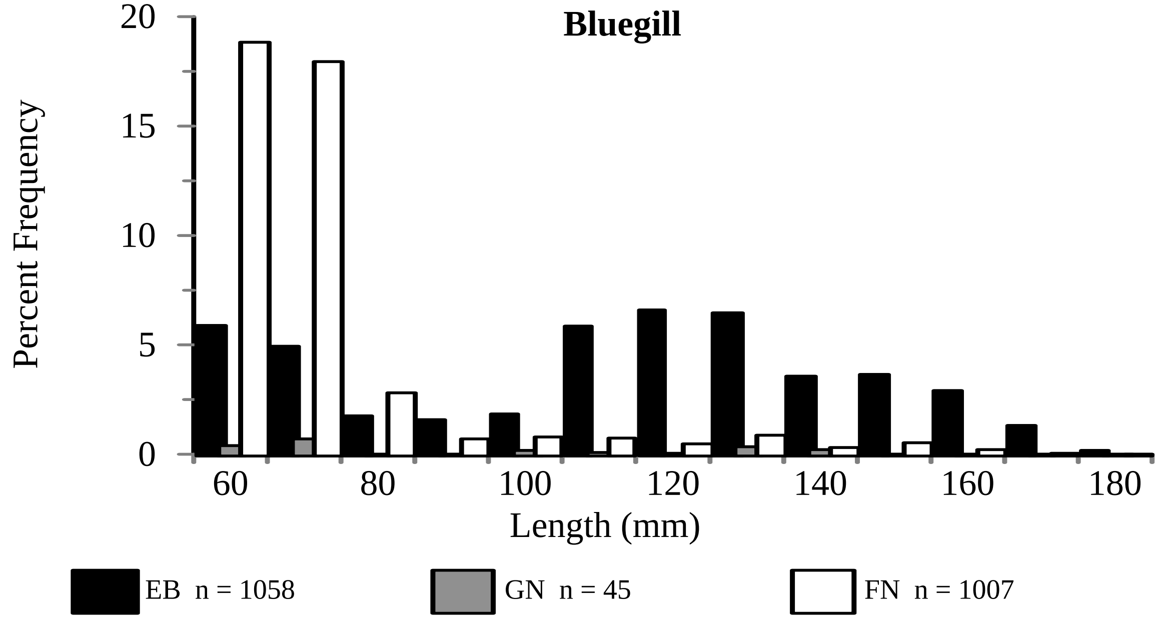

Figure 4 Length frequency of bluegill captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001.

