**Technical Report No. 15-06**

# Fish Use of Campbell Lake, Alaska, October 2005 to September 2006

**by Mark A. Somerville and Megan E. Marie**

*Campbell Lake Winter Sampling*

**June 2015**

**Alaska Department of Fish and Game** **Division of Habitat**

## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in Technical Reports by the Division of Habitat. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

**Weights and measures (metric)**

| | |
|---|---|
| centimeter | cm |
| deciliter | dL |
| gram | g |
| hectare | ha |
| kilogram | kg |
| kilometer | km |
| liter | L |
| meter | m |
| milliliter | mL |
| millimeter | mm |

**Weights and measures (English)**

| | |
|---|---|
| cubic feet per second | $ft^3/s$ |
| foot | ft |
| gallon | gal |
| inch | in |
| mile | mi |
| nautical mile | nmi |
| ounce | oz |
| pound | lb |
| quart | qt |
| yard | yd |

**Time and temperature**

| | |
|---|---|
| day | d |
| degrees Celsius | °C |
| degrees Fahrenheit | °F |
| degrees kelvin | K |
| hour | h |
| minute | min |
| second | s |

**Physics and chemistry**

| | |
|---|---|
| all atomic symbols | |
| alternating current | AC |
| ampere | A |
| calorie | cal |
| direct current | DC |
| hertz | Hz |
| horsepower | hp |
| hydrogen ion activity (negative log of) | pH |
| parts per million | ppm |
| parts per thousand | ppt, ‰ |
| volts | V |
| watts | W |

**General**

| | |
|---|---|
| Alaska Administrative Code | AAC |
| all commonly accepted abbreviations | e.g., Mr., Mrs., AM, PM, etc. |
| all commonly accepted professional titles | e.g., Dr., Ph.D., R.N., etc. |
| at | @ |
| compass directions: | |
| east | E |
| north | N |
| south | S |
| west | W |
| copyright | © |
| corporate suffixes: | |
| Company | Co. |
| Corporation | Corp. |
| Incorporated | Inc. |
| Limited | Ltd. |
| District of Columbia | D.C. |
| et alii (and others) | et al. |
| et cetera (and so forth) | etc. |
| exempli gratia (for example) | e.g. |
| Federal Information Code | FIC |
| id est (that is) | i.e. |
| latitude or longitude | lat. or long. |
| monetary symbols (U.S.) | $, ¢ |
| months (tables and figures): first three letters | Jan,...,Dec |
| registered trademark | ® |
| trademark | ™ |
| United States (adjective) | U.S. |
| United States of America (noun) | USA |
| U.S.C. | United States Code |
| U.S. state | use two-letter abbreviations (e.g., AK, WA) |

**Mathematics, statistics**

| | |
|---|---|
| *all standard mathematical signs, symbols and abbreviations* | |
| alternate hypothesis | $H_A$ |
| base of natural logarithm | *e* |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | (F, t, $\chi^2$, etc.) |
| confidence interval | CI |
| correlation coefficient (multiple) | R |
| correlation coefficient (simple) | r |
| covariance | cov |
| degree (angular ) | ° |
| degrees of freedom | df |
| expected value | *E* |
| greater than | > |
| greater than or equal to | ≥ |
| harvest per unit effort | HPUE |
| less than | < |
| less than or equal to | ≤ |
| logarithm (natural) | ln |
| logarithm (base 10) | log |
| logarithm (specify base) | $\log_2$, etc. |
| minute (angular) | ' |
| not significant | NS |
| null hypothesis | $H_O$ |
| percent | % |
| probability | P |
| probability of a type I error (rejection of the null hypothesis when true) | α |
| probability of a type II error (acceptance of the null hypothesis when false) | β |
| second (angular) | " |
| standard deviation | SD |
| standard error | SE |
| variance | |
| population | Var |
| sample | var |

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# FISH USE OF CAMPBELL LAKE, ALASKA, OCTOBER 2005 TO SEPTEMBER 2006

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# ACKNOWLEDGMENTS

We thank Tom Kron and members of the Campbell Lake Homeowners Association for logistical support, assistance in the field, shared historical knowledge of the lake, and active involvement in fish use and water quality observations in the lake. We also thank Michael Daigneault for providing multiple iterations of review and editing of this technical report.

# EXECUTIVE SUMMARY

The Alaska Department of Fish and Game, Division of Habitat (formerly the Office of Habitat Management and Permitting, Alaska Department of Natural Resources) implemented a study to gather baseline data on fish use and water quality in Campbell Lake prior to a proposed project to drawdown the lake during winter, dredge accumulated sediment, and allow the lake bed to freeze for the purposes of macrophyte removal. Data were collected on fish abundance and water quality in Campbell Lake during winter and summer so that a more informed decision could be made for project permitting and any future proposals for sediment and macrophyte removal.

## FISH RESOURCES

- Juvenile coho salmon (*Oncorhynchus kisutch*) were the most abundant species collected from Campbell Lake. Coho salmon were captured in all months except January and were most abundant from June through November.
- Two distinct cohorts of coho salmon were observed in Campbell Lake, with the larger-sized cohort present in winter and the smaller cohort entering the lake in June.
- Alaska blackfish (*Dallia pectoralis*), a nonnative species in Southcentral Alaska, were captured in Campbell Lake in all months except January.
- Chinook salmon (*O. tshawytscha*) were abundant in July, with few Chinook observed in August and September and no Chinook captured the remainder of the year.
- No Northern pike (*Esox lucius*) were observed.

## WATER QUALITY

- Campbell Lake exhibited a thermocline in summer, an inverse thermocline in winter, and complete mixing during the spring and fall months. At 1 m depth, water temperature increased rapidly between April 18 (2.4 $^{o}$C; full ice cover) and May 19 (11.7 $^{o}$C; no ice cover). At the surface, water temperature decreased rapidly between July 12 (18.3 $^{o}$C) and August 31 (10.3 $^{o}$C).
- Dissolved oxygen concentrations were uniform and favorable to fish from May to September. Decreasing dissolved oxygen concentration was observed in December, and conditions worsened through April. Campbell Lake was anaerobic at 4 m depth in February and 3 m depth in April. Dissolved oxygen concentration quickly rebounded after ice-out in May.

# INTRODUCTION

Campbell Lake is a manmade lake located in Anchorage, Alaska (Figure 1). The lake was formed in 1959 by the construction of an earthen dam across Campbell Creek. The dam is located just upstream of where the creek enters the intertidal zone of Turnagain Arm of upper Cook Inlet. The lake is primarily used as a private float plane base and for recreational watercraft. Public access to the lake is extremely limited, and the lake is closed to fishing. Campbell Lake is specified in the Anadromous Waters Catalog; it is known to support Dolly Varden (*Salvelinus malma*) and Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), coho (*O. kisutch*), and pink salmon (*O. gorbuscha*) (Johnson and Coleman 2014).

