



FISH AND WILDLIFE COMPENSATION PROGRAM

PEACE REGION

Pygmy Whitefish (*Prosopium coulterii*) Distribution Surveys in the Williston Watershed, 1999-2006

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The Fish & Wildlife Compensation Program – Peace Region is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

Fish and Wildlife Compensation Program – Peace Region

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Executive Summary

Little information is known about the biology and habitat use by the different life phases of pygmy whitefish (*Prosopium coulterii*), especially within the Williston Watershed. During the summer of 2000 through 2006, the Peace/Williston Fish and Wildlife Compensation Program (PFWWCP) conducted a series of research projects on pygmy whitefish (PW). During these studies, basic biological data such as fork length (mm) and weight (g) was collected. In addition, age structures, stomach content analysis, parasite presence, fecundity counts, etc. were conducted on some samples collected. Genetic structures (adipose, caudal fin, or pelvic fin) were also collected for future studies. General seasonal habitat requirements for this species were also observed (i.e. oxygen/temperature, light penetration, zooplankton availability, etc.). With the information learned from these studies, determining the distribution and possibly the status of pygmy whitefish in the Williston Watershed could now be documented.

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Appendix 2. Age Class Tables.

Appendix 3. The biology of pygmy whitefish, *Prosopium coulterii*, in a closed sub-boreal lake: spatial distribution and diel movements

Appendix 4. Phylogeography and the origins of range disjunctions in a north temperate fish, the pygmy whitefish (*Prosopium coulterii*), inferred from mitochondrial and nuclear DNA sequence analysis

Appendix 5. Connectivity among populations of pygmy whitefish (*Prosopium coulterii*) in northwestern North America inferred from microsatellite DNA Analyses

Appendix 6. UTM Coordinates of Sampling Events.

Background

The Pygmy Whitefish is a small, inconspicuous inhabitant of lakes and occasionally rivers of northern North America and a small portion of eastern Russia. The most striking attribute of this species are the marked disjunctions in its distribution, which have long been a source of intrigue among fish zoogeographers. Pygmy whitefish are a regionally important species (Omineca/Peace) under the Forest Practices Code, and are designated as an isolated species in British Columbia. In Alberta, there are few records (8 specimens) noted on this species and it is designated as a species that "may be at risk". Distribution within the Williston Watershed is currently unknown, with approximately 18 records in the BC Fisheries Data Warehouse (as of 2000) and other sources that have pygmy whitefish located within the Williston Watershed. Many of these records are of individual lakes and a few records are part of a chain of lakes.

Many of the historical records are dated and their content is incomplete. Lake inventory standards in the 1940's and 1950's were less stringent than present. In addition, these inventories did not incorporate the use of fine mesh nets set on the bottom of a lake, which have proven to be one of the more successful techniques for capturing this small species. One reason for the lack of life history data on pygmy whitefish is that this species is easily misidentified with the young of their close relatives, the mountain whitefish. There is a scientific and ethical responsibility to ensure that fish species do not go extinct, and with only a few records known to exist within the Williston Watershed, verification of their presence is warranted.

Longevity of the pygmy whitefish species within the Williston Watershed is one question that was posed during the initial stages of this project. Due to time, budget and staff constraints, further analysis and sampling did not occur, although data collected from this distribution study was used to develop three separate scientific journals. These journals describe further detail on the status of the species (Appendices 3-5).

Pygmy whitefish generally occur in cold, deep lakes, or cold, faster flowing rivers, thus their use of deep water locations make them relatively isolated from human disturbance. Understanding the limiting factors of the survival of this species is unknown. Consequently, confirming the presence of this species in the field and knowing their distribution within the Williston Watershed is vital in ensuring their future existence in the watershed. . A sub-set of lakes (based on extreme geographical boundaries of the watershed) was examined to validate the presence of these fish and confirming their outermost distribution within the watershed.

Williston Watershed Distribution Surveys

The objectives of the studies on pygmy whitefish over the 7 year time frame in the Williston Watershed were to:

- verify the presence and determine the distribution status of pygmy whitefish within the Williston Watershed, and
- learn more about the life history characteristic of pygmy whitefish (i.e. population status information and key field identification characteristics).

These surveys will create further awareness of the species (i.e. development of journal manuscripts, Appendices 3-5) and provide information on implementing a systematic coordinated approach for future inventories and assessments of fish and fish habitat.

Initial life history surveys took place in 2000 and 2001 in Dina Lake #1 near Mackenzie, BC, when staff confirmed the species identification features and netting procedures best suited to capture the fish. The first year of distribution surveys (2003) researched the most northern lakes (Figure 1), when staff confirmed pygmy whitefish were located in Quentin and Weissener lakes, but were absent from Thutade Lake. Year 2 (2004) researched the most southern lakes (Tacheeda) and Williston Reservoir (southern and eastern locations). Year 3 (2005) researched various lakes within the historical records southern distribution area (Aiken Lake, Upper and Lower Tacheeda Lakes, Upper and Lower Manson Lakes, and Tutizzi Lake). Year 4 (2006) researched lakes within the central region of the watershed and additional sites in Williston Reservoir: Dina Lake #1, Uslika Lake, Chuchi Lake, Arctic Lake, and Omineca Arm, and 6 Mile Bay of Williston Reservoir.

For each lake reported, the following information is reported:

- lake location and description,
- all fish species present from historical records on the lake, and
- methodology used for the survey and results for each sample year.

In addition to the lake information and catch summaries, charts of condition factor versus fork length (cm) (Appendix 1) and age class tables (Appendix 2) were completed for summary purposes. Note that not all pygmy whitefish caught were sampled for age verification, as is reflected in the absence of charts and tables for the applicable section. Condition factor in the charts has been abbreviated to CF. Netting records and individual fish records are available through the Fish Wildlife Compensation Program (FWCP) - Peace, BC Hydro (data on file). Appendix 6 contains the UTM coordinates for each sampling event.

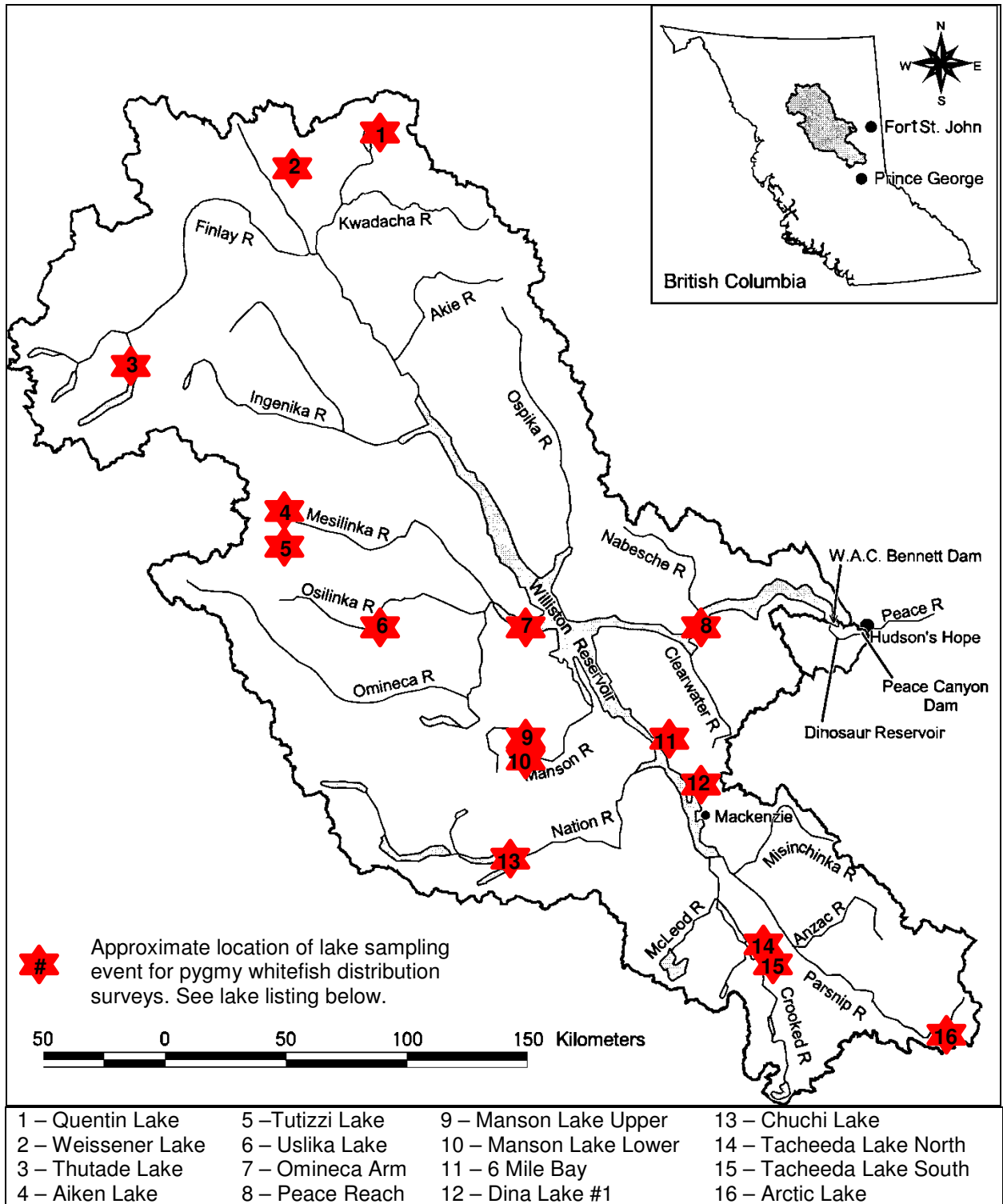


Figure 1. Overview of lake sampling locations within the Williston Watershed.

Pygmy Whitefish Identification

Williston pygmy whitefish have the following identification features (figures 2-4):

- ❖ Parr marks;
- ❖ Anal and dorsal ray counts are typically 8 or 9, rarely 10;
- ❖ Dorsal fin shape – back edge of fin is straighter up from body;
- ❖ Nose profile – round and blunt;
- ❖ Eye position – positioned more on top of head; and
- ❖ Size of lateral line scales is larger than in other whitefish species.

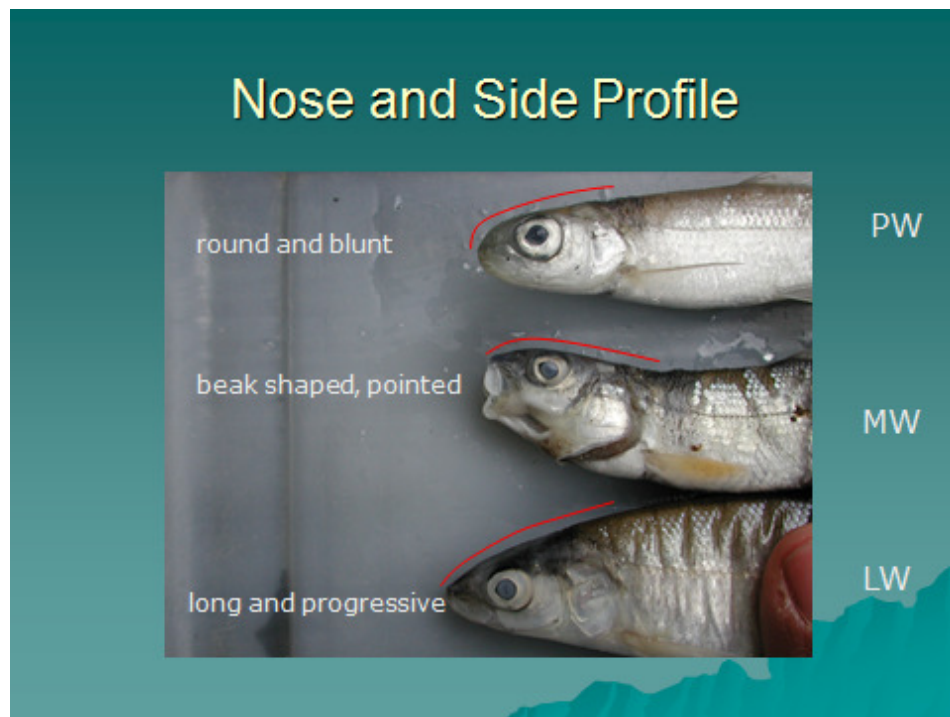


Figure 2. Nose and side profile of pygmy whitefish compared to mountain and lake whitefish.