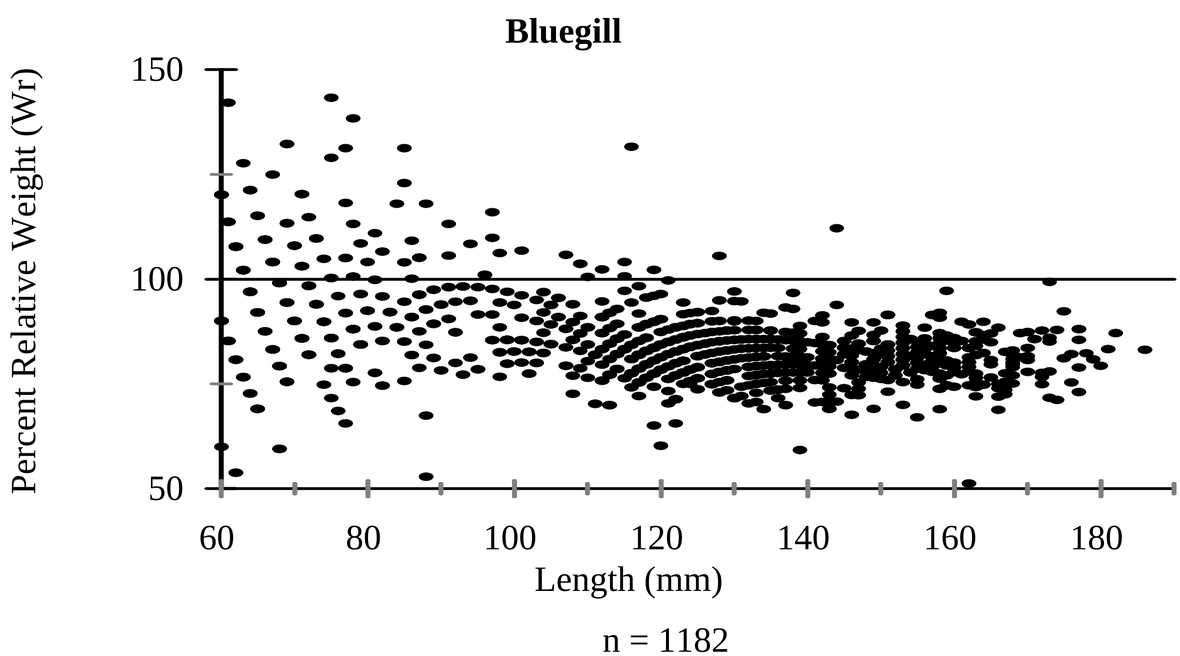

Figure 5 Relative weights of bluegill captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, W_r = 100 (Anderson and Neumann 1996).

Black Crappie

Black crappie ranged in age from one to four years with age three being the most abundant of those analyzed for age and growth (Table 10). With the exception of age three fish, the number of black crappie analyzed for age and growth was inadequate for a confident analysis. All age classes of black crappie analyzed were above the statewide average for growth. However, since stocking had occurred for several years and with fish at various ages, it would be difficult to rely on these averages since some or nearly all growth may have occurred in waters other than Washburn Island Pond. Since records indicate black crappie had been stocked since 1997 as fry, sub-adults, or adults (Table 1), we expected to observe higher numbers of adults and young-of-the-year (YOY) crappie in our samples. Since numbers of YOY fish were found low for all warmwater fish species observed (Table 4), the low number of YOY black crappie observed (n=2) was likely a result ineffective sampling or an inherent problem with the Washburn Island Pond fish community (i.e. bluegill overcrowding) rather than the black crappie population specifically.

Lengths of black crappie collected from Washburn Island Pond ranged from 100 mm to 300 mm (Table 3; Fig. 6). The variation in relative weights for black crappie less than 200 mm was greater than those longer than 200 mm, but most were above average (Fig. 7). Relative weights of black crappie greater than 200 mm were below average. The below-average relative weights of black crappie greater than 200 mm may be a result of inter-specific food competition.

Table 10 Age and growth of black crappie captured at Washburn Island Pond during October 2001. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993), and unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean length (mm) at age			
Year Class	# Fish	1	2	3	4
2000	2	45.6			
		67.9			
1999	5	32.3	112.9		
		60.6	124.8		
1998	14	53.5	142.9	184.2	
		80.2	155.6	190.5	
1997	1	60.2	203.6	253.0	273.5
		88.2	214.9	258.5	276.6
Weighted Means		48.3	138.5	188.8	273.5
		75.0	150.9	195.1	276.6
WA State Average		46.0	111.2	156.7	183.4

