# Colville Tribal Fish Hatchery

**Annual Report**
**2001 - 2002**

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# COLVILLE TRIBAL FISH HATCHERY ANNUAL REPORT FOR 2002

CCT/RF-2003-1

March 2003

# Colville Confederated Tribes Fish and wildlife Department
# Resident Fish Division

## COLVILLE TRIBAL FISH HATCHERY ANNUAL REPORT FOR 2002

October 1, 2001 – September 30, 2002
CCT Project # 3120
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Prepared for

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# Executive Summary

The Colville Tribal Hatchery produced 56,934 pounds of trout, 6,934 pounds more than the minimum production goal of 50,000 pounds. To accomplish this and to apply adaptive management based on the best available knowledge, CTH increased the size of fish planted into Colville Reservation Lakes. Considerable progress was made in 2002 to develop a captive redband trout brood stock at CTH by expanding raceway rearing space and acquiring seed fish. These efforts should start to produce eggs that can partially replace the current costal rainbow trout stocks currently being raised and stocked in 2004. Creel Data indicated that the average production of all lakes sampled was 3 pounds per pound of fish stocked. Creel data provided strong support for continued adaptive management and trout stocking into Colville Reservation waters. Creel data collection should be expanded where possible to provide a more complete picture of hatchery production benefits that occur post-stocking. Lake survey work should continue to focus on filling data gaps for reservation waters. A multitude of lakes smaller than 50 acres exist on the Colville Reservation however these waters represent mostly marginal fisheries at best and have limited production potential. The main factors limiting trout production in these waters includes, insufficient depth, warm summer temperatures, low dissolved oxygen in summer and winter, competition from non-salmonid fishes, and high alkalinity. Some smaller waters could be managed or rehabilitated to improve production but most have little productivity potentiality for trout and others could produce sustainable warm-water fisheries. Restoration or rehabilitation work for these small lakes should be prioritized with consideration for economic benefit, production capacity, long-term sustainability, risks to the ecosystem, and the desires of the Tribes membership.

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# Introduction

Federal hydropower projects as well as private power utility systems have had a major negative impact upon anadromous fish resources that once flourished in the Columbia River and it's tributaries. Several areas have been completely blocked to anadromous fish by dams, destroying the primary food resource (salmon) for many native people forcing them to rely heavily upon resident fish to replace these lost resources. The Colville Tribal Fish Hatchery is an artificial production program that addresses the loss of anadromous fish resources in the Upper Columbia Sub-Region within the "blocked area" created by the construction of Chief Joseph and Grand Coulee Dams. This project enhances resident fisheries located in the Intermountain and Columbia Cascade Provinces, specifically within the Colville Reservation portion of the Upper Columbia, SanPoil and Oakanogan Sub-Basins. The project partially mitigates for anadromous fish losses through protection/augmentation of resident fish populations to enhance fishery potential (i.e. in-place, out -of-kind mitigation) pursuant to Resident Fish Substitution Policy of the Northwest Power Planning Councils Fish and Wildlife Program. The hatchery was accepted into the Council's Fish and Wildlife Program in 1984 and the hatchery was completed in 1990.

The Colville Tribal Hatchery (CTH) is located on the northern bank of the Columbia River just down stream of the town of Bridgeport, Washington that is just down stream of Chief Joseph Dam. The hatchery is located on land owned by the Colville Tribes. The minimum production quota for this facility is 22,679 kg (50,000 lbs.) of trout annually. All fish produced are released into reservation waters, including boundary waters in an effort to provide a successful subsistence /recreational fishery for Colville Tribal members and provide for a successful non-member sport fishery. The majority of the fish distributed from the facility are intended to support "carry-over" fisheries. Fish produced at the facility are intended to be of sufficient quality and quantity to meet specific monitoring and evaluation goals and objectives outlines in the 2002 statement of work (SOW).

**Methods**

Methods used throughout this project were standard fisheries methodologies and are available in several documents already (i.e. the Colville Tribal Hatchery 2002 SOW, Colville Tribal Hatchery Genetic Management Plans, etc.). To expedite this document and reduce it's size, methods are not restated in this document unless comments were inserted indicating that a change occurred.

**Goal**

The goal of the project as stated in the 2002 Statement Of Work (SOW) was to provide artificial production of fish that will help support and enhance tribal subsistence fisheries and non-tribal recreational sport fisheries within the Colville reservation, including it's boundary waters. The majority of the hatchery production provides "carry-over" rather than a "put-and-take" fisheries.

**Results and Conclusions**

## Spawning, Rearing and Distribution

**Objectives**

1 Integrate triploiding technology and knowledge into the Colville Tribal Hatchery (CTH) yet still maintain a 22,679 kg (50,000 lbs) minimum production of resident salmonids to be planted into reservation waters. See Table 1 for specific tasks.

**Table 1**.-Tasks by numbers and description from 2002 SOW associated with this objective 1 for Colville Tribal Hatchery production with results from 2002 quantified were possible.

| Task | Description | Results/status |
|---|---|---|
| 1A | Hatch, rear and stock 19,200 lbs. of yearling (5 fish/lb) triploid rainbow trout. | Completed/on-going (29,052 pounds) |
| 1B | Hatch, rear and stock 9,600 lbs. of sub-yearling (25 fish/lb) rainbow trout of which up to 8,859 lbs. should be triploid. | Completed/on-going (12,535 pounds) |
| 1C | Hatch, rear and stock 3,683 lbs. of fingerling size (90 fish/lb) rainbow trout. | Not Completed-raised to larger sizes |
| 1D | Hatch, rear and stock 7,200 lbs. of sub-yearling (25 fish/lb) eastern brook trout of which up to 6,100 lbs. should be triploid. | Completed/on-going (5,559 pounds) |
| 1E | Hatch, rear and stock 2,424 lbs. of fingerling size (90 fish/lb) eastern brook trout. | Not Completed all fish raised to larger sizes. |
| 1F | Rear and stock 2,595 lbs. of sub-yearling (25 fish/lb) lahontan cutthroat trout. | Completed/on-going (8,172 pounds) |
| 1G | Rear and stock 2,400 lbs. of sub-yearling (25 fish/lb) westslope cutthroat trout. | Completed (1,009 pounds) |
| 1H | Rear and stock 4,480 lbs of redband trout. NOTE: We have acquired a placeholder for a minimum of 10,000 redband trout from WDFW. We would like to utilize these fish for a captive brood stock program. At this time, our rearing troughs are at capacity and expanding raceway capacity is possible using carry-over funds in 2002. | Not Completed in 2002 due to hatchery losses at the WDFW Colville Hatchery Facilities completed/on-going. |
| 1J | Provide monthly fish health monitoring for all stocks. | Completed by Bob Rogers-Fish health specialists for WDFW/ On-going |
| 1K | Receive approximately 1.3 million coastal rainbow trout green eggs from Washington Department of Fish and Wildlife facilities (in-kind support $24,000, Goldendale hatchery). | Completed/On-going (1,451,102 eggs) |

| | | |
|---|---|---|
| 1L | Develop the technical expertise and equipment necessary to triploid 800,000 eggs. | Completed |
| 1M | Annually, obtain 800,000 eastern brook trout eggs from Owhi Lake brood stock and develop the technical expertise and equipment necessary to triploid 400,000 of these eggs. | Completed/On-going (602,000 eggs) |
| 1O | Used least cost approach by obtaining 65,000 fingerling lahontan cutthroat trout for WDFW, Omak Hatchery at 300 fish/lb. (in-kind support $13,000) since both brood stocks have the same origin. | Completed/On-going (70,000@200/lb) |
| 1P | Obtain and rear 100,000 westslope cutthroat eyed eggs and 26,000 fry from WDFW hatchery located at Lake Chelan (in-kind support $9,200). | Completed (26,055 fish but no eggs received) |

**Table 2.**-Colville Tribal Hatchery 2002 production in numbers (fish or eggs) with survival for various stages in production.

**2002 stock survival at the Colville Tribal Hatchery**

| Stock | Eggs In | Survival to ponding | Fish ponded | Survival to plant or date | Fish Remaining | Fish Planted | Comments |
|---|---|---|---|---|---|---|---|
| ESRBT-01 | | | | 100% | 84,593 | 84,490 | Carry-over from last year |
| GDRBT-00-L | | | | 99% | 18,420 | 18,308 | Carry-over from last year |
| LCT01 | | | | 99% | 130,724 | 129,864 | Carry-over from last year |
| WSCT-01 | | | | 98% | 23,029 | 22,578 | Carry-over from last year |
| OBKT-01-F | 360,910 | 38% | 138,627 | 83% | | 115,125 | Stocked as subcatchables |
| GRBT01 | 602,000 | 62% | 371,248 | 96% | | 357,969 | Stocked as subcatchables |
| OBKT-01-T | 241,201 | 15% | 35,491 | 92% | 22,450 | 10,052 | Subcatchable plants and carry over |
| ERBT02T | 132,000 | 15% | 19,762 | | | | |
| GRBT01T | 400,000 | 13% | 50,061 | 53% | 179,802 | | Combined triploid rainbows after CWD outbreak |
| SRBT02T | 317,102 | 85% | 269,456 | | | | |
| **Totals** | 2,053,213 | 43% | 884,645 | 77% | 202,252 | 483,146 | Total fish planted doesn,t include carry over fish |

To achieve the minimum production quota CTH received 317,102 eyed triploid rainbow trout eggs from the WDFW Spokane Hatchery in January of 2002, plus 602,000 eyed rainbow trout eggs that were viable from the WDFW Goldendale Hatchery along with 400,000 green eggs that were triploided upon arrival at CTH in December of 2001. An additional 132,000 green eggs were provided for triploiding from the WDFW Ell Springs Hatchery on January 30$^{th}$, 2002. Eyed egg survival was predictably higher ranging from 62% for Goldendale stock eggs to 85% for triploided Spokane stocks (Table 2). Green egg survival was only 38% for viable Owhi Lake brook trout but when triploiding at CTH green egg survival ranged from 13 to 15%. Although these numbers appear low, green egg survival has been shown to be as low as 24% on salmonid eggs when a solution of 1oz salt per gallon is not used when fertilizing eggs and this occurred in 2002. Using a saline solution for fertilization has been proven to increase eye-up to around 80% this will be added to hatchery procedures starting with the late 2003 and early 2004 egg takes. The increase in egg loss due to triploiding techniques was close anticipated (50% additional loss). Actual loss for brook trout was 60%, which was reasonable for our first attempt. Considerable refinements in the equipment and procedures (i.e. building triploiding tank for unified heat dispersal, training employees, etc.) were made throughout 2002. Improved equipment and refinement of triploiding techniques should result in triploiding egg losses below 50% for next year. We will closely watch survival of eggs in the future to determine the mechanism for this low survival. Perhaps working with another entity such as the Fish and wildlife service or outside consultant such as Trout Lodge could help to improve our procedures and execution when triploiding or during the eyeing of eggs. Egg take from Owhi Lake was lower than expected at 602,000 eggs because only two egg takes were planned and the fish were more difficult to collect than in other years. A third egg take will be planned in the future to insure that sufficient eggs are collected to meet the 800,000 eggs quota.

The WDFW Chelan hatchery provided 26,055 westslope cutthroats at 450/lb these fish were reared at CTH until planted. The WDFW, Omak Hatchery supplied 70,000 Lahontan cutthroat trout at 200 fish/lb and these fish are currently being reared at CTH until released. Redband trout were approved by WDFW but unexpected hatchery losses at their Colville facility killed these fish making it impossible to complete task 1H so we deferred this task until 2003 but it is likely that only 5,000 fingerling redband trout will be made available by WDFW. The raceway expansion was completed by Roglins, on time and within budget, this should improve on-going problems related to limited rearing and holding space. Distribution efforts occurred from March to November provided the receiving waters were below 70 degrees Fahrenheit (Table 3).

The rearing of fish was excellent with high survival (average 95%) for all stocks excluding the 2002 brood year rainbow trout that experienced considerable mortality related to two separate outbreaks of bacterial coldwater disease (CWD). The disease outbreak was discovered by hatchery employees and verified by Bob Rogers health specialist for WDFW this disease is considered common at hatcheries around Washington State. Fish were treated with medicated feeds but losses reduced survival to 53%. Reduced numbers of brook trout eggs, low green egg survival, CWD outbreaks, no redband trout delivery, and experimentation with new triploiding procedures produced fewer numbers of fish at the hatchery then expected for 2002. The management priorities for stocking fish into Colville Reservation waters, is to distribute fish at the largest possible size to improve survival and return to creel. Therefore, fingerling plantings were eliminated so that more fish could be raised to catchable and sub-catchable size. The result of this change made it impossible to complete tasks 1C and 1E (Table 1) but reach the over arching goal of a minimum of 50,000 pounds of trout with an overall 2002 production of 56,934 pounds of trout.

**Table 3.-**The date, location, weight, number, and temperature of receiving water for the Colville Tribal Hatchery distributions during 2002.

**Colville Hatchery Fish Distributions from 2002**

**Lahontan Cutthroat Trout (BY-01)**

| Raceway | Date | Location | Pounds | Number | No.p/lb | Temp |
|---|---|---|---|---|---|---|
| R-5 | 3/13/2002 | Omak L. | 928 | 27,840 | 30 | 42 |
| R-5 | 3/13/2002 | Omak L. | 886 | 26,580 | 30 | 42 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R-5 | 3/15/2002 | Omak L. | 946 | 28,365 | 30 | 42 |
| R-5 | 3/26/2002 | Omak L. | 394 | 11,417 | 29 | 44 |
| R-5 | 6/11/2002 | Cook L. | 82 | 962 | 12 | |
| R-5 | 8/16/2002 | Omak L. | 1,097 | 7,712 | 7 | 69 |
| R-5 | 8/19/2002 | Omak L. | 1,139 | 8,007 | 7 | 69 |
| R-5 | 8/19/2002 | Omak L. | 1,280 | 8,998 | 7 | 69 |
| R-5 | 8/19/2002 | Omak L. | 1,420 | 9,983 | 7 | 69 |
| **Totals:** | | | **8,172** | **129,864** | | |

**Goldendale Rianbow Trout (BY-00)**

| Raceway | Date | Location | Pounds | Number | No.p/lb | Temp |
|---|---|---|---|---|---|---|
| R-1 | 3/27/2002 | Buffalo | 998 | 3,613 | 3.62 | 43 |
| R-1 | 3/28/2002 | Buffalo | 998 | 3,613 | 3.62 | 43 |
| R-1 | 3/28/2002 | Buffalo | 1,012 | 3,663 | 3.62 | 43 |
| R-1 | 3/29/2002 | Buffalo | 1,125 | 4,073 | 3.62 | 43 |
| R-1 | 4/2/2002 | Buffalo | 956 | 3,346 | 3.5 | 44 |
| R-1 | 4/2/2002 | Buffalo | 530 | 1,854 | 3.5 | 44 |
| R-1 | 4/11/2002 | L. Goose | 289 | 1,012 | 3.5 | 42 |
| | **Totals:** | | **5,089** | **18,308** | **3.62** | |

**Ell Springs Rainbow Trout (BY-01)**

| Raceway | Date | Location | Pounds | Number | No. p/lb | Temp |
|---|---|---|---|---|---|---|
| R-3 | 4/23/2002 | S. Twin | 885 | 4,190 | 4.73 | 49 |
| R-3 | 4/30/2002 | Bourgeau | 689 | 3,445 | 5 | 61 |
| R-3 | 5/1/2002 | Round | 201 | 1,005 | 5 | 55 |
| R-3 | 5/2/2002 | N. Twin | 1,195 | 5,976 | 5 | 52 |
| R-3 | 5/2/2002 | Nicholas | 100 | 500 | 5 | 59 |
| R-3 | 5/2/2002 | Sugar | 104 | 520 | 5 | 59 |
| R-3 | 5/6/2002 | Simpson | 613 | 2,532 | 4.13 | 58 |
| R-3 | 5/7/2002 | LaFleur | 1,097 | 4,531 | 4.13 | 56 |
| R-3 | 5/8/2002 | S. Twin | 1,040 | 4,295 | 4.13 | 53 |
| R-2 | 5/14/2002 | N. Twin | 1,139 | 5,012 | 4.4 | 55 |
| R-2 | 5/15/2002 | S. Twin | 1,097 | 4,827 | 4.4 | 54 |
| R-2 | 5/15/2002 | N. Twin | 1,097 | 4,827 | 4.4 | 56 |
| R-2 | 5/28/2002 | Elbow | 1,111 | 3,800 | 3.42 | 59 |
| R-4 | 6/8/2002 | Derby | 155 | 445 | 2.9 | 57 |
| R-2 | 6/10/2002 | S. Twin | 1,265 | 4,756 | 3.76 | |
| R-2 | 6/11/2002 | Cook | 133 | 500 | 3.76 | |
| R-2 | 6/12/2002 | Summit | 267 | 1,004 | 3.76 | |
| R-4 | 6/25/2002 | N. Twin | 844 | 2,616 | 3.1 | 71 |
| R-4 | 6/25/2002 | S. Twin | 942 | 2,920 | 3.1 | 72 |
| R-4 | 6/26/2002 | Hall Crk | 742 | 2,300 | 3.1 | 62 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R-4 | 6/26/2002 | Stranger | 419 | 1,300 | 3.1 | 71 |
| R-4 | 6/26/2002 | Wilmont | 290 | 900 | 3.1 | 59 |
| R-4 | 6/27/2002 | S. Twin | 956 | 2,964 | 3.1 | 74 |
| R-4 | 6/27/2002 | Mill Crk | 181 | 561 | 3.1 | 65 |
| R-4 | 6/27/2002 | Nespelem | 770 | 2,387 | 3.1 | 69 |
| R-4 | 6/28/2002 | Lost Crk | 275 | 853 | 3.1 | 59 |
| R-4 | 7/8/2002 | S. Twin | 1,111 | 3,111 | 2.8 | 70 |
| R-4 | 7/9/2002 | N. Twin | 1,097 | 3,072 | 2.8 | 70 |
| R-4 | 7/9/2002 | S. Twin | 1,223 | 3,424 | 2.8 | 72 |
| R-4 | 7/10/2002 | N. Twin | 872 | 2,442 | 2.8 | 70 |
| R-4 | 7/11/2002 | Summit | 359 | 1,004 | 2.8 | |
| R-4 | 7/11/2002 | San Poil | 180 | 504 | 2.8 | |
| R-4 | 7/18/2002 | R.Woods | 703 | 1,968 | 2.8 | 64 |
| **Totals:** | | | **23,152** | **84,490** | **avg.3.8** | |

**Westslope Cutthroat Trout (BY-01)**

| Raceway | Date | Location | Pounds | Number | No. p/lb | Temp |
|---|---|---|---|---|---|---|
| R-5 | 6/4/2002 | N. Twin | 154 | 3,443 | 22.4 | |
| R-5 | 6/4/2002 | S. Twin | 156 | 3,494 | 22.4 | |
| R-5 | 6/4/2002 | Cody | 22 | 493 | 22.4 | |
| R-5 | 6/4/2002 | Round | 89 | 1,994 | 22.4 | |
| R-5 | 6/6/2002 | Summit | 100 | 2,245 | 22.4 | |
| R-5 | 6/11/2002 | Gold | 487 | 10,909 | 22.4 | 61 |
| **Totals:** | | | **1,009** | **22,578** | | |

**Eastern Brook Trout (BY-01)**

| Raceway | Date | Location | Pounds | Number | No. p/lb | Temp |
|---|---|---|---|---|---|---|
| R-3 | 9/25/2001 | McGinnis | 1,139 | 25,624 | 22.5 | 64 |
| R-3 | 10/8/2002 | N. Twin | 621 | 15,000 | 24.2 | 61 |
| R-3 | 10/8/2002 | N. Twin | 647 | 15,632 | 24.2 | 61 |
| R-3 | 10/9/2002 | Owhi | 1,026 | 24,829 | 24.2 | 61 |
| R-3 | 10/9/2002 | L. Goose | 207 | 5,000 | 24.2 | |
| R-3 | 10/10/2002 | L. Owhi | 605 | 14,641 | 24.2 | 58 |
| R-3 | 10/10/2002 | McGinnis | 387 | 9,365 | 24.2 | 58 |
| R-3 | 10/10/2002 | Simpson | 208 | 5,034 | 24.2 | 56 |
| **Totals:** | | | **4,840** | **115,125** | | |

**Rainbow Trout (BY-01)**

| Raceway | Date | Location | Pounds | Number | No. p/lb | Temp |
|---|---|---|---|---|---|---|
| R-6 | 10/9/2002 | Duley | 857 | 30,000 | 35 | 60 |

| | | | | | | |
|---|---|---|---|---|---|---|
| R-6 | 10/9/2002 | L. Goose | 143 | 5,000 | 35 | |
| R-6 | 10/10/2002 | Sun Lakes | 1,012 | 35,450 | 35 | |
| R-6 | 10/23/2002 | Bourgeau | 806 | 20,150 | 25 | 49 |
| R-6 | 10/23/2002 | LaFluer | 806 | 20,150 | 25 | 55 |
| R-6 | 10/24/2002 | S.Twin | 1,026 | 25,650 | 25 | 55 |
| R-6 | 10/25/2002 | N.Twin | 984 | 24,605 | 25 | 56 |
| R-12 | 11/12/2002 | Round | 1,084 | 28,076 | 25.9 | 42 |
| R-12 | 11/12/2002 | S.Twin | 1,083 | 28,050 | 25.9 | 45 |
| R-12 | 11/13/2002 | Round | 266 | 6,889 | 25.9 | 43 |
| V-2 | 11/14/2002 | S.Twin | 1,041 | 39,558 | *38* | 46 |
| | | **subtotal:** | **9,108** | **263,578** | | |

**Brook Ttrout Triploids (BY-01)**

| Raceway | Date | Location | Pounds | Number | No. p/lb | Temp |
|---|---|---|---|---|---|---|
| R3 | 11/6/2002 | McGinnis | 358 | 5,005 | 13.98 | 45 |
| R3 | 11/13/2002 | Round | 214 | 2,992 | 13.98 | 43 |
| R3 | 11/14/2002 | Gold | 147 | 2,055 | 13.98 | 40 |
| | | **subtotal:** | **719** | **10,052** | | |

## Marking and Creel

**Objective 2. –** Maintain return to creel between 50 and 66% on a per pound basis and determine the contribution to subsistence and recreational fisheries of naturally produced fish, and hatchery origin fingerling, sub-yearling and legal size fish by developing a marking program for 100% of production for all creeled lakes (Owhi, North Twin, South Twin, Round, McGinnis, Buffalo, and Omak).