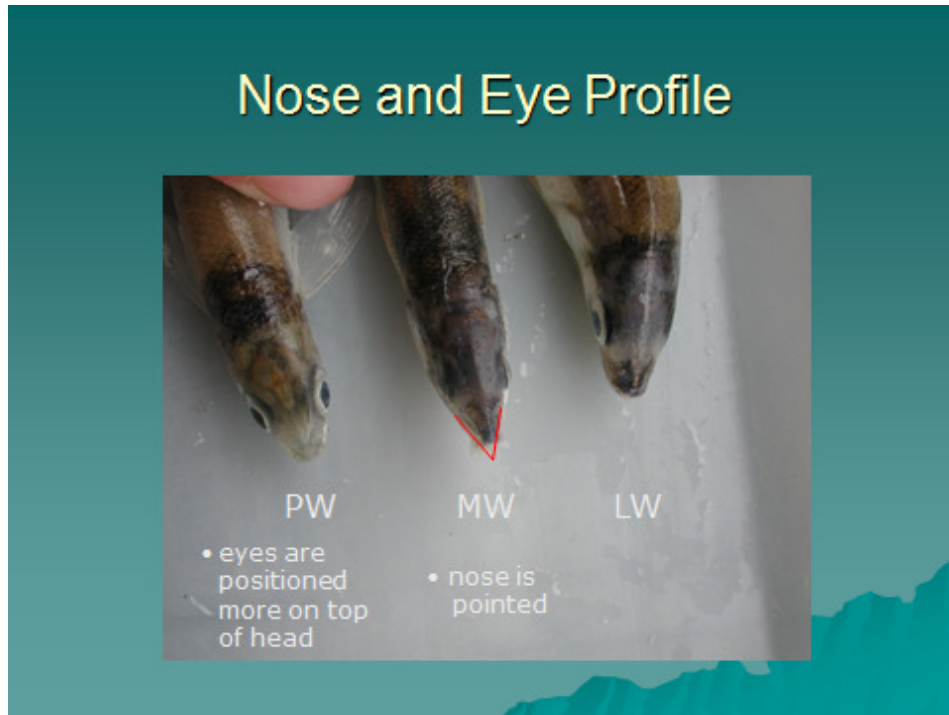


Figure 3. Nose and eye profile of pygmy whitefish compared to mountain and lake whitefish.

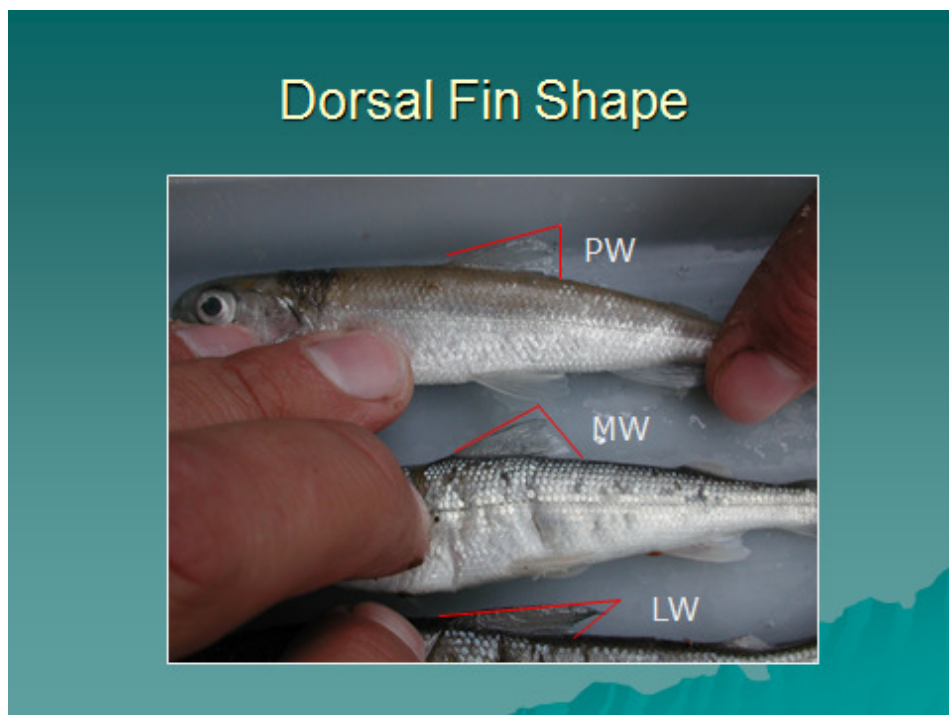


Figure 4. Dorsal fin shape of pygmy whitefish.

WILLISTON WATERSHEDS EXAMINED

DINA LAKE # 1 2000, 2001, 2004, and 2006

Location

Dina Lake #1, located 25 km north/northwest of Mackenzie, British Columbia, is the largest of a chain of ten lakes. Brook trout have been stocked discontinuously in Dina Lake #1 since 1980, while rainbow trout have been stocked annually since 1987.

Lake Description

| | |
|---------------------|--|
| Elevation: | ± 701 m |
| Lake surface area : | 158.3 ha |
| Maximum depth: | 25 m |
| U.T.M.: | 10.480658.6153999 (NAD 1983) |
| Lake Drainage: | one permanent inlet (from Dina #2); no outlet (closed) |

All species present

Rainbow trout, pygmy whitefish, longnose sucker, brook trout, lake chub.

- The 1991 survey report indicated one mountain whitefish was captured. Given the abundance of pygmy whitefish in the 1998 small lake stocking assessment, it appears that the mountain whitefish captured in 1991 was also likely misidentified and should have been reported as a pygmy whitefish instead.
- In addition, further understanding the life cycle of the pygmy whitefish and how it plays a role in the food chain in Dina Lake #1 would be beneficial. Stomach analysis indicated that the larger rainbow and brook trout were keying in on pygmy whitefish as a food source at the time of the survey.

Methodology and Results

- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- **2000:** June (10 sets), July (14 sets), September (5 sets) and October (12 sets):
 - total 41 net sets, captured 322 total pygmy whitefish.
 - Sampled in 2000: n = 297, mean CF = 0.99
 - Age classes reported (215 fish) breakdown as follows:
 - 14 unknown sex or age.
 - 95 females: ages 1 thru 5.
 - 106 males: age 1, 2, 4 and unknown on 44.
- **2001:** May (10 sets), June (12 sets), July (17 sets), August (2 sets), October (3 sets) and November (3 sets):
 - total 47 net sets, captured 368 total pygmy whitefish.
 - Sampled in 2001: n = 350, mean CF = 1.0
 - Age classes reported (368 fish) breakdown as follows:
 - 57 unknown sex or age.
 - 99 known sex: age 0+ thru 5.
 - 172 females: age 1 thru 5, with 85 unknown ages.

- 97 males: age 0+ thru 6, with 69 unknown ages.
- **2004:** July, 5 net sets, captured 39 pygmy whitefish.
 - 2004 sampling was for gill rakers counts, only fork length and weight data taken.
 - Sampled in 2004: n = 39, mean CF = 0.7
 - No age data collected in 2004 sampling session.
- **2006:** May, 2 net sets, captured 70 pygmy whitefish.
 - 2006 sampling was for genetics.
 - Sampled in 2006: n = 20, mean CF = 0.96
 - Age classes reported (20 fish) breakdown as follows:
 - 2 unknown sex or age.
 - 12 females: age 3 thru 6.
 - 6 males: age 3 thru 5.

QUENTIN LAKE 2003

Location

Quentin Lake is located 50 km northeast of Fort Ware, British Columbia (120 km by air from Mackenzie) within the Kwadacha Wilderness Park. The lake is situated in the Rocky Mountains, having high mountain ridges to the east and west. The lake drains into Warneford River to Kwadacha River to the Finlay River and into Williston Reservoir.

Lake Description

| | |
|---------------------|------------------------------|
| Elevation: | ± 927 m |
| Lake surface area : | 470.8 ha |
| Maximum depth: | 44.5 m |
| U.T.M.: | 10.0363153.6414618 |
| Lake Drainage: | 4 permanent inlets; 1 outlet |

Species present

Bull trout, Dolly Varden, longnose sucker, mountain whitefish, pygmy whitefish, rainbow trout

Methodology and Results

- Surveyed from July 26 to July 9, 2003.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- Thirteen net sets: 7 deep and 6 shore sets, captured 59 pygmy whitefish.
- Sampled in 2003: n = 39, mean CF = 1.06
- Age classes reported (39 fish) breakdown as follows:
 - 5 unknown sex or age.
 - 5 unknown sex: age 1 and 2.
 - 21 females: age 2 thru 7.
 - 8 males: age 2 thru 3.

WEISSENER LAKE 2003**Location**

Weissener Lake is located 36 km from Fort Ware, British Columbia (105 km by air from Mackenzie and 460 km from Prince George). The lake drains into Outlet Creek to McCook River to Fox River to the Finlay River and into Williston Reservoir.

Lake Description

| | |
|---------------------|------------------------------|
| Elevation: | ± 955 m |
| Lake surface area : | 791.6 ha |
| Maximum depth: | 94 m |
| U.T.M.: | 10.330475.6402668 |
| Lake Drainage: | 7 permanent inlets; 1 outlet |

All species present

Lake trout, lake whitefish, largescale sucker, longnose sucker, mountain whitefish, pygmy whitefish, rainbow trout

Methodology and Results

- Surveyed in July, 2003.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- 10 net sets: 7 deep and 3 shore sets, captured 37 pygmy whitefish.
- Sampled in 2003: n = 37, mean CF = 1.04
- Age classes reported (37 fish) breakdown as follows:
 - 22 females: age 2 thru 5.
 - 15 males: age 1 thru 3.

THUTADE LAKE 2003**Location**

Thutade Lake is located 187 km northeast of Stewart, British Columbia. The lake drains into the outlet creek, which drains into the Finlay River and into Williston Reservoir.

Lake Description

| | |
|----------------|--|
| Elevation: | ± 1,120 m |
| Perimeter : | 99300 m |
| Maximum depth: | approximately 62 m (only ½ of lake sounded in original survey) |
| U.T.M.: | 9.0609237.6295298 |
| Lake Drainage: | 15 inlets; 1 outlet with falls ~ 2 km downstream of outlet |

All species present

Bull trout, Dolly Varden, kokanee, longnose sucker, mountain whitefish, rainbow trout

Methodology and Results

- Surveyed from July 12-20, 2003.

- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- 38 net sets: 17 deep and 21 shore sets, other species captured but no pygmy whitefish.
- Sampled in 2003: n = 0, mean CF = N/A
- No age classes reported as no fish caught.

Results of captures

- No PW fish were caught, therefore no charts or tables were produced. Refer to netting records file for details on other species caught.

PEACE REACH – WILLISTON RESERVOIR 2004

Location

The Peace Reach is the eastern most portion of Williston Reservoir, and ends at the W.A.C. Bennett Dam, 24 km west of Hudson's Hope, British Columbia. The Peace Reach drains into Dinosaur Reservoir and into the Peace River downstream of the Peace Canyon Dam. Sampling was conducted between Point and Dunlevy creeks (65 km section of the Peace Reach). Dunlevy Creek is approximately 35 km driving from Hudson's Hope.

Lake Description

| | |
|---------------------|--|
| Elevation: | ± 670 m |
| Lake surface area : | 1,800 Km ² |
| Maximum depth: | ± 642.1 m (water licence minimum) to 672.08 m (maximum normal full pool storage) of entire reservoir |
| U.T.M.: | various within Peace Reach; refer to netting records |
| Lake Drainage: | 70,000 Km ² drainage area enters the reservoir, 1 permanent outlet at W.A.C. Bennett Dam |

All species present

Arctic grayling, mountain whitefish, lake whitefish, rainbow trout, kokanee, bull trout, burbot, lake trout, Dolly Varden, lake chub, largescale sucker, longnose sucker, Northern Pikeminnow, peamouth chub, prickly sculpin, pygmy whitefish, redbside shiner, sculpin general, sucker general, white sucker, whitefish general.

Methodology and Results

- Surveyed from July 26 to July 9, 2003.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- Seventeen net sets; captured 90 pygmy whitefish – not all sampled.
- Sampled in 2004: n = 46, mean CF = 1.08
- Age classes reported (39 fish) breakdown as follows:

- 10 unknown sex and age
- 39 unknown sex: age 2 thru 5.

TACHEEDA LAKES (North / Upper and South / Lower) 2004 and 2005

Location

Tacheeda Lakes are located 13 km northeast of Angusmac on Highway 97 north of Bear Lake, approximately 100 km north of Prince George, British Columbia. Tacheeda Lakes flow into the Parsnip River and into the Parsnip Reach of Williston Reservoir.