Campbell Creek flows into Campbell Lake at its northeastern end and flows out at the west end. The lake is about 2.1 km long and averages 0.25 km wide. Campbell Lake is shallow, with an average depth of 1.5 m and a maximum depth of 5.6 m. Total lake volume is 851,102 $m^3$ (MWH 2005). The upper one third of the lake and other shallow sections are inundated with thick macrophyte beds of pondweed (*Potomogeton* sp.) and Coontail (*Ceratophylum demersum*).

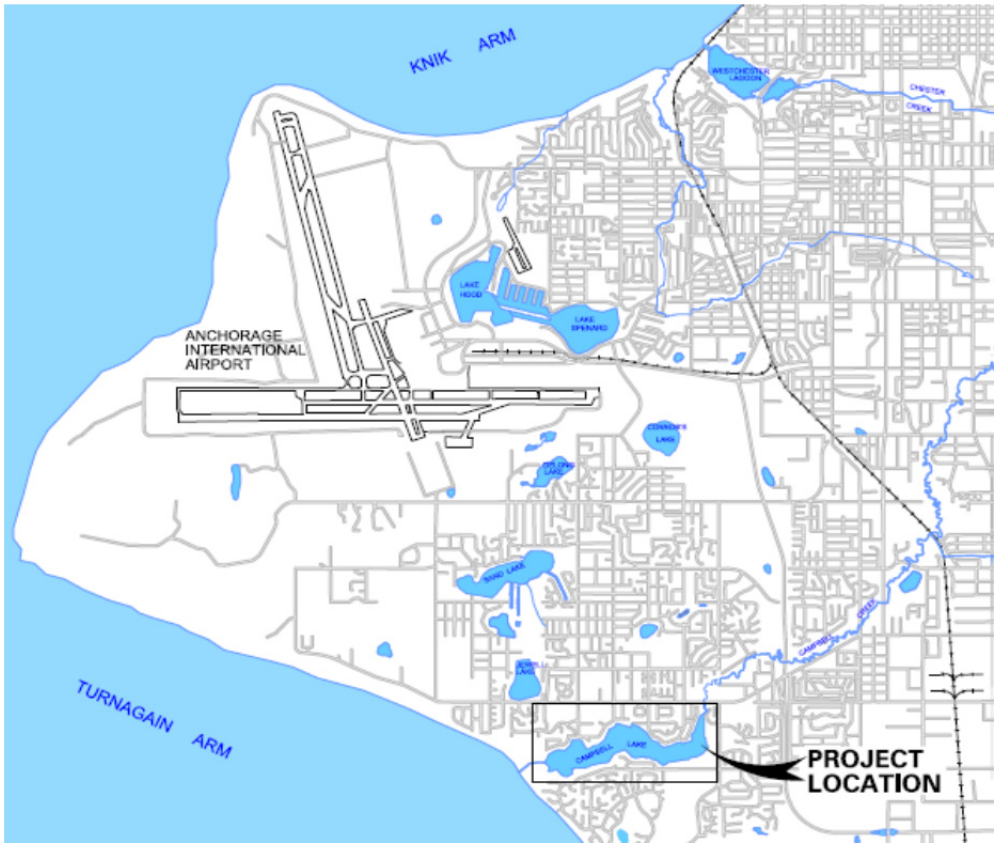



Figure 1.–Location of Campbell Lake, Anchorage.

The earthen dam that created Campbell Lake altered the sediment transport capability of Campbell Creek. Sediments normally transported to Turnagain Arm by Campbell Creek are gradually filling the lake. Campbell Lake has become shallower over time, and macrophyte growth appears to have accelerated over the past 3–5 years. Some areas of the lake have become

choked with natural or introduced macrophytes, which impede boat and float plane traffic on the lake.

In October, 2005, the Campbell Lake Homeowner's Association and the Municipality of Anchorage proposed a sediment and macrophyte reduction plan for Campbell Lake. The plan entailed dredging about 39,000 $m^3$ of sediment from the head of the lake. To accomplish this, they proposed to draw down the water level in Campbell Lake by about 2 m and expose 75% of the lake bottom. To diminish macrophyte biomass, the lake would remain drawn down from mid-October through mid-May, allowing the lake bed to freeze.

Campbell Lake provides migratory passage for Dolly Varden and coho, Chinook, sockeye, and pink salmon (Johnson and Coleman 2014). Juvenile coho salmon, Chinook salmon, sockeye salmon, Dolly Varden, and rainbow trout (*O. mykiss*) have been observed in Campbell Lake (Morsell 1988) and are presumed to rear there at various times of the year. Other fish reported in Campbell Lake include threespine stickleback (*Gasterosteus aculeatus*), ninespine stickleback (*Pungitius pungitius*), slimy sculpin (*Cottus cognatus*), Arctic lamprey (*Lampetra japonica*), and two introduced fishes: Alaska blackfish (*Dallia pectoralis*) and northern pike (*Esox lucius*) (Kron 2010, Morsell 1988).

Stocking of Campbell Creek with coho salmon smolt and catchable rainbow trout is conducted annually by ADF&G (ADF&G 2004). Campbell Creek has been historically stocked with 42,000–157,000 coho salmon as well as catchable rainbow trout (Miller and Bosch 2004). Campbell Creek currently supports a popular sport fishery for stocked and naturally-produced coho and Chinook salmon.

Our study was implemented to gather baseline data on fish use and water quality in Campbell Lake prior to the proposed drawdown, dredging, and macrophyte removal. Data were collected on fish abundance and water quality in Campbell Lake so that a more informed decision could be made during review and permitting for the proposed dredging project and any future proposals for sediment and macrophyte removal in the lake. The state and federal authorizations for the drawdown and dredging project included a requirement for water quality monitoring and fish surveys during the project (November 2006–April 2007) and for a period of 3 years following completion of the drawdown and dredging (June 2007–March 2010). The monitoring and survey work was completed by fisheries biologist Tom Kron with the assistance of Campbell Lake homeowners. Results were compiled and provided to ADF&G in 2010 (Kron 2010).

# METHODS

## FISH SAMPLING

Up to 27 steel mesh minnow traps were set along 11 transects established across Campbell Lake (Figure 2). Traps were fished for 24 hours each sampling period. Sampling occurred once each month from October 2005 through September 2006 (Appendix A). Most traps were set on the bottom of the lake. At 3 locations where the depth exceeded 3.1 m, a second trap was set to fish mid-water.

During the ice free sample periods in October and May–September, traps were set from a boat. During November through April, traps were set below the ice. Traps were set through 10-inch augured holes. The holes were covered with plywood and snow, if available, and marked with red cones. Trap pull lines were threaded through a ring attached to one end of the trap. This

allowed traps to be pulled back out of the holes without the use of hooks or reaching into the hole by hand. Mid-water traps were not strung through the attached ring so they would fish horizontally as designed.