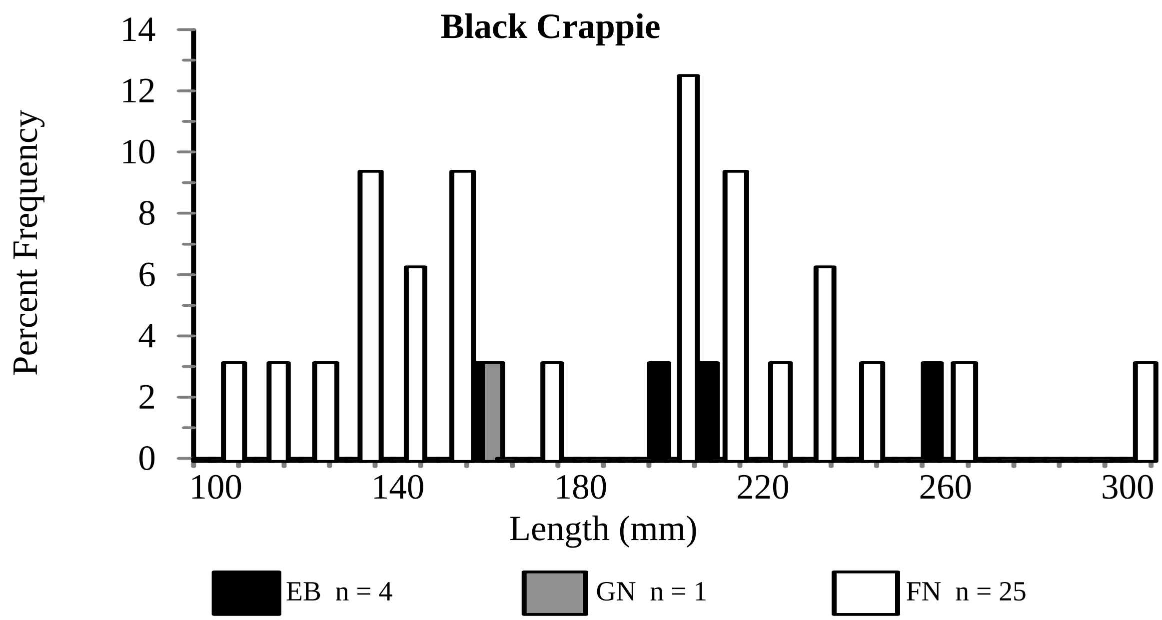

Figure 6 Length frequency of black crappie captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001.

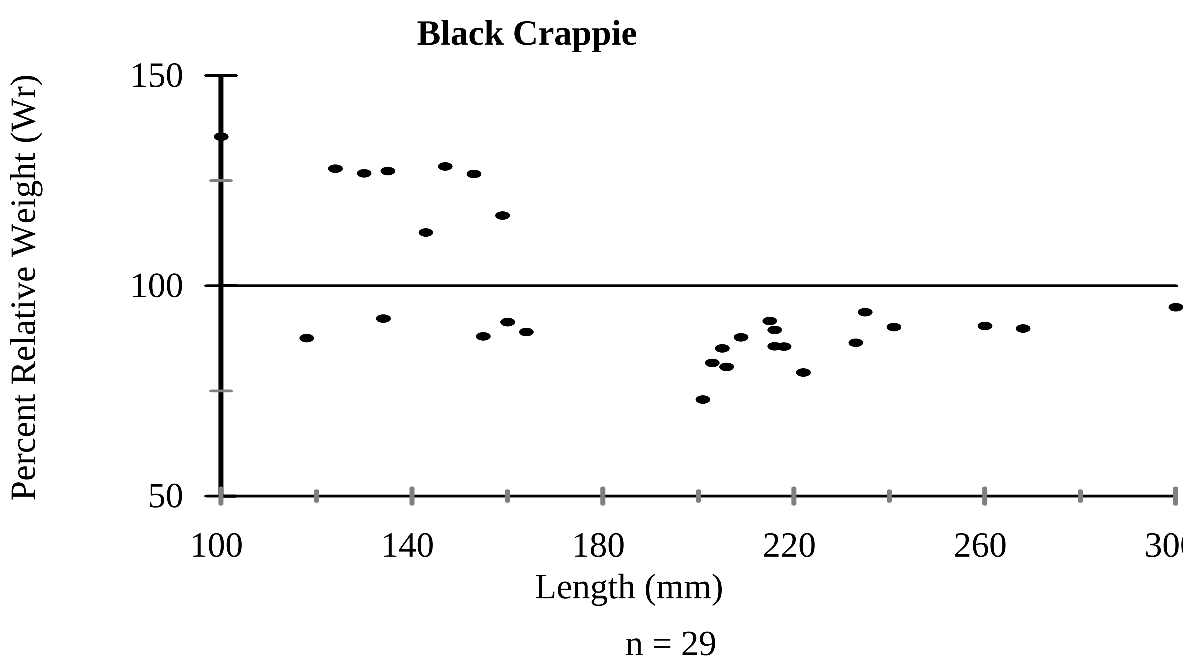

Figure 7 Relative weights of black crappie captured by a boat electrofisher (EB), gill nets (GN), and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, W_r = 100 (Anderson and Neumann 1996).

