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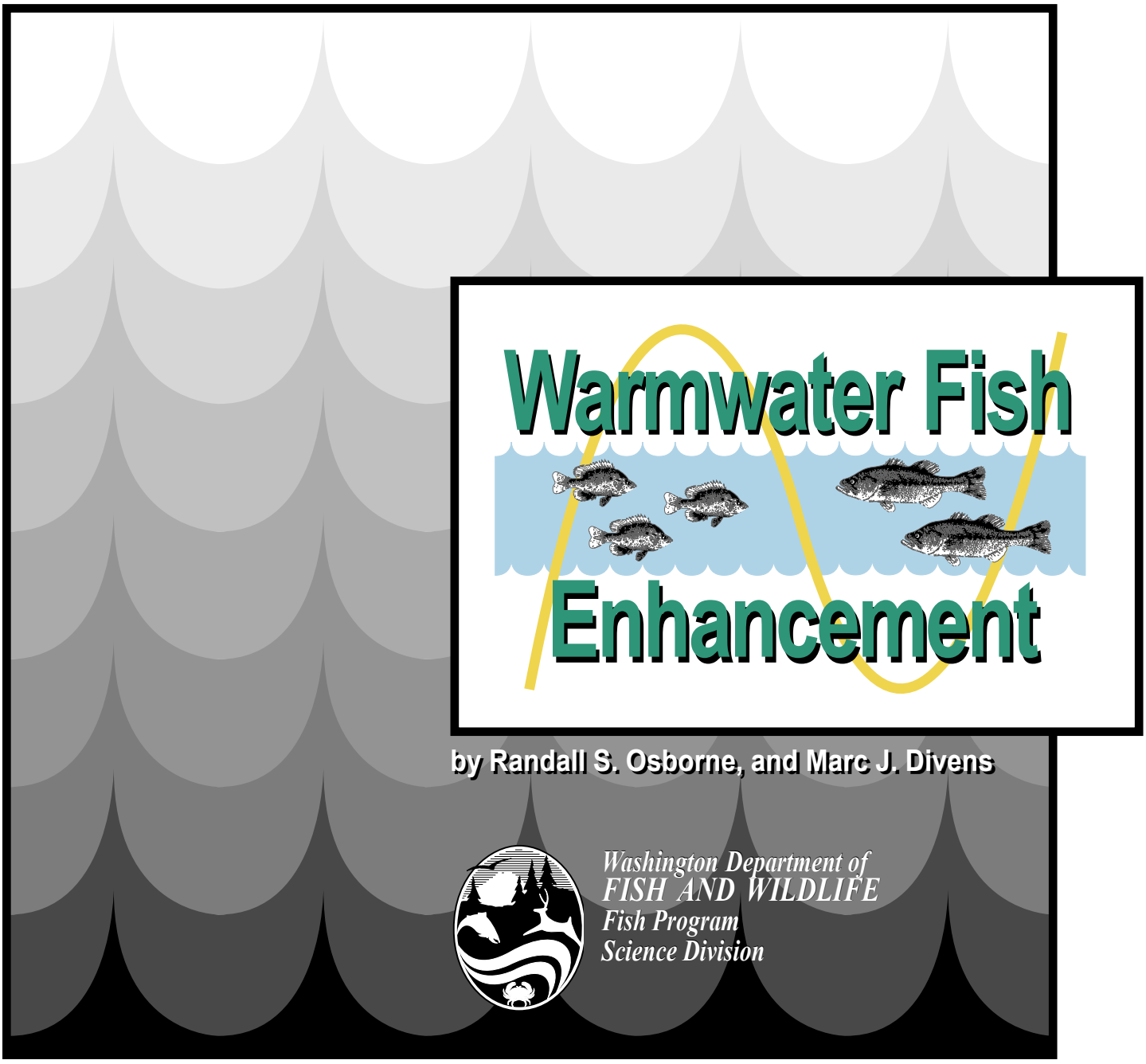
# 2004 Warmwater Fisheries Survey of Bear Lake, Spokane County, Washington




by Randall S. Osborne, and Marc J. Divens

*Washington Department of*
*FISH AND WILDLIFE*
*Fish Program*
*Science Division*

FPT 05-13

# 2004 Warmwater Fisheries Survey of Bear Lake, Spokane County, Washington

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# Abstract

Bear Lake (Spokane County) was surveyed by a 3-person investigation team June 8-9, 2004. Fish were sampled by boat electrofishing, gill netting, and fyke netting. Five fish species were collected. Excluding young-of-the-year, green sunfish *Lepomis cyanellus* (n=82) and yellow perch *Perca flavescens* (n=74) were the most abundant species sampled during collection activities. A total of 1,325 young-of-the-year yellow perch were observed during the survey. Largemouth bass *Micropterus salmoides* contributed the highest (71%) proportion of the biomass. Channel catfish *Ictalurus punctatus* and rainbow trout *Oncorhynchus mykiss* were also collected. Although a few larger size green sunfish and yellow perch were observed in Bear Lake, most are too small to provide much angling value. Largemouth bass up to 18 inches were observed in Bear Lake. However, most were sampled in areas inaccessible to shoreline anglers. Rainbow trout observed in Bear Lake were in poor condition, which is likely due to competition with the numerous green sunfish, yellow perch, and small largemouth bass in the lake. Considering the importance to the local angling public, trout stocking, or stocking a combination of trout and channel catfish, should continue. In addition, providing disabled and juvenile anglers with paved trails and fishing piers would enhance access to shoreline areas currently covered with emergent vegetation.

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# Introduction

Bear Lake (also called Kuester Lake) is located within Bear Lake County Park approximately 24 km north of the city of Spokane in Spokane County (Figure 1). Bear Lake has a surface area of 13.8 hectares, a mean depth of 6.1 meters, and is approximately 15 meters at its deepest point (Table 1). The lake has no visible inlets or outlets. Development along the lake shoreline includes a day-use picnic area, restroom facilities, and several docks. No boat launch exists on Bear Lake. Boats are allowed but must be launched by hand. Recreation activities in the area include fishing, bird watching, hiking, bicycling, swimming, and picnicking.