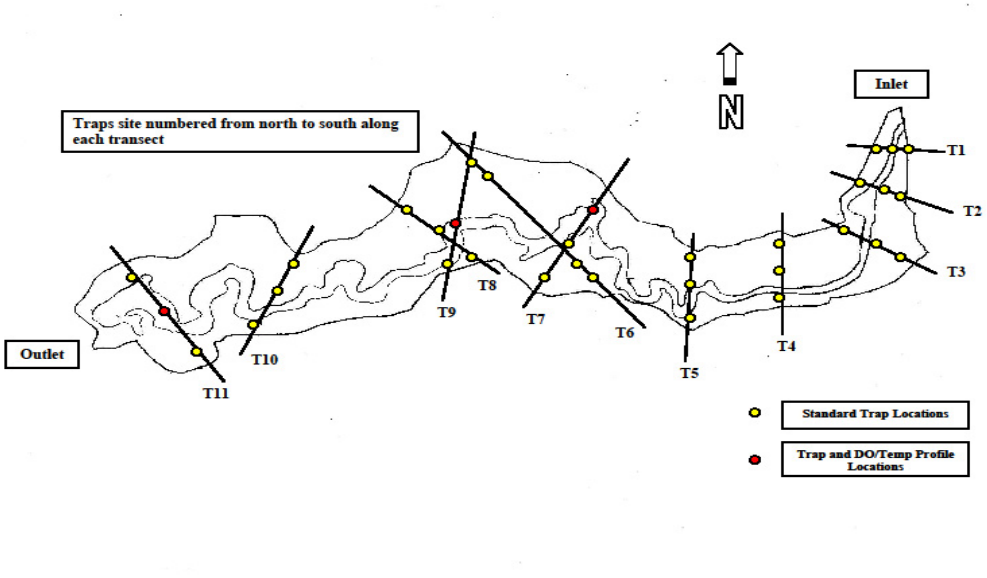



Figure 2.–Minnow trapping sites used on Campbell Lake from October 2005 through September 2006.

The number of traps set each sample period during winter was determined by the reliability of our mechanical ice auger, ice depth, and dissolved oxygen (DO) levels. In all sampling periods, we attempted to set traps to fish the length of the lake. Many of the shallow trap locations did not have sufficient water depth below the ice cover to deploy a trap. In February through April, traps were concentrated in the eastern third of the lake as DO concentrations were too low at many of the deeper trap sites toward the west end of the lake and we were concerned about fish mortality at these sites. Periodic tests of DO at trap locations were performed to assure the spot was suitable for trapping.

All captured fish were identified to species. Salmonids were measured to fork length. All other fish were measured to total length. All fish were released back into the lake at their point of capture.

## WATER QUALITY MONITORING

A Hydrolab[1] MS5 Minisonde® was deployed at site 112 near the mouth of Campbell Lake to collect water quality data during the trapping periods in November and December (Appendix A). The data logger monitored water temperature (°C), conductivity (S/cm), total dissolved solids (g/L), turbidity (NTU), pH, DO concentration (ppm), and percent saturated DO. Data were logged every 30 minutes during the sample period. The data logger was set 2 m below the ice surface in November and 4 m below the ice surface in December because of the differential ice thickness each month.

[1] Product names used in this publication are included for completeness but do not constitute product endorsement.

Beginning in December, 2005, water quality data were limited to DO concentration (mg/L) and water temperature (°C) (Appendix A). A Hach HQ20 LDO meter was used to perform DO and temperature profiles at the 3 sample sites that exceeded 3.1 m in depth (Figure 2). Data were collected at 0.31 m intervals from the water surface or the bottom of the ice to the lake bottom.

# RESULTS

## FISH RESOURCES

The 3 most abundant fish captured in minnow traps in Campbell Lake were coho salmon, Chinook salmon, and Alaska blackfish (Table 1). Other species collected in small numbers from Campbell Lake were Dolly Varden, ninespine stickleback, and slimy sculpin.

Table 1.–Number of fish captured, by date and species.

| Sample Date | # of traps set | Coho salmon | Blackfish | Chinook salmon | Dolly Varden | Stickleback | Sculpin |
|---|---|---|---|---|---|---|---|
| 5-Oct-05 | 27 | 83 | 38 | 0 | 0 | 1 | 0 |
| 16-Nov-05 | 10 | 66 | 7 | 0 | 1 | 0 | 0 |
| 20-Dec-06 | 16 | 16 | 4 | 0 | 0 | 0 | 0 |
| 15-Jan-06 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-Feb-06 | 8 | 1 | 1 | 0 | 0 | 0 | 0 |
| 16-Mar-06 | 10 | 6 | 3 | 0 | 0 | 0 | 0 |
| 18-Apr-06 | 11 | 1 | 7 | 0 | 0 | 0 | 0 |
| 18-May-06 | 27 | 11 | 30 | 0 | 0 | 0 | 0 |
| 14-Jun-06 | 25 | 78 | 10 | 0 | 0 | 0 | 0 |
| 12-Jul-06 | 27 | 64 | 15 | 221 | 0 | 0 | 0 |
| 31-Aug-06 | 27 | 100 | 18 | 16 | 0 | 0 | 1 |
| 26-Sep-06 | 27 | 91 | 41 | 3 | 0 | 0 | 1 |
| Total | 217 | 517 | 174 | 240 | 1 | 1 | 2 |

The catch-per-unit-effort (CPUE; number of fish caught per trap, per day) was calculated for coho salmon, Chinook salmon, and Alaska blackfish in Campbell Lake (Figure 3). CPUE was highest in September and October for Alaska blackfish, in November for coho salmon, and in July for Chinook. The CPUE for Chinook salmon in July was the highest observed for any species during the study period. CPUE for coho and blackfish declined in December and, for coho salmon, remained low until June. Coho salmon and Alaska blackfish CPUE were fairly steady through the summer months. In contrast, Chinook salmon CPUE was high in July, but low the remainder of the sampling period.