Pumpkinseed Sunfish

Pumpkinseed ranged in age from one to four years with age one being the most abundant of those analyzed for age and growth (Table 11). The number of age two and older pumpkinseed analyzed for age and growth were inadequate for a confident analysis. All age classes of pumpkinseed analyzed were above the statewide average for growth. Lengths of pumpkinseed collected from Washburn Island Pond ranged from 71 mm to 169 mm (Table 3; Fig. 8). Relative weights of pumpkinseed were average or slightly above average for most fish (Fig. 9). Relative weights of pumpkinseed less than 120 mm in length were found to be similar to relative weights of black crappie and bluegill of the same size range. Few pumpkinseed were collected in sizes greater than 120 mm; therefore, no comparison with same-size black crappie and bluegill was done for this size range. Only one YOY pumpkinseed was collected during this survey (Table 4).

Table 11 Age and growth of pumpkinseed captured at Washburn Island Pond during October 2001. Shaded values are mean back-calculated lengths using the direct proportion method (Fletcher et al. 1993), and unshaded values are mean back-calculated lengths using Lee's modification of the direct proportion method (Carlander 1982).

		Mean length (mm) at age			
Year Class	# Fish	1	2	3	4
2000	38	30.3			
		46.7			
1999	5	30.0	90.6		
		49.5	98.9		
1998	1	38.7	107.7	143.4	
		57.4	115.2	145.1	
1997	1	31.4	80.1	127.2	162.0
		51.7	93.3	133.4	163.1
Weighted Means		30.5	91.5	135.3	162.0
		47.4	100.4	139.2	163.1
WA State Average		23.6	72.1	101.6	122.7

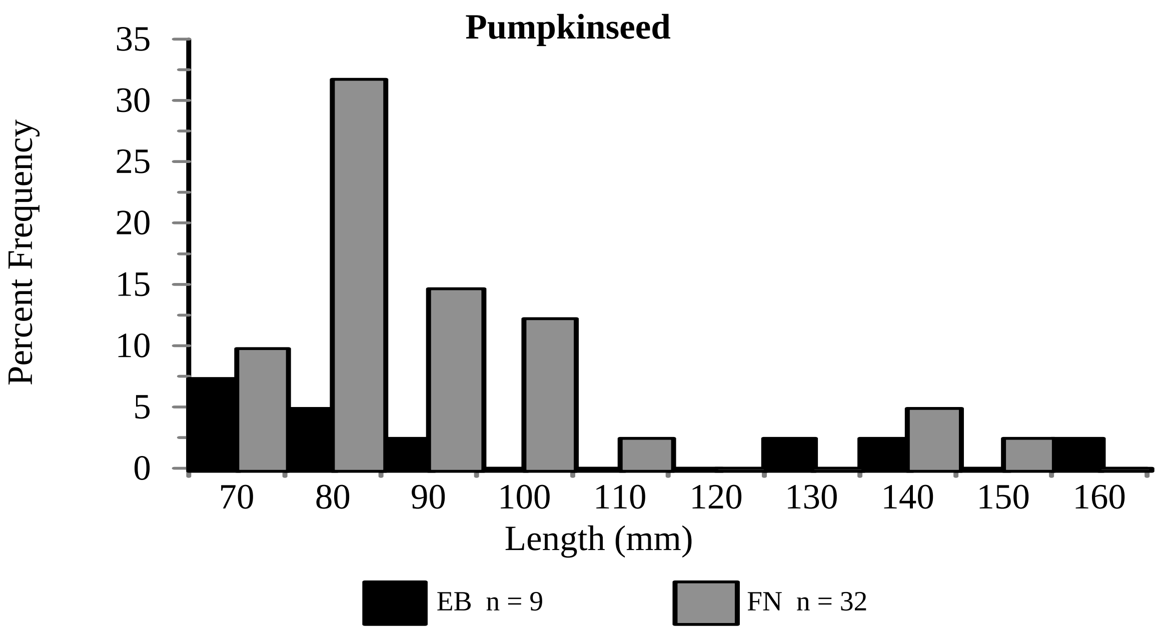

Figure 8 Length frequency of pumpkinseed captured by a boat electrofisher (EB) and fyke nets (FN) in Washburn Island Pond during October 2001.