**Table 1.** Physical characteristics of Bear Lake (Spokane County).

| Physical Parameters | Measurement |
|---|---|
| Surface Area (ha) | 13.8 |
| Shoreline Length (km) | 1.8 |
| Maximum Depth (m) | 15.2 |
| Mean Depth (m) | 6.1 |
| Volume (acre-ft) | 690.0 |
| Shoreline Development $D_L$ | 1.3 |

Historically, rainbow trout *Oncorhynchus mykiss* were the primary emphasis of fish management in Bear Lake. However, warmwater fish species such as largemouth bass *Micropterus salmoides*, yellow perch *Perca flavescens*, and black crappie *Pomoxis nigromaculatus* were present in the lake since before 1939 (WDFW unpublished data). Channel catfish *Ictalurus punctatus* were first stocked (n=1,200) in the lake in 2003 (Table 2). The first recorded rainbow trout stocking occurred in 1938 (WDFW 2004). Since 1989, WDFW has stocked over 62,000 rainbow trout into Bear Lake ranging in size from 6.4 to 0.2 fish/pound (Table 2). Currently, Bear Lake is managed as a juvenile fishing water which entitles juveniles under 15 years of age, licensed adults accompanied by a juvenile, and persons possessing a reduced fee disability license, to fish the lake. Bear Lake is open year-round under the following regulations: trout - daily catch limit 5/day, no minimum size; channel catfish - daily catch limit 5/day, no minimum size; largemouth bass - daily catch limit 5/day, no minimum size, only bass less than 12 inches or greater than 17 inches may be retained, no more than one over 17 inches may be retained, bass may be caught, retained, and released alive from a livewell until a daily limit is in possession. There is no size or catch limit on yellow perch or green sunfish *Lepomis cyanellus*.

On June 8-9, 2004, personnel from the WDFW Warmwater Enhancement Program conducted a fishery assessment on Bear Lake. The results from this survey were used to identify possible trends in abundance, condition, reproduction, and population size structure of fish in the lake.

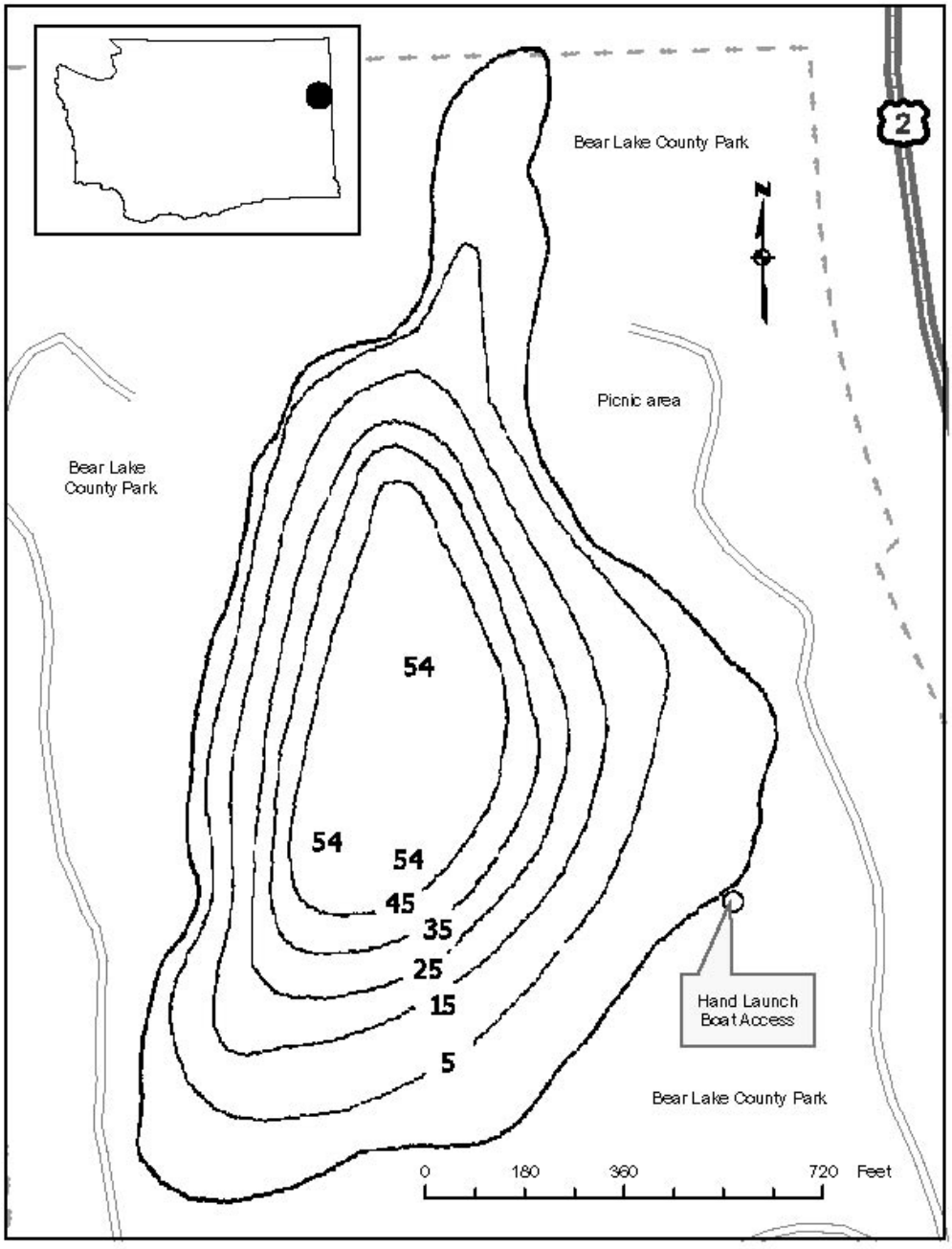


**Figure 1. Bathymetric map of Bear Lake (Spokane County).**

**Table 2.** Fish stocked into Bear Lake (Spokane County) by WDFW. Species included rainbow trout (RB) and channel catfish (CC).