All species present

Dolly Varden, lake trout, lake whitefish, longnose sucker, mountain whitefish, Northern Pikeminnow, peamouth chub, prickly sculpin, pygmy whitefish, rainbow trout, redbreast shiner, sucker (general), white sucker, whitefish (general)

Tacheeda Lake North / Upper

Lake Description

| | |
|---------------------|-----------------------------|
| Elevation: | ± 726 m |
| Lake surface area : | 590.9 ha |
| Maximum depth: | 59.4 m |
| U.T.M.: | 10. 532165.6064758 |
| Lake Drainage: | 1 inlet; 2 outlets reported |

Methodology and Results

- Surveyed from August / September, 2004 and August 2005.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- **2004:** 6 net sets: 3 deep and 3 shore sets, captured 25 pygmy whitefish.
 - Sampled in 2004: n = 25, mean CF = 1.02
 - Age classes reported (25 fish) breakdown as follows:
 - 5 unknown sex or age.
 - 12 females: age 1, and 2 thru 6.
 - 8 males: age 2 thru 5.
- **2005:** 5 net sets: 2 deep and 3 shore sets, captured 130 - sampled 50 pygmy whitefish.
 - Sampled in 2005: n = 50, mean CF = 0.97
 - No age data taken in 2005.

Tacheeda Lake South / Lower

Lake Description

| | |
|---------------------|--------------------|
| Elevation: | ± 734 m |
| Lake surface area : | 600 ha |
| Maximum depth: | 59.4 m |
| U.T.M.: | 10.530236.6062481 |
| Lake Drainage: | 3 inlets; 1 outlet |

Methodology and Results

- Surveyed from August / September, 2004 and August 2005.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- **2004:** 4 net sets: 2 deep and 2 shore sets, captured 39 pygmy whitefish.
 - Sampled in 2004: n = 39, mean CF = 0.99
 - Age classes reported (39 fish) breakdown as follows:
 - 9 unknown sex or age.
 - 1 unknown sex age 1.
 - 17 females: age 3 thru 5, and age 8.
 - 12 males: age 1 thru 5.
- **2005:** 6 net sets: 3 deep and 3 shore sets, captured 55 pygmy whitefish.
 - Sampled in 2005: n = 53, mean CF = 1.03
 - No age data taken in 2005.

AIKEN LAKE 2005

Location

Aiken Lake is located 203 km northeast of Smithers.

Lake Description

| | |
|---------------------|--------------------|
| Elevation: | ± 942 m |
| Lake surface area : | 240.5 ha |
| Maximum depth: | 34 m |
| Littoral Area : | 92.8 ha |
| U.T.M.: | 10.331748.6256295 |
| Lake Drainage: | 2 inlets; 1 outlet |

All species present

Dolly Varden, lake trout, lake whitefish, mountain whitefish, rainbow trout

Methodology and Results

- Surveyed from July 26 to July 9, 2003.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- Thirteen net sets: 7 deep and 6 shore sets, captured 59 pygmy whitefish.
- Sampled in 2005: n = 71, mean CF = 0.86
- Age classes reported (44 fish) breakdown as follows:

- 36 females: age 2 thru 9.
- 8 males: age 2 thru 6.

TUTIZZI LAKE 2005

Location

193 km northeast of Smithers

Lake Description

Elevation: \pm 1,034 m
 Lake surface area : 445 ha
 Maximum depth: 30 m
 Littoral Area : 121.1 ha
 U.T.M.: 10.340188.6243172
 Lake Drainage: 12 inlets; 1 outlet

All species present

Burbot, Dolly Varden, lake trout, mountain whitefish, pygmy whitefish, rainbow trout, slimy sculpin

Methodology and Results

- Surveyed July 7, 2005.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- 4 net sets: 2 deep and 2 shore sets, captured 67 pygmy whitefish.
- Sampled in 2005: n = 66, mean CF = 0.81
- Age classes reported (56 fish) breakdown as follows:
 - 1 unknown sex or age.
 - 1 unknown sex age 1.
 - 44 females: age 2 thru 9.
 - 10 males: age 2, and age 4 thru 7.

MANSON LAKES (Upper and Lower) 2005

Location

6 km southeast to the town of Manson Creek

All species present

Dolly Varden, lake trout, lake whitefish, largescale sucker, longnose sucker, mountain whitefish, Northern Pikeminnow, peamouth chub, prickly sculpin, pygmy whitefish, rainbow trout

Manson Lake Upper

Lake Description

Elevation: \pm 878 m
 Lake surface area : 216.5 ha
 Maximum depth: 39 m
 U.T.M.: 10. 414765.6164135
 Lake Drainage: 2 inlets; 1 outlet

Methodology and Results

- Surveyed July 19, 2005.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- 7 net sets: 3 deep and 4 shore sets, captured 65 pygmy whitefish.
- Sampled in 2005: n = 65, mean CF = 0.87
- Age classes reported (65 fish) breakdown as follows:
 - 1 unknown sex or age.
 - 10 unknown sex age 1, age 3 thru 6, and age 10.
 - 39 females: age 1 thru 8, and age 11.
 - 15 males: age 1 thru 5 and age 8.

Manson Lake Lower 2005

Lake Description

| | |
|---------------------|-------------------|
| Elevation: | ± 869 m |
| Lake surface area : | 222.5 ha |
| Maximum depth: | 48.5 m |
| U.T.M.: | 10.414898.6161931 |
| Lake Drainage: | 1 inlet; 1 outlet |

Methodology and Results

- Surveyed July 18, 2005.
- Used a variety of sinking monofilament gill nets. Majority of sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. Deep net sets were also utilized to see how deep these fish could inhabit. We also used 32 and 38 mm gill nets to look for larger size pygmies. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- Minnow traps and dip nets were used to capture young-of-the-year sized fish.
- 4 net sets: 2 deep and 2 shore sets, captured 71 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, general seasonal habitat requirements for this species were observed (i.e. oxygen/temperature, light penetration, zooplankton availability, etc).
- Sampled in 2005: n = 71, mean CF = 0.92
- Age classes reported (50 fish) breakdown as follows:
 - 1 unknown sex or age.
 - 10 unknown sex age 1.
 - 25 females: age 1 thru 3, and ages 7 and 9.
 - 14 males: age 2 thru 4.

USLIKA LAKE 2006**Location**

Uslika Lake is located 256 km northwest, driving from Mackenzie, British Columbia. The lake drains into the Osilinka River.

Lake Description

| | |
|---------------------|-------------------|
| Elevation: | ± 897 m |
| Lake surface area : | 157 ha |
| Maximum depth: | 62 m |
| Littoral Area : | 24 ha |
| U.T.M.: | 10.361612.6219332 |
| Lake Drainage: | 1 inlet; 1 outlet |

All species present

Dolly Varden, lake trout, lake whitefish, longnose sucker, pygmy whitefish, rainbow trout, white sucker

Methodology and Results

- Surveyed July 24-27, 2006.
- Used a variety of sinking monofilament gill nets. Sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- 11 net sets, captured 59 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, a limnology station was established in the deepest location of the lake.
- Sampled in 2006: n = 50, mean CF = 0.96
- Age classes reported (52 fish) breakdown as follows:
 - 1 unknown sex or age.
 - 1 unknown sex age 2.
 - 37 females: age 2 thru 9, and age 11.
 - 13 males: age 2 thru 5, and age 7 thru 9.

OMINECA ARM – WILLISTON RESERVOIR 2006**Location**

Omineca Arm is located in the central west portion of Williston Reservoir North of Mackenzie, British Columbia. The Omineca Arm drains the Omineca, Osilinka and Mesilinka rivers into Williston Reservoir.

Lake Description

| | |
|---------------------|--|
| Elevation: | ± 670 m |
| Lake surface area : | 1,800 Km ² |
| Maximum depth: | ± 642.1 m (water licence minimum) to 672.08 m (maximum normal full pool storage) of entire reservoir |
| U.T.M.: | 10.422648.6207701 |
| Lake Drainage: | 70,000 Km ² drainage enters the reservoir, 1 permanent outlet at W.A.C. Bennett Dam |

All species present

Arctic grayling, mountain whitefish, lake whitefish, rainbow trout, kokanee, bull trout, burbot, lake trout, Dolly Varden, lake chub, largescale sucker, longnose sucker, Northern Pikeminnow, peamouth chub, prickly sculpin, pygmy whitefish, redbside shiner, sculpin general, sucker general, white sucker, whitefish general.

Methodology and Results

- Surveyed July 17-19, 2006.
- Used a variety of sinking monofilament gill nets. Sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- 5 net sets, captured 55 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, a limnology station was established in the deepest location of the lake.
- Sampled in 2006: n = 47, mean CF = 0.94
- Age classes reported (47 fish) breakdown as follows:
 - 1 unknown sex age 2.
 - 26 females: age 2 thru 3.
 - 20 males: age 2 thru 3.

6 MILE BAY – WILLISTON RESERVOIR 2006**Location**

6 Mile Bay is located in the southern portion of Williston Reservoir, North of Mackenzie, British Columbia.

Lake Description

| | |
|---------------------|--|
| Elevation: | ± 670 m |
| Lake surface area : | 1,800 Km ² |
| Maximum depth: | ± 642.1 m (water licence minimum) to 672.08 m (maximum normal full pool storage) of entire reservoir |
| U.T.M.: | 10.473496.6160931 |
| Lake Drainage: | 70,000 Km ² drainage area enters the reservoir, 1 permanent outlet at W.A.C. Bennett Dam |

All species present

Arctic grayling, mountain whitefish, lake whitefish, rainbow trout, kokanee, bull trout, burbot, lake trout, Dolly Varden, lake chub, largescale sucker, longnose sucker, Northern Pikeminnow, peamouth chub, prickly sculpin, pygmy whitefish, redbside shiner, sculpin general, sucker general, white sucker, whitefish general.

Methodology and Results

- Surveyed July 8-10, 2006.
- Used a variety of sinking monofilament gill nets. Sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.

- 9 net sets, captured 32 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, a limnology station was established in the deepest location of the lake.
- Sampled in 2006: n = 26, mean CF = 0.99
- Age classes reported (26 fish) breakdown as follows:
 - 1 unknown sex and age.
 - 19 females: age 2 thru 4.
 - 6 males: age 2 thru 4.

CHUCHI LAKE 2006

Location

Chuchi Lake is located 82 km from Fort St. James, British Columbia. The lake drains into the Nation River.

Lake Description

| | |
|---------------------|---------------------------|
| Elevation: | ± 869 m |
| Lake surface area : | 4672.8 ha |
| Maximum depth: | 78 m |
| Littoral Area : | 1272 ha |
| U.T.M.: | 10.411261.6116674 |
| Lake Drainage: | numerous inlets; 1 outlet |

All species present

Dolly Varden, lake trout, lake whitefish, longnose sucker, pygmy whitefish, rainbow trout, white sucker, burbot, largescale sucker, mountain whitefish, Northern Pikeminnow, peamouth chub, prickly sculpin, redbreast shiner

Methodology and Results

- Surveyed July 4-7, 2006.
- Used a variety of sinking monofilament gill nets. Sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded. Other fish species were enumerated and a rough estimate of their length was recorded.
- 9 net sets, captured 46 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, a limnology station was established in the deepest location of the lake.
- Sampled in 2006: n = 32, mean CF = 0.82
- Age classes reported (34 fish) breakdown as follows:
 - 27 females: age 2 thru 3, and age 5.
 - 7 males: age 2 and age 4.

ARCTIC LAKE 2006

Location

Arctic Lake is located 50.4 km from Prince George, British Columbia. The lake drains into the Parsnip River.