**Task 2a. -** Develop/implement marking program for hatchery origin fish (approx. 1,000,000 fish).

**Task 2b. -** Conduct roving creel census surveys on Buffalo Lake, Owhi Lake, North Twin Lake, and South Twin Lake.

**Task 2c. -** Conduct voluntary creel census surveys on McGinnis, Round, and Omak Lakes.

**Task 2d. -** Conduct elastomer tag retention study.

In 2001, the Colville Tribes built an elastomer-tagging trailer. During 2002, this trailer successfully tagged 737,517 rainbow trout and 145,665 brook trout that were stocked into Colville Reservation waters. Because preliminary results indicated that only approximately 76% of the tagged fish retained those marks for a period of one-year a secondary mark (removal of the adipose fin) was also used so that hatchery fish could be differentiated from wild fish. Elastomer tags were injected subcutaneously near the right eye of each rainbow trout and into the anal fin of brook trout. The methodology called for placing different marks on fingerling, subcatchable, and catchable stocks. In 2002, reduced numbers of fish at the hatchery as discussed earlier identified logistic problems with this methodology so after consultations with other hatchery workers and biologists it was decided that making all fish the same would still allow contributions from fish stocked at various sizes. Fish stocked at fingerling, subcatchable, and catchables during the same year would continue to be easily separated by size so it was not necessary to mark these fish differently. Different colors will be utilized to differentiate between planting years and the adipose clip will be the primary mark for identifying hatchery and wild fish. Approximately 1,010,000 fish were tagged in 2002 only 395,072 stocked trout were marked with elastomer while another 289,935 were stocked with fin clips only. Fin clipping was completed on another 198,175 fish that remained on station as carry over for planting next year and 179,300 fish were not marked because they were cutthroat trout or were stocked into off-reservation waters.

**Table 4.**-Creel data from roving creel collected during 2002 and compared with historic averages if possible to determine fishery trends and hatchery stocking success.

| Data from all lakes compared to historic were a volunteer creel was conducted during 2002 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake | Species Stocked | Angler Days* | # Fish Harvested* | # Fish Caught* | CPUE | Average Length (inches) | Average Weight (lbs.) | Pounds Harvested | Pounds Stocked | % Return to Creel | % of total Catch |
| Buffalo[1] | All Fish | 5,365 | 10,360 | 15,170 | 0.54 | 14.4 | | | | | 100 |
| | RBT | | 8,800 | 13,135 | 0.71 | 11.7 | 1.15 | 11,917 | 13,792 | 86 | 87 |
| | EBT | | 0 | 0 | 0 | N/A | N/A | 0 | 0 | 0 | 0 |
| 1977-89 avg. | All Fish | 5,075 | N/A | 22,925 | 0.86 | 10.3 | | | | | 100 |
| Little Goose[2] | All Fish | 722 | 3,249 | 3,610 | 0.63 | 13.1 | | | | | 100 |
| | RBT | | 2,888 | 3,249 | 0.56 | 13.3 | 1.01 | 2,906 | 650 | 447 | 90 |
| | EBT | | 361 | 361 | 0.13 | 13 | 0.93 | 337 | 207 | 163 | 10 |
| 1977-89 avg. | All Fish | 646 | N/A | 17,119 | 0.48 | 10.3 | | | | | 100 |
| North Twin | All Fish | 21,568 | 47,180 | 62,008 | 0.41 | 14 | | | | | 100 |
| | RBT | | 37,407 | 51,224 | 0.48 | 13.9 | 1.33 | 49,830 | 10,366 | 488 | 83 |
| | EBT | | 3,370 | 3,370 | 0.40 | 14.8 | 1.2 | 4,051 | 1,268 | 320 | 5 |
| South Twin | All Fish | 9,367 | 25,872 | 27,216 | 0.44 | 14 | | | | | 100 |
| | RBT | | 19,152 | 20,496 | 0.54 | 13.4 | 1.27 | 24,327 | 14,485 | 168 | 75 |
| | EBT | | 1,680 | 1,680 | 0.15 | 13.7 | 1.09 | 1,829 | 0 | N/A | 6 |
| Combine avg. | All Fish | 14,645 | | | | | | | | | 100 |
| 1991-2001[3] | RBT | | 22,199 | N/A | 0.45 | 12 | 0.81 | 35,962 | 10,212 | 352 | 80 |
| | EBT | | 4,900 | N/A | 0.11 | 13 | 1.05 | 5,145 | 1,263 | 407 | 12 |
| Owhi[4] | EBT | 2,163 | 15,960 | 16,450 | 1.40 | 17 | 1.4 | 22,298 | 1,026 | 2,173 | 100 |
| 1991-2001 | EBT | 2,441 | 16,274 | N/A | 1.12 | 14.3 | 1.12 | 18,204 | 889 | 2,040 | 100 |
| Round | All Fish | 3,223 | 15,795 | 17,199 | 0.90 | 13.5 | | | | | 100 |
| | RBT | | 2,808 | 3,159 | 0.30 | 13.5 | 1.01 | 2,881 | 2,351 | 122 | 18 |
| | EBT | | 12,987 | 14,040 | 1.50 | 13.5 | 0.93 | 12,727 | 214 | 595 | 82 |
| Insufficient data exists for comparison since 1960 so no historic reference is given | | | | | | | | | | | |

* estimated values extripolated from creel data collect throughout the year and expanded.

1) Creel data indicates near zero angling occurred during winter months so data were expanded for only 8-months.

2) Only 4-creel days in 2002 and minimal creel days for historic average made catch estimates highly variable.

3) Historic creel data were averaged for North and South Twin Lakes, not possible to separate at this time.

4) Owhi lake creel data only reflects winter fishery (Dec., Jan., & Feb.) other months have minimal angler effort.

Roving creel data was collected for Buffalo, Little Goose, North Twin, South Twin, Owhi, and Round Lakes in 2002 (Table 4). Creel data from Buffalo and Owhi Lakes was compiled and analyzed from shorter periods than one-year because these lakes have little or no angling pressure during certain months. Little Goose and Round Lakes were added to provide more diversity to the sample of lakes involved in the creel. These two lakes were selected because they are located close to other lakes already scheduled. This allowed the creel clerk to collect data when anglers were not present at lakes scheduled and because smaller lakes were under represented in the original group.

Catch per unit effort was higher or close to historic averages for all lakes during 2002. All lakes showed good return to creel of stocked fish. Buffalo Lake only returned 0.86 pounds of trout for every pound stocked (Table 4). However, Buffalo Lake has a self-sustaining population of kokanne salmon and largemouth bass that contributed 13% of the total angler catch. This lake also produces a large harvest of crawfish annually. Stocking rates may need to be reduced or some unknown environmental condition may be limiting trout production at Buffalo Lake. All data collected to date indicates that this lake should provide ideal habitat for salmonid production so low return to creel estimates are surprising. Round and South Twin lakes were the only waters where brook trout return to creel was higher than that for rainbow trout. South Twin and Buffalo Lakes were not stocked in 2002, so high brook trout returns in South Twin indicate good carry-over from 2001, sufficient to maintain harvest similar to historic. Buffalo Lake had no return to creel for brook trout from 2001 indicating that environmental conditions at this lake are not well suited to brook trout (Table 4). Brook trout returns at Round Lake indicate that some natural reproduction maybe occurring and that future stocking should reduce rainbow trout numbers and focus more on developing the brook trout potential of this lake. All lakes had longer average lengths for trout when compared to the historic averages however some large fish were purchased by the tribes and stocked into many of these waters so these results maybe skewed. These lakes represent over 78% of all fish stocked on the Colville Reservation. The average return to creel for all reservation lakes was 3 pounds of trout for every pound stocked. The high return-to-creel estimates indicate strong support for continued adaptive management and stocking of Colville Reservation waters.

**Table 5.-**Comparison of voluntary creel results for 2002 compared to historic data collected from 1975-2001 for Omak Lake.

| Omak Lake lahontan cutthroat trout return to creel | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Description | Angler Days | Pounds Stocked | Number Caught | CPUE | Avg. Size (lbs) | Pounds Caught | Pounds Harvested | % Return to Creel | % Return Harvest | % C&R |
| 2002 Annual Data | 1,168 | 8,090 | 5,237 | 1.6 | 2.32 | 12,135 | 2,449 | 150 | 30 | 79.8 |
| Annualized 1975-2001 | N/A | 2,104 | 1,441 | 0.53 | 2.30 | 3,486 | 2,724 | 166 | 130 | 61 |

Voluntary creel data provides a low cost method for collecting creel information but this data has two major assumptions. First, not all anglers will provide catch information so annualizing data is difficult because the portion of reporting anglers is unknown. During 2002, we were able to determine that 39% of the anglers at Omak Lake provided useful information. This information will allow these results to be annualized with greater accuracy than was previously possible. Second, data collected is biased by the anglers because many different people are filling out forms and they interpret information request differently. We have noticed that during the catch and release season on Omak Lake that anglers reported information on all fish caught and this is the desired information. However, during the season when harvest was possible, anglers typically only provided information on what was harvested. We have and will continue to make the forms as easy as possible to fill out correctly and inform anglers of the need for complete information, but it is likely that this problem will persist over time regardless. Therefore, when interpreting the results for volunteer creel data one must realize these data are skewed as follows:

1) Fish lengths are longer than the true mean.
2) Effort is less than the true value.
3) Fish caught is less than the true value.
4) Harvest values are the most accurate values but do not provide the most meaningful data for Omak Lake because considerable catch and release angling occurs.

Although results for volunteer data must be reviewed critically in light of the above assumptions, we still believe that this data provides important and valuable least cost data. We plan to expand the number of lakes covered by volunteer collection sites. In the fall of 2002, boxes were placed at McGinnis and Round lakes. Insufficient data was collected for meaningful analysis in 2002 but starting in 2003 these lakes should provide data to help evaluate hatchery stockings and angler success. We collected roving creel data from Round Lake in 2002 and these data will be used to evaluate differences in the two creel data collection methods in 2003.

We stocked considerably more pounds of fish at Omak Lake than historically because these fish were raised to a large size but the number of fish was less than is some past years. Angler catch rates increased over 3 times the historic rate during 2002 and the average fish was larger (Table 5). Fish size was likely influenced by changes in the creel forms in 2002. We provided space for all fish in each 1-inch length class to be entered. Historically fish were lumped in five size ranges. The increased resolution of fish length will be useful for determining regulation changes in the future and provide a more accurate estimate of average fish size (Figure 1). Catch and release angling increased probably as a result for higher catch rates. The return to catch is primarily used to evaluate stocking of Omak Lake rather than return to harvest because of the importance of catch and release angling. The return to catch was slightly lower than the historic average but was still greater than 100, showing good carryover of fish stocked (Table 5). The slight decrease in return of hatchery fish is more a result of increased pounds stocked than reduced survival or production, but this will be better determined after next year because few of these fish were available for harvest due to the 14-inch minimum size limit at this lake. The return to catch of 1.5 pound of fish for every pound of fish stocked indicates strong support for continued adaptive management and stocking by CTH at this lake.

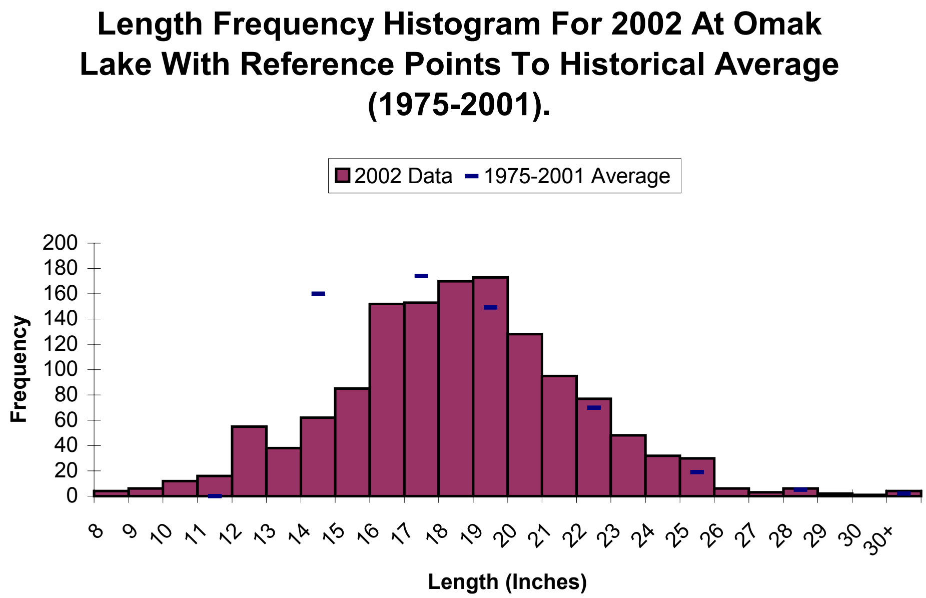



**Figure 1**.-Length frequency histogram for voluntary creel data collected from Omak Lake in 2002 with reference points for historic categories collected from 1975-2001.

An elastomer tag retention study is currently on going at CTH with data being collected for the long-term retention of these tags. Elastomer tagging is a relatively new technique and has not been rigorously tested for trout or other resident fish but has shown promising result for anadromous and marine fishes. During 2002, fish were tagged with elastomer marks and preliminary findings indicate that only 70-80% of these rainbow trout retained marks after a period of 7-months. It is our hope to monitor these fish for a period of no less than 2-years provided adequate holding space is available. Once the long-term assessment is completed, then a second short-term study looking at differences in tag retention between trout species, tag color, and marking locations will be initiated to determine how these differences could modify long-term tagging results. Rearing space limitations at CTH will greatly impact the number of trials and the timeline in which they can be completed. A peer reviewed journal article is planned once all the data has been collected, compiled, and analyzed.

## Brood Stock Development

**Objective 3.** Determine bull trout, redband rainbow trout and westslope cutthroat trout presence/distribution/ status and determine potential as an initial production source for developing a captive brood stock program.

**Task 3a. -** Conduct presence/absence surveys throughout lotic systems on the Colville Reservation.

**Task 3b. -** Conduct genetic evaluation of bull trout, rainbow trout and cutthroat trout identified in 3a.

**Objective 8.-** Develop a captive redband rainbow trout brood stock program at CTH and determine suitable lakes for establishing a wild/supplemented brood stock population.

**Task 8a**. – Utilize carry-over funding to expand CTH facilities by installing two 10'x100' vinyl raceways currently stored at CTH.

**Task 8b.** – Collect or purchase redband rainbow trout brood fish.

**Task 8c.** – Determine lakes suitable for future wild or supplemented brood stock populations to be established.

Objectives 3 and 8 of the 2002 SOW had considerable overlap. This overlap was discovered after reviewing information obtained through the Fish and Wildlife Bull trout survey work and the Lake Roosevelt Habitat Improvement (BPA project # 199001800) data. Streams were selected that had a known history of redband trout. DNA samples from fish collected last fall indicated that 100% pure redband trout populations existed in the North Fork of Hall, and the middle section of Bridge Creek. Anecdotal evidence identified redband populations may have existed in Jack, and 25-mile creeks. Kartar Creek was surveyed to assist with data collection for another project. The survey and fish collection work resulted in no redband trout being collected from the North Fork of Hall, 25-mile, or Kartar creeks. Repeated attempts were made on the North fork of Hall Creek but only very few fish were found and none were brought back to the hatchery. This work was hampered by dry conditions that resulted in high fire risks and extremely low water conditions. Jack creek was surveyed in the fall of 2002 and DNA samples were collected from redband trout and sent to Matt Powell at the University of Idaho for analysis. These DNA results will be reported in 2003. We collected 253 redband trout from the middle section of Bridge Creek and these fish were taken to the Colville tribal hatchery, placed in isolation, and determined to be disease free by The Washington Animal Disease Diagnostic Laboratory located at Washington State Unviserssity. These native redbands are growing rapidly but the number of fish has been reduced by cannibalism, difficulties in feed training, and disease inspections. We current have 193 of these redbands remaining on station. To verify that these fish are pure DNA samples were sent to Matt Powell for analysis and result have not been received yet. No westslope cutthroat trout, or bull trout were encountered but large numbers of brook trout were.

We selected Roglin's Inc. in a competitive bidding process to complete the raceway expansion work at CTH. Roglin's Inc. was selected because of price, experience, and reputation by an ad hoc committee comprised of Dan Fairbank, John Arterburn, Rodney Stensgar, and Jerry Marco. On the first day of August, raceway work began and was supervised by Dan Fairbank. This work was completed by September 15, 2002 on time and within budget. The additional raceway space will be used for captive brood stock rearing. Once the raceways were completed, 5,000 redband trout were picked-up from the WDFW Colville Hatchery and brought back to CTH. DNA samples were collected and sent to Matt Powell for analysis and provided these fish represent a pure strain will be used to seed the captive redband brood stock. If successful, the need for objectives 3 and 8 will be greatly reduced with the exception of task 8c (this work will be discussed as part of objective 4). The Phalen Lake redband trout received from the WDFW Colville Hatchery originate from Nancy Creek located just north of the Colville Reservation so these would be a locally adapted stock. Egg production is unlikely prior to the brood year 2004 and the hatchery production of these fish will be a part of objective 1 in the SOW in future years. All work has been completed for 2002 and future work will be based on the findings of DNA analysis and is contingent upon need.

## Lake Population and Specification Surveys

The following objectives and tasks were all meet or exceeded in 2002. Considerable overlap and efficiencies were possible by collecting data for several items when field crews visited certain lakes. More than 40 lakes were visited by field personnel and considerable data was collected. Much of the data collected will be incorporated into a separate document that is scheduled to be completed sometime in 2003 or 2004 titled "Colville Reservation Lakes Compendium, Limiting Factors, and Management Plan" once all lakes have been sampled. This document is identified in the 2003 SOW. The data collected on the contractually obligated 5-lakes is included in the attached appendices. Work on objective 7 is behind schedule due to the passing of Ed Broch who was leading this part of the project before passing away in 2001. Replacing his knowledge and expertise has been difficult and presented us with many problems. We are working through these difficulties and have been working on literature reviews, and collecting preliminary field samples to develop effective sampling, laboratory, identification, and reporting mechanisms. Progress is being made and we have begun talks with other university professors that could possibly help with completing this important work.

**Objective 4**. – Collect temperature, bathymetry, and oxygen profiles plus presence/absence of fish data for 5 lakes per year for lakes currently stocked by this program and for new potential fisheries.

**Objective 5**. – Collect relative abundance data on 5 lakes per year currently being stocked by the CTH that do not have a creel census component.

**Objective 6**. – Evaluate the populations of non-native, non-salmonid species illegally introduced into lakes currently being stocked by this program with emphasis on largemouth bass.

**Objective 7**. – Determine zooplankton peak emergence timing and large cladoceran/ small cladoceran ratios along with identifying important zooplankton/fish interactions for 5 lakes/year as an initial step in establishing carrying capacity estimates for lakes that receive stocking from this project.

**Table 6.-**Lake population and specification tasks, descriptions and the results, quantified where possible for 2002.

| Task | Description | Results/status |
|---|---|---|
| Task 4a | Collect temperature and oxygen profiles from 5 lakes per year. | Completed/on-going (29 lakes sampled-see appendix) |

| | | |
|---|---|---|
| Task 4b | Make bathymetry maps of 5 reservation lakes not mapped already but currently stocked by this program. | Completed/on-going (11 lakes-see appendix) |
| Task 4c | Use criteria from 2002 SOW to determine the level of data to be collected from new waters.<br>Level 1-Lakes with a theoretical maximum depth of greater than 3 meters will be designated to have temperature and oxygen profiles developed.<br>Level 2-If temperature, and oxygen profile indicate suitable habitat then total dissolved solids measurements will be taken.<br>Level 3-If total dissolved solids are below 5,800 mg/l then presence/absence of fish surveys will be conducted. | Completed/on-going (40 lakes surveyed, 29 meet level 2 criteria, and 11 meet level 3 criteria) |
| Task 5a | Relative abundance surveys of stocked lakes. | Completed/on-going (See appendix) |
| Task 7a | Investigate zooplankton peak emergence timing and large to small cladoceran ratios on 5 lakes per year currently stocked by this program and identify important zooplankton/fish interactions as an initial step in establishing carrying capacity estimates for lakes across the Colville Reservation. | Particularly Completed/ on-going background research and preliminary samples collected. |
| Task 8c | Determine lakes suitable for future wild or supplemented brood stock populations to be established. | Completed/on-going (Incorporated into part of task 4c) |

Following the summary are eight technical reports related to lake specifications and surveys conducted in 2002. These reports should be viewed as drafts because they will be updated as new or additional data becomes available and were designed to be iterative documents. The general conclusions from these reports were that introduced predators and competitors are common in many of the smaller Colville Reservation Lakes and that these habitats are marginal for salmonids. It is expected that these lakes receive little fishing pressure but data is insufficient to be certain of this. However, these lakes provide important diversity in the fishing experience for the anglers that utilize them. Many of these lakes could be actively managed to improve habitat conditions with good results and developed into carry-over trout fisheries, or shifted to warm water fisheries (The Colville Tribes are not in favor of this option). Several of these lakes are limited to being used as put-and-take fisheries but the limited angler use makes this practice questionable from an economic perspective.