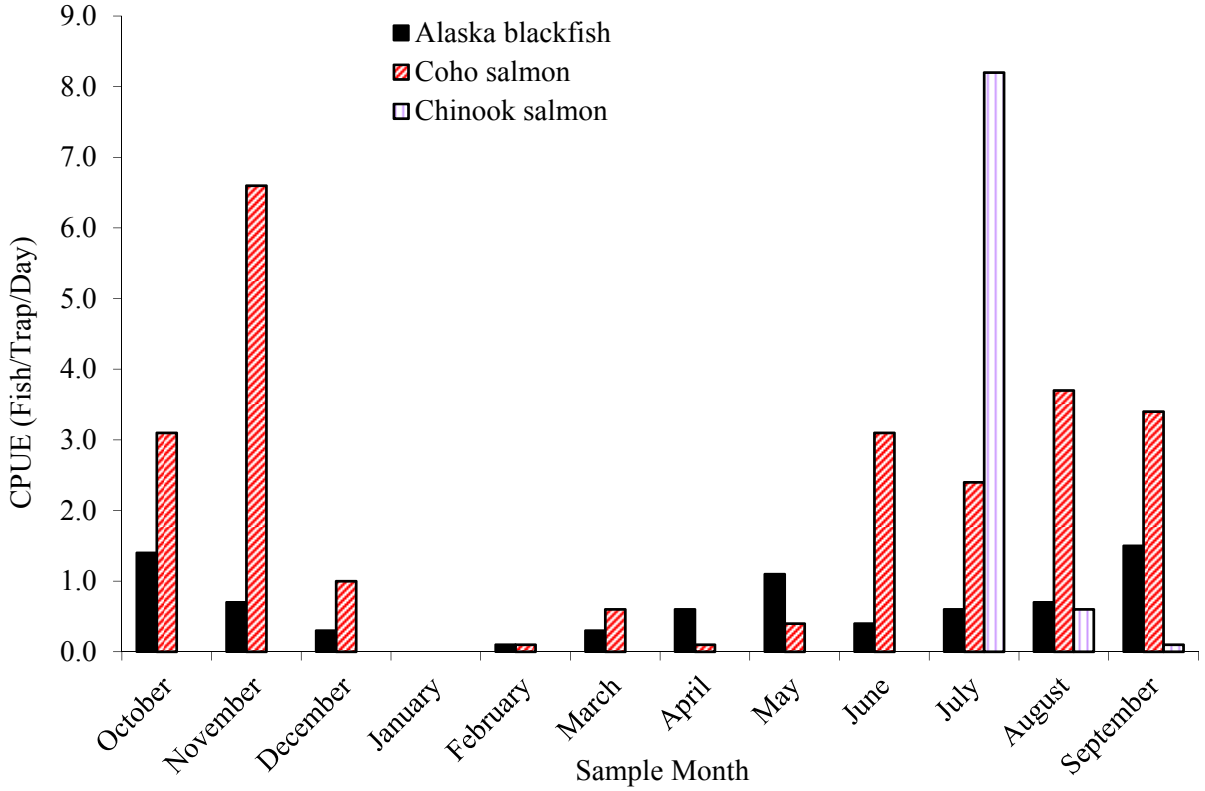



Figure 3.–CPUE for coho salmon, Chinook salmon, and Alaska blackfish in Campbell Lake.

Coho salmon fork length ranged from 38 to 178 mm and averaged 100 mm for the study period (Table 2). Campbell Lake coho salmon were smaller in the summer months compared to the fall and winter (Figure 4). Chinook salmon fork length ranged from 39 to 95 mm and averaged 58 mm for the study period (Table 2). Chinook salmon monthly length frequencies did not exhibit any specific pattern across months (Figure 5). Alaska blackfish total length range from 50 to 175 mm; average length was 117 mm (Table 2). There was no discernable pattern in lengths from month to month; pooled length frequency exhibited a standard bell-shaped curve with a tail toward the shorter lengths (Figure 6).

Table 2.–Length statistics for fish captured in Campbell Lake.

| | Length* (mm) | | |
|---|---|---|---|
| Species | Average | Minimum | Maximum |
| Coho Salmon | 100 | 38 | 178 |
| Chinook Salmon | 58 | 39 | 95 |
| Alaska Blackfish | 117 | 50 | 175 |

*Fork length for salmon, total length for blackfish.

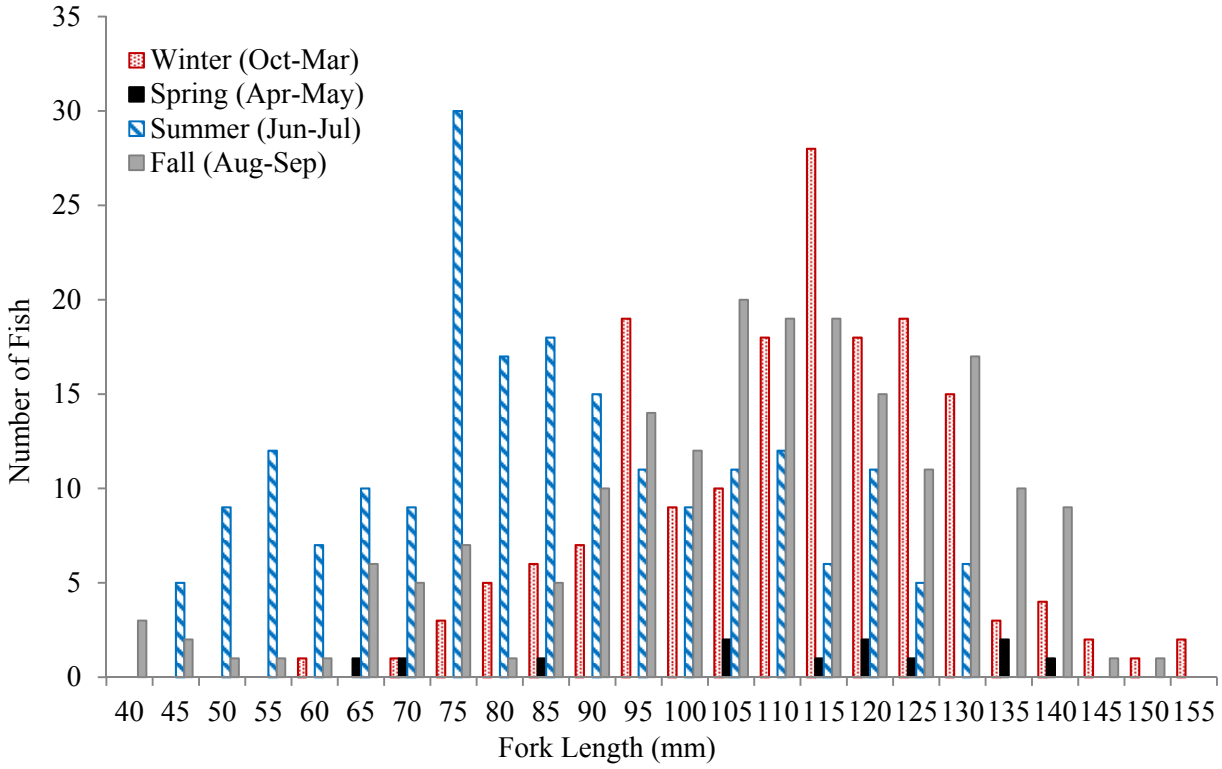



Figure 4.–Length frequency of coho salmon.