| Year | Species | Number | Fish/lb. | Year | Species | Number | Fish/lb. |
|---|---|---|---|---|---|---|---|
| 1989 | RB | 10 | 0.7 | 1999 | RB | 250 | 0.4 |
| | RB | 598 | 2.3 | | RB | 1,000 | 3.2 |
| 1990 | RB | 2,024 | 4.5 | | RB | 2,103 | 4.3 |
| 1991 | RB | 2,001 | 2.6 | | RB | 4,070 | 5.5 |
| 1992 | RB | 2,090 | 2.1 | 2000 | RB | 50 | 0.4 |
| 1994 | RB | 40 | 0.3 | | RB | 2,024 | 4.4 |
| | RB | 8,132 | 3.8 | | RB | 1,996 | 6.4 |
| 1995 | RB | 15 | 0.2 | 2001 | RB | 50 | 0.2 |
| | RB | 5,031 | 4.3 | | RB | 2,000 | 3.7 |
| 1996 | RB | 30 | 0.6 | | RB | 4,043 | 4.8 |
| | RB | 4,687 | 4.3 | 2002 | RB | 254 | 0.3 |
| 1997 | RB | 17 | 0.3 | | RB | 2,210 | 3.4 |
| | RB | 78 | 0.8 | 2003 | RB | 2,964 | 3.8 |
| | RB | 5,054 | 4.5 | | RB | 2,025 | 4.5 |
| 1998 | RB | 100 | 0.2 | | CC | 1,200 | 1.3 |
| | RB | 5,070 | 6.0 | 2004 | RB | 2,300 | 4.3 |

# Methods and Materials

Bear Lake was surveyed by a 3-person team on June 8-9, 2004. All fish were collected using a boat electrofisher, gill nets, and fyke nets. The electrofishing unit consisted of a Smith-Root GPP electrofishing boat, using a DC current of 120 cycles/sec at 3 to 4 amps power. Experimental gill nets (45.7 m x 2.4 m) consisted of variable size (13, 19, 25, and 51 millimeter [mm] stretched) monofilament mesh. Fyke nets were constructed of a main trap (4.7 m long and 1.2 m in diameter with five aluminum hoops), a single 30.3 m lead, and two 7.6 m wings. All netting material was constructed of 6.35 mm nylon mesh.

Sampling locations were selected by dividing the shoreline into three sections of approximately 400 meters each. All three sections were sampled by nighttime boat electrofishing. Electrofishing was conducted in shallow water (depth range: 0.2 - 1.5 m), adjacent to the shoreline at a rate of approximately 18.3 m/minute for 600 second intervals (Bonar et al. 2000). Total electrofishing time during the survey was 1,800 seconds. Two sections were sampled by gill netting and two by fyke netting (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 (one net night each). This methodology was used to maintain a standardized 3:2:2 ratio of electrofishing to gill netting to fyke netting (three 10-minute electrofishing sections: two net-nights of gill netting: two net-nights of fyke netting) which was consistent with statewide Warmwater Program protocol (Bonar et al. 2000). All sampling was conducted during night time hours when fish are most numerous along the shoreline, thus maximizing the efficiency of each gear type. Sampling at night can be more effective because some fish species seek shelter during the day and move freely at night (Helfman 1983).

Captured fish were identified to species, measured in millimeters to total length (TL), and weighed to the nearest gram (g). Approximately 200 yellow perch less than 90 mm TL were measured and weighed. All other yellow perch less than 90 mm TL were enumerated. Total length data were used to construct length-frequency histograms and to evaluate the size structure of the warmwater gamefish. Scales were collected from largemouth bass, green sunfish, and yellow perch to analyze age and growth. The above species were assigned to a 10 mm size group based on total length, and scale samples were collected from five fish in each size group (Bonar et al. 2000). Scale samples were mounted on adhesive data cards, pressed onto acetate slides using a Carver® laboratory press, and aged according to Jearld (1983) and Fletcher et al. (1993).

Species composition, by weight (kg) and number, was determined from fish captured. Fish less than one year old, i.e., young-of-the-year, were excluded from all analyses. Including young-of-the-year fish in the calculation of species composition can give a false impression of year class strength due to the abundance of small fish, which can suffer extensive mortality during the first winter (Chew 1974). In addition, eliminating young-of-the-year fish prevents distortions in analyses that may have occurred 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. The CPUE of electrofishing was determined by dividing the number of fish captured by the total amount of time that was electrofished. Similarly, CPUE of gill netting and fyke netting was determined by dividing the number of fish captured by the total time the nets were deployed. Standardized CPUE allows for comparisons of catch rates between different lakes or sampling dates on the same water.

Relative weight ($W_r$) was used to evaluate the condition of fish in Bear Lake. 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 standard (75$^{th}$ percentile) for that species and length. The index is defined as $W_r = W/W_s$ H 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 $(W_s)$ was derived from a standard weight-length ($\log_{10}$) relationship which was defined for each species of interest (Anderson and Neumann 1996, Bister et al. 2000). Minimum lengths were used for each species as the variability can be significant for young-of-the-year fish. Relative weights less than 50 and greater than 150 were excluded from our analyses as we suspected unreliable weight measurements.

Age and growth of warmwater gamefish in Bear Lake 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). Where applicable, mean back-calculated lengths-at-age (direct proportion) for all warmwater gamefish species were compared to those of either eastern Washington or statewide averages (Fletcher et al.1993).

The proportional stock density (PSD) of each warmwater gamefish species was determined following procedures outlined in Anderson and Neumann (1996). Proportional stock density uses two measurements, stock length and quality length, to provide useful information about the

proportion of various size fish in a population. Stock length is defined as the minimum size of a fish which provides recreational value or the approximate length when fish reach maturity (Table 3). Quality length is defined as the minimum size of a fish that most anglers like to catch or begin keeping. Proportional stock density is calculated using the number of quality size fish, divided by the number of stock size fish, multiplied by 100. Stock and quality lengths, which vary by species, are based on percentages of world-record lengths. Stock length is 20-26 percent of world record length, whereas quality length is 36-41 percent of world record length.

**Table 3.** Minimum total length (mm) categories of warmwater fish species used to calculate PSD and RSD values (Anderson and Neumann 1996; Bister et al. 2000). Numbers in parenthesis represent percentages of world record lengths (Gabelhouse 1984).

| | Standard Length Categories | | | | |
|---|---|---|---|---|---|
| **Species** | **Stock (20-26%)** | **Quality (36-41%)** | **Preferred (45-55%)** | **Memorable (59-64%)** | **Trophy (74-80%)** |
| Yellow perch | 130 | 200 | 250 | 300 | 380 |
| Green sunfish | 80 | 150 | 200 | 250 | 300 |
| Largemouth bass | 200 | 300 | 380 | 510 | 630 |

Relative stock density (RSD) of each warmwater gamefish species was examined using the 5-cell model proposed by Gabelhouse (1984). In addition to stock and quality lengths, the Gabelhouse model adds preferred, memorable, and trophy categories (Table 3). Preferred length (RSD-P) is defined as the minimum size of fish anglers would prefer to catch. Memorable length (RSD-M) 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. 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. Relative stock density differs from PSD in that it is more sensitive to changes in year-class strength. Relative stock density is calculated as the number of fish within the specified length category, divided by the total number of stock length fish, multiplied by 100. Eighty-percent confidence intervals for PSDs and RSDs are provided as an estimate of statistical precision and were calculated using normal approximation (Conover 1980; Gustafson 1988).