## Expenditures

**Table 7**.-Project costs incurred during 2002 and paid by the Colville Tribes reimbursement by BPA was still incomplete as of the writing of this report.

| **Budget Expense Summary For Twelve Months Ending September 30, 2002 as of 3/10/2003** | | | | |
|---|---|---|---|---|
| Account Description | Invoices Paid | Encumbered | Annual Budget | Carry-over |

| | | | | |
|---|---|---|---|---|
| Salaries 60010, 510 | $246,398 | $0 | $268,856 | $22,458 |
| Fringe includes accounts 61110,15,20,30,35,40,50,80 | $32,328 | $0 | $39,385 | $7,057 |
| Office Supply 62110,70 | $17,332 | $202 | $17,100 | -$434 |
| Sub Contracts 63410 | $201,530 | $16,000 | $224,473 | $6,943 |
| Telephone 64010 | $6,600 | $0 | $5,000 | -$1,600 |
| Utilities 64020 | $49,509 | $5 | $42,500 | -$7,014 |
| Travel and Training 65010,210 | $10,478 | $20 | $25,324 | $14,826 |
| Vehicle Repairs 66040 | $1,034 | $0 | $4,800 | $3,766 |
| Fuel 66050,65 | $5,362 | $0 | $6,500 | $1,138 |
| GSA 66090 | $14,870 | $0 | $13,440 | -$1,430 |
| Vehicle Insurance 66095 | $9,155 | $0 | $5,004 | -$4,151 |
| Building R&M 67020 | $4,197 | $0 | $10,200 | $6,003 |
| Equipment R&M 67110 | $12,532 | -$20 | $10,000 | -$2,512 |
| Property Insurance 69930 | $4,941 | $0 | $4,941 | $0 |
| Field Supplies 72110 | $125,472 | $11,040 | $130,800 | -$5,712 |
| Hatchery Supplies 72115,25 | $4,312 | $0 | $17,425 | $13,113 |
| Capitol Equipment 78015 | $54,449 | $3,800 | $71,500 | $13,251 |
| Non Capitol Equipment | $42,264 | $5,522 | $32,000 | -$15,786 |
| Indirect Costs 69805 | $103,733 | $0 | $113,188 | $9,455 |
| **2002 year-end accruals** | **$946,496** | **$36,569** | **$1,042,436** | **$59,371** |
| **Unpaid billings from 2002** | **$703,644** | **-$200,000** | **$503,644** | |
| **Billings paid by BPA in 2002** | **$442,715** | **$200,000** | **$642,715** | |

## Summary

The Colville Tribal Hatchery completed most tasks in 2002 and exceeded expectations on many other tasks. The hot dry weather did hinder work but provided an opportunity to collect some data during an extreme period. Hatchery production goals were accomplished although brook trout production was lower than expected and fingerling stockings were curtailed in favor of stocking fish of larger sizes. Production changes at CTH should continue to focus on developing reliable sources of locally adapted trout stocks. Developing locally adapted fish stocks provides the most ecologically friendly approach to continued hatchery production that supports important subsistence and recreational harvest. Creel data collected in 2002 provided strong evidence for continued stocking of North and South Twin, Omak, Owhi, Round, Little Goose, and Buffalo Lakes. These data also provided support for modifying the species composition used when stocking some lakes particularly by reducing rainbow trout plantings in Round Lake. Lakes under 50 acres were identified as having some major constraints in regards to providing carry-over fisheries. Alkalinity, temperature, and oxygen issues along with competition from introduced largemouth bass and brown bullheads provide most of these small lakes with limiting environmental and biological conditions. Although it is possible to rehabilitate or manage some of these lakes to improve habitat and allow fish to carry-over from one year to the next, at other lakes the economic costs make this work hard to justify. Initial survey work has been completed for most lakes on the Colville Reservation and a schedule for monitoring these lakes on a once every 5-year basis would likely provide sufficient information to monitor changes to trend analysis, stocking rates, management regulations,

etc. however specific projects such as hatchery/wild contributions may require additional fish population sampling.  Results indicate that creeled lakes produced 3 pounds of fish for every pound stocked on average and expanding creel information to determine return to creel for additional lakes would provide a method for evaluating continued stocking and help prioritize rehabilitation or restoration efforts in the future.

**Appendix**

# Bourgeau Lake

2002 Technical Report

Photo 1: North view of Bourgeau Lake.

**Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program.**

## Introduction

Bourgeau Lake is located approximately 5 miles south of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From June 17 to June 20, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with ISRP mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure, while David Christensen, Larry Boyd and Levi Morris carried out the fieldwork.

Bourgeau Lake is a closed basin runoff fed lake that drains intermittently into Stray Dog Canyon and eventually into Lake Roosevelt located 1.9 miles downstream (Halfmoon 1978). During periods of high flow Apex Lake drains into Bourgeau Lake (Halfmoon 1978). A Ponderosa pine forest with mixed fir and broadleaf surrounds the northern end of the lake. The southwestern end is open rangeland with grass and shrub utilized heavily by livestock. Bourgeau Lake is generally characterized as a nutrient rich, eutrophic system with marsh like habitat on the northern end and thick aquatic macrophyte growth around the entire perimeter.

| Table 1. Physical Data of Bourgeau Lake | |
|---|---|
| Elevation | 579.1 m |
| Surface Area | 8.86 ha. |
| Volume | 708,000 m^3 |
| Maximum Depth | 16.46 m |
| Mean Depth | 9.14 m |
| Trophic State | Eutrophic |

Bourgeau Lake is stocked in the spring and fall with rainbow trout *Oncorhynchus mykiss* that range in size from 25 fish/lb to 5 fish/lb. The lake received 3,445 rainbows in 2002, 4,756 in

2001, and 5,000 in 2000. In the spring of 2002, triploid rainbow trout ranging from 2-10 lbs. were also stocked in the lake. No natural reproduction occurs in the lake for rainbow trout. All rainbow trout are hatchery produced. Largemouth bass *Micropterus salmoides*, pumkinseed *Lepomis gibbosus*, and brown bullheads *Ameiurus nebulosus* are abundant in the lake and reproduce naturally. The lake is managed as a tribal and non-tribal member fishery and receives moderate fishing pressure. Refer to Table 1 for physical data of Bourgeau Lake.

Sampling effort with sinking gill nets from 1979-1989 revealed rainbow trout, brook trout *Salvelinus fontinalis*, brown bullheads, and largemouth bass. These nets were set for 1 night only and no other sampling methods were used. Rainbow trout and brown bullheads appeared regularly in the samples while largemouth bass samples were sporadic from 1979-1989.

The sampling effort in June 2002 revealed 23 rainbow trout all between 220–360 mm in length, 31 largemouth bass between 120–440 mm, 218 pumkinseed between 40-170 mm, and 47 brown bullheads between 220–260 mm. Condition factors (Wr) on rainbow trout and pumkinseed samples decrease linearly below 100 and indicate possible system constraints. Habitat samples show limited dissolved oxygen and temperature regimes supporting this assumption. However, condition factors for largemouth bass and brown bullheads suggest these fish are in good health.

## Methods

Bourgeau Lake was sampled for three nights using one 150 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 9 pm and pulled the next day at 6 am for an approximate set of 9 hours. The net was set on the western side of the lake directly across from the boat ramp (Figure 1).

One trap net with two leading ends was placed along the eastern shoreline in approximately 4 feet of water for three nights (Figure 1). The net was set at 9 pm and pulled the next day at 6 am for an approximate set of 9 hours.

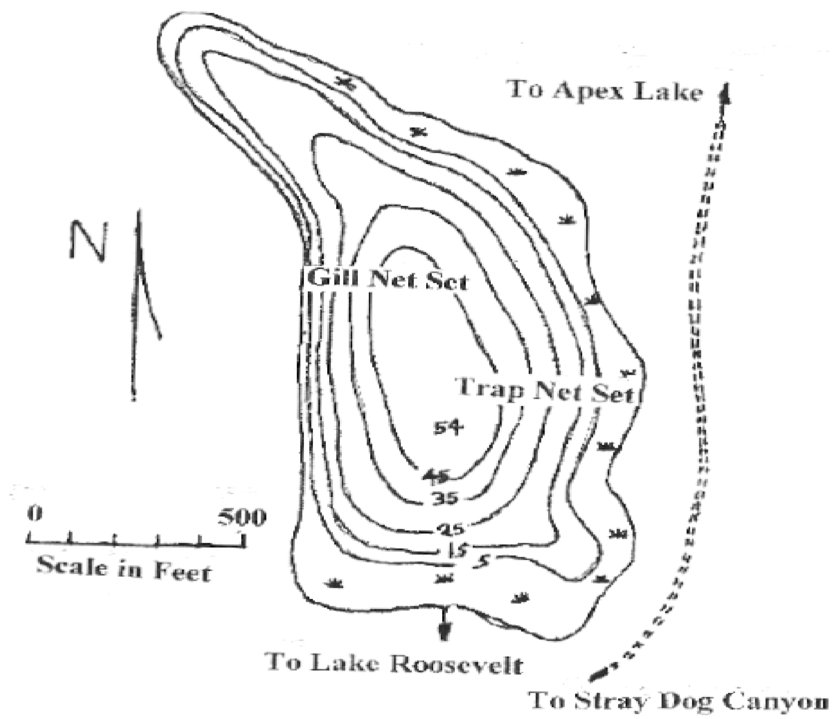



**Figure 1.** Bathymetric map of Bourgeau Lake that illustrates gill and trap net sets as well as lake contours in feet.

The entire shoreline of Bourgeau Lake was sampled using a Smith-Root GPP 5.0 electro fishing boat with umbrella shaped anodes and hanging cable cathodes. The boat was fixed with a 5000-watt generator. Range and duty cycle were adjusted when appropriate to solicit fish taxis (response to electrical current). Sampling the entire shoreline took approximately one hour. Sampling consisted of three passes per night for three nights.

Only data from the first electro fishing pass on the first night was analyzed statistically and discussed in this report to prevent inaccurate results due to repeat captures of fish sampled with the electro fishing boat. Only the first night gill and trap net data was analyzed in order to prevent recapture bias. All other net sets and electro fishing passes were designed to further investigate fish populations.

All rainbow trout were sampled for length, weight and elastomer tag identification. Largemouth bass and pumkinseeds were sampled for length, weight, and scale samples. Brown bullheads were sampled for length and weight. Community composition, relative abundance, length class frequencies and relative weights were determined for rainbows, largemouth, pumkinseeds and bullheads. Preferred stock densities (PSD) were determined for largemouth bass and pumkinseeds. Scale samples have not been analyzed to date so no age correlated information on bass or pumkinseeds will be discussed. Only fish over 100 mm were considered in the samples due to collection bias with smaller fish.

Relative weights (Wr) were determined by two formulas:

1. Power Function $W = a*L^b$

Estimated values of (a) and (b) come from the regression line graphed from the log length (x-axis) against the log weight (y-axis) of the species. The slope is represented by (a) while the y-intercept is represented by (b). These values can be obtained for the species on page 462, Table 15.1 of Fisheries Techniques, second edition produced by the American Fisheries Society, 1996. Ws is the actual weight of the sampled fish.

2. Relative Weight $Wr = W/Ws*100$

Preferred stock density (PSD) was calculated by the equation:

PSD = (# of fish >or= minimum quality length / # of fish >or= stock length) * 100

Minimum quality and stock lengths for various species is contained on page 464, Table 15.2 of Fisheries Techniques, second edition produced by the American Fisheries Society, 1996.

Habitat data was collected from Bourgeau Lake on 6/17/02. Information collected were secchi disc depth, alkalinity, hardness, percent littoral macrophyte community, average macrophyte community width, three macro invertebrate samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Macro invertebrate and zooplankton samples have not been processed to date and will not be discussed. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter.

## Results

One night of sampling on June 17, 2002 yielded 23 rainbow trout, 31 largemouth bass, 218 pumkinseed, and 47 brown bullhead. Refer to Figure 2 for fish community structure. Rainbow trout comprise 7% of the catch while largemouth bass 10%, pumkinseed 68%, and brown bullhead 15%.

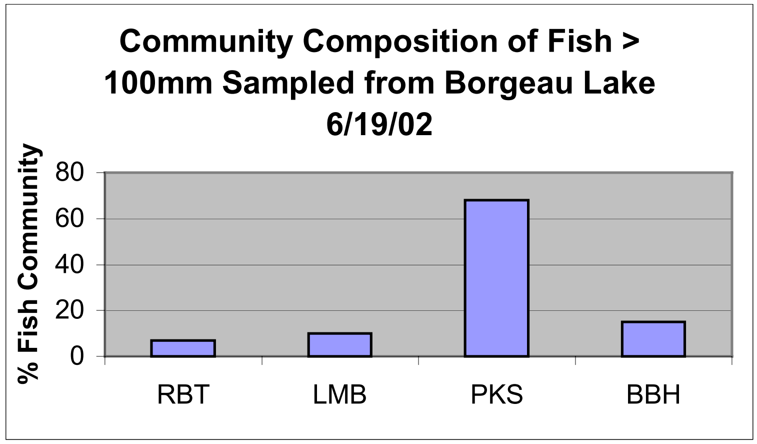



**Figure 2.** Fish community composition by percent of fish sampled over 100 mm. Rainbow trout (RBT), largemouth bass (LMB), pumkinseed (PKS), brown bullhead (BBH).

Rainbow trout length distribution comprised two different size groups: the first group consisted of 17 fish between 220-300 mm and the second group was 6 fish between 330-370 mm (Figure 3). Largemouth bass samples expressed a skewed length distribution of 28 fish between 120-260 mm and only 3 fish greater than 320 mm with no fish between 260-320 mm (Figure 4). Length distributions for pumkinseed showed a narrow pyramid distribution of 217 fish between 70-170 mm with no fish greater than 170 mm (Figure 5). Brown bullhead distribution was limited to 17 fish between 220-260 mm (Figure 6).

Of the 23 rainbow trout sampled, 17 (74%) were adipose fin clipped, and 10 (43%) retained white elastomer injection tags inserted while at the Colville Tribal Trout Hatchery. The white elastomer tags indicate that these fish were stocked during the April 30$^{th}$, 2002 plant. All other rainbow trout sampled that were within the first length class represented in Figure 3 are most likely planted together, even though not all fish were marked with the white elastomer injection. These unmarked fish probably received poor elastomer injections that did not retain in the epidermis. The larger fish are carry-over fish that were planted in 2001. There are no wild rainbow trout in Bourgeau Lake. Relative weights (Wr) were used to access relative condition of individual fish. Relative weight values greater than 100, generally suggest good health and adequate environmental conditions for the species. Relative weights of rainbow trout sampled from Bourgeau Lake ranged between 81 and 100 as expressed in Figure 7. The trend line for each species indicated that relative weight declined as length increased except for largemouth bass. Largemouth bass relative weights are all between 81 and 127 for fish between 120-260 mm with a range from 138 to 189 for fish between 320-440 mm (Figure 8). Brown bullhead relative weights only decrease from 127 to 108 as length increased (Figure 10) indicating that brown bullhead condition is good overall.

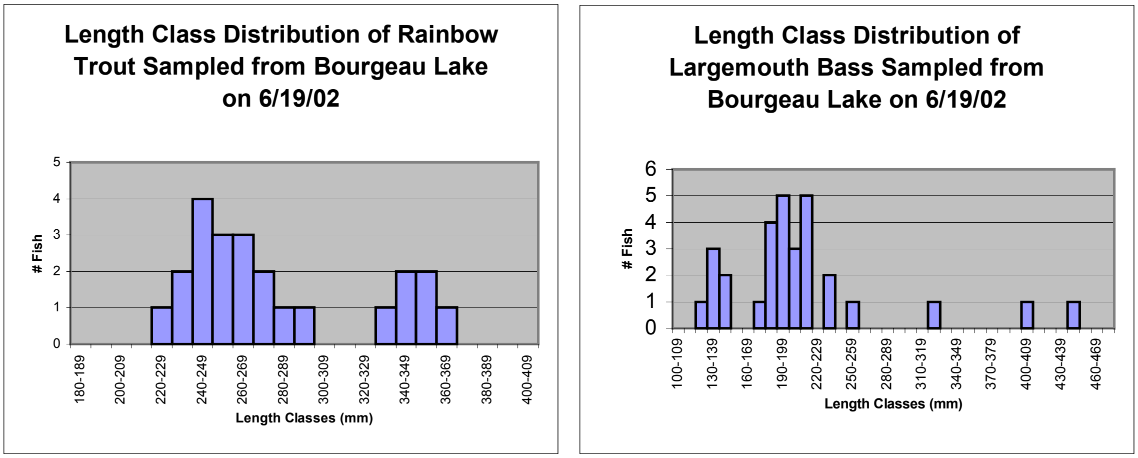



**Figure 3,4:** Length classes of rainbow trout and largemouth bass sampled from Bourgeau Lake 6/17/02.

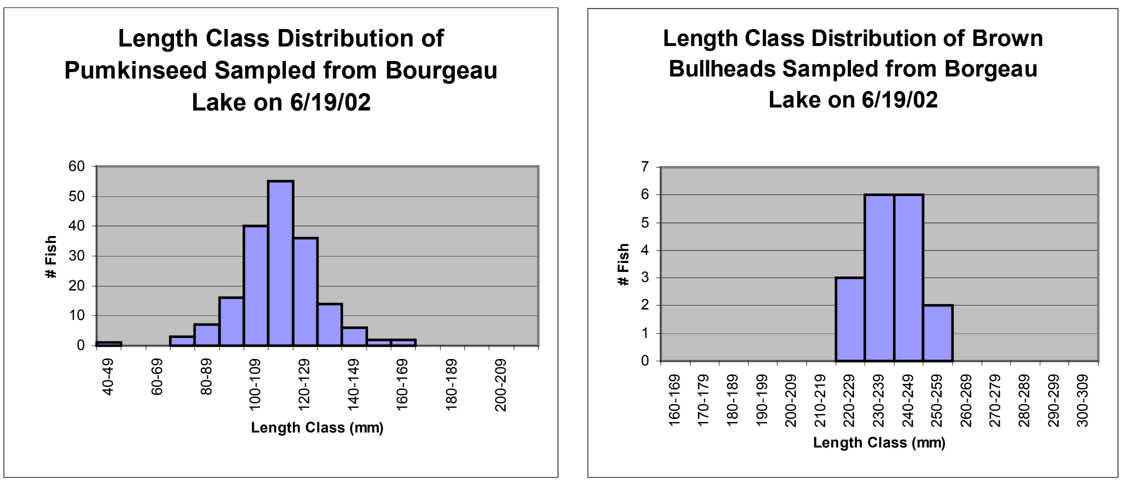
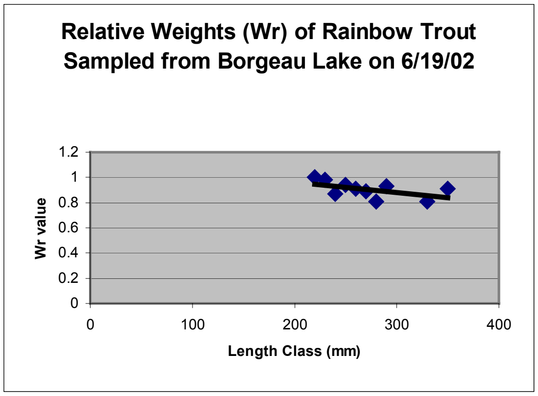



**Figure 5,6:** Length classes of pumkinseed and brown bullheads sampled from Bourgeau Lake on 6/17/02.

Preferred stock density (PSD) was determined for largemouth bass and pumkinseed. Preferred stock densities express the relationship of quality-size bass (>300 mm) to stock-sized bass (>200 mm) and quality-sized pumkinseeds (>150 mm) to stock-sized pumkinseed (>80 mm). Low preferred stock densities (PSD) were calculated for largemouth bass (21.43) and pumkinseed (2.25). There were only 3 quality-sized bass compared to 14 stock-sized bass and 4 quality-sized pumkinseed compared to 178 stock-sized pumkinseed in our sample. The PSD for pumkinseed may be slightly different because 35 fish were not weighed and dropped from the sample.

Secchi disc reading was 6.5 m. Macrophyte (rooted aquatic vegetation) growth was extensive in Bourgeau Lake and encompasses 100% of the littoral zone (shoreline habitat). Figure 11 depicts the oxygen-temperature profile. Oxygen levels at the surface are 10 mg/l and drop to 6 mg/l at 5 m in depth. From 6 m depth to the bottom (19 m) the



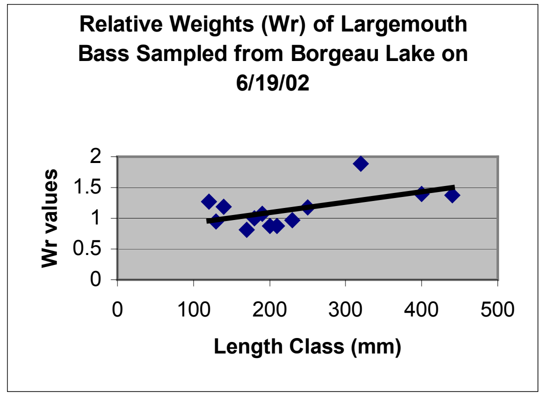
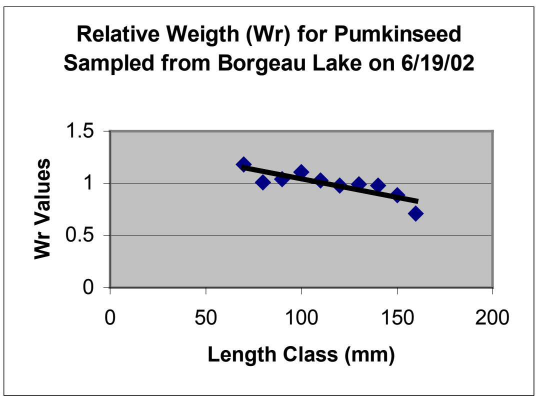




**Figure 7, 8:** Relative weight (Wr) of rainbow trout and largemouth bass sampled from 6/17/02. Wr values greater than 1 generally represent good health and adequate environmental conditions for these species.



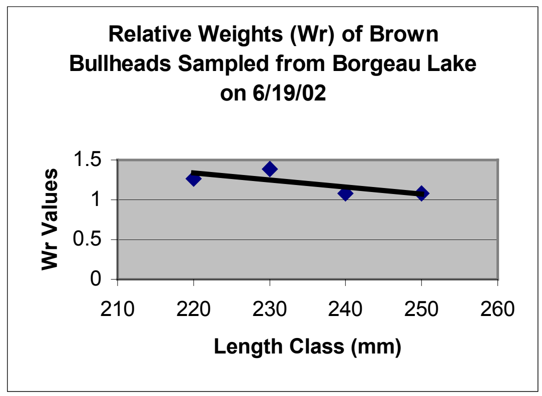




**Figure 9,10:** Relative weights (Wr) of pumkinseed and brown bullheads sampled from 6/17/02. Wr values greater than 1 generally represent good health and adequate environmental conditions for these species.

dissolved oxygen declines from 3.3 mg/l to .1 mg/l. Temperature levels are 23 C at the surface and 20.8 C at 4 m in depth. At 5 m the temperature is 18.7 C. The 5 m depth depicts the thermocline (line of stratification) for Bourgeau Lake.