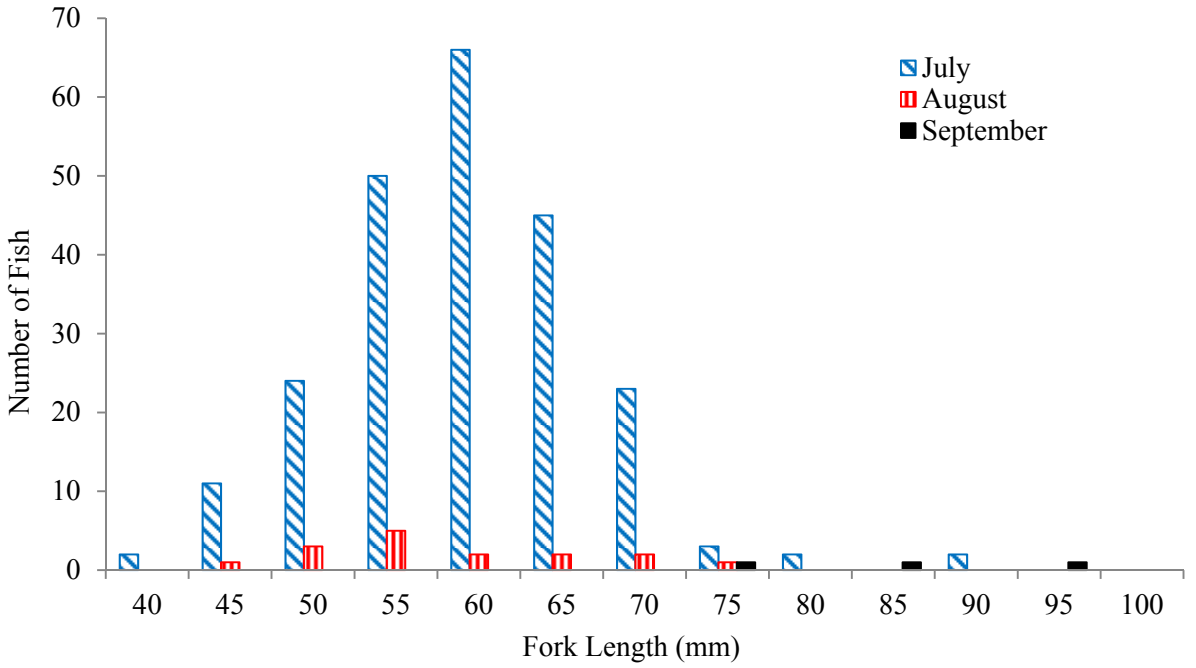



Figure 5.–Length frequency of Chinook salmon.

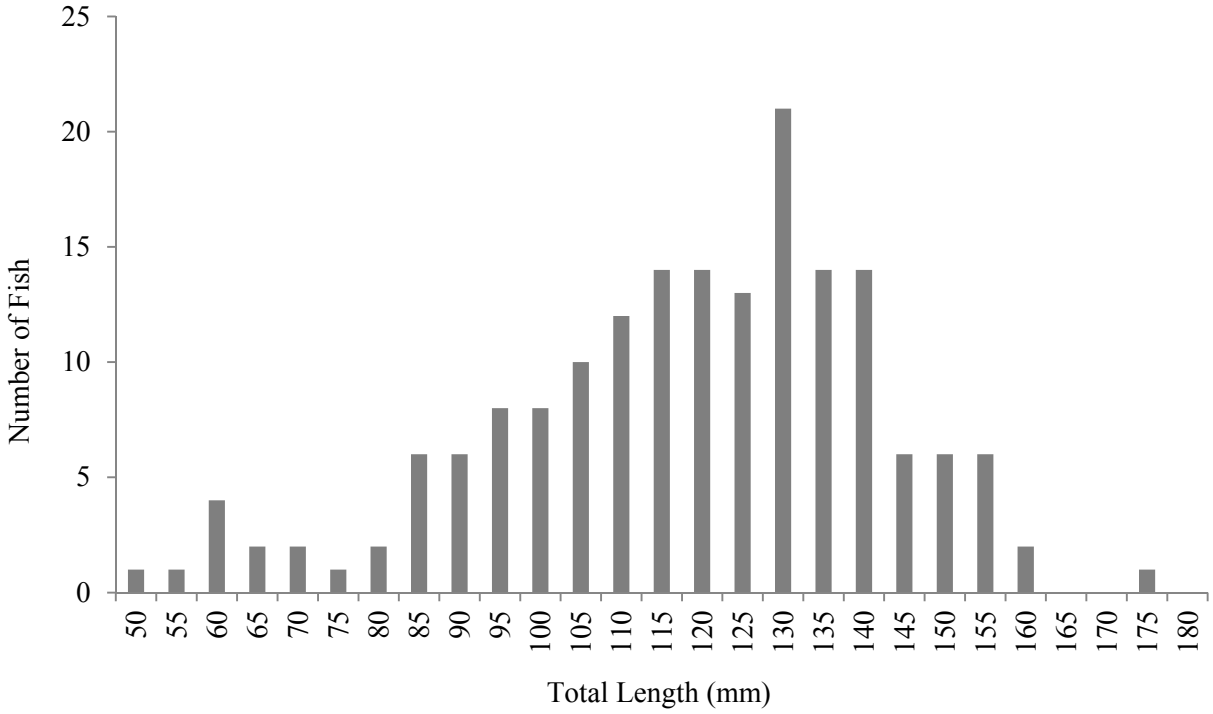



Figure 6.–Length frequency of Alaska blackfish.

There was no discernible pattern in catch at depth for either coho salmon or blackfish (Figure 7 and Figure 8). While most fish were captured in the upper 2 m of the lake, the majority of traps were also set within this depth range.