Lake Description

| | |
|---------------------|-------------------|
| Elevation: | ± 749 m |
| Lake surface area : | 109 ha |
| Maximum depth: | 34.5 m |
| U.T.M.: | 10.583771.6032384 |
| Lake Drainage: | 3 inlet; 1 outlet |

All species present

Dolly Varden, lake trout, lake whitefish, longnose sucker, pygmy whitefish, rainbow trout, Arctic grayling, kokanee, mountain whitefish, redbreast shiner, round whitefish

Methodology and Results

- Surveyed June 21-22, 2006.
- Used a variety of sinking monofilament gill nets. Sets were with a 3 panel net comprising of 14, 19, and 25 mm sizes. The nets were set perpendicular to the shore where the 14 mm net was closest to the shore and the 25 mm extended towards deeper water. All panels were 2.4 m wide by 15.24 m long. Depth and time of each set, the catches, and locations (UTM's), were recorded.
- The intent of surveys on Arctic Lake was focusing on Kokanee. However, any pygmy whitefish encountered were sampled for the pygmy whitefish distribution summary.
- 4 net sets, captured 6 pygmy whitefish.
- basic biological data was collected: length, weight, age, stomach content analysis, parasite presence, fecundity counts, etc. In addition, a limnology station was established in the deepest location of the lake.
- Sampled in 2006: n = 6, mean CF = 0.89
- No age data collected, therefore no age class table

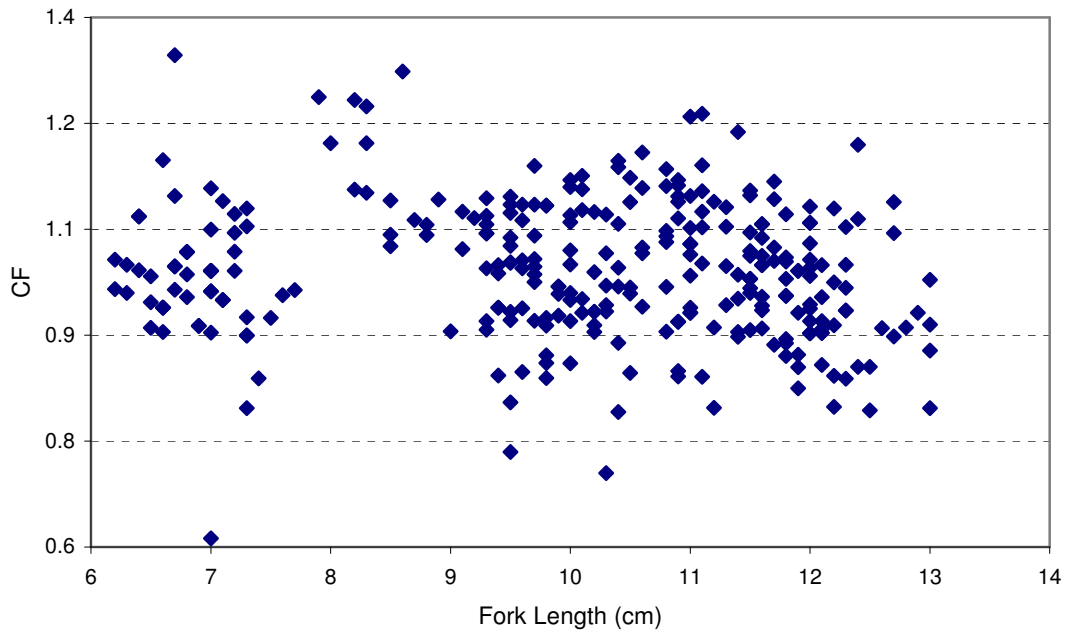
REFERENCES

- McPhail, J. D. and R. J. Zemlak. October 2001. Pygmy whitefish studies on Dina Lake #1, 2000. Peace/Williston Fish and Wildlife Compensation Program, Report No. 245. 36pp plus appendices.
- Zemlak, R.J. 1999. Fish stocking assessment of Dina Lake #1, 1998. Peace/Williston Fish and Wildlife Compensation Program Report No. 194. 19pp plus appendices.
- Zemlak, R.J. and J.D. McPhail. 2003. Pygmy Whitefish studies on Dina Lake #1, 2001. Peace/Williston Fish and Wildlife Compensation Program Report No. 279. 35pp plus appendices.

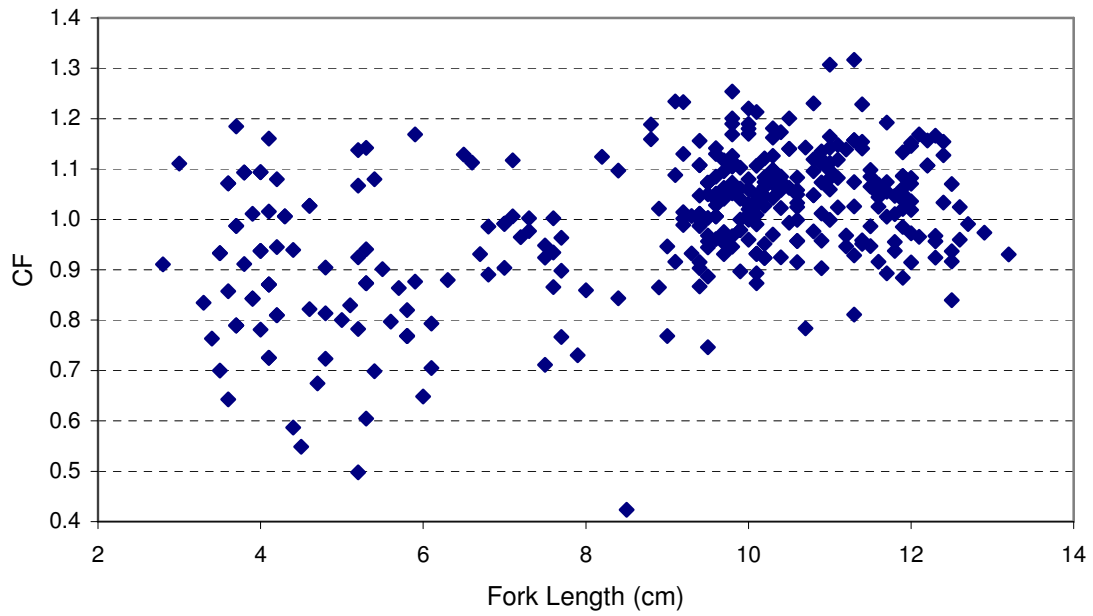
Appendix 1

Condition Factor versus Fork Length (cm) Charts

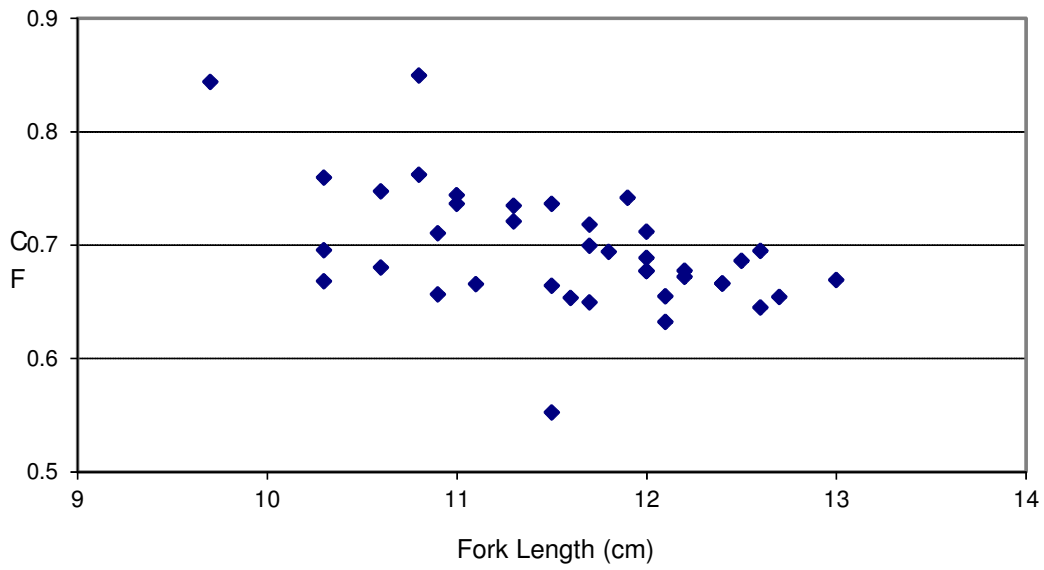
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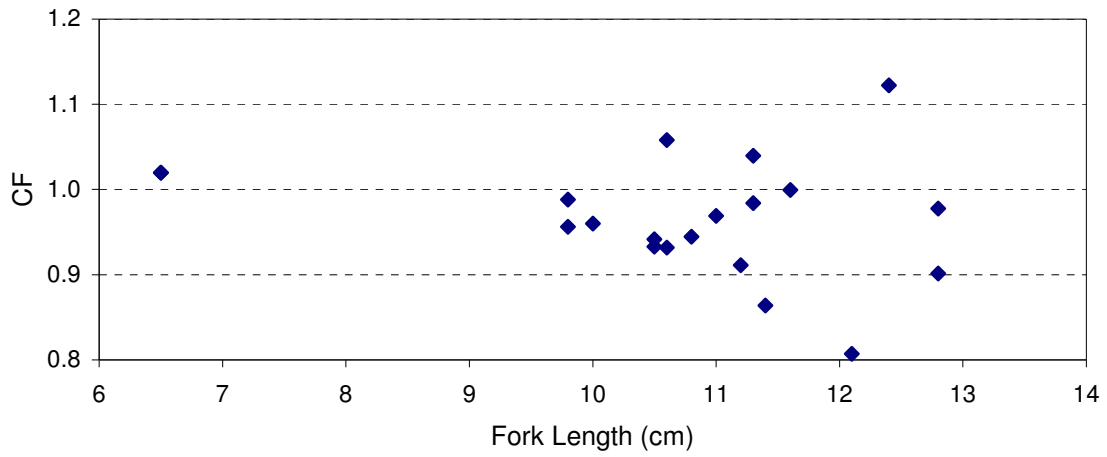
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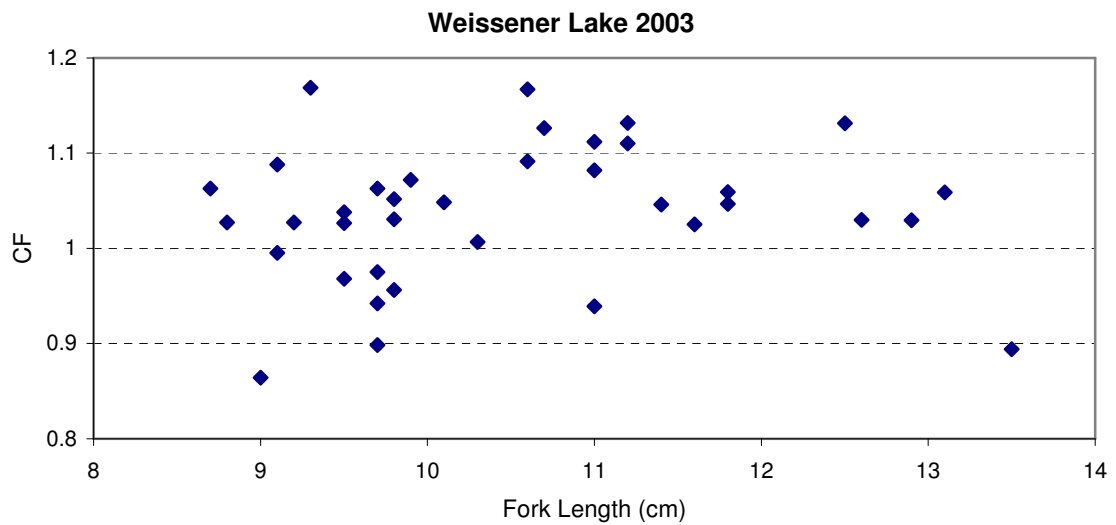
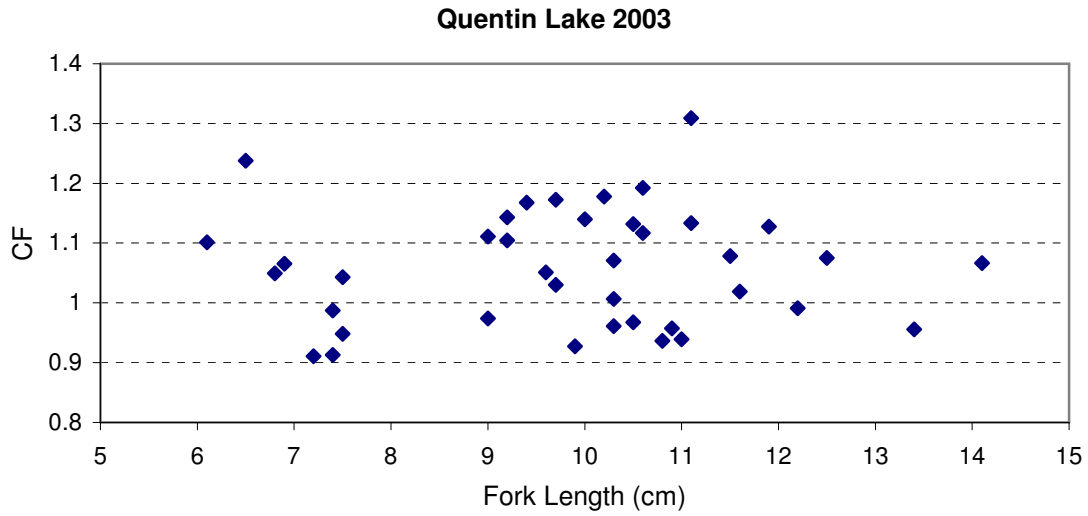