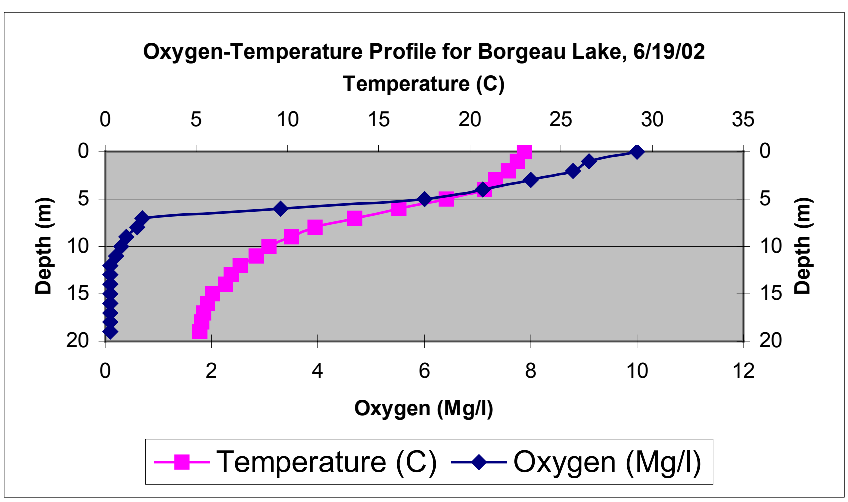



**Figure 11:** Oxygen-temperature profile for Bourgeau Lake taken on 6/19/02. Maximum depth is 19 m and Secchi disc reading was 6.5 m.

## Discussion

The fish community of Bourgeau Lake as of 6/17/02 (Figure 2) shows a similar structure as those found by single gill net sets from 1979-1989. However, pumkinseeds were not sampled in the lake until 1989, but may have existed before and not appeared in the samples. Brook trout were stocked from 1979-1989 but have not been stocked in the last three years and no longer exist in the lake. Pumkinseed, largemouth bass, and brown bullheads were most likely illegally introduced by anglers.

Two distinct length classes of rainbow trout exist in Bourgeau Lake when the sampling procedure was conducted on 6/17/02 (Figure 3). The first group were all between 220-300 mm in length and represent the majority of the sample. These fish were the only group that contained white elastomer marked fish. The white elastomer mark indicates these fish were planted on April 30$^{th}$, 2002. Only 43% were marked while the others were unmarked. Because no wild fish exist in the lake it is safe to assume all of these rainbow trout within the first length group are from the same plant.

The second rainbow trout length group represented in Figure 3 shows fish between 330-370 mm. These fish do not contain white elastomer injection tags and are considerably larger than the first group by an average of 219.6 g. These fish are most likely carry-over fish that were planted in 2001. Over-winter survival of these rainbow trout indicate sufficient conditions for salmonids in the lake. However, winterkills have occurred in past winters. We also do not know how many fish entered the winter of 2001-2002, so many fish may have experienced lethal conditions during that time. We only know that a portion of them survived to 2002.

Oxygen-temperature problems still exist in the lake due to high organic plant decomposition that occurs throughout the year, but is highest during the winter. Approximately 100% of the lake littoral zone has thick aquatic macrophyte growth. This may be having a negative effect on rainbow trout survival and growth. Rainbow trout can tolerate temperatures above 20 C for short periods, but temperatures levels of 24.7 to 25.2 C are lethal (Behnke 1992).
Figure 11 shows the dissolved oxygen and temperature relationship in Bourgeau Lake. On 6/18/02 less than 1m of habitat existed for salmonids so rainbow trout were limited to this small area of available habitat where oxygen and temperature were sustainable. These conditions increase stress greatly and limits the amount of movement the rainbow trout can make to find food.

Largemouth bass and pumkinseed populations in Bourgeau Lake are correlated to each other. Figure 4 shows largemouth bass length distributions to be skewed to the left with 28 smaller bass (130-260 mm), while only 3 exist above 300 mm. Figure 5 shows a typical pyramid shaped histogram for pumkinseed but a distribution of small fish all below 170 mm in length. It appears pumkinseed may be competing with juvenile largemouth bass and preventing them from reaching larger sizes. Preferred stock densities (PSD) and relative weights (Wr) support this assumption as well. Low PSD values for both largemouth and pumkinseed in Bourgeau Lake indicate that reproduction is high while growth rates and survival to larger sizes is low. Relative weights (Wr) of pumkinseed are decreasing with size because food becomes more difficult to obtain. However, the few bass that survive long enough to reach a size in wich they can feed on pumkinseed (> 300 mm) grow very well and exhibit Wr values well above 100.

The abundant pumkinseed sunfish are competing with themselves and the juvenile bass, preventing them from reaching larger sizes. The low bass PSD (high number of fish <300 mm) could be a result of high angler harvest of the larger fish > 300 mm. High angler removal of mid sized and large bass would reduce predation on the pumpkinseeds allowing them to increase in number to the point they are now. This could allow for competition with juvenile bass for macroinvertebrates and zooplankton and prevent the development of larger bass even if angler harvest declines. The brown bullhead population may be influenced by the largemouth and pumkinseed relationship. They comprised 15% of the total catch this is considerably less than Simpson Lake where bullheads were 86% of the catch.

Oxygen-temperature issues in Bourgeau Lake do not seem to be affecting largemouth bass, pumpkinseeds, and bullheads like they are rainbow trout. Sunfish can survive in dissolved oxygen conditions down to 3 mg/l and bullheads can survive even lower levels. These warm-water fish can tolerate temperatures above 25 C which is lethal for salmonids (Behnke 1996).

## Management Recommendations

Because some over-winter survival occurs, we should continue stocking the lake at our current rate. To increase winter survival and year-round growth in Bourgeau Lake and raise dissolved oxygen levels, cattle should be excluded from the lake, thus reducing the amount of nutrient input into the lake that promotes aquatic macrophyte and phytoplankton production and decomposition.

Creel work should be done regularly to determine angler harvest on adult largemouth bass if they are considered an important component of Bourgeau Lake. This could help us determine if the low number of adult fish is due to competition with abundant pumkinseed or by fishing pressure. Bourgeau Lake could provide an excellent bass fishery if competition with pumkinseed or angler harvest of adult fish were reduced. This would allow for a general increase in the number and size of bass as well as increase predation on pumkinseed. Pumkinseed population reduction would also lead to larger panfish. Current regulations attempt to reduce adult bass exploitation by allowing for the harvest of “5 fish, only fish less than 12” or over 17” may be kept, no more than 1 over 17.” These regulations are designed to help increase the number of quality bass (> 300 mm) and large bass (> 380 mm) in Bourgeau Lake and to increase the overall size of the pumkinseed but requires cooperation from anglers. Bourgeau Lake will continue to be stocked annually and monitored every 3 to 5 years using the methods as outlined in this report. Voluntary creel surveys should be utilized to increase creel data for this lake.

# Camille Lake

2002 Technical Report

**Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program**

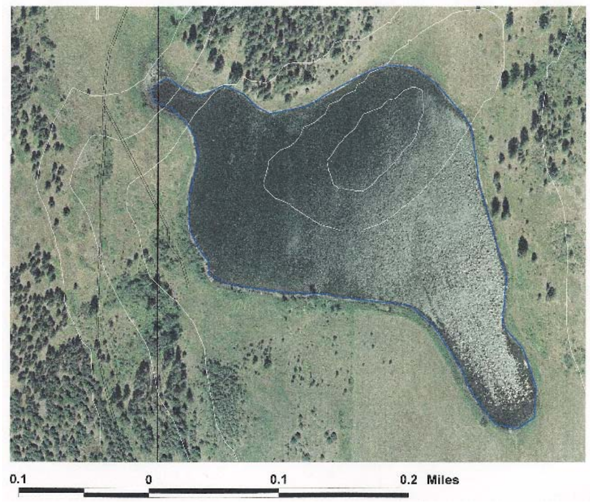



**Photo 1.** Aerial view of Camille Lake located approximately 2.5 miles west of Inchelium on the Colville Confederated Tribes Reservation.

## Introduction

Camille Lake is located approximately 2.5 miles west of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From July 16 to July 18, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with the Independent Scientific Review Panel (ISRP) mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure while David Christensen, Larry Boyd and Anthony Cleveland carried out the fieldwork.

| **Table 1.** Physical Data of Camille Lake | |
|---|---|
| Surface Area | 8.094ha. |
| Maximum Depth | 11m |
| Mean Depth | 4.877m |
| Trophic State | Eutrophic |

Camille Lake is a 20-acre eutrophic water body that reaches a maximum depth of 9.75m (Figure 1). The trophic status of the lake was determined by high recorded temperatures (26-27 C), low recorded dissolved oxygen (< 1 mg/l) below 4 m (see Figure 2), intense filamentous green algal blooms throughout the lake, and extensive cattail and reed development along the shoreline. All observations were made during the July, 2002 sampling period. See Table 1 for physical data on Camille Lake. The drainage basin of the lake is only .5 square miles and consists mainly of open rangeland with grasses and scattered shrub (Halfmoon 1978). The hillsides are forested with Ponderosa pine and Douglas fir. Access to Camille Lake is poor and requires extensive driving on and off primitive roads.

Very little data has been collected in the past on Camille Lake. Oxygen-temperature profiles were taken in 1983 and revealed values similar to the levels seen in our sample depicted in Figure 2. Dissolved oxygen levels <5mg/l and temperatures >25C as observed in Camille Lake can be lethal for salmonids (Behnke 1992). Prior to 1975, some trout were stocked in the lake with the addition of an aeration system used to increase dissolved oxygen levels to allow for increased salmonid survival. However, the attempt was unsuccessful and stocking was discontinued and the aeration system removed. Our sampling efforts in July 2002 contained only two brown bullheads *Ameiurus nebulosus*.

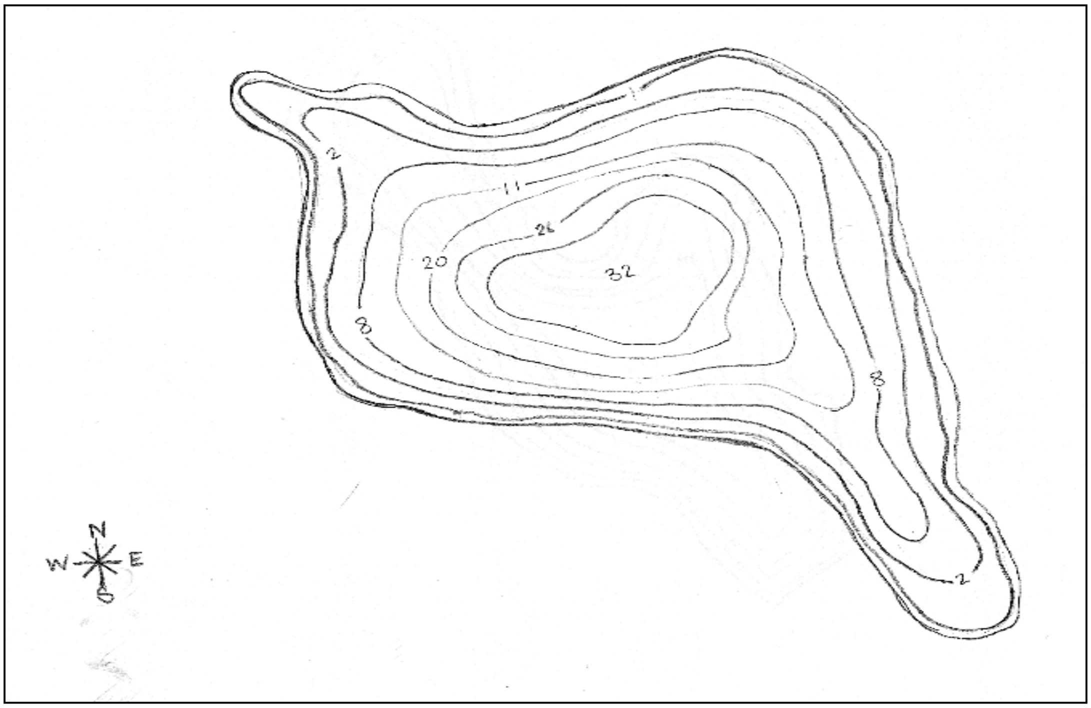



**Figure 1.** Bathymetric map of Camille Lake depicting contours in feet. Lake area is 20-acres, maximum depth is 32 feet and mean depth in 16 feet.

## Methods

Camille Lake was sampled for three nights using one 250 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 5 p.m. and pulled the next day at 8 a.m. for an approximate set of 15 hours. The net was set on the southern side of the lake to a maximum depth of 20ft.

One trap net with two leading ends was placed along the far northern shoreline in approximately 4ft of water for three nights. The net was set at 5 p.m. and pulled the next day at 8 a.m. for an approximate set of 15 hours.

Habitat data was collected from Camille Lake on 7/16/02. Information collected were secchi disc depth, alkalinity, percent littoral macrophyte community, average macrophyte community width, three macroinvertebrates samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Macroinvertebrates and zooplankton samples have not been processed to date and will not be discussed. A complete sample analysis should be completed by the spring of 2003. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter.

## **Results**

Three nights of gill and trap net sampling yielded only two brown bullheads. Both fish were sampled by gill net on the last night. The fish were 200mm at 155g and 195mm at 118g. No fish were sampled with the trap net during the sampling period.

Habitat samples taken during the sampling period showed a secchi disc reading of 4.25m, alkalinity of 600 mg/l, and macrophyte growth around the entire lake perimeter. Figure 2 is a depiction of oxygen-temperature profiles taken from Camille Lake on 7/18/02. Dissolved oxygen levels are above 6mg/l from a depth of 3m to the surface. Dissolved oxygen values are <1mg/l from a depth of 4m to the bottom. Temperature values were 27.2 C at the surface to 22.5 C at a depth of 5m.

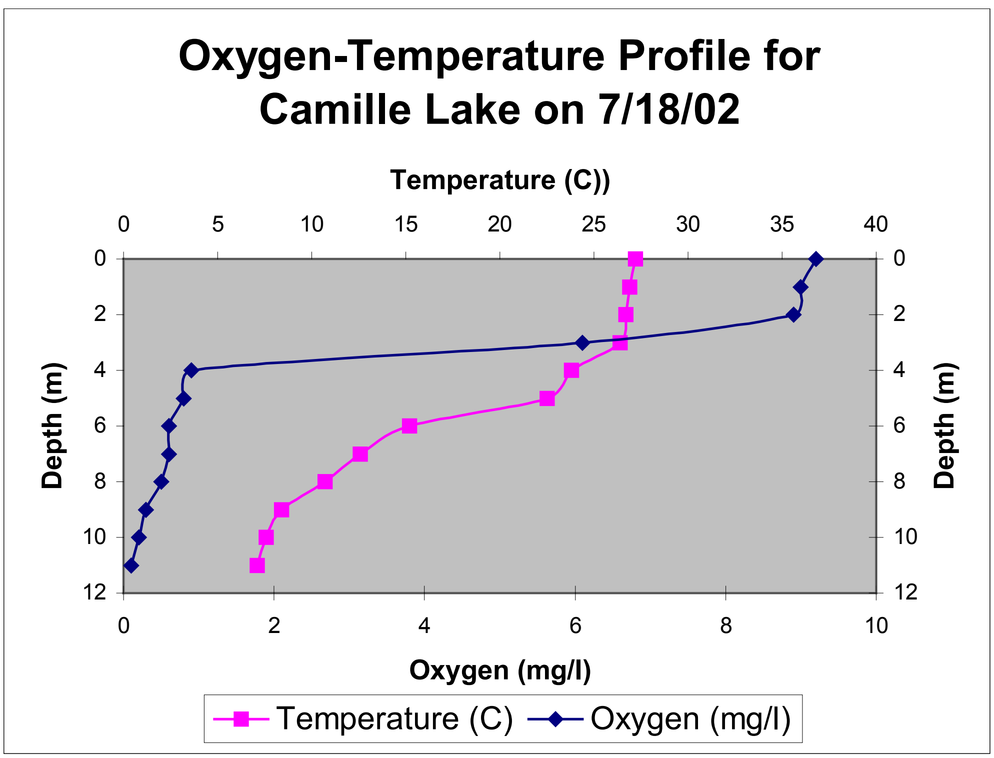



**Figure 2.** Oxygen-temperature profile for Camille Lake taken on 7/18/02. Maximum depth is 11m. Isotherm (line of stratification) is between 2 and 4m.

## Discussion

Figure 2 indicates severely limiting dissolved oxygen and temperature levels in Camille Lake for 7/18/02. Adequate salmonid oxygen levels of >5mg/l (Behnke 1992) and centrarchid levels of >3mg/l only exist down to a depth of 3m. Temperatures are extremely high ranging from 27.2C at the surface to 22.5C at a depth of 5m. See Figure 2. This leaves no thermal refuge or sufficient dissolved oxygen for salmonids if they were to be planted into the lake (Behnke 1992).

Oxygen-temperature profiles taken in the summer of 1983 revealed similar values as those expressed in Figure 2. Dissolved oxygen levels >5mg/l did not exist at depths lower than 4m. Temperatures from 4m to the surface were above 20C. It was concluded at that time that sufficient salmonid habitat was not available and the lake should no longer be included in the stocking schedule.

Despite the use of an aeration system before 1975, dissolved oxygen levels remained insufficient for salmonids to survive that were planted in the lake. Currently, only brown bullheads exist in the lake. Only two brown bullheads appeared in the three-day sample period indicating some kind of ecological constraint on this species as well. Current and historical data suggests this lake cannot adequately support salmonid populations.

## Management Recommendations

- Explore tribal member interest in developing Camille Lake into a warm water fishery.
- If a fishery is desired, improve access to the lake by redefining the entrance road.
- Leave the lake in the current state to be utilized as wildlife habitat.

# Fish Lake

2002 Technical Report


**Photo 1.** Aerial view of Fish Lake located 7.6 miles southwest of Inchelium on the Colville Confederated Tribes Reservation, WA. Scale is in miles.

## Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program

## Introduction

Fish Lake is located 7.6 mi. southwest of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From July 17 to July 18, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with the Independent Scientific Review Panel (ISRP) mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure while David Christensen, Larry Boyd and Anthony Cleveland carried out the fieldwork.

Fish Lake is a 2-acre eutrophic water body that reaches a maximum depth of 4.87m (Figure 1). The trophic status of the lake was determined by high recorded temperatures (20.2-22.7 C), low recorded dissolved oxygen (< 1 mg/l) below a depth of 1m (see Figure 2), extensive macrophyte development, and extensive floating cattail development along the shoreline. More than 1-acre of the lake is under floating cattail mats. Refer to Photo 1. Fish Lake contains a small, wild population of largemouth bass *Micropterus*

| **Table 1.** Physical Data of Fish Lake | |
|---|---|
| Elevation | 591.3m |
| Surface Area | .81ha. |
| Maximum Depth | 4.87m |
| Mean Depth | 3.05m |
| Trophic State | Eutrophic |

*salmoides*. All observations were made during the July, 2002 sampling period. See Table 1 for physical data on Fish Lake. Drainage is into Nez Perce Creek (Halfmoon 1978). The hillsides are forested with Ponderosa pine and Douglas fir and are extensively utilized for timber harvest and livestock grazing. Access to Fish Lake is good but no facilities are offered at the lake and fishing is limited due to heavy cattail growth.

Little data has been collected in the past on Fish Lake. Oxygen-temperature profiles were taken in 5/24/79 and a gill net was set over-night. The gill net set captured 5 brook trout *Salvalinus fontinalis* between 295mm-370mm and 25 Chinook salmon *Oncorhynchus tshawytscha* between 119mm-220mm.

Dissolved oxygen levels >5mg/l did not exist in Sugar Lake on 7/10/02 sampling period (See Figure 2). Dissolved oxygen levels <5mg/l are lethal for salmonids (Behnke 1992). Our sampling efforts in July 2002 contained only 6 largemouth bass between 150-260mm in length.

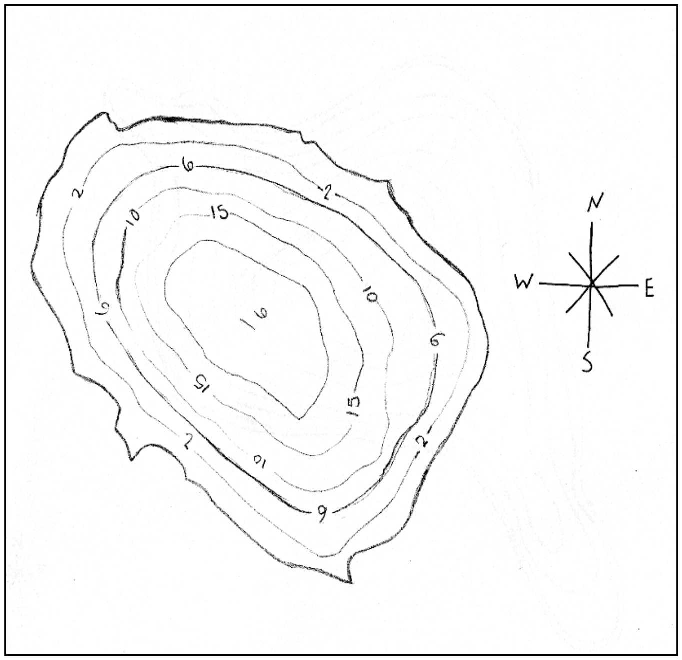



**Figure 1**. Bathymetric map of Fish Lake depicting contours of open water portion of lake measured in feet. The actual lake extends further

## Methods

Fish Lake was sampled for two nights using one 250 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 3 p.m. and pulled the next day at 9 a.m. for an approximate set of 18 hours. The net was set across the middle of the lake going west to east and to a maximum depth of 16ft.

Habitat data was collected from Fish Lake on 7/16/02. Information collected were secchi disc depth, alkalinity, percent littoral macrophyte community, average macrophyte community width, three macroinvertebrates samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter on the sampling date and on 2/8/03.

## Results

Two nights of gill and trap net sampling yielded 6 largemouth bass. All fish were sampled by gill net. The fish lengths and weights were all between 150-260mm and 175-230g. All largemouth bass sampled were between 1 and 3 years of age.