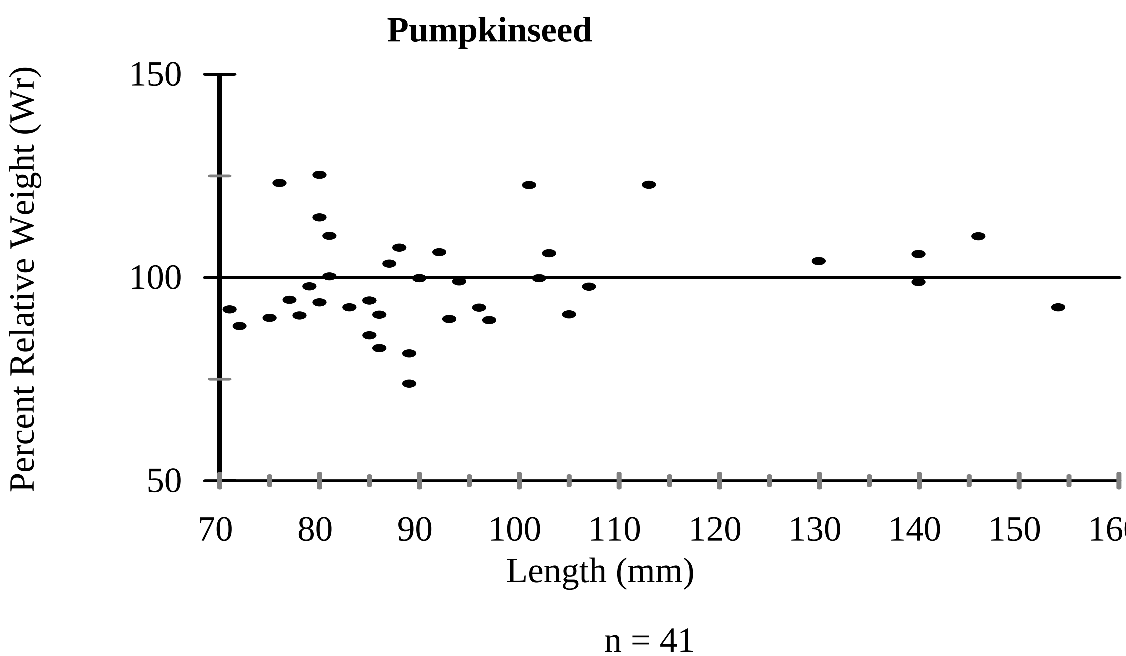

Figure 9 Relative weights of pumpkinseed captured by a boat electrofisher (EB) and fyke nets (FN) in Washburn Island Pond during October 2001, as compared to the national average, W_r = 100 (Anderson and Neumann 1996).

Channel Catfish

Three channel catfish were collected during this warmwater fish survey. Catfish ranged in length from 422 mm to 482 mm (Table 3) and were found with slightly below-average relative weights. Channel catfish have been stocked in Washburn Island Pond since 1997 as fingerlings, sub-adults, and adults (Table 1). The presence of channel catfish in our samples was expected; however, due to the small size of the lake (140 acres) and the number of catfish stocked since 1997 (n=5,664), we expected to see a higher number of catfish during the survey. Explanations for the low observance of channel catfish in the October survey may be predation by largemouth bass on stocked fingerling catfish, natural mortality, exploitation, or inability of our sampling gear to effectively capture these fish. Of the 5,664 channel catfish stocked in Washburn Island Pond since 1997, 4,000 were stocked as fingerlings. Channel catfish less than 200 mm in length can be vulnerable to predation by largemouth bass (Heidinger 1999). Stocking larger channel catfish (> 200 mm), as was done during 2000 and 2001, may increase catfish survival in waters containing largemouth bass. Angler exploitation may also be a factor, however; no harvest information from Washburn Island Pond is available at the time of this writing.