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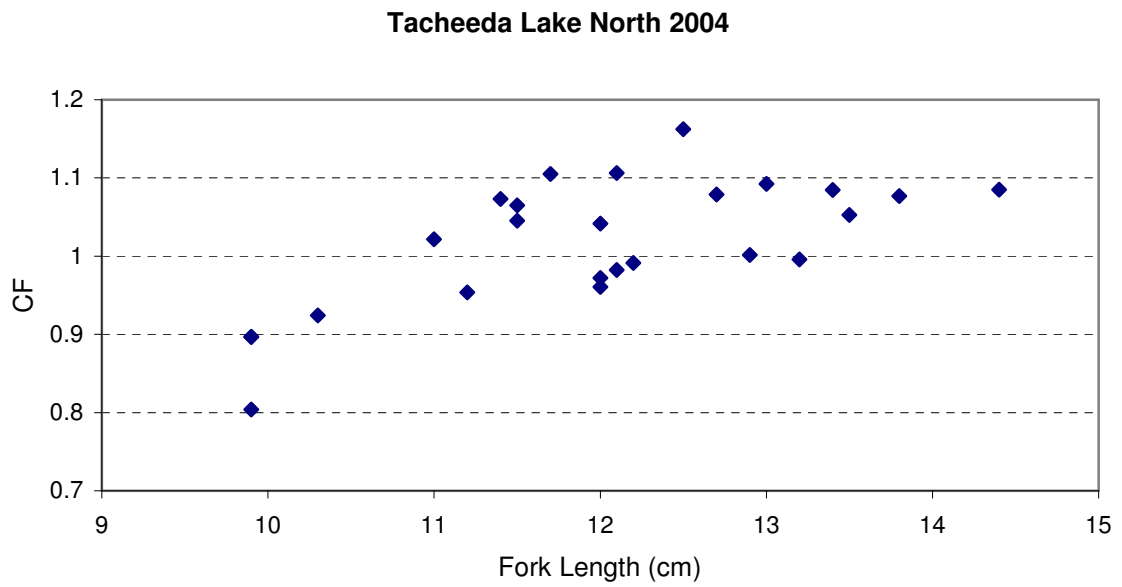
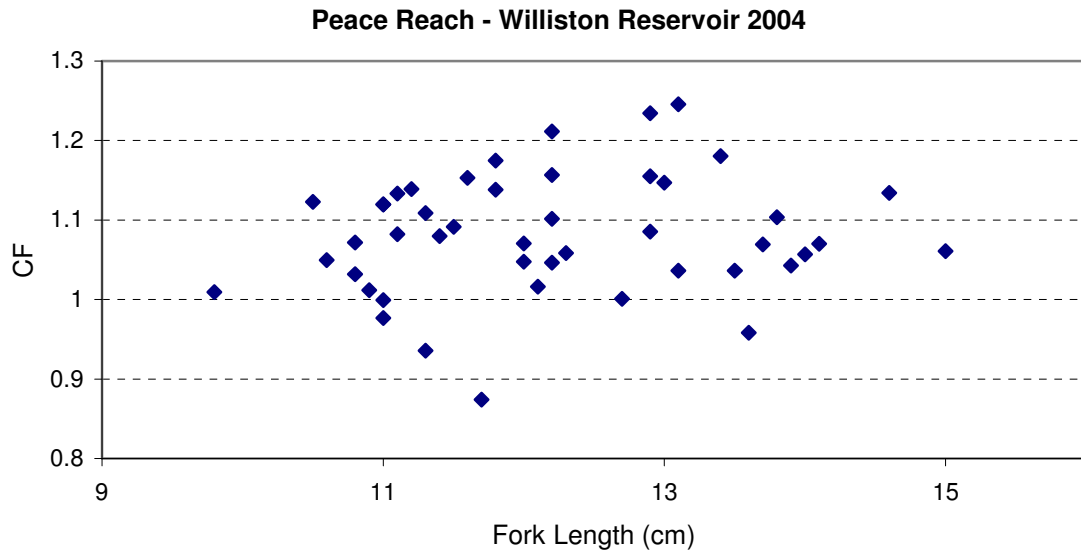
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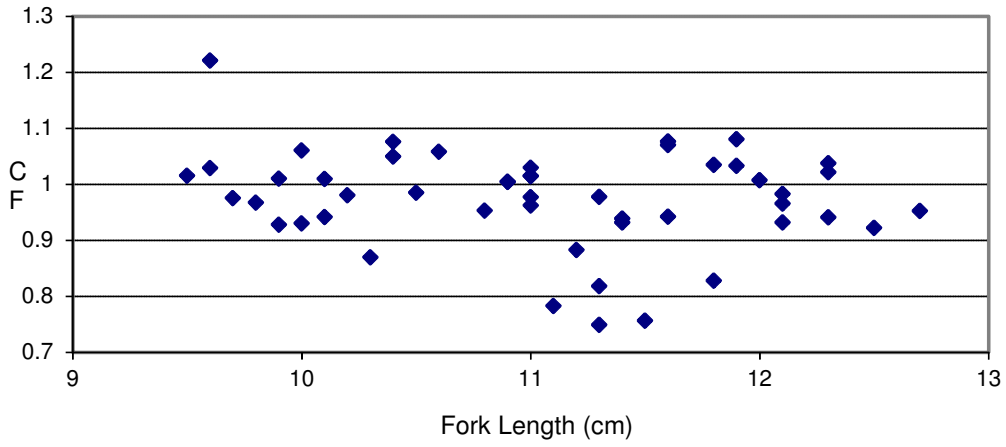


Thutade Lake 2003

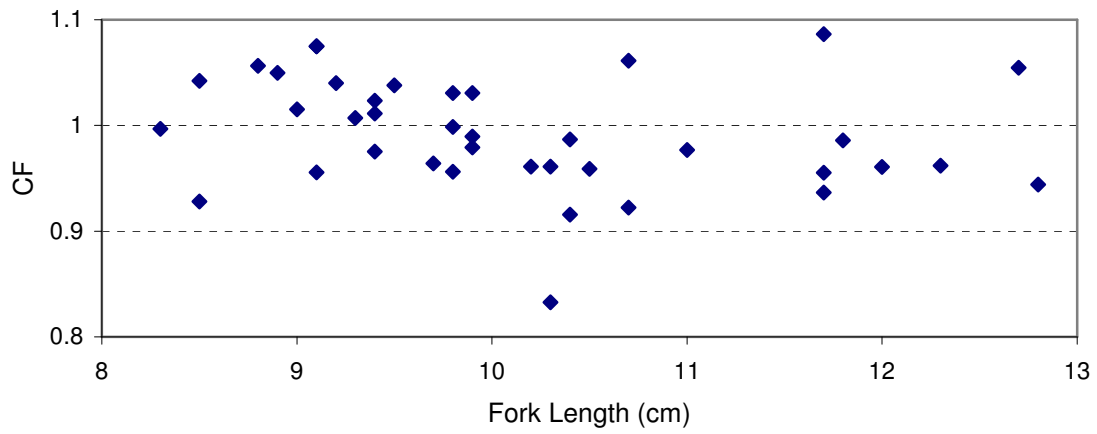
- No PW fish were caught, therefore no charts or tables were produced. Refer to netting records file for other species details.



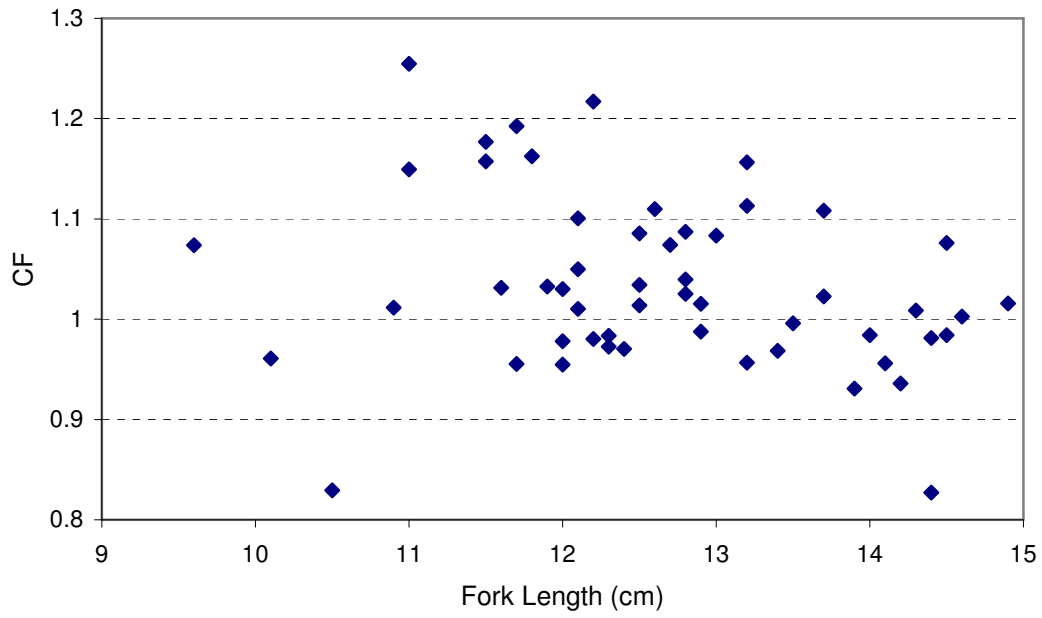
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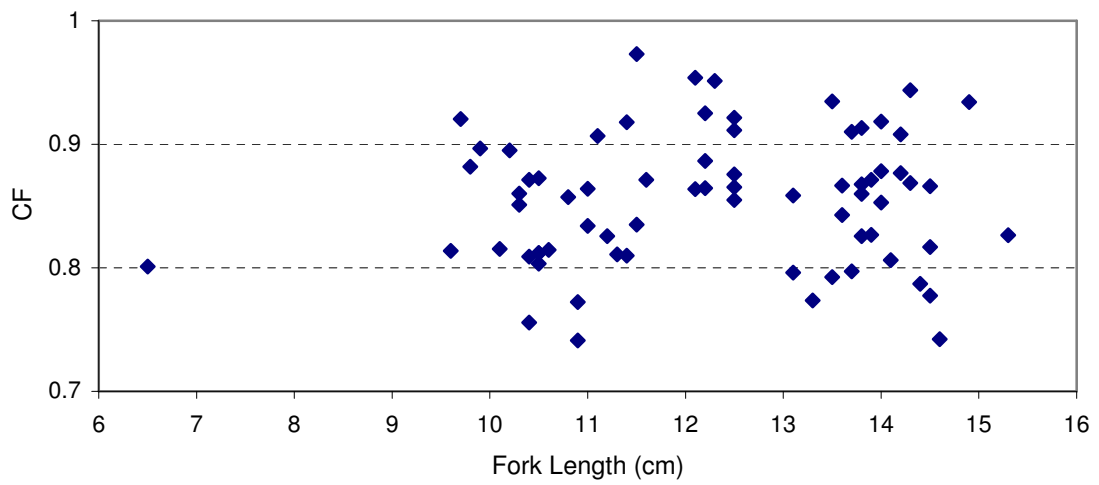
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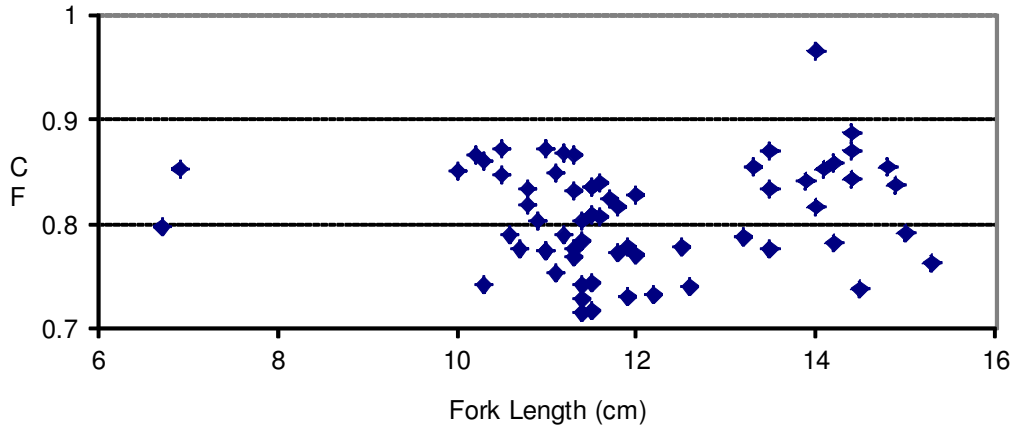
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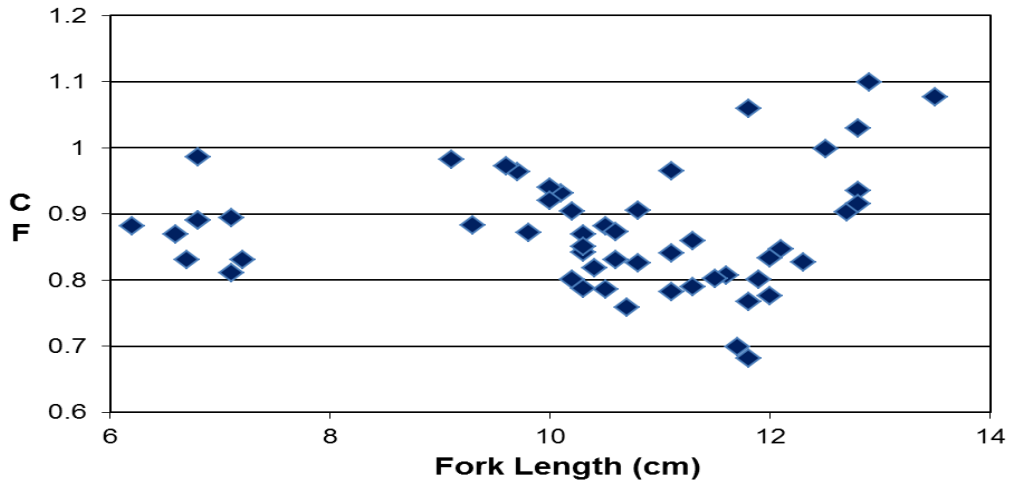
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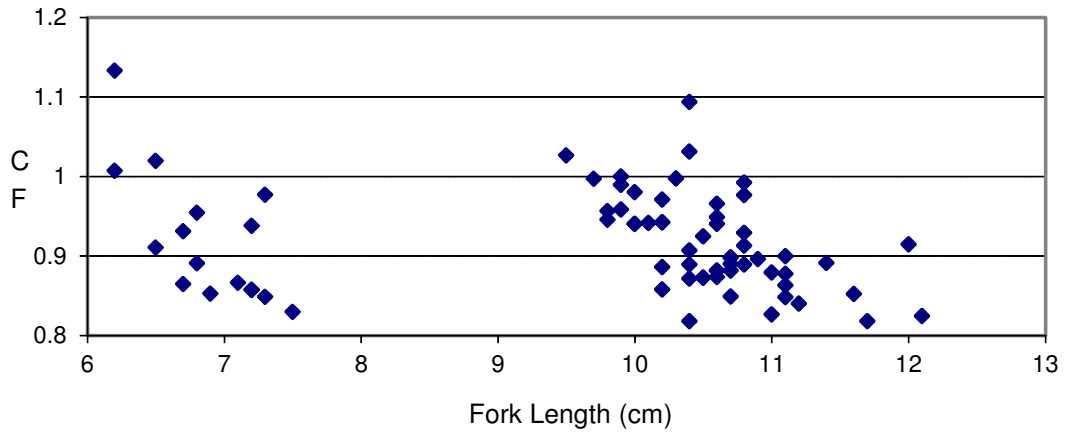
Tutizzi Lake 2005