Macroinvertebrate samples yielded a total of 17 *amphipoda*, 1 *zygoptera*, 1 *anisoptera*, 1 *chironomidae*, 12 snails. Zooplankton samples expressed 344 large (>5nm) and 114 small (<5nm) zooplankton per 1m^3.

Habitat samples taken during the sampling period showed a secchi disc reading of 2.5m, alkalinity of 105mg/l, and macrophyte growth around the entire lake perimeter including dense cattail mat formation (See Photo 1). Figure 2 is a depiction of oxygen-temperature profiles taken from Fish Lake on 7/17/02. Dissolved oxygen levels only reach 3.3mg/l at the surface. Dissolved oxygen values are <1mg/l from a depth of 1m to the bottom. Temperature values were 22.7 C at the surface to 20.2 C at a depth of 2m.

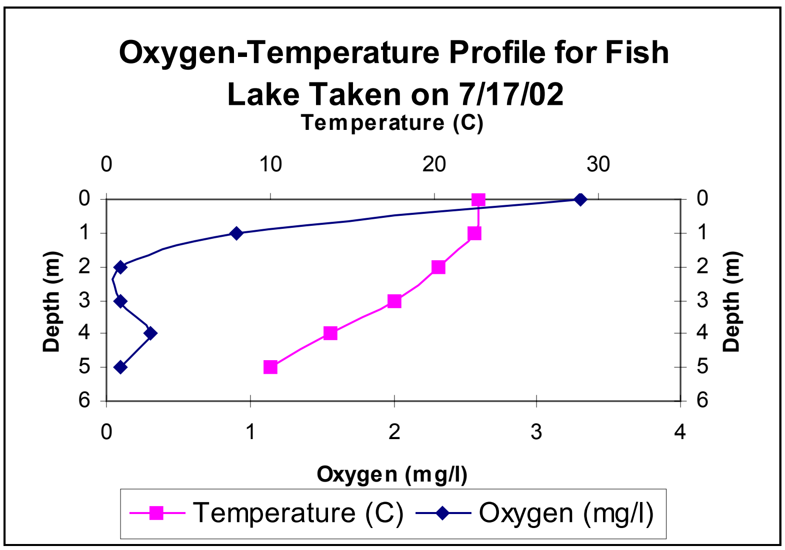



**Figure 2.** Oxygen-temperature profile for Fish Lake taken on 7/17/02. Maximum depth is 4.87m.

## Discussion

Largemouth bass were the only fish in the sample and all were between 150-260 mm, illustrating a narrow length range. All of these sampled fish had 1 or 2 scale annuli indicating they were all 1-2 and/or approaching 3 years of age. No forage fish appear to exist in Fish Lake for bass to feed upon as indicated by only a few, young bass appearing in our sample. Juvenile bass may do well feeding upon the abundance of zooplankton (344 large (>5nm) and 114 small (<5nm per 1m^3) but do poorly as they increase in size and their diet shifts to forage fish that do not exist in the lake.

Poor dissolved oxygen condition <3.3mg/l at the surface and approaching 0mg/l at only 2m suggests no potential salmonid habitat (See Figure 2). Winter dissolved oxygen levels may be even lower and could have a negative effect on the bass population in Fish Lake.

Approximately 1-acre at least is covered by dense floating cattail mats leaving less than 1-acre of open water. Fishing access is very limited due to this development.

## Management Recommendations

- If a warm-water fishery is desired, introduce a forage fish to improve bass population and size distribution.

- If a warm-water fishery is desired, improve fishing access by constructing docks and walkways through cattails.

- Manage as productive wetland wildlife habitat and leave the wetland in the current condition if no fishery is desired.

# Lake Lafleur

2002 Technical Report

## Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program.

## Introduction

Lake Lafleur is a 24.8 acre system located approximately nine miles north of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From July 23 to July 25, 2002 the lake was sampled to determine habitat and fish population parameters. This sample was performed in compliance with ISRP mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure, while David Christensen, Larry Boyd and Anthony Cleveland carried out the fieldwork.

Lake Lafleur is part of a series of lakes that comprise the Lafleur Lakes. These lakes exist in a marshy meadow basin. In general, Lake Lafleur is a closed basin, runoff fed lake that drains intermittently into the Inchelium watershed. Drainage flow is north into Cedar Creek which is a tributary of Barnaby Creek and eventually into Lake Roosevelt (Halfmoon 1978). A dominant Ponderosa pine forest with mixed fir and larch surrounds the lake. Heavy logging operations are currently in progress around the lake.

Lake Lafleur is generally characterized as a nutrient rich, eutrophic system. It is stocked in the spring and fall with rainbow trout *Oncorhynchus mykiss* that range in size from 25 fish/lb to 5 fish/lb. The lake received 4,531 rainbows in 2002, 7,004 in 2001, and 3,015 in 2000. In the spring of 2002, triploid rainbow trout ranging from 2-10 lbs. were also stocked in the lake. No natural reproduction occurs in the lake for rainbow trout. Largemouth bass *Micropterus salmoides* and brown bullheads *Ameiurus nebulosus* are abundant in the lake and reproduce naturally. The lake is managed as a tribal and non-tribal member fishery and receives moderate fishing pressure. Refer to Table 1 for physical data of Simpson Lake.

**Table 1. Physical Data of Lake Lafleur.**

| | |
|---|---|
| Elevation | 704.1 m. |
| Surface Area | 4.9 ha. |
| Maximum Depth | 11 m. |
| Mean Depth | 7 m. |
| Trophic State | Eutrophic |

Sampling effort with sinking gill nets in 1980 revealed rainbow trout, brook trout *Salvalinus fontinalis*, and brown bullheads. No largemouth bass were sampled in 1980 but appeared in samples taken in 1986. The magnitude of largemouth bass and brown bullheads sampled from the 1980 and 1986 gill net sets are inconclusive due to gill net sampling bias towards these two species. Sampling information before 1980 is minute and inconclusive.

The sampling effort in July 2002 revealed 53 rainbow trout all between 130–520 mm in length, 56 largemouth bass between 80–290 mm, and 23 brown bullheads between 230–360 mm. Condition factors on all species sampled indicate possible system constraints. Habitat samples also support this assumption.

## Methods

Lake Lafleur was sampled for two nights using one 150 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 7-8 pm and pulled the next day at 6-7 am for an approximate set of 11 hours. The net was set on the southern side of the lake approximately 100 m south of the boat ramp (Figure 1).

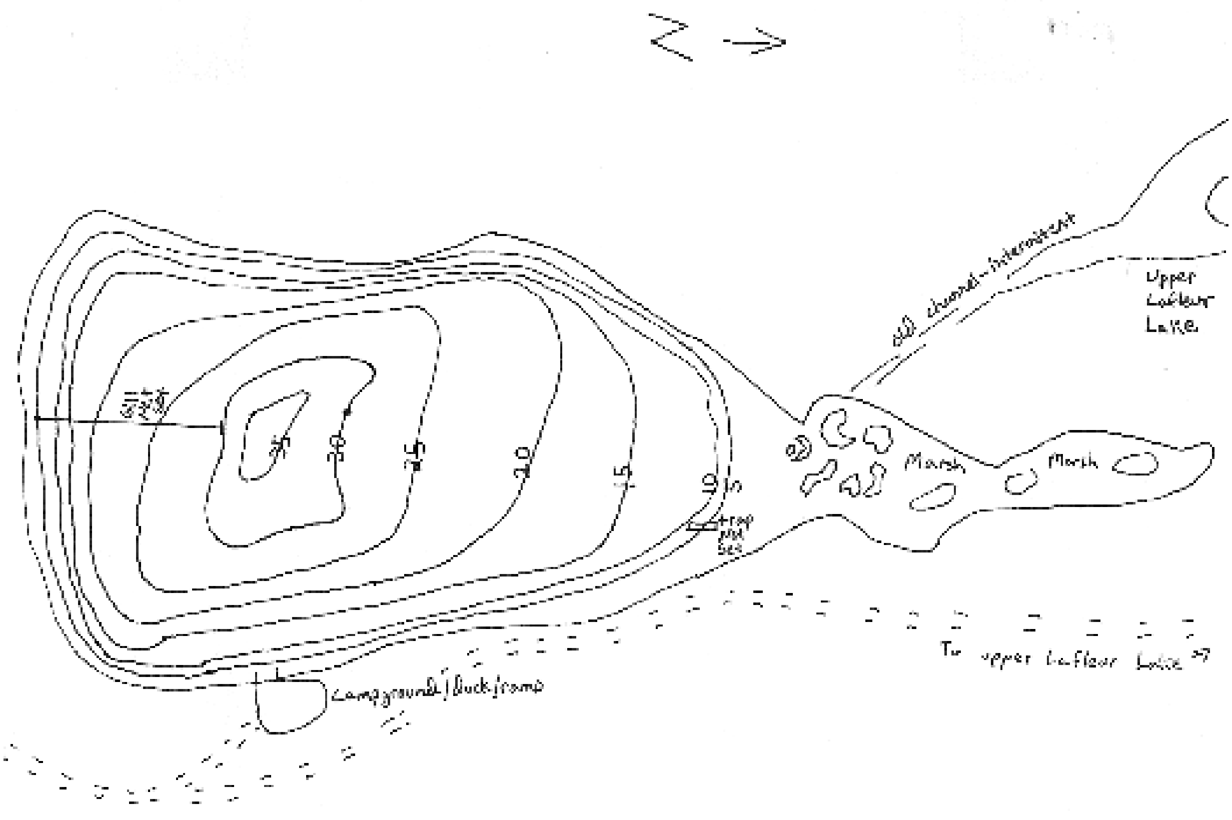



**Figure 1:** Bathymetric map of Lake Lafleur that illustrates gill and trap net sets as well as lake contours in feet.

One trap net with two leading ends was placed in the far northeastern cove in approximately 4 feet of water for two nights (Figure 1). The net was set at 7-8 pm and pulled the next day at 7-8 am for an approximate set of 11 hours.

The entire shoreline of Lake Lafleur was sampled using a Smith-Root GPP 5.0 electrofishing boat with umbrella shaped anodes and hanging cable cathodes. The boat was fixed with a 5000-watt generator. Range and duty cycle were adjusted when appropriate to solicit fish taxis (response to electrical current). Sampling the entire shoreline took approximately one hour. Sampling consisted of three passes per night for two nights.

Only data from the first electro fishing pass on the first night was analyzed statistically and discussed in this report to prevent inaccurate results due to repeat captures of fish sampled with the electro fishing boat. Only the first night gill and trap net data was analyzed in order to prevent recapture bias. All other net sets and electro fishing passes were designed to further investigate populations and to remove brown bullheads from the lake.

All rainbow trout were sampled for length, weight and elastomer tag identification. Largemouth bass were sampled for length, weight, and scale samples. Brown bullheads were sampled for length, weight and mechanical removal from Simpson Lake. Community composition, relative abundance, length class frequencies and relative weights were determined for rainbows, largemouth, and bullheads. Prefered stock densities (PSD) were determined for largemouth bass. Scale samples have not been analyzed to date so no age correlated information on bass will be discussed. Only fish over 100 mm were considered in the samples due to collection bias with smaller fish.

Habitat data was collected from Lake Lafleur on 7/24/02. Information collected were secchi disc depth, alkalinity, hardness, percent littoral macrophyte community, average macrophyte community width, three macroinvertibrate samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Macroinvertibrate and zooplankton samples have not been processed to date and will not be discussed. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter.

## Results

One night of sampling on July 23, 2002 yielded 53 rainbow trout, 56 largemouth bass, and 23 brown bullheads. Refer to Figure 2 for fish community structure. Rainbow trout comprised 40% of the catch while largemouth bass were 42%, and brown bullheads 17%.

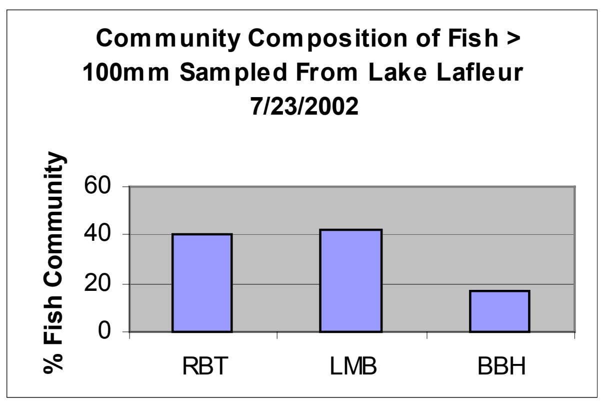



**Figure 2.** Fish community composition by percent of fish over 100 mm sampled.

Length frequencies of rainbow trout were between 130-520 mm. Length frequencies for largemouth bass sampled were 80-290 mm and brown bullheads were 230-360 mm. Refer to Figures 3,4,5 for length frequencies graphs.

Of the 53 rainbow trout sampled, 20 (38%) were adipose fin clipped, and 17 (32%) retained white elastomer injection tags inserted while at the Colville Tribal Trout Hatchery. The white elastomer tags indicate that these fish were stocked during the May 6th , 2002 plant. All other rainbows sampled were within 10-20 mm, because all fish were stocked at the same time. Although not all fish retained their elastomer tags possibly due to receiving poor elastomer injections. All other fish were either non-marked triploid adults or fish stocked the previous year before the tagging program was initiated. No natural reproduction exists in Lake Lafleur.

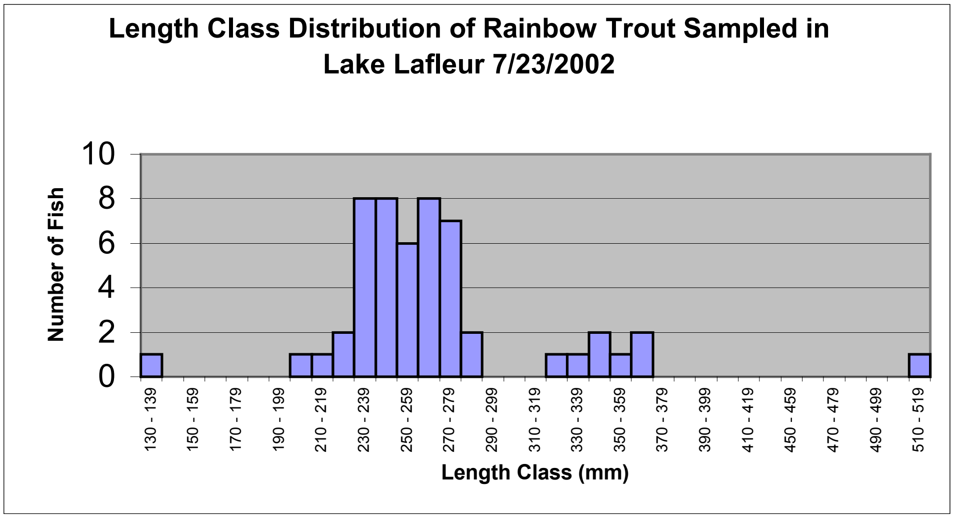



**Figure 3:** Length classes of rainbow trout sampled in Lake Lafleur on 7/23/02.

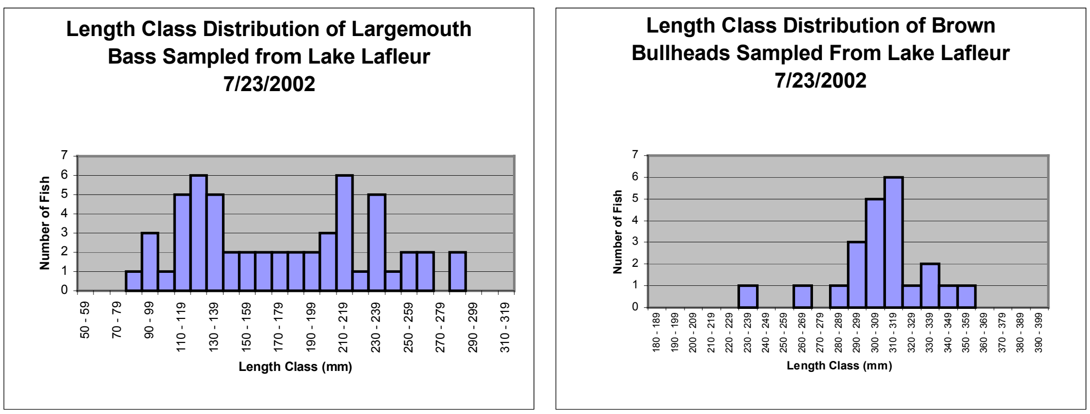



**Figure 4, 5:** Length classes of largemouth bass and brown bullheads sampled in Lake Lafleur on 7/23/02.

Relative weights (Wr) were used to access relative condition of the fish in relation to environmental conditions. Relative weight values greater than 100 generally suggest good fish health and adequate environmental conditions. Relative weights of rainbow trout, largemouth bass, and brown bullheads are contained in Figures 6,7,8.

Relative weights of rainbow trout ranged from 75 to 105. The trend line shows a general increase in condition with increased size of fish. However, the condition trend line is skewed due to one fish with a condition of 1.05. The one fish that had a Wr value of 1.05 was a 510 mm triploid rainbow that was stocked in June. If this fish was removed, the trend line would be decreasing. Relative weights of largemouth bass were between 65 and 123. The trend line for largemouth bass declines to below 100 with an increase in fish length. Relative weights for brown bullheads are all between 71 and 102.

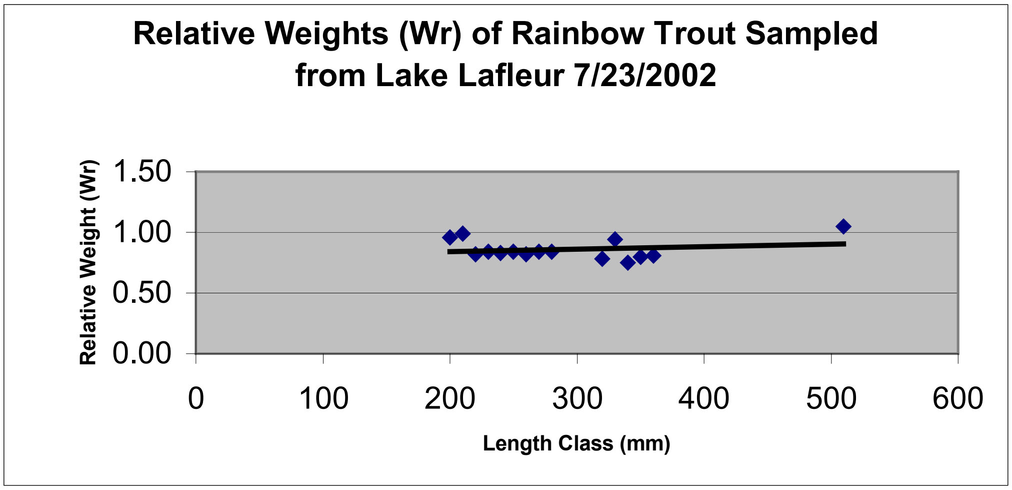
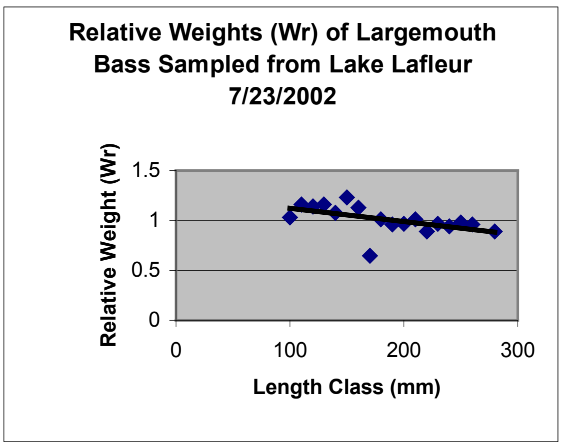



**Figure 6:** Relative weight (Wr) of rainbow trout sampled in Lake Lafleur on 7/23/02. Values greater than 1 generally represent good health and adequate environmental conditions for the species.



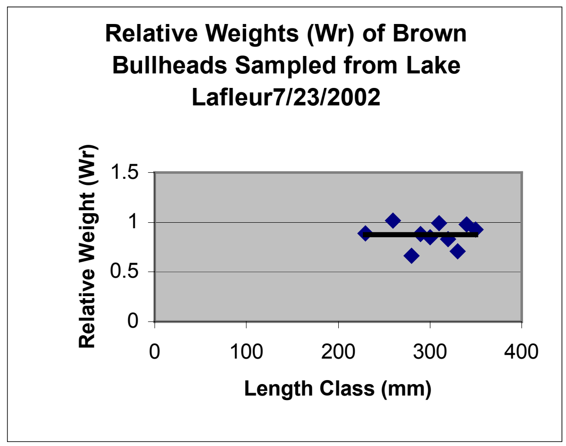




**Figure 7, 8:** Relative weight (Wr) of largemouth bass and brown bullheads sampled in Lake Lafleur on 7/23/02. Values greater than 1 generally represent good health and adequate environmental conditions for the species.

Prefered stock densities (PSD) were not calculated for largemouth bass because no quality size bass sampled from Lake Lafleur.

Secchi disc reading was 4.25 m. Alkalinity values were 104 mg/l CaCO3, and hardness values were 159 mg/l CaCO3. Macrophyte (rooted aquatic plants) growth is extensive in Lake alfleur and encompass over 90% of the lake shoreline (littoral habitat). Figure 9 depicts the oxygen-temperature profile and reveals high summer temperatures (20.4-23.2 C) to 4m depth. The oxygen line depicts less than adequate (< 5 mg/l) levels for salmonids from 7m depth to the bottom.