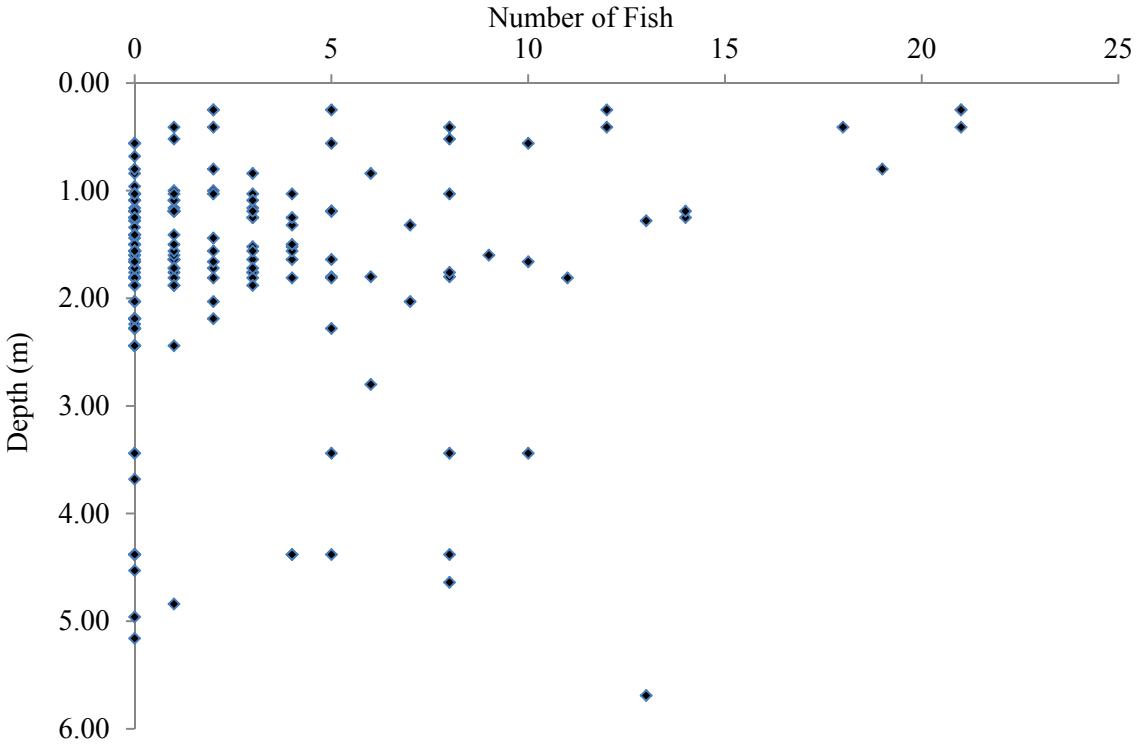



Figure 7.–Coho salmon catch at depth data.

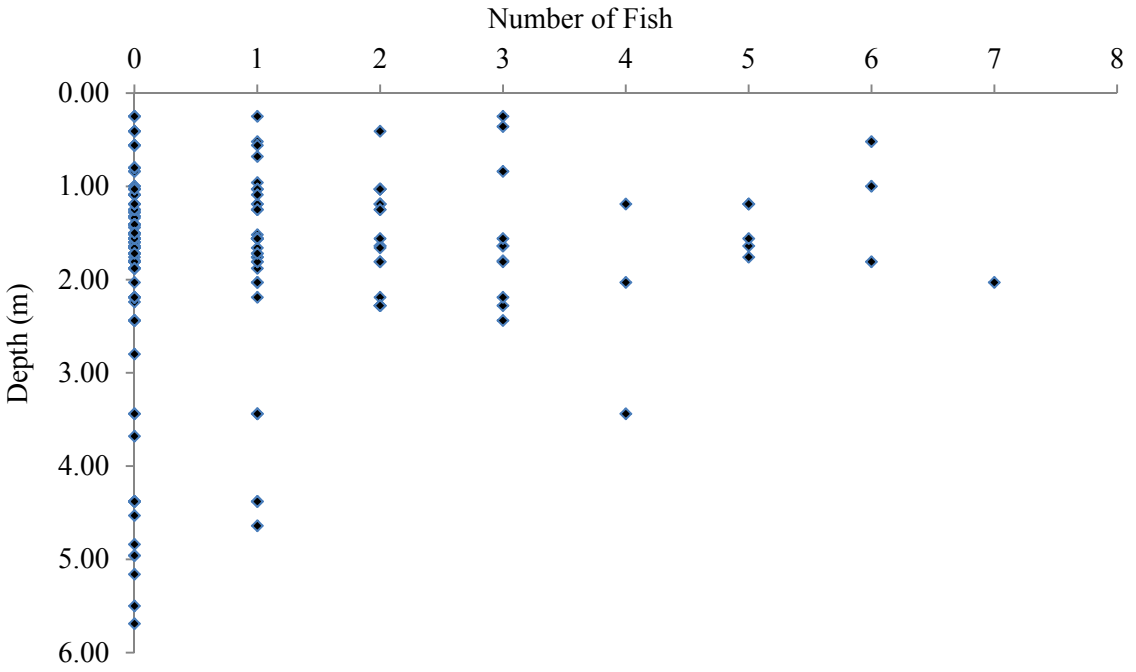



Figure 8.–Blackfish catch at depth data.

## WATER QUALITY

A suite of water quality data for Campbell Lake was collected in early winter, 2005 (Table 3). Campbell Lake is cold, with relatively low pH. Between November and December, temperature and conductivity increased and DO decreased, although the readings were obtained from different depths. Total dissolved solids and pH remained constant.

Table 3.–Campbell Creek water quality data for November and December.

| | Average Readings for Deployment Period | |
|---|---|---|
| Parameter | November 18, 2005 | December 21, 2005 |
| Deployment Duration (hrs) | 21 | 42 |
| Depth (m) [from ice surface] | 2.0 | 4.0 |
| Water Temp ($C^o$) | 1.94 | 3.87 |
| Conductivity (S/cm) | 176.0 | 390.0 |
| Total Dissolved Solids (g/L) | 0.1 | 0.25 |
| pH | 5.48 | 5.12 |
| Dissolved Oxygen (ppm) | 10.66 | 1.10 |
| Dissolved Oxygen % Saturation | 76.7 | 8.3 |

DO levels at depth were relatively constant from May to September (Figure 9). At some time prior to December, the lake probably stratified, contributing to anoxic conditions beginning at 2 m deep. At a depth of 2 m, DO concentration dropped from 10.20 ppm in December to 4.80 ppm in April. Anaerobic conditions were documented at 4 meters depth in February and 3 meters depth in April.