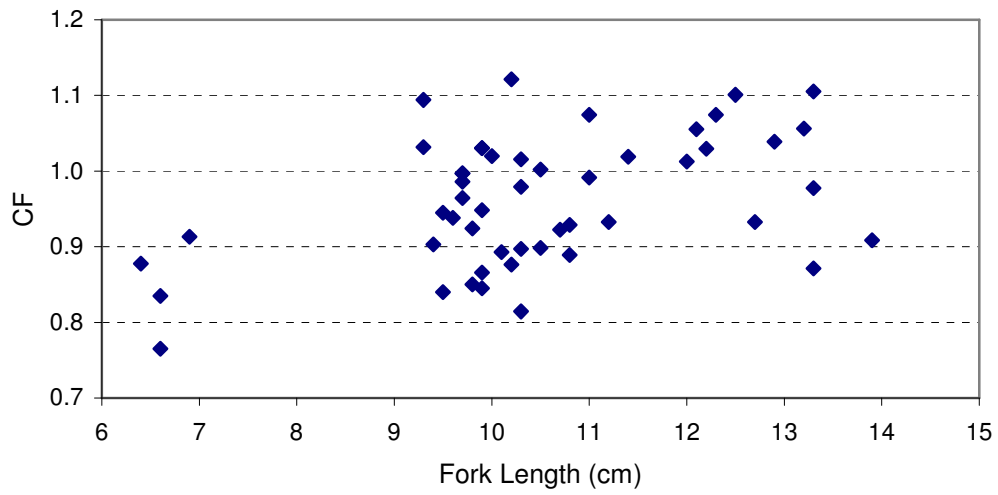
Manson Lake Upper 2005



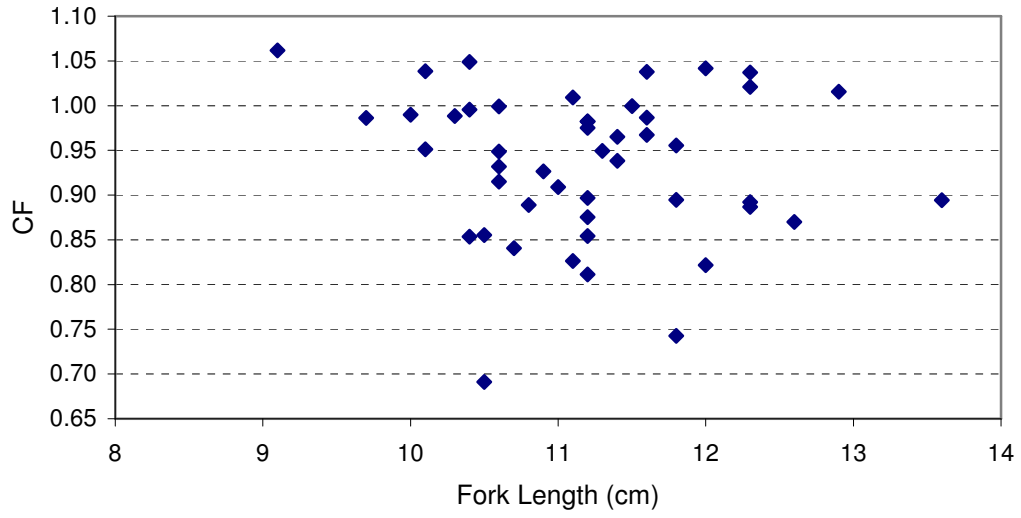
Manson Lake Lower 2005



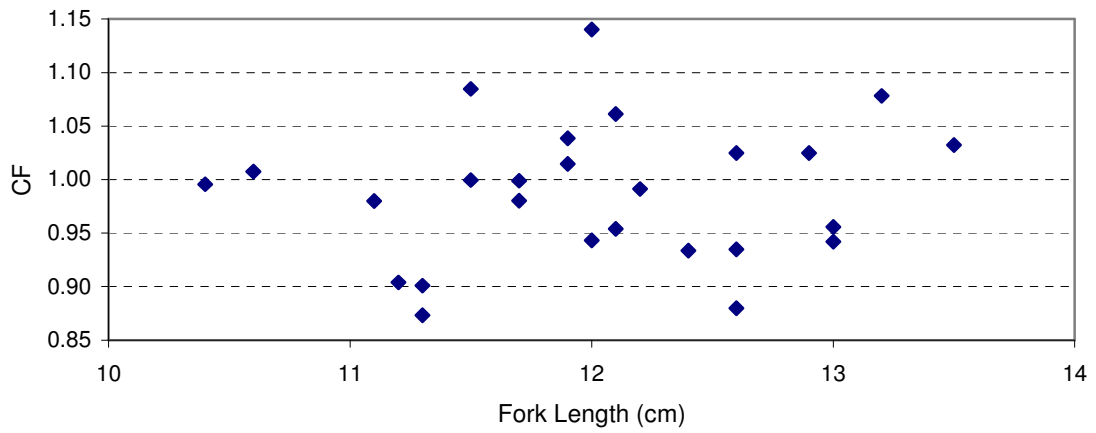
Uslika Lake 2006



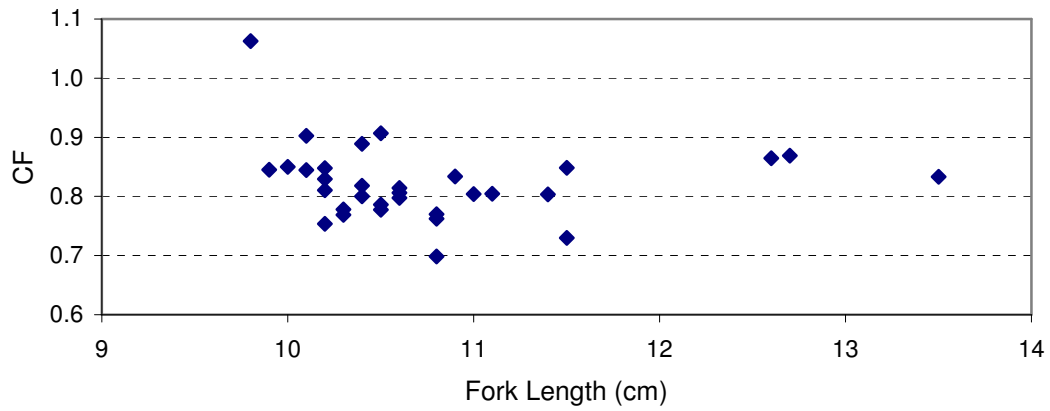
Omineca Arm - Williston Reservoir 2006



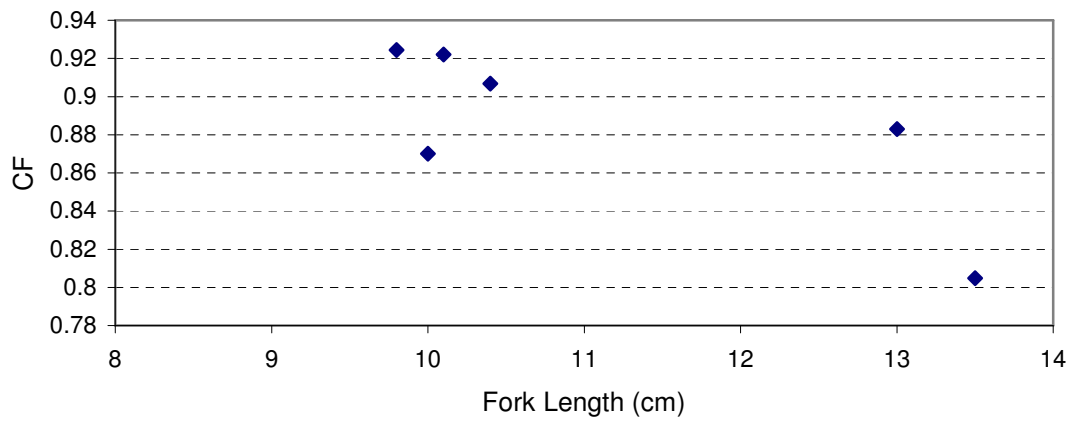
6 Mile Bay - Williston Reservoir 2006



Chuchi Lake 2006



Arctic Lake 2006



Appendix 2

Age Class Tables

Dina Lake #1 - 2000

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 14 | 10.6 | 7.5-12.5 | 1.5 | 11.0 | 8.6-14.3 | 2.6 |
| 1 | F | 15 | 8.7 | 6.6-10.6 | 1.2 | 11.0 | 2.7-13.8 | 3.5 |
| 2 | F | 40 | 10.5 | 7.3-12.2 | 0.8 | 11.9 | 4.2-16.5 | 2.7 |
| 3 | F | 19 | 11.7 | 10.8-12.9 | 0.5 | 15.9 | 11.2-22.3 | 2.6 |
| 4 | F | 17 | 12.1 | 11.1-13.0 | 0.5 | 16.5 | 14.5-21.5 | 2.2 |
| 5 | F | 3 | 12.3 | 16.1-12.7 | 0.3 | 19.0 | 16.1-21.4 | 2.7 |
| UNK | F | 108 | 10.8 | 2.5-13.0 | 1.7 | 13.1 | 2.5-22.3 | 4.8 |
| 1 | M | 28 | 7.7 | 6.2-9.6 | 1.1 | 4.8 | 2.1-9.4 | 2.3 |
| 2 | M | 32 | 9.7 | 8.7-10.5 | 0.5 | 9.1 | 6.9-12.6 | 1.5 |
| 4 | M | 2 | 10.5 | 10.3-10.6 | 0.2 | 11.7 | 11.1-12.2 | 0.8 |
| UNK | M | 44 | 7.9 | 6.4-10.0 | 1.3 | 5.4 | 2.7-10.2 | 2.6 |