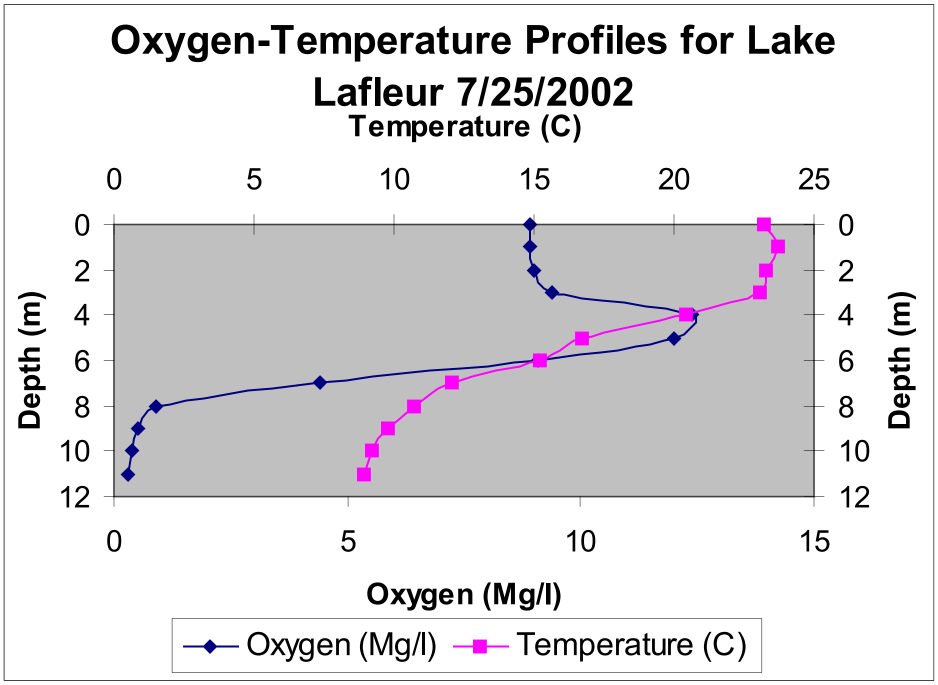



**Figure 9:** Oxygen-temperature profile for Lake Lafleur taken on 7/24/02. Maximum depth is 11 m and secchi disc reading was 4.25 m.

## Discussion

The sampling effort on July 23-25, 2002 gave 53 rainbow trout, 56 largemouth bass, and 23 brown bullheads. See figure 2. This sample is slightly different than gill net samples taken in 1980 and 1986. The current and past samples both had rainbow trout and brown bullheads. However, brown bullheads were much more abundant in the 1980 sample than in the 2002 sample despite the 2002 sample including gill net, trap net, and electro fishing techniques. The 1980 sample included gill net sampling only. The 1986 gill net set revealed 1 largemouth bass and only 6 brown bullheads despite 62 brown bullheads being sampled in 1980. This was likely due to rehabilitation efforts in 1985 that used rotenone in an attempt to eliminate brown bullhead abundance at this lake.

The 2002 sample suggests a community shift in Lake Lafleur from 1980 to the present. Rainbow trout are still present at similar numbers as in the 1980 and 1986 sample most likely due to stocking rates. However, the appearance of largemouth bass in our samples and the decline of brown bullheads suggest that illegal introductions by anglers or an incomplete kill of bullheads in 1985 has had a major impact on the fish community structure at this lake.

Figure 4 represents the length frequencies of largemouth bass sampled from Lake Lafleur in July 2002. All fish are between 80-290 mm in length while the majority of these fish (43 of the 56 sampled) are from 110-240 mm. Relative weights (Wr) of largemouth bass support that food resources are limiting with values ranging from 65 and 123. See Figure 7. The higher values belong to smaller fish. As fish size increases, the relative weight value of the fish declines. Condition declines as largemouth bass in this lake grow. In general, relative weights at or above 100 represent fish in good condition.

The narrow length range and low relative weights (Wr) for largemouth bass are due to a combination of factors. No forage fish exist in Lake Lafleur for sub-adult and adult fish to feed on. The smaller bass do well feeding on macroinvertibrates and zooplankton but as they increase in size no forage fish are available, so they starve. The preferred stock density (PSD) for bass in Lake Lafleur is 0 because no quality sized fish (> 300 mm) were sampled. This is due to the lack of forage for larger fish. Also, largemouth bass in Washington are at the fringe of their habitat capabilities. The growing seasons are simply to short for bass to consistently reach large sizes. Good reproduction of the smaller bass and the poor condition for larger fish leads to the expression of current results by this population.

Largemouth Bass populations maybe impacting brown bullheads and rainbow trout in the lake. Brown bullhead abundance has decreased in size since 1980 because of reclamation work in 1985. Largemouth abundance is also increasing although these fish are mostly small. The 2002 sample had 23 bullheads between 220-360 mm these fish are considerably longer than fish from other comparable waters such as Simpson Lake and Borgeau Lake were bullheads are much more abundant and range from 70-270 mm. Bullhead in this lake have less competition and therefore grow to a larger size than in Bourgeau and Simpson Lakes. Relative weights (Wr) of brown bullheads were between 66 and 102 suggesting that environmental conditions or forage availability are influencing bullheads.

Abundant but small largemouth bass may be influencing the rainbow trout. Because of competition in the littoral habitats (shoreline habitats) has depleted macro invertebrates and zooplankton resources. The available food for rainbow trout is limiting production. Although we have not analyzed our macro invertebrate samples, we did notice the lack of insects taken around the lake shoreline. No dragon or damselflies were observed in the three days we were sampling Lake Lafleur.

Rainbow trout are also affected by physical limitations occurring in the lake. Figure 9 depicts the oxygen-temperature relationship in Lake Lafleur on 7/23/2002. High water temperatures ranging from 20.4-23.2 C exist from the surface down to approximately 4m. From 5m deep all the way to the bottom temperatures are 8.9-16.7 C which is more suitable for rainbow trout survival and growth (Behnke 1992). Oxygen levels are adequate from the surface (8.9 mg/l) to 6 m depth where dissolved oxygen is 9.1 mg/l. This allows rainbow trout approximately 2 m of adequate habitat at a depth of approximately 5-6 m where temperature and dissolved oxygen levels are sustainable. All other depths are either too warm (> 20 C) or have insufficient dissolved oxygen levels (< 5 mg/l) for good rainbow trout growth and survival. In extreme conditions such as heavy ice cover in winter or long periods of hot weather in summer the oxygen-temperature conditions may intensify to the point were fish kills could be observed.

Oxygen levels in the lake are depleted by organic macrophyte and phytoplankton decomposition that exists on the bottom half (hypolimnion) of the lake. Over 90% of the shoreline is dominated by aquatic macrophytes. This organic growth accompanied by poor dissolved oxygen levels support the assumption that Lake Lafleur is marginal for salmonid survival and growth due to oxygen levels.

Relative weight values support the assumption that physical habitat and/or competition with largemouth bass is affecting rainbow trout growth and survival. Figure 6 depicts relative weight values for rainbow trout to be between 78 and 105. Only 1 rainbow trout had a Wr value over 1 and it was an adult triploid rainbow that was stocked in June. All other fish had Wr values between 78 and 99. This indicates that the rainbow trout are in sub-optimal condition in Lake Lafleur.

Even though oxygen-temperature conditions are not optimum, some over-winter survival does occur. Figure 3 shows two distinct clusters of size classes. The most abundant trout are all between 200-300 mm while the smaller cluster is between 320-380 mm long. The most abundant group of shorter trout contained all the white elastomer tagged fish in the entire sample. The white elastomer tag indicates these fish were stocked on 5/7/02. Even though not all fish had white elastomer marks the whole group is most likely from the same stocking batch because of similar size and because no wild trout are known to exist in this lake.

The group of longer fish lacked elastomer marks, this indicates they were stocked the previous year before the elastomer tagging program was instituted. The group of longer fish shows that some over-winter survival is occurring in Lake Lafleur. However, relative weights (Wr) are low as depicted in Figure 6 and growth rates are marginal. Fish stocked on 5/7/02 were on average 110g/fish and almost three months later were on average 157g/fish. This is a growth of 47g in 3 months. Fish stocked the previous spring were on average 110g/fish and were on average 393g/fish when sampled on 7/23/02. This is a growth of 283g/fish in 1 year.

## Management Recommendations

Due to the abundance of and competition with largemouth bass, rainbow trout food resources are limiting in Lake Lafleur. A removal program should be considered for both brown bullhead and largemouth bass if a rainbow trout fishery is the main objective. Removal could be done chemically or mechanically. Mechanical removal would reduce the abundance of largemouth bass but not eradicate them. Mechanical removal would need to be an annual or biannual operation. An ongoing mechanical removal program would reduce competition for limited food resources and benefit rainbow trout production. Mechanical removal could be accomplished with an electro fishing boat owned and operated by the tribe or by encouraging anglers to harvest all bass caught, despite the size. Most likely, electro fishing would be the more successful if accompanied by angler encouragement.

Chemical removal with compounds such as rotenone would be effective at eradicating the largemouth bass but may not be completely effective on eradicating bullheads due to their tolerance and ability to store oxygen in their body and burrow in bottom sediments (Wydoski and Wiley 1999). However, complete bullhead eradication was observed in Wisconsin when rotenone was applied just before the lake froze, this allowed rotenone to remain active for longer (Wydoski and Wiley 1999). Chemical controls are controversial and would target all the fish in the lake, not just the bullheads. Rotenone also negatively affects other organisms such as zooplankton and macro invertebrates that fish utilize as food (Wydoski and Wiley 1999). Wydoski and Wiley 1999, stated that salamanders and turtles have been killed by rotenone applications. These two species are abundant in Lake Lafleur.

Any chosen removal program would need to be accompanied by construction of an artificial rock or sand filter that would provide a fish barrier in the small channel that connects the two lake basins during high water events. An abundant population of brown bullheads already exists in upper Lafleur Lake so fish removed could be relocated into this body of water.

Increasing the forage base at Lafleur Lake would benefit all fish. Transplanting amphipods (scuds and crawfish) and other large invertebrates (i.e. damsel and dragonflies) along with a forge fish (i.e. peamouth chub) can be easily accomplished by collecting specimens from other lakes and transporting them to Lafluer Lake. Such introductions will require reducing the current fish abundance by reducing stocking levels of trout and by implementing one of the removal options first. If a bass fishery is desired by anglers and Tribal members then a forage fish such as pumkinseed *Lepomis gibbosus* could be introduced. This would provide forage for larger bass and could increase the size and health of these fish dramatically. However, pumkinseed are known to have negative implications on salmonid fisheries by increasing competition.

Over-winter survival occurs in Lake Lafleur but we do not know to what extent. Continued monitoring and elastomer tagging of all hatchery fish will help us to evaluate survivability in the future. An oxygenation system could be installed to increase dissolved oxygen levels in the lake and further increase survivability and available habitat in Lake Lafleur.

Reducing the number of fish stocked per year in Lake Lafleur would help reduce competition. This would increase the available food resources in the lake for the rainbow trout that are stocked. Reduced stocking accompanied by largemouth bass and brown bullhead removal would help decrease competition and allow for better growth and survival.

A combination of these recommendations would be most beneficial at Lake Lafleur and could lead to a more productive and satisfying fishery for tribal members and non-members to enjoy. If implemented, these actions should be monitored using a voluntary creel annually and fish populations sampled every 3 to 5 years by electro fishing and gill-net surveys to access project goals.

# Little Owhi Lake

2002 Technical Report

**Photo 1.** South facing view of Little Owhi Lake located approximately 1.5 miles north of Big Owhi Lake on the Colville Confederated Tribes Reservation, WA. Photo also depicts fishery technicians installing solar power aeration system supports.

**Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program**

## Introduction

Little Owhi Lake is located 1.5 miles north of Big Owhi Lake on the Colville Confederated Tribes Reservation in north central Washington State. On Aug. 15, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with the Independent Scientific Review Panel (ISRP) mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure while David Christensen, Larry Boyd, Anthony Cleveland, and Marvin Bob carried out the fieldwork.

Little Owhi Lake is an 18-28 acre eutrophic water body that reaches a maximum depth of 17m (Figure 1). The trophic status of the lake was determined by high recorded temperatures (19 C) down to 4m, low recorded dissolved oxygen (< 1mg/l) below 5m in summer and below 2m in the winter (see Figure 2,3), extensive macrophyte development, and extensive cattail and reed development along the shoreline. All observations were made during the Aug, 2002 sampling period. See Table 1 for physical data on Little Owhi Lake. Drainage is into Big Owhi Lake and eventually into the Nespelem River. The hillsides are forested with Ponderosa pine and Douglas fir and are extensively utilized for timber harvest and livestock grazing. Access to Little Owhi Lake is good but no facilities are offered at the lake.

**Table 1.** Physical Data of Little Owhi Lake

| | |
|---|---|
| Surface Area | 7.3-11.3ha. |
| Maximum Depth | 17m |
| Mean Depth | 7.6m |
| Trophic State | Eutrophic |

Little data has been collected in the past on Little Owhi Lake. An attempt was made in the 70's to locate the lake and sample it. However, a small pond was mistaken for Little Owhi Lake and no further research was conducted. Our sampling efforts in Aug. 2002 revealed a maximum depth of 17m, contained no fish and revealed stressful dissolved oxygen conditions. See figures 2 and 3 for oxygen-temperature information.

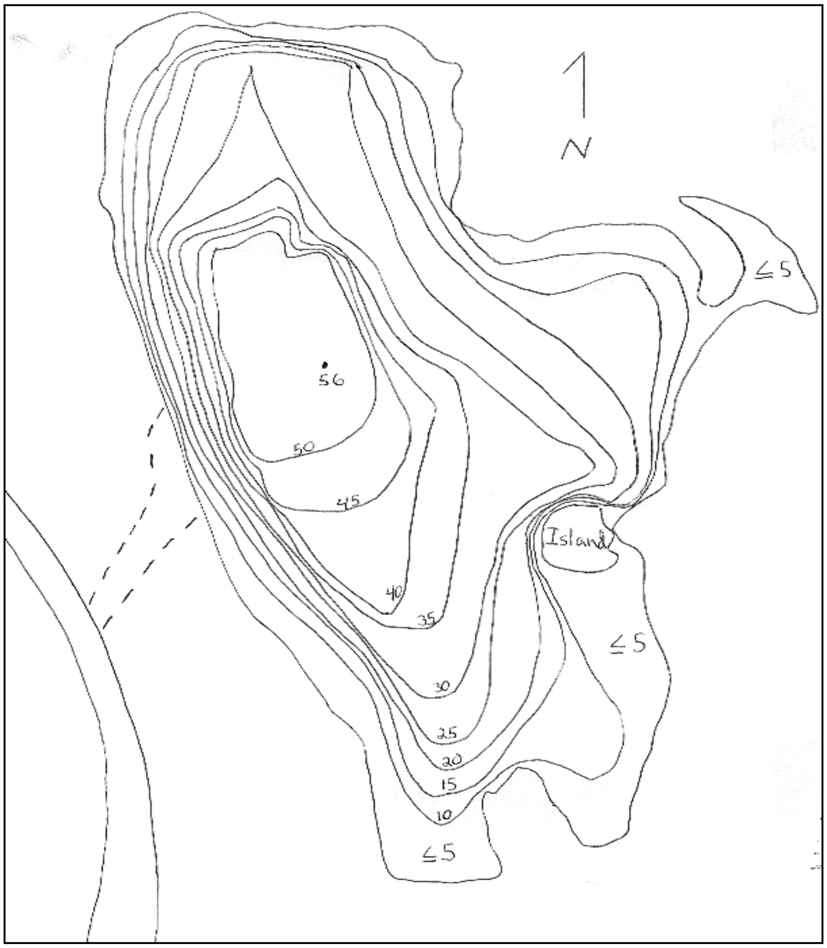



**Figure 1.** Batgymetric map of Little Owhi Lake depicting contours in feet. Lake area is 18-28 acres, maximum depth is 56 feet and mean depth is 25 feet.

## Methods

Little Owhi Lake was sampled for one night using one 250 ft. by 6 ft. sinking experimental monofilament gill net. The net was set in the afternoon at 2 p.m. and pulled the next day at 8 a.m. for an approximate set of 18 hours. The net was set across the middle of the deepest section west to east and to a maximum depth of 50ft.

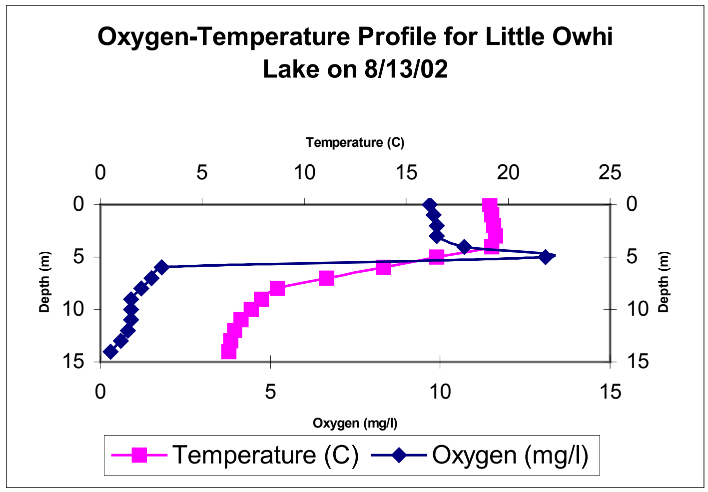
One trap net with two leading ends was placed along the far eastern shoreline and just south of the island in approximately 4ft of water for one night. The net was set at 2 p.m. and pulled the next day at 8 a.m. for an approximate set of 18 hours.

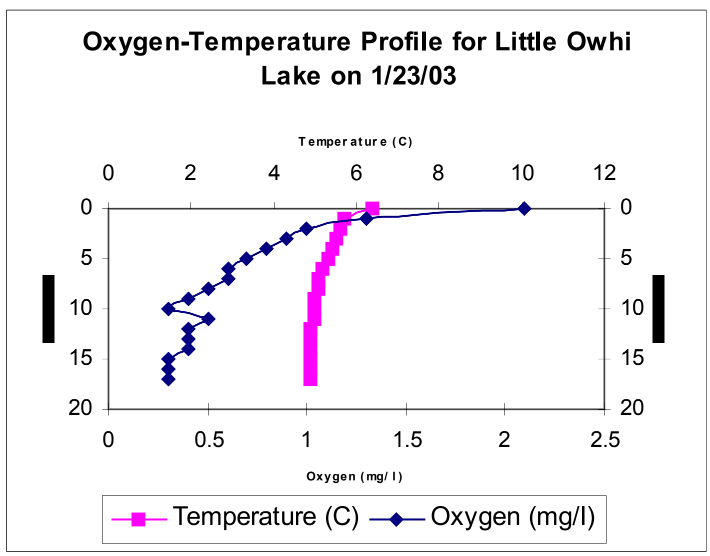
Habitat data was collected from Little Owhi Lake on 8/13/02. Information collected were secchi disc depth, alkalinity, percent littoral macrophyte community, average macrophyte community width, three macroinvertebrates samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter on the sampling date and on 1/23/03.

## Results

One night of gill and trap net sampling yielded no fish. However, 18 large brown and spotted salamanders were sampled in the trap net with 2 painted turtles. Our macroinvertibrate samples revealed 84 large *amphipoda*, 1 crawfish, 1 *gerridae*, 11 *ephemeroptera*, 9 *coleoptera*, 2 *anisoptera*, 2 *chironomidae*, 14 snails. Our zooplankton sample showed 89 large (>5nm) plankton per 1m^3 and 172 small (<5nm) plankton per 1m^3.

Habitat samples taken during the sampling period showed a secchi disc reading of 4.25m, alkalinity has not been determined, and aquatic macrophyte growth around the entire perimeter of the lake. Figure 2 and 3 are depictions of oxygen-temperature profiles taken from Little Owhi Lake on 8/13/02 and 1/23/03. Dissolved oxygen levels are <2mg/l from a depth of 6m to the bottom on 8/13/02. On 1/23/02 dissolved oxygen levels were <2mg/l from a depth of 1m all the way to the bottom.




**Figures 2 and 3.** Oxygen-temperature profile for Little Owhi Lake taken on 8/13/02 and 1/23/03. Maximum depth is 17m.

## Discussion

No salmonids exist in Little Owhi Lake but have been stocked periodically in the past without much documentation (CCT 2003, personal communication). Approximately 300 triploid brook trout *Salvalinus fontinalis* were planted into Little Owhi during the fall of 2002. Our gill and trap net sampling procedures confirmed the lack of fish in the lake but were conducted before the fall, 2002 plant.

Adequate dissolved oxygen levels for salmonids (>5mg/l) exist from 5m to the surface on our 8/13/02 sampling date. An abundance of large amphipods and a moderate abundance of zooplankton (89 large/1m^3, 172 small/1m^3) could provide a good forage base for salmonids if stocked in the lake. However, winter dissolved oxygen levels did not exceed 2.1mg/l in the entire sample taken on 1/23/03. Dissolved oxygen levels this low would not allow for salmonid survival.

An attempt has been made to increase winter dissolved oxygen values to a level that can support salmonids (>5mg/l) by the installation of a solar powered aeration system. The system has been in operation since 1/23/03 and is hoped to be successful. If successful, the lake will continue to be stocked each year with brook trout. Only brook trout will be used to ensure no introgression with our Big Owhi Lake brood stock occurs.

## Management Recommendations

- Continue monitoring dissolved oxygen to determine aeration system success.
- If aeration system is successful, resume stocking brook trout each year.
- Provide better fishing access to the lake such as docks and parking.
- If aeration system is unsuccessful, manage the lake as wildlife habitat.

# Nicholas Lake

2002 Technical Report

**Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program**

**Photo 1.** View of Nicholas Lake and Chara bench. Notice sharp drop off at the edge of the bench.

## Introduction

Nicholas Lake is located approximately 12 miles north of Inchelium on the west side of Stahley Mtn. in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From July 10 to July 13, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with ISRP mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure while David Christensen, Larry Boyd and Anthony Cleveland carried out the fieldwork.

Nicholas Lake is a small 2-acre chara bench lake where aquatic macrophytes grow extremely thick creating a shallow bench around the deeper locations. A chara bench exists around the entire lake leaving a circular drop off in the center. This deeper area only consists of approximately 30-40% of the entire lake. The rest is chara bench development. Depths can range from 2-3 feet at the edge of the bench to 34 feet only a few meters from the drop off. Refer to Figure 1 for lake contours.

| **Table 1. Physical Data of Nicholas Lake** | |
|---|---|
| Elevation | 810.8 m |
| Surface Area | .8094 ha. |
| Maximum Depth | 10.67 m |
| Mean Depth | 6.1 m |
| Trophic State | Eutrophic |

Nicholas Lake has a small outlet stream on the southwestern corner of the lake. An inlet stream has not been identified but if it exists would have to be minute. Most likely, springs, runoff, and ground water feed the lake. The lake is heavily forested pre-dominantly by fir on all sides. Livestock grazing is heavy around the lake. The lake is nutrient rich and is classified as eutrophic.