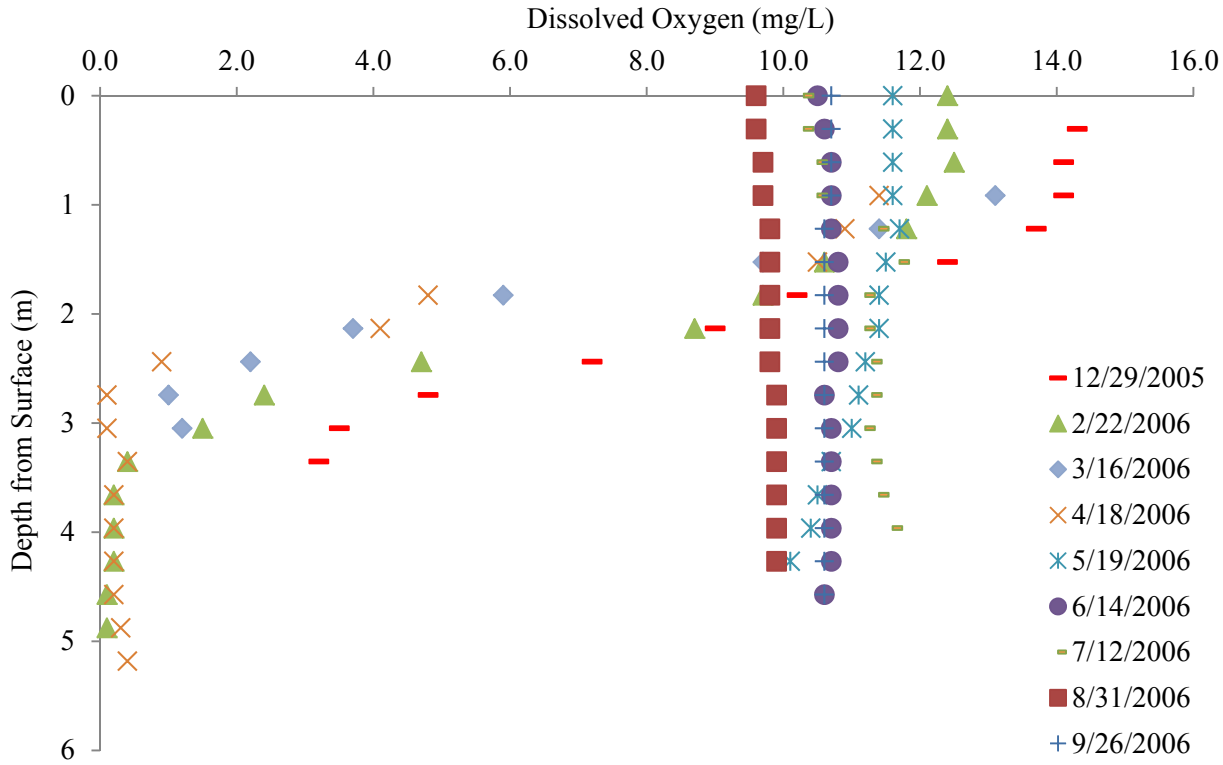



Figure 9.–Dissolved oxygen profile near Campbell Lake outlet (Site 112) for December 2005 through September 2006.

Temperature at depth was relatively constant in the spring and fall (May, June, August, and September; Figure 10). In mid-summer (July), a thermocline existed between 1 and 2 m depth. In the winter (December–April) under the ice, water temperature was cooler near the surface and warmer at depth.

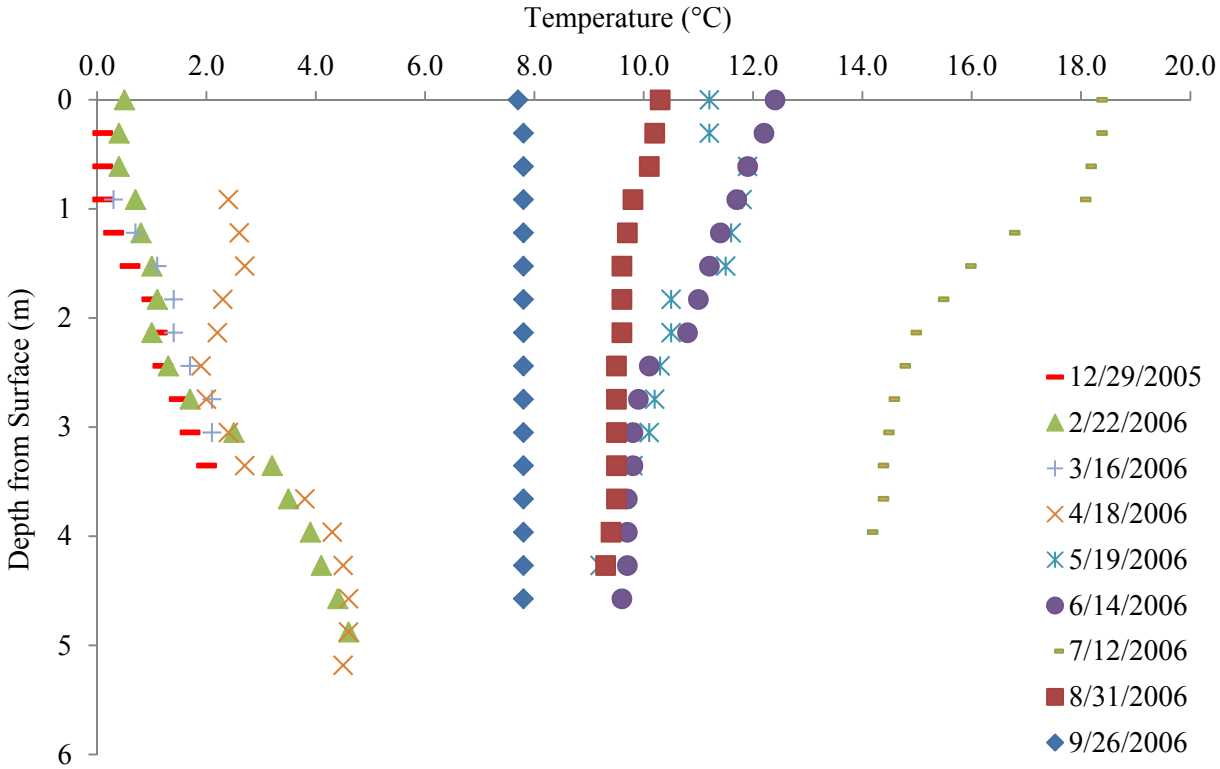



Figure 10.–Temperature profile near Campbell Lake outlet (Site 112) for December 2005 through September 2006.

# DISCUSSION

The 3 most abundant fish species were coho salmon, Alaska blackfish, and Chinook salmon. A few Dolly Varden, stickleback, and sculpin were captured. Our catch data are similar to those reported by Morsell (1988), who sampled Campbell Lake in November and December, 1988. Morsell captured primarily coho salmon but also captured small numbers of Chinook salmon, sockeye salmon, rainbow trout, Dolly Varden, ninespine stickleback, and Arctic lamprey. Morsell (1988) did not report catching Alaska blackfish. Alaska blackfish are native to Alaska, but they are an introduced species in the Anchorage area (Morrow 1980). Alaska blackfish were likely introduced to the Campbell Creek/Campbell Lake watershed sometime after the work of Morsell (1988).

Coho salmon were present in Campbell Lake in all months except January, although the lack of documented presence in January could be a function of limited sampling effort (i.e., 2 traps)

(Table 1). Coho salmon abundance and CPUE was high from June through November. Coho salmon length frequency distribution in the summer appeared different than the fall and winter period (Figure 4). In the summer, there were smaller fish that were mostly absent during other times of the year. Smaller coho salmon in June and July suggests the arrival of young-of-year salmon that emerged from spawning areas throughout Campbell Creek and likely use Campbell Lake for summer rearing. Whether these June and July arrivals stay in the lake to rear and overwinter or return to Campbell Creek to rear or overwinter remains unclear. Larger coho salmon dominate the fall and winter catch, suggesting that Campbell Lake may play an important role in rearing and overwintering for coho salmon preparing to emigrate. Sandercock (1991) noted that coho salmon smolt size varies by location, with an observed length range over the species geographic distribution of 74–165 mm. Thus, many of the coho salmon captured in the fall and winter were of adequate size to smolt.