Summary and Management Strategies

Originally a steelhead rearing pond, Washburn Island Pond was created in the 1960s as a mitigation facility for the construction and operation of Wells Dam. After the facility was decommissioned in the mid-1970s, Washburn Island Pond was rehabilitated first in 1975 and again in 1985. Currently, Washburn Island Pond is isolated from surface connection with the Columbia River to maintain its popular warmwater fishery. Warmwater fish surveys have since been conducted in 1998 by boat electrofisher, and in 2001 using methods described in this report. Since 1997, two popular warmwater gamefish, black crappie and channel catfish, have been stocked in Washburn Island Pond in an effort to enhance the existing warmwater fishery. The management strategy for Washburn Island Pond is to provide a quality size (150 mm) and larger bluegill fishery, a largemouth bass fishery with an emphasis on catching more smaller-size fish with the occasional large bass, and provide additional angling opportunities for black crappie and channel catfish.

Seven fish species were observed in Washburn Island Pond during this warmwater fish survey. While black crappie, pumpkinseed, brown bullhead, channel catfish, and largemouth bass were warmwater fish species observed during our survey, all were found in low density compared to bluegill. Bluegill catch rates were found to be nearly 2.5 times higher than observed during the 1998 electrofishing survey (Jackson 1998). Additionally, bluegill exhibited below average growth and, with the exception of bluegill smaller than 100 mm in length, relative weights were below the national average. The PSD and length frequency indices confirmed that the Washburn Island Pond bluegill population contained a high percentage of stock size and smaller bluegill, similar to the big bass option described by Gabelhouse et al. (1984). This is in contrast with management objectives for bluegill and largemouth bass for this waterbody. Largemouth bass were found in higher density than other fish species collected with the exception of bluegill, yet an analysis of CPUE, growth, and PSD indices indicate the population is in low density. Largemouth bass were also found to have catch rates approximately 50 percent of those observed by Jackson (1998), suggesting this population may have declined in size since the 1998 survey.

Black crappie and channel catfish were the only fish species actively being stocked in Washburn Island Pond at the time of our survey. Both species were found in lower numbers than expected. It is unknown whether predation, angler exploitation, stocking rates, ineffectiveness of sampling gears, or other factors contributed to the low numbers of these species observed during our survey. Future warmwater fish surveys may be needed to better assess these two fish populations in order to determine the effectiveness of the current stocking plan. Additionally, a creel survey could provide needed information on angler harvest rates for these species, as well as fish size and catch rate information.

The following strategies were developed in response to Washburn Island Pond management goals in relation to the fish community status observed during the October 2001 warmwater survey, and findings from a 1998 electrofishing survey. It is likely the following strategies will need to be implemented in some combination in order to achieve management goals.

Strategy 1: Reduce bluegill density using non-regulatory means

Physical removal of bluegill from Washburn Island Pond would be labor intensive but might provide additional benefits. First, significantly reducing the number of bluegill within Washburn Island Pond should allow largemouth bass an opportunity to expand their populations while reducing the competition with bluegill for food and space. The resulting increase in the largemouth bass population should, over time, increase predation upon bluegill. To meet the Washburn Island Pond management goal for largemouth bass and bluegill, these changes would be needed in order to shift largemouth bass PSD in line with the panfish option described by Gabelhouse et al. (1984). Secondly, bluegill captured and removed using a boat electrofisher or fyke nets could be transported to other lakes or waters in need of bluegill, and restocked.

The number of bluegill that will need to be removed in order to facilitate this population shift is unknown. Removal efforts should start by removing several thousand bluegill a year until desired levels of bluegill and largemouth bass are attained. Removal efforts may need to continue for several years, the duration depending on whether largemouth bass expansion occurs from natural reproduction or stocking. Warmwater assessment surveys should occur each year bluegill removal occurs to monitor changes in the fish community. Bluegill removal may be increased or decreased in effort, number of fish removed, or duration (years of removal), depending on survey results. Warmwater surveys should continue to monitor the Washburn Island Pond fish community every two to three years once desired levels of bluegill and largemouth bass have been reached.