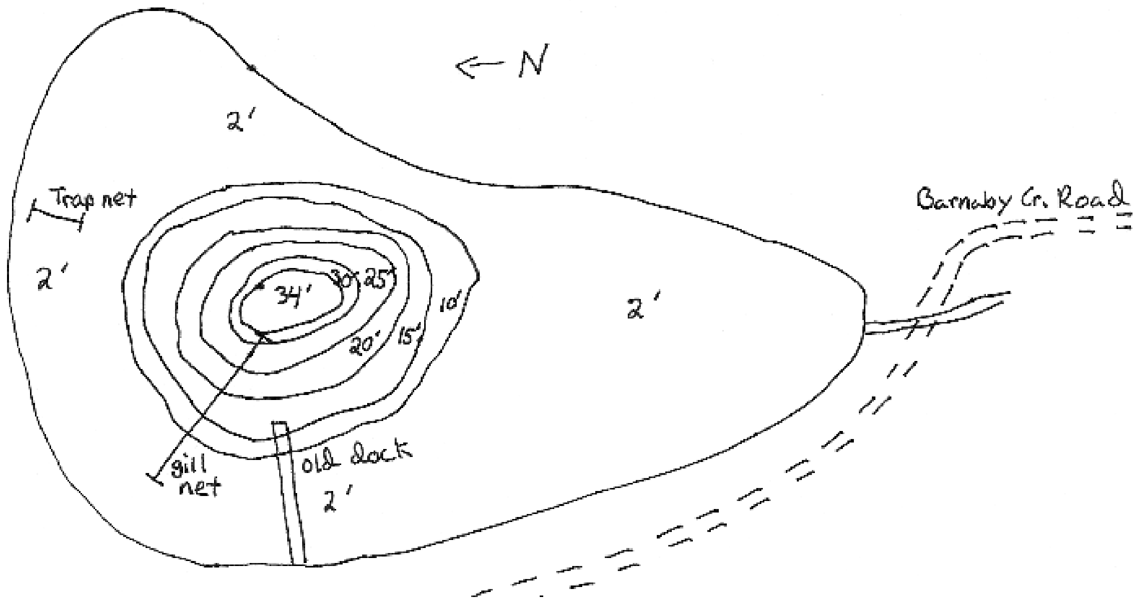



**Figure 1.** Bathymetric map of Nicholas Lake showing contours in feet. Gill net and trap net locations are also expressed on the figure.

Nicholas Lake is stocked each spring with rainbow trout *Oncorhynchus mykiss* that range in size from 25 fish/lb to 5 fish/lb. The lake received 500 in 2002, 1,487 in 2001, and 1,989 in 2000. In the spring of 2002, 50 adult triploid rainbow trout averaging 1-2 lbs. were planted in the lake as well. Brook trout have been stocked in the past at levels from 1,000-5,145 per year but stocking procedures were discontinued periodically due to the lack of angler use (Halfmoon 1978). No natural reproduction occurs in the lake. All trout are hatchery produced.

Sampling effort with gill nets in 1981 and 1982 revealed no fish in the sample. No other gill net sampling was conducted at the best of our knowledge for this lake until our procedures were performed in 2002. In 2002, we set 1 gill net on July 10th and July 11th and caught 34 rainbow trout between 275-387 mm in length. Condition factors (Wr) for the rainbow trout sampled were relatively low indicating possible environmental constraints on these fish.

## Methods

Nicholas Lake was sampled for two nights using one 250 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 6 pm and pulled the next day at 9 am for an approximate set of 15 hours. The net was set on the northwestern side of the lake about 100m above the old fishing dock (Figure 1).

One trap net with two leading ends was placed along the far northern shoreline in approximately 4 feet of water for two nights (Figure 1). The net was set at 6 pm and pulled the next day at 9 am for an approximate set of 15 hours.

All rainbow trout were sampled for length, weight and elastomer tag identification. Community composition, relative abundance, length class frequencies and relative weights were determined for rainbows.

Relative weights (Wr) were determined by two formulas:

3. Power Function  $W = a*L^b$

Estimated values of (a) and (b) come from the regression line graphed from the log length (x-axis) against the log weight (y-axis) of the species. The slope is represented by (a) while the y-intercept is represented by (b). These values can be obtained for the species on page 462, Table 15.1 of Fisheries Techniques, second edition produced by the American Fisheries Society, 1996. Ws is the actual weight of the sampled fish.

4. Relative Weight  $Wr = W/Ws$

Habitat data was collected from Nicholas Lake on 7/11/02.  Information collected were secchi disc depth, alkalinity, hardness, percent littoral macrophyte community, average macrophyte community width, three macroinvertebrates samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Macroinvertebrates and zooplankton samples have not been processed to date and will not be discussed. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter.

## Results

From the 2-night gill net set in Nicholas Lake we sampled 34 rainbow trout between 240-390 mm in length. Twenty-nine of the 34 fish sampled were between 260-310 mm. One fish was sampled that was 246 mm, one at 340 mm, and 2 fish between 380-390 mm. See Figure 2 for length class information. No fish were sampled in the trap net for both nights. Like many of the small reservation lakes, painted turtles were captured in the trap nets.  In two nights we sampled 19 turtles and released all 19. No other fish species were sampled from the lake.

Of the 34 sampled rainbow trout, 31 (91%) were adipose fin clipped and 19 (55%) were marked with white elastomer injection tags while at the Colville Tribal Trout Hatchery. The white elastomer tags indicate that these fish were stocked during the May 2nd, 2002 plant. All the sampled fish were hatchery oriented fish and came from the Colville Tribal Trout Hatchery in May, except for the three fish greater than 340 mm that may be carry-overs, or surviving triploid adults that were planted in June 2002.

Relative weights (Wr) were used to access relative condition of the fish in relation to environmental conditions. Values greater than 1 generally suggest good health and adequate environmental conditions for the species while values below 1 suggest poor health and inadequate environmental conditions.

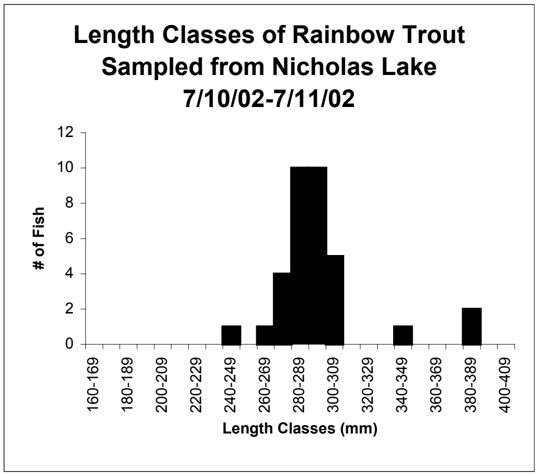



**Figure 2.** Length distribution of rainbow trout Sampled from Nicholas Lake on 7/10-7/11/02.

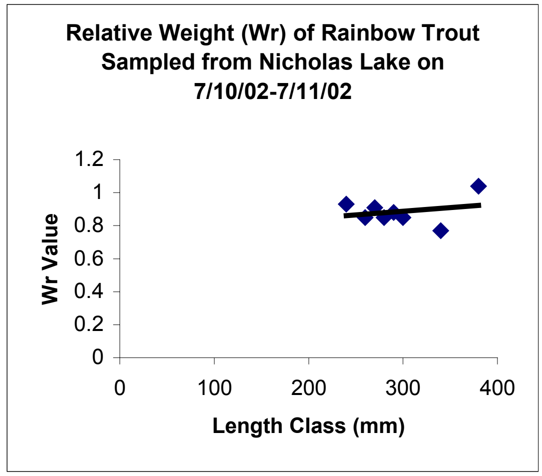



**Figure 3.** Relative weight (Wr) values for rainbow trout sampled from Nicholas Lake on 7/10-7/11/02.

Wr values greater than 1 generally represent good fish growth and good environmental condition for the species.

Figure 3 shows the average relative weight (Wr) condition factors for rainbow trout length classes sampled from Nicholas Lake in July 2002. Five of the 8 values plotted are below .9, 2 points are below .94 and only 1 point is above 1.

Habitat samples taken from Nicholas Lake show that productivity is limiting. Alkalinity samples were 70 CaCO3 and hardness was 95 CaCO3. Secchi disc depth was 4.25 m. Macrophyte growth encompassed 100% of the littoral community (shoreline habitat) and approximately 70% of the entire lake. Figure 4 depicts oxygen-temperature profile taken from the lake on 7/11/02. Oxygen levels are greater than 10 mg/l down to 7 m and between 18-19 mg/l at 5-6 m depth. Temperature levels from the surface to 3 m are high for salmonids at 21-23 C but decrease from 19.6 C at 4 m to 8.5 C at the bottom.

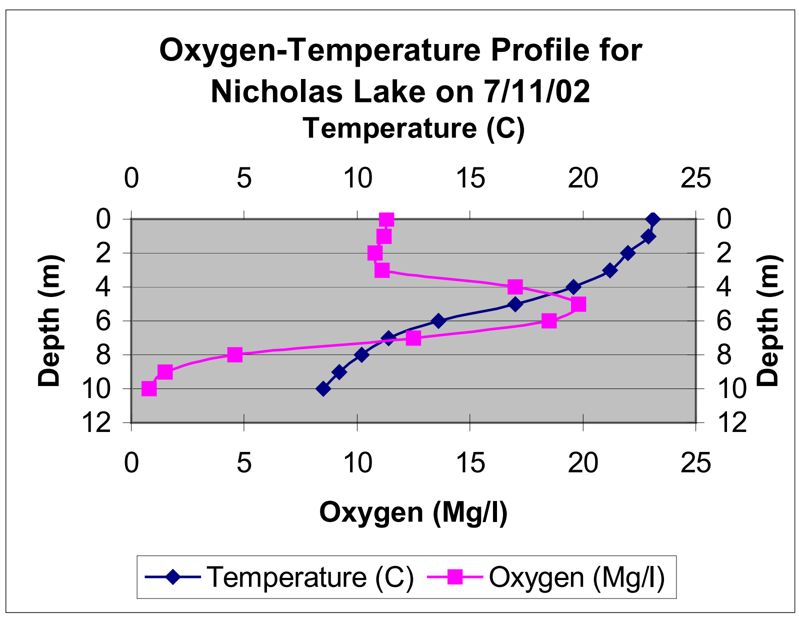



**Figure 4.** Oxygen-temperature profile for Nicholas Lake taken on 7/11/02. Maximum depth is 10.67 m. Isotherm (line of stratification) is at 6.5 m.

## Discussion

Hatchery stocking records show that fish stocked in Nicholas Lake on 5/2/02 were on average 91g and during the sampling period were on average 245g (excluding fish > 340 mm that are assumed to be stocked triploid adults). This represents a growth rate of 154g in 2.5 months. Fast growth could be a result of large quantities of food resources when the fish were first planted in the lake. Few, if any fish were in the lake prior to the May 2002 plant, so food resources were abundant.

However, low relative weight (Wr) condition factors in Figure 3 suggest the fish are lower in weight than what they should be at their current length. They grew fast initially, but as food resources became limited, their weight declined, giving them poor relative weight values as illustrated in Figure 3.

The lake is relatively unproductive despite the high level of aquatic macrophyte growth. Alkalinity levels were only 70 $CaCO_3$ suggesting low amounts of (+) ions such as Mg, Ca, and Na which aquatic flora and fauna utilize for growth and physiological regulation.

Figure 4 depicts an oxygen-temperature profile for Nicholas Lake on 7/11/02. The graph illustrates optimum salmonid dissolved oxygen levels > 6 mg/l to depths of 7 m. The temperature line shows stressful salmonid temperature levels > 20 mg/l down to 3 m. This leaves adequate salmonid habitat on the sampling date at 4-7 m depth. This depth only represents a minute area of the 2-acre lake. See Figure 1 for lake depths. All the fish sampled came from around this depth. Stocked fish are concentrated in a small area resulting in resource competition, reduced growth, and stress.

The larger fish (>340 mm) in the sample were most likely the adult triploid rainbows planted in June 2002, rather than fish stocked the previous year. Due to the lack of carry-over fish in our sample we can assume that the previous years stocked fish died during the winter due to low dissolved oxygen levels. Winterkills have been recorded in the past and due to the enormous amounts of organic plant growth that decompose heavily in winter, at least partial fish kills could occur every year.

Fishing pressure is relatively low at this lake but exploitation can easily reduce the number of larger fish in a population. However, this is assumed not to be the case with Nicholas Lake. Voluntary creel surveys and further habitat sampling may reveal a combination of the two factors.

## Management Recommendations

- Install voluntary creel boxes at this lake to determine angler pressure and satisfaction.
- Increase angler access to lake by reconstructing fishing dock.
- If angler interest is high, explore possibility of aeration system installation to increase dissolved oxygen levels in the lake.

# Simpson Lake

2002 Technical Report

**Photo 1**. View of Simpson Lake south shore and gill net set.

**Colville Confederated Tribes Fish Hatchery Monitoring and Evaluation Program**

## Introduction

Simpson Lake is located approximately eight miles north of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From June 24 to June 27, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with ISRP mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure, while David Christensen, Larry Boyd and Levi Morris carried out the fieldwork.

Simpson Lake is a closed basin, runoff fed lake that drains slowly into the Inchelium watershed. Drainage flow is southeasterly into Little Jim Creek and eventually into Lake Roosevelt (Halfmoon 1978). A Ponderosa pine forest with mixed fir and larch surrounds the lake. Simpson Lake is generally characterized as a nutrient rich, eutrophic system. It is stocked in the spring and fall with brook trout *Salvalinus fontinalis* ranging from 25 fish/lb to 5 fish/lb and has been stocked in the past with rainbow trout *Oncorhynchus mykiss* as fingerlings (Halfmoon 1978). No natural reproduction occurs in the lake for these two species. Brown bullheads *Ameiurus nebulosus* are abundant in the lake and reproduce naturally. The lake is reserved for tribal members only and is managed as a brook trout fishery at their request. Refer to Table 1 for physical data of Simpson Lake.

**Table 1. Physical Data of Simpson Lake.**

| | |
|---|---|
| Elevation | 685.8 m |
| Surface Area | 8.9 ha. |
| Volume | 262700 m^3 |
| Maximum Depth | 12.19 m |
| Mean Depth | 6.1 m |
| Trophic State | Eutrophic |

Little information has been collected on Simpson Lake in the past. Data was collected in September of 1975, July 1976 and July 1977 by gill net. These samples included 8-19 inch rainbow trout and 9-13 inch brook trout (Halfmoon 1978). Gill net samples taken in 1981, 1983, and 1988 revealed only brook trout and a few redside shiners. The trout samples all demonstrated good condition factors, indicating an abundance of food organisms and/or proper stocking rates in the lake. The trout population during these times was indicated to be stable despite a history of random winterkills that had occurred previously and reported in 1979.

The sampling effort in June 2002 revealed 59 rainbow trout all between 200 and 260 mm in size and 295 brown bullheads between 70 and 190 mm. This sample was indicative of a fish community shift from the samples taken in 1975, 1976, 1977, 1981, 1983, and 1988 that revealed brook and rainbow trout only with a few redside shiners. Condition factors and length frequencies taken on the sampled rainbow trout and brown bullhead indicate system constraints. Habitat samples were also indicative of this assumption.

## Methods

Simpson Lake was sampled for three nights using one 150 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 8-9 pm and pulled the next day at 8-9 am for an approximate set of 12 hours. The net was set on the southern side of the lake approximately 1/16 mile south of the boat ramp (Figure 1).

One trap net with two leading ends was placed in the far northwestern cove in approximately 4 feet of water for three (Figure 1).

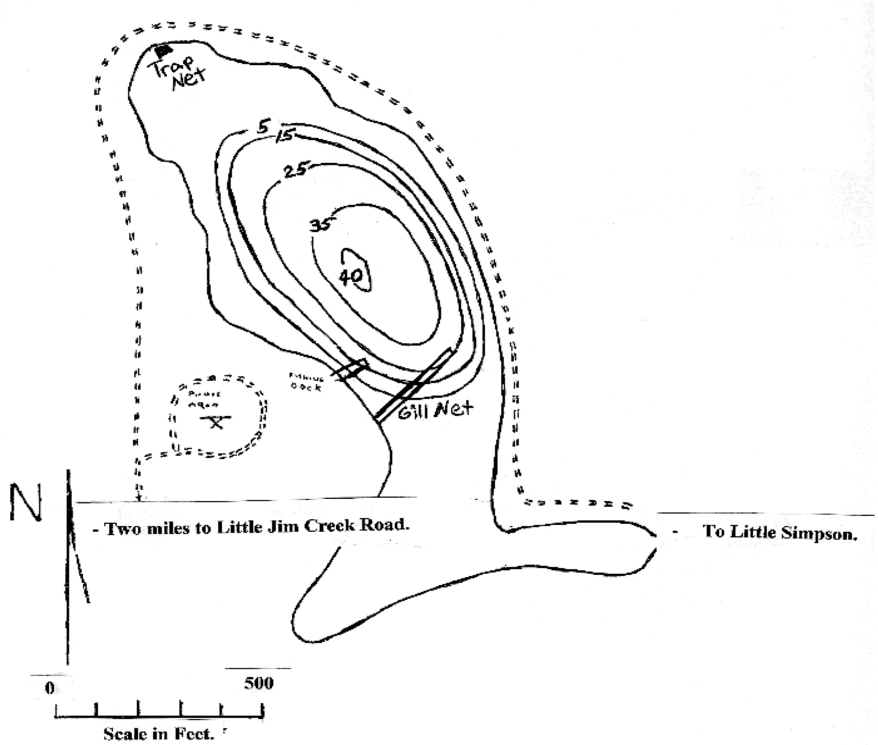



**Figure 1.** Bathymetric map of Simpson Lake that illustrates nights gill and trap net sets as well as lake contours in feet.

The net was set at 8-9 pm and pulled the next day at 8-9 am for an approximate set of 12 hours

The entire shoreline of Simpson Lake was sampled using a Smith-Root GPP 5.0 electrofishing boat with umbrella shaped anodes and hanging cable cathodes. The boat was fixed with a 5000-watt generator. Range and duty cycle were adjusted when appropriate to solicit fish taxis (response to electrical current). Sampling the entire shoreline took approximately one hour. Sampling consisted of three passes per night for two nights.

Only data from the first electro fishing pass on the first night was analyzed statistically and discussed in this report to prevent inaccurate results due to repeat captures of fish sampled with the electro fishing boat. Only the first night gill and trap net data was analyzed in order to prevent recapture bias. All other net sets and electro fishing passes were designed to further investigate populations and to remove brown bullheads from the lake.

All rainbow trout were sampled for length, weight and elastomer tag identification. Brown bullheads were sampled for length, weight and mechanical removal from Simpson Lake. Community composition, relative abundance, length class frequencies and relative weights were determined for rainbows and bullheads. Only fish over 100 mm were considered in the sample due to collection bias with smaller fish.

Habitat data was collected from Simpson Lake on 6/24/02. Information collected were secchi disc depth, alkalinity, hardness, percent littoral macrophyte community, average macrophyte community width, three macroinvertibrate samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Macroinvertibrate and zooplankton samples have not been processed to date and will not be discussed. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter.

## Results

One night of sampling on June 25, 2002 yielded 46 rainbow trout, 295 brown bullheads, and 1 redside shiner *Richardsonius balteatus*. Refer to Figure 2 for fish community structure. Brown bullheads comprised 86 % of the catch while rainbow trout only 13.5 %. Redside shiners were .3 % of the sample.

No brook trout were sampled during this procedure. Brook trout were stocked the previous fall and spring. No brown bullheads were sampled in 1975, 1976, 1977, but dominated the catch in this sample.

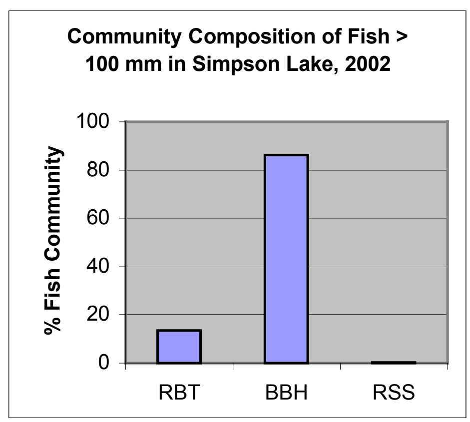
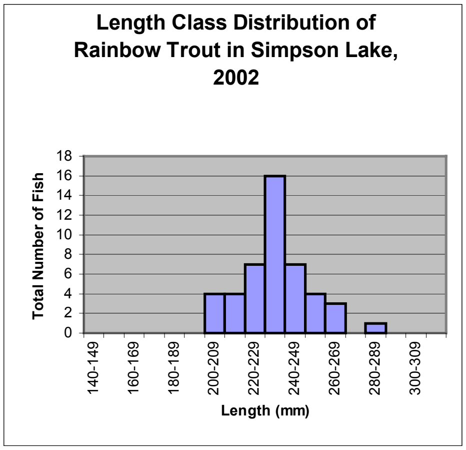



**Figure 2.** Fish community composition by percent of fish over 100 mm sampled.

Length frequencies of rainbow trout were all between 200 and 290 mm. Length frequencies of brown bullheads were all between 70 mm and 190 mm. Refer to Figure 3 and Figure 4.



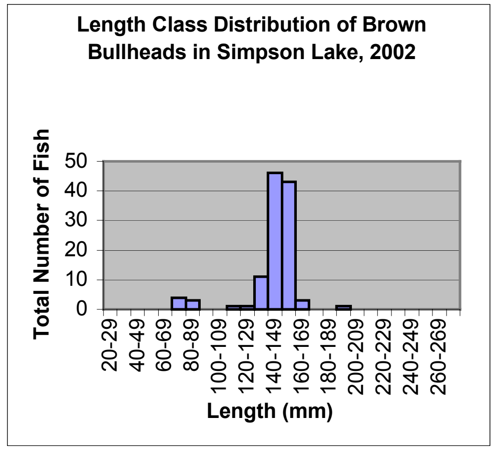
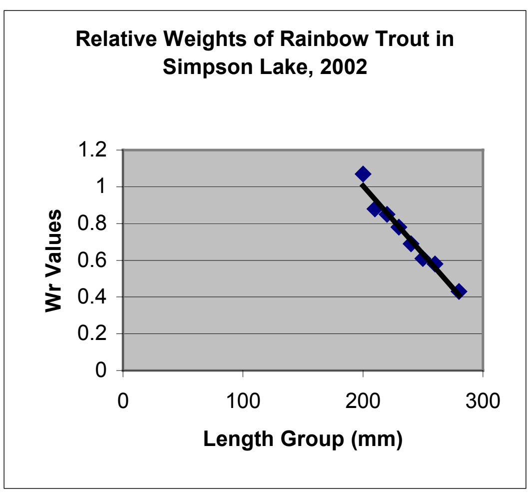




**Figure 3.** Length classes of rainbow trout sampled in Simpson Lake on 6/25/02.

**Figure 4.** Length classes of brown bullhead sampled in Simpson Lake 6/25/02.

Of the 46 rainbow trout sampled, 45 (98 %) were adipose fin clipped, and 32 (70 %) retained white elastomer injection tags inserted while at the Colville Tribal Trout Hatchery. The white elastomer tags indicate that these fish were stocked during the May 6th, 2002 plant. All other rainbows sampled were most likely stocked with these fish as well. Though they were not elastomer tagged, they are all within the same size class as the others, indicating they are of the same year plant, but received poor elastomer injections.