Dina Lake #1 - 2001

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 57 | 5.5 | 2.8-9.6 | 2.0 | 1.6 | 0.2-8.9 | 1.4 |
| 0+ | UNK | 16 | 4.6 | 3.0-5.6 | 0.8 | 0.9 | 0.3-1.4 | 0.4 |
| 1 | UNK | 17 | 5.5 | 3.7-7.0 | 0.8 | 1.6 | 0.4-3.4 | 0.8 |
| 2 | UNK | 5 | 4.5 | 4.1-4.8 | 0.5 | 0.7 | 0.5-0.8 | 0.2 |
| 3 | UNK | 2 | 4.6 | 3.9-5.3 | 1.0 | 0.8 | 0.6-0.9 | 0.2 |
| 4 | UNK | 1 | 12.8 | N/A | N/A | ? | N/A | N/A |
| 5 | UNK | 1 | 12.5 | N/A | N/A | 16.4 | N/A | N/A |
| UNK | F | 85 | 10.7 | 6.6-13.2 | 1.4 | 13.5 | 2.6-22.0 | 4.8 |
| 1 | F | 11 | 9.5 | 5.7-12.7 | 2.2 | 9.9 | 1.6-20.3 | 6.3 |
| 2 | F | 40 | 10.4 | 7.0-12.3 | 1.1 | 12.4 | 3.0-20.7 | 3.7 |
| 3 | F | 22 | 10.5 | 5.9-12.5 | 2.0 | 12.9 | 1.8-20.1 | 5.5 |
| 4 | F | 9 | 11.9 | 11.0-12.9 | 0.7 | 17.4 | 13.4-20.9 | 2.8 |
| 5 | F | 5 | 10.9 | 8.9-11.9 | 1.3 | 14.2 | 6.1-17.5 | 4.7 |
| UNK | M | 69 | 9.7 | 7.1-12.2 | 1.0 | 9.5 | 3.8-21.0 | 2.7 |
| 0+ | M | 2 | 6.9 | 6.1-7.7 | 1.1 | 2.7 | 1.8-3.5 | 1.2 |
| 1 | M | 6 | 9.6 | 9.1-10.0 | 0.3 | 9.1 | 6.4-10.2 | 1.4 |
| 2 | M | 15 | 9.8 | 9.1-10.8 | 0.5 | 9.9 | 6.9-15.5 | 2.1 |
| 3 | M | 2 | 9.8 | 9.2-10.1 | 0.4 | 10.0 | 9.2-10.8 | 1.1 |
| 4 | M | 1 | 10.1 | N/A | N/A | 9.6 | N/A | N/A |
| 5 | M | 1 | 9.9 | N/A | N/A | 9.5 | N/A | N/A |
| 6 | M | 1 | 10.0 | N/A | N/A | 9.6 | N/A | N/A |

Dina Lake #1 - 2004

➤ No age sampling conducted

Dina Lake #1 - 2006

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | UNK | 2 | 6.5 | 6.5-6.5 | 0 | 2.8 | 2.8-2.8 | 0 |
| 3 | F | 2 | 10.7 | 10.0-11.4 | 1.0 | 11.2 | 9.6-12.8 | 2.3 |
| 4 | F | 7 | 11.3 | 10.6-12.4 | 0.7 | 14.3 | 11.9-21.4 | 3.2 |
| 5 | F | 2 | 11.5 | 11.3-11.6 | 0.2 | 15.3 | 15.0-15.6 | 0.4 |
| 6 | F | 1 | 12.8 | N/A | N/A | 18.9 | N/A | N/A |
| 3 | M | 2 | 10.2 | 9.8-10.6 | 0.6 | 10.1 | 9.0-11.1 | 1.5 |
| 4 | M | 3 | 10.3 | 9.8-10.5 | 0.4 | 10.3 | 9.3-10.9 | 0.9 |
| 5 | M | 1 | 12.8 | N/A | N/A | 0.5 | N/A | N/A |

Quentin Lake 2003

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 5 | 10.0 | 7.2-14.1 | 2.8 | 10.0 | 3.4-29.9 | 10.6 |
| 1 | UNK | 3 | 7.0 | 6.5-7.5 | 0.5 | 3.6 | 3.4-4.0 | 0.3 |
| 2 | UNK | 2 | 6.5 | 6.1-6.8 | 0.5 | 2.9 | 2.5-3.3 | 0.6 |
| 2 | F | 7 | 9.1 | 7.4-10.3 | 1.2 | 7.9 | 4.0-11.0 | 2.8 |
| 3 | F | 10 | 10.9 | 9.0-12.5 | 0.9 | 14.0 | 8.1-21.0 | 3.8 |
| 4 | F | 2 | 11.5 | 10.8-12.2 | 1.0 | 14.9 | 11.8-18.0 | 4.4 |
| 6 | F | 1 | 13.4 | N/A | N/A | 23.0 | N/A | N/A |
| 7 | F | 1 | 11.9 | N/A | N/A | 19.0 | N/A | N/A |
| 2 | M | 7 | 9.9 | 9.0-11.1 | 0.8 | 11.2 | 7.1-15.5 | 3.0 |
| 3 | M | 1 | 10.0 | N/A | N/A | 11.4 | N/A | N/A |

Weissener Lake 2003

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | F | 13 | 10.1 | 9 – 11.8 | 0.9 | 10.5 | 6.3-17.4 | 3.4 |
| 3 | F | 6 | 11.6 | 10.3-12.9 | 1.0 | 16.5 | 11.0-22.1 | 4.5 |
| 4 | F | 2 | 13.0 | 12.5-13.5 | 0.7 | 22.1 | 22.0-22.1 | 0.1 |
| 5 | F | 1 | 13.1 | N/A | N/A | 23.8 | N/A | N/A |
| 1 | M | 1 | 9.3 | N/A | N/A | 9.4 | N/A | N/A |
| 2 | M | 13 | 9.9 | 8.7-11.4 | 0.9 | 10.7 | 7.0-15.9 | 3.3 |
| 3 | M | 1 | 10.6 | N/A | N/A | 13.9 | N/A | N/A |

Thutade Lake 2003

- No PW fish were caught (NFC), therefore no charts or tables were produced.

Peace Reach – Williston Reservoir 2004

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | UNK | 5 | 11.2 | 9.8-12.2 | 1.0 | 15.8 | 9.5-21.0 | 4.3 |
| 3 | UNK | 19 | 11.8 | 10.5-14.1 | 1.0 | 18.0 | 12.5-30.0 | 5.2 |
| 4 | UNK | 14 | 13.1 | 10.9-15.0 | 1.1 | 25.3 | 12.5-35.8 | 5.5 |
| 5 | UNK | 1 | 12.2 | N/A | N/A | 22.0 | N/A | N/A |
| UNK | UNK | 10 | 12.1 | 10.8-14.6 | 1.2 | 19.7 | 13.0-35.3 | 7.6 |

Tacheeda Lake North 2004

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 5 | 12.0 | 9.9-14.4 | 1.7 | 18.7 | 7.8-32.4 | 9.3 |
| 1 | F | 1 | 9.9 | N/A | N/A | 8.7 | N/A | N/A |
| 3 | F | 5 | 11.9 | 11.2-13.0 | 0.7 | 17.4 | 13.4-24.0 | 4.0 |
| 4 | F | 3 | 13.4 | 13.2-13.5 | 0.2 | 25.0 | 22.9-26.1 | 1.8 |
| 5 | F | 2 | 13.4 | 12.9-13.8 | 0.6 | 24.9 | 21.5-28.3 | 4.8 |
| 6 | F | 1 | 12.0 | N/A | N/A | 18.0 | N/A | N/A |
| 2 | M | 2 | 10.1 | 9.9-10.3 | 0.3 | 9.4 | 8.7-10.1 | 1.0 |
| 3 | M | 4 | 12.0 | 11.4-12.5 | 0.5 | 19.0 | 15.9-22.7 | 2.9 |
| 4 | M | 1 | 12.2 | N/A | N/A | 18.0 | N/A | N/A |
| 5 | M | 1 | 11.5 | N/A | N/A | 15.9 | N/A | N/A |

Tacheeda Lake North 2005

- No age sampling conducted

Tacheeda Lake South 2004

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 9 | 10.3 | 8.9-12.8 | 1.6 | 11.9 | 7.4-21.6 | 5.7 |
| 1 | UNK | 1 | 9.1 | N/A | N/A | 7.2 | N/A | N/A |
| 3 | F | 9 | 10.5 | 9.8-11.7 | 0.6 | 11.6 | 9.5-17.4 | 2.6 |
| 4 | F | 5 | 10.5 | 9.8-11.7 | 0.7 | 11.0 | 9.1-15.0 | 2.4 |
| 5 | F | 2 | 12.0 | 11.7-12.3 | 0.4 | 16.6 | 15.3-17.9 | 1.8 |
| 8 | F | 1 | 12.0 | N/A | N/A | 16.6 | N/A | N/A |
| 1 | M | 2 | 8.4 | 8.3-8.5 | 0.1 | 5.7 | N/A | 0 |
| 2 | M | 5 | 9.1 | 8.5-9.7 | 0.5 | 7.8 | 6.4-8.8 | 0.9 |
| 3 | M | 3 | 9.4 | 8.8-9.9 | 0.6 | 8.5 | 7.2-10.0 | 1.4 |
| 4 | M | 1 | 9.8 | N/A | N/A | 9.0 | N/A | N/A |
| 5 | M | 1 | 10.4 | N/A | N/A | 11.1 | N/A | N/A |

Tacheeda Lake South 2005

- No age sampling conducted

Aiken Lake 2005

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | F | 3 | 9.06 | 6.5 – 10.5 | 2.2 | 7.0 | 2.2 – 9.5 | 4.2 |
| 3 | F | 6 | 10.65 | 9.6 – 12.1 | 0.9 | 10.42 | 7.2 – 15.3 | 2.8 |
| 4 | F | 5 | 11.54 | 10.6 – 12.5 | 0.9 | 13.62 | 9.7 – 17.8 | 3.5 |
| 5 | F | 4 | 12.88 | 11.2 – 13.7 | 1.1 | 18.1 | 11.6 – 23.4 | 4.9 |
| 6 | F | 10 | 14.11 | 13.3 – 14.6 | 0.4 | 23.47 | 18.2 – 27.6 | 2.6 |
| 7 | F | 6 | 13.12 | 13.8 – 14.9 | 0.4 | 25.2 | 22.8 – 30.9 | 3.0 |
| 8 | F | 1 | 13.9 | N/A | N/A | 23.4 | N/A | N/A |
| 9 | F | 1 | 15.3 | N/A | N/A | 29.6 | N/A | N/A |
| 2 | M | 3 | 10.2 | 9.7 – 10.5 | 0.4 | 9.2 | 8.4 – 10.1 | 0.9 |
| 3 | M | 1 | 9.9 | N/A | N/A | 8.7 | N/A | N/A |
| 4 | M | 2 | 10.95 | 10.5 – 11.4 | 0.6 | 11.5 | 9.4 – 13.6 | 3.0 |
| 5 | M | 1 | 10.3 | N/A | N/A | 9.4 | N/A | N/A |
| 6 | M | 1 | 11.5 | N/A | N/A | 12.7 | N/A | N/A |

Tutuzzi Lake 2005

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 0 | UNK | 1 | 7.6 | N/A | N/A | 2.4 | N/A | N/A |
| 1 | UNK | 1 | 6.9 | N/A | N/A | 2.8 | N/A | N/A |
| 2 | F | 1 | 10.6 | N/A | N/A | 9.4 | N/A | N/A |
| 3 | F | 7 | 11.1 | 10.2 – 11.8 | 0.6 | 11.3 | 9.2 – 13.4 | 1.6 |
| 4 | F | 9 | 11.8 | 11.0 – 15.0 | 1.2 | 13.2 | 10.3 – 26.7 | 5.1 |
| 5 | F | 10 | 11.6 | 10.3 – 13.5 | 0.9 | 12.5 | 9.4 – 20.5 | 3.1 |
| 6 | F | 8 | 13.6 | 11.4 – 14.9 | 1.2 | 21.0 | 10.6 – 27.7 | 5.9 |
| 7 | F | 4 | 13.8 | 13.3 – 14.5 | 0.5 | 22.6 | 20.1 – 26.5 | 2.8 |
| 8 | F | 4 | 14.3 | 13.9 – 14.8 | 0.4 | 25.2 | 22.6 – 26.5 | 2.3 |
| 9 | F | 1 | 14.2 | N/A | N/A | 24.6 | N/A | N/A |
| U | M | 1 | 10.0 | N/A | N/A | 8.5 | N/A | N/A |
| 2 | M | 1 | 10.8 | N/A | N/A | 10.5 | N/A | N/A |
| 4 | M | 1 | 11.2 | N/A | N/A | 12.2 | N/A | N/A |
| 5 | M | 4 | 11.5 | 11.4 – 11.6 | 0.1 | 11.7 | 10.8 – 13.1 | 1.1 |
| 6 | M | 2 | 11.1 | 10.7 – 11.4 | 0.5 | 10.3 | 9.5 – 11.0 | 1.1 |
| 7 | M | 1 | 13.5 | N/A | N/A | 19.1 | N/A | N/A |