# Results

## Species Composition

A total of five fish species were observed in June 2004 (Table 4). Warmwater gamefish comprised approximately 95 percent of the total fish captured. Excluding young-of-the-year for all species encountered, green sunfish was the most numerous species (35.7%) encountered in the samples, but contributed less than 10 percent of the biomass. Yellow perch and largemouth bass also represented a relatively high proportion of the sample by number. Although largemouth bass comprised approximately 26 percent of the total fish sampled, they contributed over 70 percent of the biomass. Channel catfish and rainbow trout, combined, contributed less than 7 percent of the sample by number. Yellow perch was the only species of which a substantial portion of the sample consisted of young-of-the-year (Table 5).

**Table 4.** Species composition, by weight (kg) and number, of fish (excluding young-of-the-year) collected at Bear Lake (Spokane County), June 2004.

| | Species Composition | | | | | |
|---|---|---|---|---|---|---|
| | Weight | | Number | | Size Range (mm TL) | |
| Type of Fish | kg | % | No. | % | Min. | Max. |
| Channel catfish | 0.7 | 2.0 | 2 | 0.9 | 263 | 392 |
| Green sunfish | 3.3 | 9.5 | 82 | 35.7 | 60 | 217 |
| Largemouth bass | 24.6 | 70.7 | 59 | 25.7 | 105 | 454 |
| Rainbow trout | 3.4 | 9.9 | 13 | 5.7 | 228 | 487 |
| Yellow perch | 2.7 | 7.9 | 74 | 32.2 | 90 | 223 |

**Table 5.** Species composition, by weight (kg) and number, of all fish collected at Bear Lake (Spokane County), June 2004.

| | Species Composition | | | | | |
|---|---|---|---|---|---|---|
| | Weight | | Number | | Size Range (mm TL) | |
| Type of Fish | kg | % | No. | % | Min. | Max. |
| Channel Catfish | 0.7 | 1.8 | 2 | 0.1 | 263 | 392 |
| Green Sunfish | 3.3 | 8.3 | 83 | 5.3 | 37 | 217 |
| Largemouth Bass | 24.6 | 61.3 | 60 | 3.9 | 95 | 454 |
| Rainbow Trout | 3.4 | 8.6 | 13 | 0.8 | 228 | 487 |
| Yellow Perch | 8.0 | 20.1 | 1,399 | 89.9 | 55 | 223 |

## Catch Per Unit Effort

Largemouth bass were sampled at the highest rate by boat electrofishing followed by yellow perch and green sunfish (Table 6). Green sunfish, yellow perch, and largemouth bass were captured at the highest rates, respectively, by gill netting. Fyke netting catch rates were highest for green sunfish and yellow perch, but were low for all other species.

**Table 6.** Mean catch per unit effort (CPUE) by sampling method, including 80 percent confidence intervals, for fish (excluding young-of-the-year) collected from Bear Lake (Spokane County) in June 2004.

| | Gear Type | | | | | |
|---|---|---|---|---|---|---|
| | Electrofishing | | Gill Netting | | Fyke Netting | |
| Species | No./hour | No. Sites | No./Net Night | Net Nights | No./Net Night | Net Nights |
| Channel Catfish | 2.00 ± 2.56 | 3 | 0.00 | 2 | 0.00 | 2 |
| Green Sunfish | 66.00 ± 17.7 | 3 | 12.00 ± 8.97 | 2 | 12.50 ± 10.89 | 2 |
| Largemouth Bass | 108.00 ± 46.77 | 3 | 2.50 ± 1.92 | 2 | 0.00 | 2 |
| Rainbow Trout | 2.00 ± 2.56 | 3 | 2.00 ± 1.28 | 2 | 0.00 | 2 |
| Yellow Perch | 86.00 ± 16.81 | 3 | 5.00 ± 6.41 | 2 | 10.50 ± 13.46 | 2 |

## Stock Density Indices

Sample sizes of stock-length fish were low for all species (Table 7) and resulting stock density values should be viewed with caution. Largemouth bass proportional stock density (PSD) and relative stock density (RSD) were high indicating a high proportion of large fish in the population. Most green sunfish were small as evidenced by the low PSD values; however, preferred size green sunfish were observed in low numbers. Few stock size yellow perch were sampled.

**Table 7.** Traditional stock density indices, including 80 percent confidence intervals, of fish collected from Bear Lake (Spokane County) in June 2004.

| Species | # Stock Length | PSD | RSD-P | RSD-M | RSD-T |
|---|---|---|---|---|---|
| | | **Electrofishing** | | | |
| Largemouth Bass | 35 | 71 ± 10 | 40 ± 11 | 0 | 0 |
| Green Sunfish | 26 | 4 ± 5 | 0 | 0 | 0 |
| Yellow Perch | 14 | 14 ± 12 | 0 | 0 | 0 |
| | | **Gill Netting** | | | |
| Largemouth Bass | 4 | 75 ± 28 | 50 ± 32 | 0 | 0 |
| Green Sunfish | 22 | 5 ± 6 | 0 | 0 | 0 |
| Yellow Perch | 10 | 100 ± 0 | 0 | 0 | 0 |
| | | **Fyke Netting** | | | |
| Green Sunfish | 22 | 27 ± 12 | 9 ± 8 | 0 | 0 |
| Yellow Perch | 10 | 10 ± 12 | 0 | 0 | 0 |

# Largemouth Bass

Largemouth bass sampled from Bear Lake ranged in length from 105 to 454 mm TL (Table 4; Figure 2) and ranged in age from 1 to 10 years (Table 8). With the exception of ages 2, 3, 4, and 5, growth of Bear Lake largemouth bass was below the eastern Washington average. One young-of-the-year largemouth bass was sampled (Table 5) during June 2004. The low number of young-of-the-year largemouth bass in the sample may have been an artifact of sample timing and/or gear bias. Largemouth bass exhibited variable condition, with relative weight values both above and below the national standard (Figure 3).