Relative weights (Wr) were used to access relative condition of the fish in relation to environmental conditions. Values greater than 100 generally suggest good health and adequate environmental conditions. Relative weights of rainbow trout and brown bullheads are contained in Figure 5 and Figure 6.



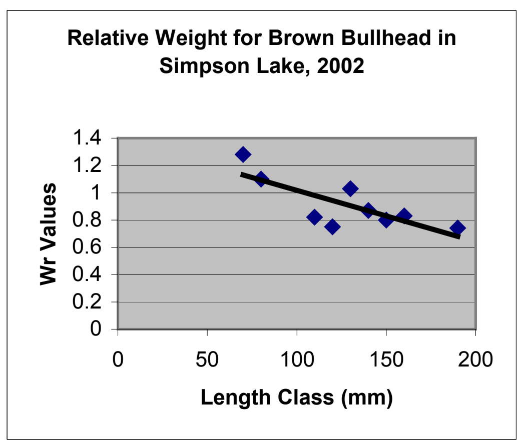




**Figure 5**. Relative weight (Wr) of rainbow trout sampled in Simpson Lake on 6/25/02. Values greater than one generally represent good health and adequate environmental conditions for the species.

**Figure 6**. Relative weight (Wr) of brown bullhead sampled in Simpson Lake on 6/25/02. Values greater than one generally represent good health and adequate environmental conditions for the species.

Secchi disc reading was relatively shallow at only 1.7 m. Figure 7 depicts the oxygen-temperature profile and reveals extremely warm water temperatures (19-25 C) from the surface to 5 m depth.  The oxygen line depicts extremely low oxygen levels (2.8 - .3 mg/l) from 6 m all the way to the bottom.

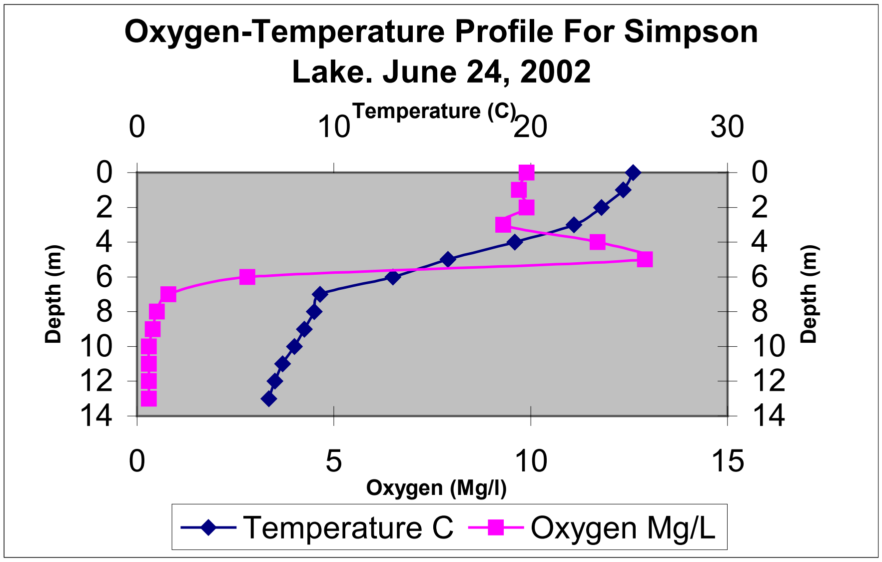



**Figure 7.** Oxygen-temperature profile for Simpson Lake taken on 6/24/02. Maximum depth is 12.19 m and secchi disc reading was 1.7 m.

## Discussion

Since no brown bullheads were sampled in 1975, 1976, 1977, 1981, 1983, and 1988 we can assume they were introduced after those dates and before the present unless those gill net sets were inconclusive. This may be possible since we sampled only a couple bullheads in our 2002 gill net sets. All other bullhead samples were taken by electro fishing and trap net sets which were not used in the previous samples.  Currently, bullheads dominate the catch in both numbers (295) (Figure 2) and weight (10,243 g) despite their smaller size (Figure 4). Only 46 rainbow trout were sampled with a total weight of 5,104 g despite their larger size (Figure 3).

Brown bullheads are capable of surviving in poor environmental conditions when other species may be constrained (Simpson and Wallace 1982). Without a predator to feed on these fish, bullhead populations may grow until they are constrained only by their own competition.  This is evident in Simpson Lake.  All brown bullheads sampled were between 70 and 190 mm (Figure 4).  This is a very small size distribution when compared to near by Lake Lafleur were only 23 bullheads were sampled with a length distribution between 230 and 350 mm.  Lake Lafleur contains largemouth bass that may feed upon bullheads or compete with them for food as juveniles.  This type of interaction does not exist in Simpson Lake.

Bullheads in Simpson Lake appear to be overpopulated and stunted due to this competition among themselves.  Figure 6 also expresses this relationship with relative weight values (Wr). Smaller fish do well with (Wr) values between 100 and 150.  As the fish get older (Wr) values drop linearly until they approach 75.  After that, no samples were taken.  This may suggest as bullheads increase in size and require more food their (Wr) values decrease because of the increased competition with other bullheads. The food is simply not available for fish to grow to larger sizes and their overall condition declines.

The abundance of small bullhead has a significance impact on the trout population as well. An overpopulation of brown bullheads may suppress the trout population by over utilizing limited food resources. This can affect on growth rates, relative weights, and survival of all trout species. Rainbow trout sampled were between 200 and 290 mm (Figure 3). All size classes minus greater than 200mm expressed (Wr) values below 100. The Wr values decrease rapidly with length for rainbow trout. The largest size class (280 mm) had the lowest (Wr) value (43) indicating a very emaciated condition.

These lower (Wr) values may indicate competition for food resources with brown bullheads as well as habitat problems in the lake. Oxygen-temperature profiles taken showed that oxygen might be a limiting factor in Simpson Lake for rainbow trout. Figure 7 shows on 6/24/02 temperature readings were between 19.2 and 25.2 C for the first 4 m. All these values are above the preferred salmonid range of (13 – 16 C) while the first meter below the surface was near critical levels of 24.7 to 25.2 C (Behnke 1992). Optimum salmonid temperatures were not reached until 5 m below the surface.

Dissolved oxygen readings were between 12.9 mg/l and 9.9 mg/l from the surface to 5 m (Figure 7). These levels are adequate for salmonid survival and growth. However, oxygen levels plummet to 2.8 mg/l at 6 m and then to below 1 mg/l all the way to the bottom. Dissolved oxygen levels below 5 mg/l are lethal for salmonids. This leaves a preferred salmonid temperature and oxygen zone at 5 m depth only for this date. We can assume these conditions to be worse during extreme times of the year. All other depths contain inadequate temperature or dissolved oxygen levels for this date. The small habitable area results in interspecific competition along with the already described intraspecific competition and makes the relative weight data more understandable. Limited habitat and limited food resources within this habitat are major limiting factors at Simpson Lake.

Habitat samples taken in the past reveal potential oxygen and temperature limitations in Simpson Lake but not like in our 2002 sample. In July, 1981 the maximum temperature was only 19.5 C at the surface while adequate dissolved oxygen levels only reached to 3.5 m below the surface. In July, 1983 samples showed adequate temperature and dissolved oxygen to depths of 5 m. Both gillnet samples for these two years revealed numerous healthy brook trout.

On May 6$^{th}$, 2002, 2,532 white elastomer tagged rainbow trout were stocked into Simpson Lake, 8,602 brook trout were stocked in the fall of 2001, and 5,000 brook trout in the fall of 2000. The lack of brook trout in our 2002 sample indicates complete mortality, most likely during the winter. Because 70 % of our rainbows sampled in 2002 had white elastomer injection marks, we can conclude they were stocked on May 6$^{th}$, 2002. All unmarked fish were within the same size classes of the marked fish. This show us they are of the same batch because elasometer tag retention is only expected to be 70-80% maximum. These marked fish tell us that no existing rainbows from the year before survived, possibly due to low oxygen levels during the winter. However, brown bullheads continued to thrive despite the poor conditions.

## Management Recommendations

Due to the overpopulation and competition exhibited by brown bullheads in Simpson Lake a removal program should be considered for these fish. Removal could be done chemically or mechanically. Mechanical removal would reduce the population, not eradicate it. Mechanical removal would need to be an annual or biannual operation. An ongoing mechanical removal program would reduce the population in order to minimize competition. The surviving bullheads would be fewer and larger allowing for larger and healthier salmonids such as expressed in Lake Lafleur. Mechanical removal would target only brown bullheads and would not have a direct affect on any other fish or organisms in the lake. The success of a removal program for a brown bullhead at this lake with its high abundance would be unlikely to succeed because rapid reproduction expressed by brown bullheads would rapidly replace any removed fish. Mechanical remove could be an important tool to prolong the benefits of chemical removal should the fish kill be less than 100%.

Therefore chemical removal with compounds such as rotenone are more likely to be successful but may not be completely effective on eradicating bullheads due to their tolerance and ability to store oxygen in their body and burrow in bottom sediments (Wydoski and Wiley 1999). However, complete bullhead eradication was observed in Wisconsin when rotenone was applied just before the lake froze, which allowed rotenone to remain active for longer (Wydoski and Wiley 1999). Chemical controls are often controversial and would target all the fish in the lake, not just the bullheads. Rotenone also negatively affects other organisms such as zooplankton and macroinvertibrates that fish utilize as food (Wydoski and Wiley 1999). Wydoski and Wiley 1999, stated that salamanders and turtles have been killed by rotenone applications. These two species are abundant in Simpson Lake. A reintroduction program for macro invertebrates especially amphipods would help mitigate these impacts.

In order to maintain a carry-over fishery in Simpson Lake, oxygen problems must be addressed in addition to competition problems. The most effective short-term solution is to install a solar power aeration system that would increase dissolved oxygen levels enough to reduce or prevent winter-kills by allowing for better survival. This would also increase the amount of habitat in the lake for trout to utilize for feeding and growing. This would reduce interspecific competition but not reduce intraspecific competition and may slightly increase fish size and health. The monitoring and evaluation program has already purchased a solar power aeration system and with plans to install it during the spring of 2003 into Simpson Lake.

The Tribal membership prefers that Simpson Lake be managed as a brook trout fishery for tribal members only. Managing this lake for brook trout compounds problems with poor survival because these fish grow slowly therefore only a small number of catchable sized fish should be stocked until the necessary permits and application of rotenone or other chemical control can be scheduled and implemented over winter.

The combination of chemical reclamation, macro invertebrate reintroduction, installation of an aeration system, and restocking brook trout would be benefit the Simpson Lake fishery enormously and could lead to a productive and satisfying fishery for tribal members to enjoy. If implemented, these actions would be monitored continuously by voluntary creel and fish populations will be sampled every 3 to 5 years after reclamation using electro fishing, gill and trap net surveys to access project goals.

# Sugar Lake

2002 Technical Report

Photo 1. View of Sugar Lake from the west shoreline. The lake is located in Ferry County north of Inchelium on the Colville Confederated Tribes Reservation, WA.

**Colville Confederated tribes Fish Hatchery Monitoring and Evaluation Program**

## Introduction

Sugar Lake is located north of Inchelium in Ferry County on the Colville Confederated Tribes Reservation in north central Washington State. From July 10 to July 11, 2002 the lake was sampled to determine habitat, fish population parameters and wild/hatchery fish interactions. This sample was performed in compliance with the Independent Scientific Review Panel (ISRP) mandate to monitor and evaluate the Colville Tribal Fish Hatchery production and release of resident salmonids into reservation waters. Dan Fairbank directed the procedure while David Christensen, Larry Boyd and Anthony Cleveland carried out the fieldwork.

Sugar Lake is a 2-acre eutrophic water body that reaches a maximum depth of 9.45m (Figure 1). The trophic status of the lake was determined by high recorded temperatures (22.1-23.7 C), low recorded dissolved oxygen (< 1 mg/l) below 4 m (see Figure 2,3), extensive macrophyte development,and extensive cattail and reed development along the shoreline. All observations were made during the July, 2002 sampling period. See Table 1 for physical data on Sugar Lake. Drainage is into Barnaby Creek (Halfmoon 1978). The hillsides are forested with Ponderosa pine and Douglas fir and are extensively utilized for timber harvest and livestock grazing.

**Table 1.** Physical Data of Sugar Lake

| | |
|---|---|
| Surface Area | .81ha. |
| Maximum Depth | 9.45m |
| Mean Depth | 7.01m |
| Trophic State | Eutrophic |

Access to Sugar Lake is good but no facilities are offered at the lake and fishing from shore is limited due to heavy cattail growth.

Little data has been collected in the past on Sugar Lake. Oxygen-temperature profiles were taken in 10/5/79 and revealed values even lower than the levels seen in our sample depicted in Figure 2. Dissolved oxygen levels >5mg/l did not exist in Sugar Lake on this date. Dissolved oxygen levels <5mg/l are lethal for salmonids (Behnke 1992). Our sampling efforts in July 2002 contained only 2 rainbow trout *Oncorhynchus mykiss* at 270mm and 330mm in length.

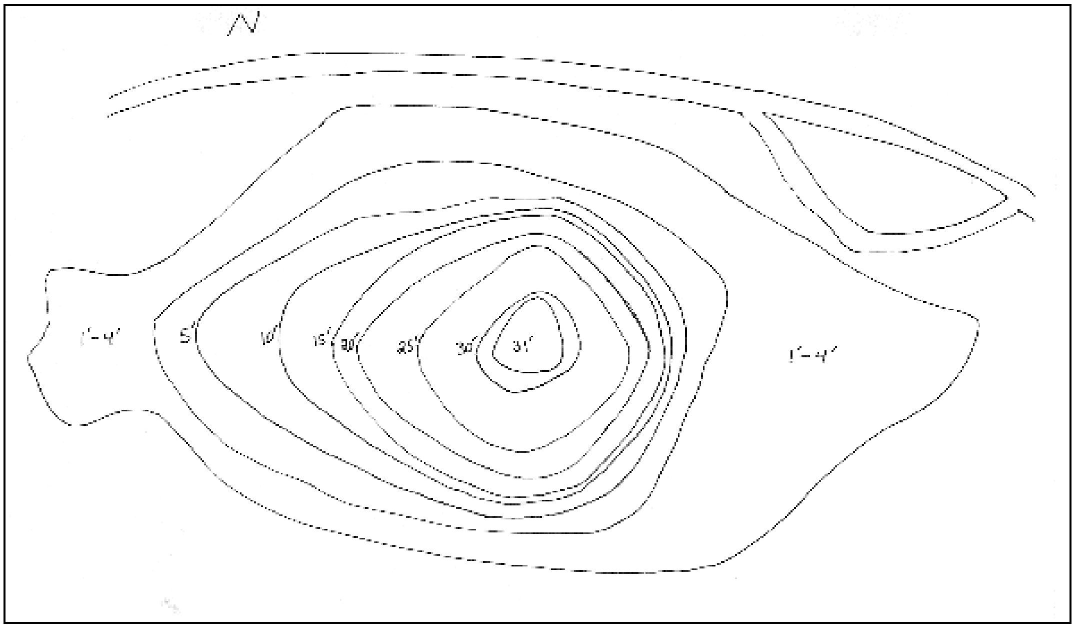



**Figure 1.** Bathymetric map of Sugar Lake depicting contours in feet. Lake area is 2-acres, maximum depth is 31 feet and mean depth is 23 feet.

## Methods

Sugar Lake was sampled for two nights using one 250 ft. by 6 ft. sinking experimental monofilament gill net. The net was set each night at 8 p.m. and pulled the next day at 9 a.m. for an approximate set of 13 hours. The net was set across the middle of the lake going south to north and to a maximum depth of 30ft.

One trap net with two leading ends was placed along the far eastern shoreline in approximately 4ft of water for three nights. The net was set at 8 p.m. and pulled the next day at 9 a.m. for an approximate set of 13 hours.

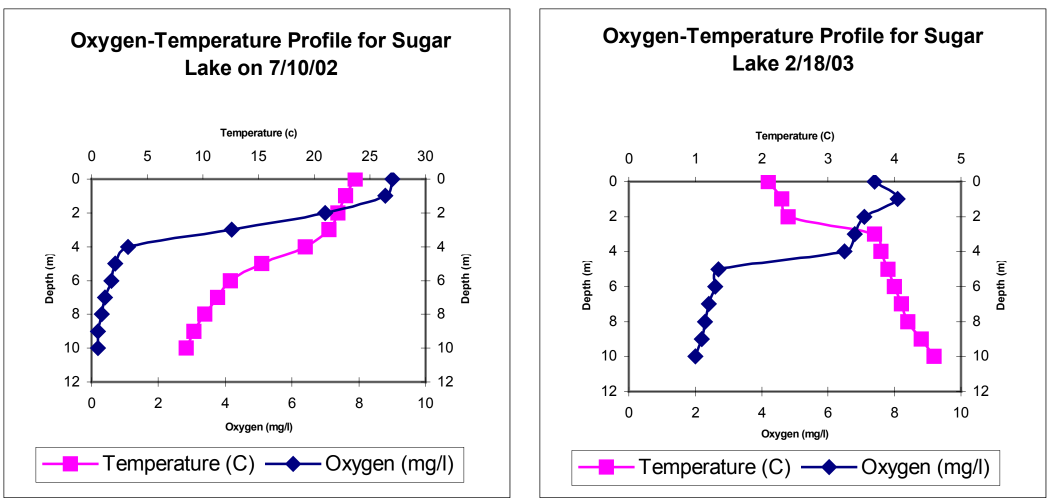
Habitat data was collected from Sugar Lake on 7/16/02. Information collected were secchi disc depth, alkalinity, percent littoral macrophyte community, average macrophyte community width, three macroinvertebrates samples from random locations using D-nets, three zooplankton samples taken from each third of the length of the lake with a standard hoop trawl. Oxygen and temperature profiles were taken from the deepest location in the lake with a Pelican 1120 Case meter on the sampling date and on 2/8/03.

# Results

Two nights of gill and trap net sampling yielded two rainbow trout. Both fish were sampled by gill net. The fish were 270mm at 280g and 330mm at 420g. No fish were sampled with the trap net during the sampling period.

Macroinvertebrate samples yielded a total of 4 amphipoda, 64 zygoptera, 35 anisoptera, 7 *corixidae*, 1 *belostomatidae*, and 2 coleoptera. Zooplankton samples expressed 138 large (>5nm) and 198 small (<5nm) zooplankton per 1m^3.

Habitat samples taken during the sampling period showed a secchi disc reading of 6.25m, alkalinity of 219mg/l, and macrophyte growth around the entire lake perimeter. Figure 2 and 3 are depictions of oxygen-temperature profiles taken from Sugar Lake on 7/10/02 and 2/18/03. Dissolved oxygen levels are above 5mg/l from a depth of 3m to the surface on 7/10/03 and 4m to the surface on 2/18/03. Dissolved oxygen values are <1mg/l from a depth of 4m to the bottom on 7/10/02 and <3mg/l from a depth of 5m to the bottom on 2/18/03. Temperature values were 23.7 C at the surface to 21.3 C at a depth of 3m.




**Figures 2,3.** Oxygen-temperature profile for Sugar Lake taken on 7/10/02 and 2/18/03. Maximum depth is 9.45m.

# Discussion

On 5/02/02, 520 rainbow trout at 5 fish/lb. were stocked into Sugar Lake including 50, 4-10 lb. triploid adult rainbow trout. Only 2 fish were sampled in our gill and trap net sampling effort. The lack of fish could possibly be due to fishing pressure and/or stressful oxygen and temperature conditions in the lake (Figures 2 and 3). No creel work has been done on the lake to determine fishing pressure and angler satisfaction.

Adequate salmonid dissolved oxygen levels (>5mg/l) on 7/10/02 existed at the surface and down to 2m. Temperature levels from 2m depth to the surface were 22.1-23.7 C. Temperatures at this level are stressful to salmonids and can possibly lead to the death of the fish (Behnke 1992). Rainbow trout in Sugar Lake are confined to the top 2m of depth where dissolved oxygen levels exist but so do stressful temperatures. Winter oxygen-temperature profiles expressed in Figure 3 show dissolved oxygen levels >6.5mg/l from 4m to the surface. This is considerably better than the summer profile and could possibly allow for over-winter trout survival in the lake.

Macroinvertebrate samples showed 64 *zygopterans* and 35 *anisopterans* wich provide excellent littoral forage for salmonids. Zooplankton samples also showed adequate food availability of large plankton (138 zoopl./1m^3). However, because of stressful temperature extremes and dissolved oxygen levels much of these forage items become unavailable to trout in the lake during summer months.

High water temperatures and low dissolved oxygen levels in the hypolimnion are common in nutrient rich eutrophic lakes (Wetzel 2000). Sugar Lake has naturally succeeded to this eutrophic state over time. Logging operations and grazing practices may have increased nutrification of the lake and accelerated the aging process leading to poor water quality.

## Management Recommendations

- Reduce stocking from 1,000 catchables in the spring to 3,000 subcatchables in the fall to increase fish production from this lake due to poor water quality that mainly occurs during summer months.

- Explore alternatives to increasing dissolved oxygen levels such as aeration systems.

- Reduce nutrification of the lake by eliminating cattle grazing around the lake.

- Install voluntary creel boxes at this lake to determine angling effort and return to creel.