Mason Lake Upper 2005

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 1 | 11.7 | N/A | N/A | 18 | N/A | N/A |
| 1 | UNK | 4 | 7.5 | 6.6 – 9.6 | 1.4 | 4.1 | 2.5 – 7.8 | 2.5 |
| 3 | UNK | 1 | 12.0 | N/A | N/A | 14.0 | N/A | N/A |
| 4 | UNK | 2 | 11.6 | 10.9 – 12.3 | 1.0 | 13.7 | 10.4 – 17.0 | 4.7 |
| 5 | UNK | 1 | 6.8 | N/A | N/A | 3.1 | N/A | N/A |
| 6 | UNK | 1 | 6.8 | N/A | N/A | 2.8 | N/A | N/A |
| 10 | UNK | 1 | 11.5 | N/A | N/A | 12.7 | N/A | N/A |
| UNK | F | 7 | 10.2 | 6.7 – 12.2 | 1.8 | 10.0 | 8.5 – 23.6 | 10.7 |
| 1 | F | 2 | 11.6 | 10.2 – 12.9 | 1.9 | 16.1 | 8.5 – 23.6 | 10.7 |
| 2 | F | 1 | 11.5 | N/A | N/A | 8.8 | N/A | N/A |
| 3 | F | 12 | 11.6 | 9.3 – 13.5 | 1.3 | 14.7 | 7.1 – 26.5 | 6.0 |
| 4 | F | 9 | 11.2 | 10.3 – 12.5 | 0.8 | 12.9 | 9.2 – 19.5 | 3.1 |
| 5 | F | 4 | 11.2 | 10.1 – 12.3 | 0.9 | 12.7 | 9.6 – 15.4 | 2.4 |
| 6 | F | 1 | 12.8 | N/A | N/A | 19.2 | N/A | N/A |
| 7 | F | 1 | 10.6 | N/A | N/A | 9.9 | N/A | N/A |
| 8 | F | 1 | 10.8 | N/A | N/A | 10.4 | N/A | N/A |
| 11 | F | 1 | 11.1 | N/A | N/A | 10.7 | N/A | N/A |
| UNK | M | 3 | 10.7 | 10.2 – 11.0 | 0.4 | 10.3 | 9.4 – 10.9 | 0.8 |
| 1 | M | 3 | 6.8 | 6.2 – 7.2 | 0.6 | 2.7 | 2.1 – 3.1 | 0.5 |
| 2 | M | 2 | 9.6 | 9.1 – 10.0 | 0.6 | 8.3 | 7.4 – 9.2 | 1.3 |
| 3 | M | 2 | 11.1 | 10.5 – 11.6 | 0.8 | 11.4 | 10.2 – 12.6 | 1.7 |
| 4 | M | 3 | 10.8 | 10.3 – 11.7 | 0.8 | 9.9 | 9.1 – 11.2 | 1.2 |
| 5 | M | 1 | 10.7 | N/A | N/A | 9.3 | N/A | N/A |
| 8 | M | 1 | 10.3 | N/A | N/A | 8.6 | N/A | N/A |

Manson Lake Lower 2005

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 1 | 6.2 | N/A | N/A | 2.4 | N/A | N/A |
| 1 | UNK | 10 | 6.9 | 6.2 – 7.5 | 0.4 | 3.1 | 2.5 – 3.8 | 0.4 |
| 1 | F | 1* | 10.8 | N/A | N/A | 12.5 | N/A | N/A |
| 2 | F | 6 | 10.2 | 9.8 – 10.8 | 0.3 | 9.3 | 4.0 – 12.3 | 2.8 |
| 3 | F | 16 | 10.8 | 9.8 – 11.7 | 0.6 | 9.4 | 2.6 – 13.3 | 3.5 |
| 7 | F | 1 | 11.4 | N/A | N/A | 13.2 | N/A | N/A |
| 9 | F | 1 | 12.0 | N/A | N/A | 15.8 | N/A | N/A |
| 2 | M | 7 | 10.3 | 9.7 – 10.8 | 0.5 | 10.3 | 9.1 – 11.7 | 0.9 |
| 3 | M | 6 | 10.5 | 10.3 – 10.7 | 0.2 | 10.9 | 10.4 – 11.6 | 0.5 |
| 4 | M | 1 | 10.4 | N/A | N/A | 12.3 | N/A | N/A |

*NW comment - think this otolith was from a different fish – age doesn't match FL + W

Usluka Lake 2006

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 1 | 6.6 | N/A | N/A | 2.2 | N/A | N/A |
| 2 | UNK | 1 | 6.9 | N/A | N/A | 3.0 | N/A | N/A |
| UNK | F | 1 | 9.8 | N/A | N/A | 8.7 | N/A | N/A |
| 2 | F | 1 | 6.4 | N/A | N/A | 2.3 | N/A | N/A |
| 3 | F | 5 | 10.1 | 9.8 – 10.8 | 0.4 | 9.2 | 8.0 – 11.7 | 1.5 |
| 4 | F | 6 | 9.8 | 9.3 – 10.2 | 0.4 | 8.8 | 7.5 – 10.2 | 1.0 |
| 5 | F | 8 | 10.6 | 9.3 – 12.9 | 1.3 | 12.2 | 8.1 – 22.3 | 5.0 |
| 6 | F | 4 | 11.7 | 9.9 – 12.7 | 1.3 | 16.6 | 10.0 – 19.1 | 4.4 |
| 7 | F | 7 | 11.9 | 9.9 – 13.9 | 1.6 | 16.8 | 10.0 – 26.0 | 6.7 |
| 8 | F | 2 | 12.4 | 12.3 – 12.5 | 0.1 | 20.8 | 20.0 – 21.5 | 1.1 |
| 9 | F | 1 | 13.3 | N/A | N/A | 23.0 | N/A | N/A |
| 11 | F | 1 | 13.2 | N/A | N/A | 24.3 | N/A | N/A |
| 2 | M | 1 | 6.6 | N/A | N/A | 2.4 | N/A | N/A |
| 3 | M | 4 | 10.0 | 9.5 – 11.0 | 0.7 | 9.6 | 7.2 – 13.2 | 2.6 |
| 4 | M | 3 | 10.8 | 10.3 – 11.2 | 0.5 | 11.7 | 10.7 – 13.1 | 1.3 |
| 5 | M | 2 | 9.8 | 9.7 – 9.9 | 0.1 | 8.7 | 8.2 – 9.1 | 0.6 |
| 7 | M | 1 | 9.9 | N/A | N/A | 10.0 | N/A | N/A |
| 8 | M | 1 | 10.2 | N/A | N/A | 11.9 | N/A | N/A |
| 9 | M | 1 | 11.4 | N/A | N/A | 15.1 | N/A | N/A |

Omineca Arm – Williston Reservoir 2006

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | UNK | 1 | 9.1 | N/A | N/A | 8.0 | N/A | N/A |
| 2 | F | 14 | 10.9 | 10.1 – 11.8 | 0.5 | 11.5 | 8.0 – 15.7 | 2.0 |
| 3 | F | 12 | 12.0 | 11.2 – 13.6 | 0.7 | 16.2 | 11.4 – 22.5 | 3.5 |
| 2 | M | 10 | 10.5 | 9.7 – 11.6 | 0.5 | 11.3 | 9.0 – 15.4 | 1.7 |
| 3 | M | 10 | 11.6 | 11.1 – 12.3 | 0.5 | 15.0 | 11.3 – 19.3 | 2.5 |

6 Mile Bay– Williston Reservoir 2006

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| UNK | UNK | 1 | 13.0 | N/A | N/A | 20.7 | N/A | N/A |
| 2 | F | 6 | 11.4 | 10.4 – 11.9 | 0.6 | 14.7 | 11.2 – 17.5 | 2.5 |
| 3 | F | 12 | 12.4 | 11.5 – 13.2 | 0.5 | 19.2 | 16.3 – 24.8 | 2.6 |
| 4 | F | 1 | 13.5 | N/A | N/A | 20.7 | N/A | N/A |
| 2 | M | 3 | 11.2 | 10.6 – 11.7 | 0.6 | 13.5 | 12.0 – 15.7 | 2.0 |
| 3 | M | 2 | 11.95 | 11.3 – 12.6 | 1.0 | 15.7 | 12.6 – 18.7 | 4.3 |
| 4 | M | 1 | 11.5 | N/A | N/A | 15.2 | N/A | N/A |

Chuchi Lake 2006

| Age Class | Sex | Sample No. | Mean Length (cm) | Range of Length (cm) | SD for Length | Mean Weight (g) | Range of Weight (g) | SD for Weight |
|-----------|-----|------------|------------------|----------------------|---------------|-----------------|---------------------|---------------|
| 2 | F | 19 | 10.6 | 10.1 – 11.4 | 0.3 | 9.6 | 8.5 – 11.9 | 0.9 |
| 3 | F | 7 | 11.5 | 10.2 – 12.7 | 0.9 | 12.6 | 8.6 – 17.8 | 3.6 |
| 5 | F | 1 | 13.5 | N/A | N/A | 20.5 | N/A | N/A |
| 2 | M | 6 | 10.2 | 9.8 – 10.5 | 0.3 | 8.8 | 8.0 – 10.0 | 0.7 |
| 4 | M | 1 | 10.0 | N/A | N/A | 8.5 | N/A | N/A |

Arctic Lake 2006

- Six PW were caught but no age analysis was conducted therefore no table.

Appendix 3

The biology of pygmy whitefish, *Prosopium coulterii*,
in a closed sub-boreal lake: spatial distribution and diel
movements

Environ Biol Fish (2006) 76:317–327
DOI 10.1007/s10641-006-9035-2

Authors:

Randy J. Zemlak J. D. McPhail

Appendix 4

Phylogeography and the origins of range disjunctions in a north temperate fish, the pygmy whitefish (*Prosopium coulterii*), inferred from mitochondrial and nuclear DNA sequence analysis

Journal of Biogeography (J. Biogeogr.) (2011)

Authors:

Jonathan D. S. Witt^{1,2*}, Randy J. Zemlak³ and Eric B. Taylor²

Appendix 5

Connectivity among populations of pygmy
whitefish (*Prosopium coulterii*) in northwestern
North America inferred from microsatellite DNA
Analyses

Canadian Journal of Zoology, 2011, Vol. 89, No. 4 : pp. 255-266

Authors:

E.B. Taylor, J.L. Gow, J. Witt, and R. Zemlak

Appendix 6

UTM Coordinates of Sampling Events

UTM Coordinates of Sampling Events

| | | | |
|-----------------------------------|----|--------|---------|
| Dina Lake #1 | 10 | 480658 | 6153999 |
| Quentin Lake | 10 | 363153 | 6414618 |
| Weissener Lake | 10 | 330475 | 6402668 |
| Thutade Lake | 9 | 609237 | 6295298 |
| Peace Reach - Williston Reservoir | 10 | 487122 | 6204151 |
| Tacheeda Lake North (Upper) | 10 | 532165 | 6064758 |
| Tacheeda Lake South (Lower) | 10 | 530236 | 6062481 |
| Aiken Lake | 10 | 331748 | 6256295 |
| Tutizzi Lake | 10 | 340188 | 6243172 |
| Manson Lake Upper | 10 | 414765 | 6164135 |
| Manson Lake Lower | 10 | 414898 | 6161931 |
| Uslika Lake | 10 | 361612 | 6219332 |
| Omineca Arm - Williston Reservoir | 10 | 422648 | 6207701 |
| 6 Mile Bay - Williston Reservoir | 10 | 473496 | 6160931 |
| Chuchi Lake | 10 | 411261 | 6116674 |
| Arctic Lake | 10 | 583771 | 6032384 |