**Table 8.** Back calculated mean length at age (mm) of largemouth bass collected at Bear Lake (Spokane County) during June 2004. Unshaded values represent length at age calculated using the direct proportion method (Fletcher et al. 1993). Shaded values represent length at age calculated using Lee's modification of the direct proportion method (Carlander 1982).

| | | Mean Total Length (mm) at Age | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year Class** | **No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 2003 | 18 | 123 | | | | | | | | | |
| | | 124 | | | | | | | | | |
| 2002 | 11 | 54 | 190 | | | | | | | | |
| | | 68 | 192 | | | | | | | | |
| 2001 | 1 | 54 | 115 | 245 | | | | | | | |
| | | 70 | 126 | 246 | | | | | | | |
| 2000 | 6 | 56 | 131 | 206 | 305 | | | | | | |
| | | 72 | 143 | 212 | 305 | | | | | | |
| 1999 | 2 | 80 | 182 | 261 | 325 | 375 | | | | | |
| | | 96 | 192 | 267 | 328 | 376 | | | | | |
| 1998 | 5 | 56 | 140 | 235 | 306 | 349 | 390 | | | | |
| | | 74 | 153 | 243 | 310 | 351 | 390 | | | | |
| 1997 | 2 | 53 | 139 | 186 | 265 | 326 | 351 | 376 | | | |
| | | 70 | 151 | 196 | 271 | 329 | 352 | 376 | | | |
| 1996 | 5 | 52 | 137 | 218 | 287 | 333 | 365 | 392 | 413 | | |
| | | 69 | 150 | 228 | 293 | 337 | 367 | 393 | 413 | | |
| 1995 | 4 | 50 | 119 | 162 | 224 | 259 | 303 | 330 | 363 | 401 | |
| | | 67 | 133 | 174 | 233 | 266 | 307 | 334 | 365 | 401 | |
| 1994 | 3 | 54 | 110 | 161 | 207 | 244 | 281 | 315 | 349 | 371 | 400 |
| | | 71 | 124 | 173 | 217 | 252 | 287 | 319 | 351 | 372 | 400 |
| Overall Mean | | 63 | 140 | 209 | 274 | 314 | 338 | 353 | 375 | 386 | 400 |
| Weighted Mean | | 88 | 159 | 215 | 283 | 317 | 346 | 358 | 382 | 388 | 400 |
| E. WA Mean | | 69 | 136 | 189 | 249 | 300 | 352 | 422 | 438 | NA | NA |

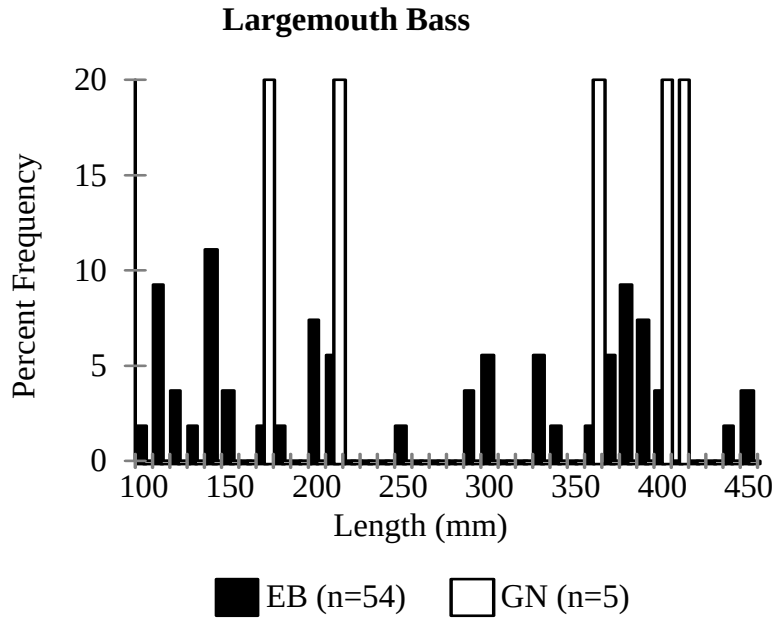


**Figure 2.** Length frequency distribution of largemouth bass sampled by boat electrofishing (EB) and gill netting (GN) at Bear Lake (Spokane County) in June 2004.

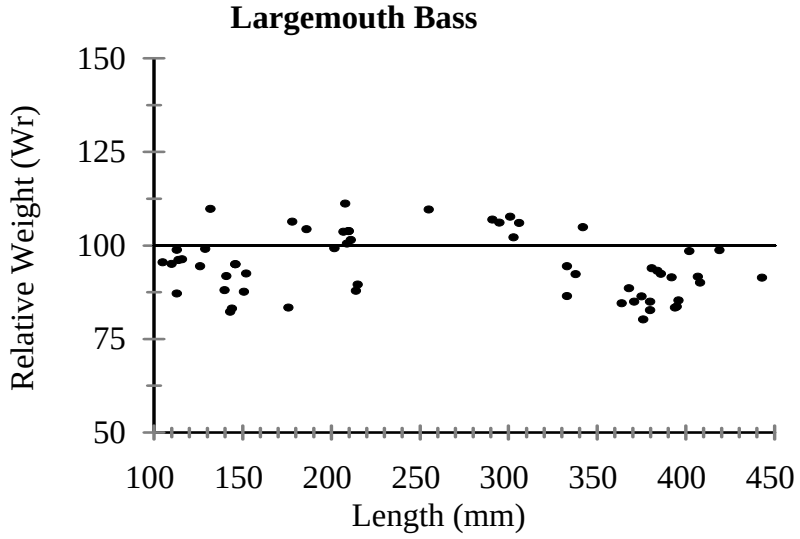


**Figure 3.** Relative weights of largemouth bass (n=59) sampled at Bear Lake (Spokane County) in June 2004, as compared to the national 75$^{th}$ percentile, $W_r$=100 (Anderson and Neumann 1996).