Strategy 2: Fish Stocking

Stocking of largemouth bass in conjunction with bluegill removal may expedite the desired population shift toward fewer, larger bluegill and numerous smaller-sized largemouth bass with the occasional larger bass. To achieve the desired bluegill fishery in Washburn Island Pond, largemouth bass will need to be plentiful enough to sustain adequate predation upon the prolific bluegill population. We recommended stocking largemouth bass at a length of approximately 250 mm (10 inches) and 5 to 10 fish per acre for a period of two to three years or until natural reproduction sustains the desired bass population. Largemouth bass in this size category should quickly grow into the protected slot length limit (12 to 17 inches), the size range where bass are known to exhibit high levels of piscivory. If the desired size of largemouth bass is not available, smaller bass may be stocked at slightly higher levels.

The Washburn Island Pond management strategy for black crappie and channel catfish is to provide additional angling opportunities for these species. Both species were observed during our October 2001 warmwater survey, although they were found in low numbers. We recommend stocking of these two species continue at the current stocking rates, however; a creel census should be conducted to determine what level of angler harvest is being created from the stocking of these species.

Strategy 3: Creel Census

Little information is known about the harvest of warmwater gamefish from Washburn Island Pond. We recommend a periodic creel census be conducted, as time and budget permits, to monitor harvest of largemouth bass, bluegill, black crappie, and channel catfish population. Creel information may be valuable in determining the effects of regulation changes, implementation of management strategies, and provides a measure for evaluating fish stocking activities.

Strategy 4: Population Monitoring

A warmwater fish survey should be conducted every three to four years to monitor age and size structure, condition, species composition, PSD, catch rates, and abundance. In addition, monitoring of the fish community is recommended at least yearly if management strategies have been implemented. These warmwater surveys can be a useful tool for aiding management biologists in detecting changes in fish community structure associated with fish stocking, regulation changes, or fish removal activities.

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Glossary

Catch Per Unit Effort (CPUE): Is defined as the number of fish captured by a sampling method (i.e., electrofisher, gill nets, or fyke nets) divided by the amount of time sampled.

Confidence Interval (CI): Is defined as an estimated range of values that is likely to include an unknown population parameter with a percentage or degree of confidence.

Memorable Size: Is defined as fish anglers remember catching, and also identified as 59-64 percent of the world record length. Memorable length varies by species.

Preferred Size: Is defined as the size fish anglers preferred to catch when given a choice, and also identified as 45-55 percent of world record length. Preferred length varies by species.

Proportional Stock Density (PSD): Is defined as the number of quality length fish and larger, divided by the number of stock sized fish and larger, multiplied by 100.

Quality Length: Is defined as the length at which anglers begin keeping fish. Also identified as 36-41 percent of world record length. Quality length varies by species.

Relative Stock Density (RSD): Is defined as the number of fish of a specified length category (preferred, memorable, or trophy) and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Preferred Fish (RSD-P): Is defined as the number of fish in the preferred size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Memorable Fish (RSD-M): Is defined as the number of fish in the memorable size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Stock Density of Trophy Fish (RSD-T): Is defined as the number of fish in the trophy size category and larger, divided by the number of stock length fish and larger, multiplied by 100.

Relative Weight (W_r): The comparison of the weight of a fish at a given size to the national average weight (W_r = 100) of fish of the same species and size.

Standard Weight (W_s): Is defined as a standard or average weight of a fish species at a given length determined by a national length-weight regression.

Stock Length: Is defined by the following: 1) approximate length of fish species at maturity, 2) the minimum length effectively sampled by traditional sampling gears, 3) minimum length of fish that provide recreational value, and 4) 20-26 percent of world record length. Stock length varies by species.

Total Length (TL): Is defined as the length measurement from the anterior most part of the fish to the tip of the longest caudal (tail) fin ray (compressed).

Trophy Size: Is defined as the minimum size fish worthy of acknowledgment. Is also identified as 74-80 percent of world record length. Trophy length varies by species.