## Green Sunfish

Green sunfish sampled from Bear Lake ranged in length from 60 to 217 mm TL (Table 4; Figure 4) and ranged in age from 1 to 7 years (Table 9). Although in low numbers, green sunfish sampled during this survey grew to 7 years of age, whereas the green sunfish population observed by Osborne and Divens (2004) in Pierre Lake grew to only 5 years of age. However, growth observed in both the Bear Lake and Pierre Lake green sunfish populations were similar between ages 1 and 5. One young-of-the-year green sunfish was sampled (Table 5) from Bear Lake in June 2004. The low number of young-of-the-year green sunfish in the sample may have been an artifact of sample timing and/or gear bias. The condition of green sunfish varied and appeared to increase with length (Figure 5). Larger green sunfish may experience a reduction in intra- and/or inter-specific competition and are able to utilize larger food items.

**Table 9.** Back calculated mean length at age (mm) of green sunfish collected at Bear Lake (Spokane County) during June 2004. Unshaded values represent length at age calculated using the direct proportion method (Fletcher et al. 1993). Shaded values represent length at age calculated using Lee's modification of the direct proportion method (Carlander 1982).

| | | Mean Total Length (mm) at Age | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year class** | **No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 2003 | 2 | 44 | | | | | | |
| | | 48 | | | | | | |
| 2002 | 13 | 29 | 70 | | | | | |
| | | 36 | 72 | | | | | |
| 2001 | 10 | 32 | 65 | 95 | | | | |
| | | 39 | 69 | 96 | | | | |
| 2000 | 17 | 34 | 67 | 109 | 130 | | | |
| | | 41 | 72 | 110 | 130 | | | |
| 1999 | 2 | 21 | 54 | 87 | 120 | 140 | | |
| | | 30 | 60 | 91 | 121 | 140 | | |
| 1998 | 4 | 23 | 57 | 100 | 139 | 170 | 189 | |
| | | 32 | 64 | 104 | 141 | 171 | 189 | |
| 1997 | 2 | 30 | 69 | 119 | 161 | 180 | 200 | 217 |
| | | 39 | 76 | 123 | 163 | 182 | 201 | 217 |
| Overall mean | | 30 | 64 | 102 | 137 | 163 | 195 | 217 |
| Weighted Mean | | 38 | 70 | 105 | 134 | 166 | 193 | 217 |
| WA State Mean | | NA | NA | NA | NA | NA | NA | NA |

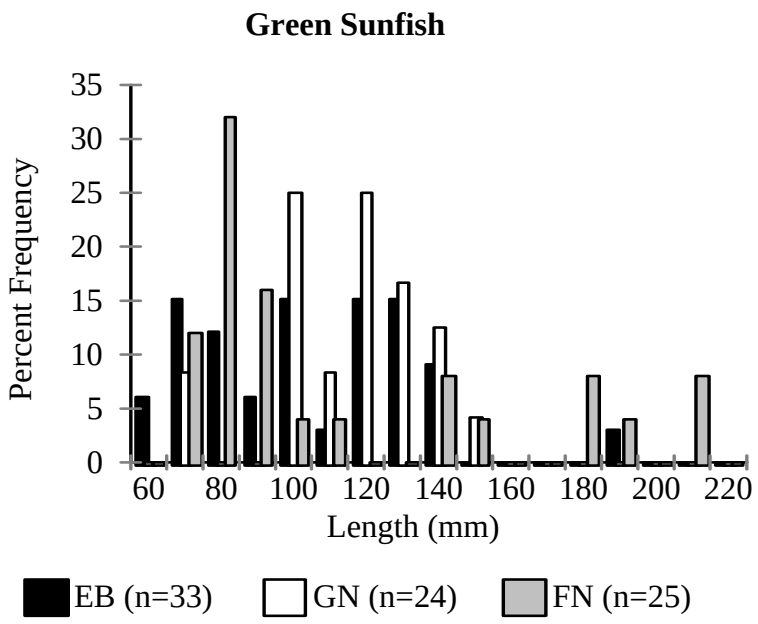


**Figure 4.** Length frequency distribution of green sunfish sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) at Bear Lake (Spokane County) in June 2004.

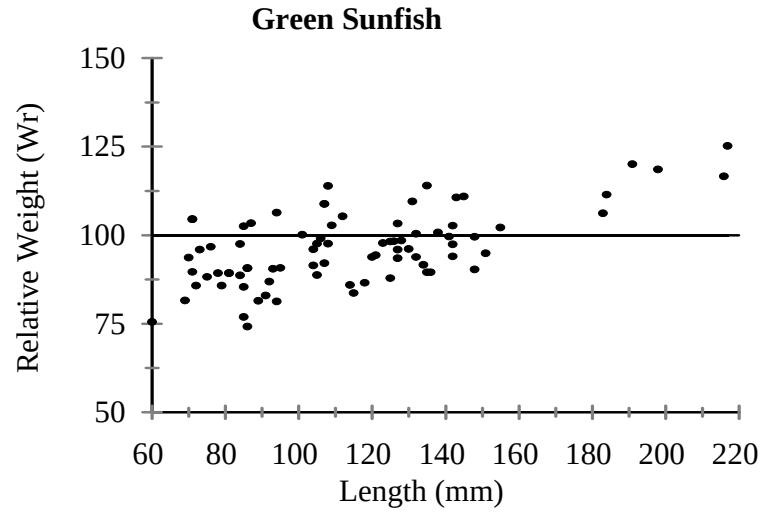


**Figure 5.** Relative weights of green sunfish (n=82) sampled at Bear Lake (Spokane County) in June 2004, as compared to the national 75$^{th}$ percentile, $W_r$=100 (Anderson and Neumann 1996).

## Yellow Perch

Yellow perch sampled from Bear Lake ranged in length from 90 to 223 mm TL (Table 4; Figure 6) and ranged in age from 1 to 4 years (Table 10). With the exception of age 1, growth of Bear Lake yellow perch were slightly below the statewide average. Length frequency distribution (Figure 6) and age data (Table 10) suggest a possible year-class failure in 2001. A total of 1,325 young-of-the-year yellow perch were sampled (Table 5) in June 2004. The condition of yellow perch were below the national standard at all sizes (Figure 7).

**Table 10.** Back calculated mean length at age (mm) of yellow perch collected at Bear Lake (Spokane County) during June 2004. Unshaded values represent length at age calculated using the direct proportion method (Fletcher et al. 1993). Shaded values represent length at age calculated using Lee's modification of the direct proportion method (Carlander 1982)

| | | Mean Total Length (mm) at Age | | | |
|---|---|---|---|---|---|
| **Year Class** | **# Fish** | **1** | **2** | **3** | **4** |
| 2003 | 20 | 68 | | | |
| | | 75 | | | |
| 2002 | 8 | 80 | 132 | | |
| | | 93 | 135 | | |
| 2001 | 0 | -- | -- | -- | |
| | | -- | -- | -- | |
| 2000 | 24 | 53 | 98 | 151 | 190 |
| | | 74 | 112 | 158 | 191 |
| Overall Mean | | 67 | 115 | 151 | 190 |
| Weighted Mean | | 78 | 118 | 158 | 191 |
| WA State Mean | | 60 | 120 | 152 | 193 |

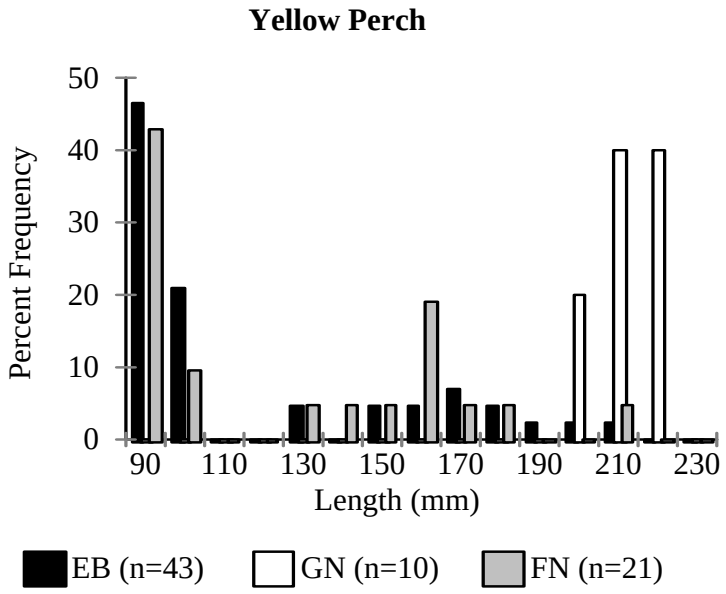


**Figure 6.** Length frequency distribution of yellow perch sampled by boat electrofishing (EB), gill netting (GN), and fyke netting (FN) at Bear Lake (Spokane County) in June 2004.

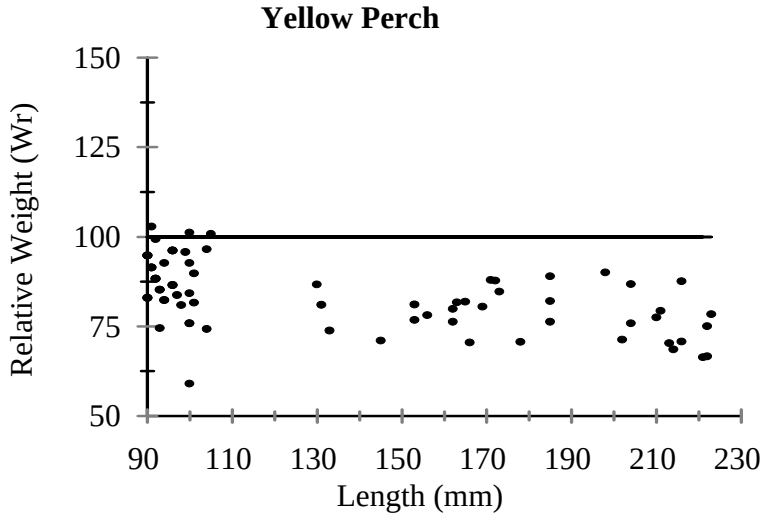


**Figure 7.** Relative weights of yellow perch (n=74) sampled at Bear Lake (Spokane County) in June 2004, as compared to the national 75$^{th}$ percentile, $W_r$=100 (Anderson and Neumann 1996).

## Rainbow Trout

Rainbow trout sampled from Bear Lake ranged in length from 228 to 487 mm TL (Table 4; Figure 8). Rainbow trout length frequency distribution is illustrative of a stocked "put-and-take" population and does not indicate natural reproduction. The condition of rainbow trout sampled was far below the national standard (Figure 9). Age and growth were not analyzed for rainbow trout.

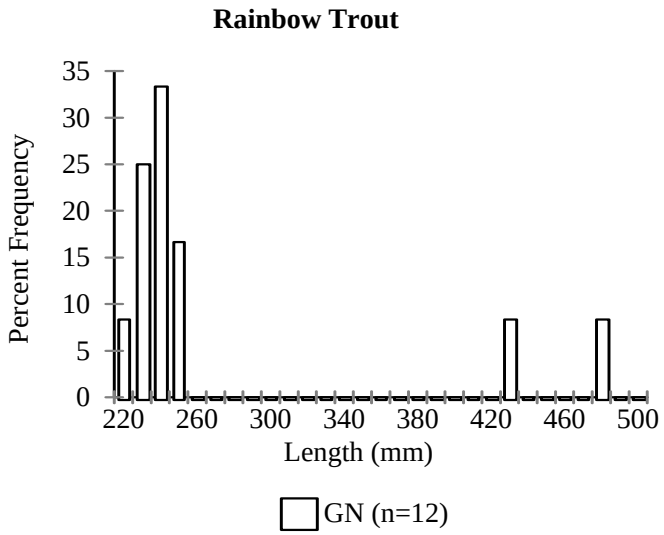


**Figure 8.** Length frequency distribution of rainbow trout sampled by gill netting (GN) at Bear Lake (Spokane County) in June 2004.

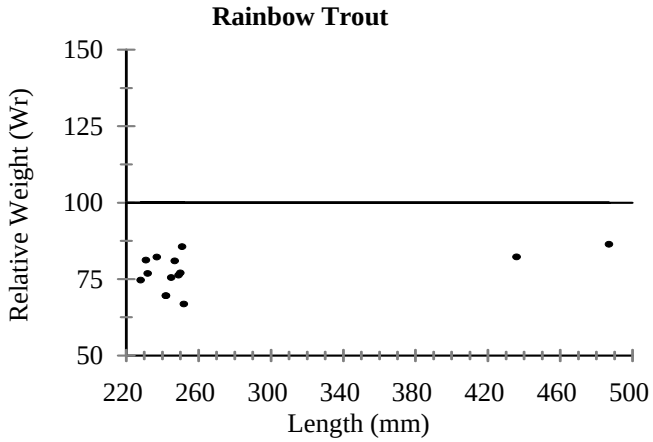


**Figure 9.** Relative weights of rainbow trout (n=13) sampled at Bear Lake (Spokane County) in June 2004, as compared to the national 75$^{th}$ percentile, $W_r$=100 (Anderson and Neumann 1996)

## Channel Catfish

A total of two channel catfish were sampled in Bear Lake during the June 2004 survey. One channel catfish was 263 mm in length and weighed 146 g. The other channel catfish was 392 mm in length and weighed 556 g. Both channel catfish were in good condition and exhibited relative weights near the national standard.

# Discussion

Presently, the most prominent component of the recreational fishery in Bear Lake is that of stocked hatchery trout. Although a few of the lake's disabled, juvenile, and accompanying adult anglers fish from boats, most utilize the fishing docks and landscaped shoreline available in the county park. Although rainbow trout up to 19 inches were sampled, all were in condition far below the national standard ($75^{th}$ percentile). This is likely due to competition with the populations of yellow perch, green sunfish, and smaller largemouth bass in the lake which also exhibited low relative weights. Largemouth bass up to 454 mm (18 inches) appear to be in moderate density; however, over 70 percent of Bear Lake's shoreline is covered with emergent vegetation and most largemouth bass were sampled in areas inaccessible to shoreline anglers. Over 1,300 young-of-the-year yellow perch were sampled indicating a strong 2004 year class. Although yellow perch up to 223 mm (9 inches) presently appear in moderate density, this strong year class may pose future problems since this species is prone to overpopulation and stunting in small lakes (Wydoski and Whitney 2003). Green sunfish up to 217 mm (8.5 inches) were sampled; however, most were small and likely provide little angling opportunity.

# Management Considerations

## Stocking

Considering the importance to the local angling public, trout and channel catfish stocking should continue at the current rates. The Washington Department of Fish and Wildlife stocks 2,000-5,000 rainbow trout into Bear Lake annually. In 2003, WDFW introduced channel catfish into Bear Lake to help reduce green sunfish and yellow perch densities and to provide the public with additional angling opportunity. Currently, the channel catfish stocking strategy includes stocking the lake in alternate years at a rate of 25 fish/acre. Channel catfish are typically stocked at 10-12 inches in length, whereas trout are stocked into Bear Lake at various sizes, including catchables and excess hatchery brood fish. Stocking excess hatchery brood trout, coupled with the high growth potential of channel catfish gives anglers the opportunity to catch fish of different sizes, including an occasional trophy size fish. The rainbow trout-channel catfish combination, or "adipose" option, is currently being used in some WDFW Region 3 waters with good success. The current state record channel catfish came from a pond managed under this management scheme (Divens et al. 2003). Management biologists should monitor Bear Lake to evaluate population dynamics of stocked channel catfish, including growth and condition, and to determine whether channel catfish, when stocked at the current rate, are reducing densities of yellow perch and green sunfish.

## Enhanced Shoreline Access

Over 70 percent of Bear Lake's shoreline is inaccessible to bank anglers. The addition of paved trails and fishing piers would enhance disabled and juvenile angler access to areas of the lake previously covered with emergent vegetation. Fishing piers would also serve as seasonal fish cover. In addition, artificial structure or fish attractors could be placed near each pier to promote harvest of the overabundant yellow perch and green sunfish in the lake. Artificial structure may also increase shoreline angler satisfaction and maximize the benefits of the fishing piers.

# Literature Cited


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, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Bister, T. J., D. W. Willis, M. L. Brown, S. M. Jordan, R. M. Neumann, M. C. Quist, and C. S. Guy. 2000. Proposed standard weight ($W_s$) equations and standard length categories for 18 warmwater nongame and riverine fish species. North American Journal of Fisheries Management 20:570-574.

Bonar, S. A., B. D. Bolding, and M. Divens. 2000. Standard fish sampling guidelines for Washington State pond and lake surveys. Report No. FPT 00-28, Washington Department of Fish and Wildlife, Olympia, Washington. 24pp.

Carlander, K. D. 1982. Standard intercepts for calculating length from scale measurements for some centrarchid and percid fishes. Transactions of the American Fisheries Society 111:332-336.

Chew, R. L. 1974. Early life history of the Florida largemouth bass. Fishery Bulletin No.7. Florida Game and Freshwater Fish Commission. 76 pp.

Conover, W. J. 1980. Practical nonparametric statistics, 2nd edition. John Wiley and Sons, Inc., New York, New York.

Divens, M. J., H. Woller, and R. Osborne. 2003. Warmwater fisheries surveys of the I-82 ponds (Yakima County) 2000 & 2001. Technical Report FPT04-01, Washington Department of Fish and Wildlife, Olympia, Washington.

Fletcher, D., S. A. Bonar, B. D. Bolding, A. Bradbury, and S. Zeylmaker. 1993. Analyzing warmwater fish populations in Washington State. Warmwater fish survey manual. Washington Department of Fish and Wildlife, Olympia, Washington. 164pp.

Gablehouse, D. W., Jr. 1984. A length categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gustafson, K. A. 1988. Approximating confidence intervals for indices of fish population size structure. North American Journal of Fisheries Management 8:139-141.

Helfman, G. S. 1983. Underwater methods. Pages 349-369 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Jerald, A., Jr. 1983. Age determination. Pages 301-324 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Osborne, R. S. and M. J. Divens. 2004. 2002 warmwater fisheries survey of Pierre Lake, Stevens County, Washington. Technical Report FPT 04-07. Washington Department of Fish and Wildife, Olympia.

WDFW. 1939. Unpublished fisheries report on Kuester Lake. Washington Department of Fish and Wildlife, Region 1 Fisheries Management.

WDFW. 2004. Fish stocking records of Bear Lake, Spokane County. Fish Stocking Database, Washington Department of Fish and Wildlife, Olympia.

Wydoski, R. S. and R. R. Whitney. 2003. Inland fishes of Washington, 2nd edition. American Fisheries Society in Association with University of Washington Press, Seattle and London.

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