Chinook salmon presence and length distribution in Campbell Lake differed from coho salmon. Chinook salmon were first documented in July in high abundance, and CPUE and abundance dropped sharply after July (Table 1 and Figure 3). Chinook salmon remained present in Campbell Lake into September. The July length frequency distribution suggests these Chinook salmon were young-of-year that emerged elsewhere in the Campbell Creek watershed. Healy (1991) indicated that Chinook fry often drift downstream for considerable distance prior to taking up stream residence. Murphy et al. (1989) (as cited in Healy 1991) observed habitat segregation between cohabiting Chinook and other salmonids; Chinook fry were mainly in riverine habitat and seldom found in still water, such as beaver ponds or off-channel sloughs. The high abundance of fry-length Chinook salmon in July and very few captured any other time of year may be a function of Chinook fry drifting downstream after emergence, then migrating back upstream to take up stream residence.

Adult sockeye salmon are present in Campbell Creek in low numbers. Lake rearing by juvenile sockeye salmon is well documented. We did not catch juvenile sockeye salmon during this study. Kron (2010) reported catching 324 sockeye salmon using a small mesh beach seine, although the time of year these fish were captured was not noted. Beach seines are the preferred gear type for capturing sockeye salmon juveniles as sockeye are known to exhibit minnow trap avoidance.

Campbell Lake exhibits characteristics of a dimictic lake in a sub-arctic environment (Horne and Goldman 1994). In the winter under ice cover, Campbell Lake exhibits inverse thermal stratification, where water at about 4 °C (i.e., maximum density) is found near the lake bottom and cooler, lighter water floats near the top. Between April 18 (full ice cover) and May 19 (no ice cover), water temperature at 1 m increased rapidly from 2.4 $^{o}$C to 11.7 $^{o}$C. A thermocline begins to develop in June and is evident in July (Figure 10). Between July 12 and August 31, water temperature at the surface decreased rapidly from 18.3 °C to 10.3 °C. Complete lake mixing appears to occur in the spring and fall (Figure 10). In addition to the influence of wind, increased Campbell Creek flow from spring snowmelt and fall rain likely contribute to the mixing of Campbell Lake. Rainfall in the month of August was 7.36 inches, which was 4.11 inches higher than the historical August average (http://www.ncdc.noaa.gov/cdo-web/).

From May to September, DO concentrations were uniform across all depths and were near saturation (i.e., levels optimal for fish). In the winter months (December to April), DO remained near saturation in the first 2 m of water and conditions become more anoxic with depth. Campbell Lake water was anaerobic at 4 m depth in February and 3 m depth in April, suggesting increasingly worse DO conditions for fish as the winter progressed. Other factors likely

contribute to the low winter DO concentrations, such as lower flow from Campbell Creek and biological oxygen demand from Campbell Lake.

Based on data collected during this study, observations made during drawdown, and additional construction and post-project monitoring, lowering the lake level in winter to freeze macrophytes and dredge shallow lake areas did not negatively impact salmonids using Campbell Lake. If a similar project is proposed in the future, a number of things should be considered during the planning, design, and permit review. First, the timing and rate of lake drawdown is key to minimizing potential effects to fish. Determining the ideal drawdown time and rate in any given year is a function of fall water conditions. The short window to target is after most of the adult coho salmon have passed through the lake into the creek but before the lake begins to freeze. Because juvenile fish get isolated in deep water pockets in the lake, open water access to these areas makes fish removal and transfer to open water more efficient and effective. The rate of drawdown likely influences the number of fish that get trapped; a slower drawdown may provide fish more opportunity to move into the active channel. Second, mitigation for macrophyte removal is not necessary. We expected juvenile salmonids to use macrophytes for cover habitat but found no evidence of fish preferentially using these vegetated areas of the lake. Also, post-project monitoring (Kron 2010) did not document fish preferentially using brush bundles that were placed in the lake to mitigate the loss of macrophytes. Third, the active stream channel that established in the lakebed after drawdown may have a net benefit for juvenile salmonids. After drawdown, the total available habitat area is reduced, but DO concentrations in the active channel throughout the winter are more favorable than the lake. The lake becomes more anoxic as the winter progresses and some areas become anaerobic in late winter (Figure 9). While we did not conduct rigorous comparisons of winter habitat use, we observed more fish in the active stream channel than throughout the lake. This is an anecdotal observation that could be a function of fish being concentrated into a smaller area, differences in fish abundance between years, or a true preference for habitat with better DO concentrations. Finally, drawing down the lake does not appear to be an effective means to remove macrophytes. Various environmental factors influence the effectiveness of this method, such as mild winter temperatures or snow and ice cover that insulates the vegetation. If future macrophyte removal in Campbell Lake is desired, we suggest that mechanical removal methods be investigated.

# REFERENCES CITED


Alaska Department of Fish and Game (ADF&G). 2004. Statewide stocking plan for recreational fisheries, 2004-2008. Alaska Department of Fish and Game, Juneau.

Healy, M. C. 1991. Life history of Chinook salmon. Pages 311–393 [*In*] C. Groot, and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver.

Horne, A. J. and C. R. Goldman. 1994. Chapter 4, Heat. [*In*] Limnology, 2nd Edition. McGraw-Hill, Inc., New York.

Johnson, J., and J. Coleman. 2014. Catalog of waters important for the spawning, rearing, or migration of anadromous fishes – Southcentral Region, Effective June 1, 2014. Alaska Department of Fish and Game, Special Publication No. 14-03, Anchorage.

Kron, T. 2010. Campbell Lake biological studies 2006–2010. Summary report of citizen science efforts related to Campbell Lake drawdown, fish recovery, habitat structures, macrophytes, water quality, and fish presence.

Miller, M. G., and D. Bosch. 2004. Area management report for the recreational fisheries of Anchorage, 2003. Alaska Department of Fish and Game, Fishery Management Report No. 04-07, Anchorage.

Morrow, J. E. 1980. Freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage.

Morsell, J. W. 1988. Campbell Lake minnow trap study. Draft report prepared by Northern Ecological Services for Ott Engineers, Inc., Anchorage.

Murphy, M. L., J. Heifetz, J. F. Thedinga, S. W. Johnson, and K. V. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Oncorhynchus*) in the glacial Taku River, Southeast Alaska. Canadian Journal of FishEries and Aquatic Sciences. 46: 1677–1685.

MWH. 2005. Campbell Lake sediment reduction project. Permit Application Report prepared by MWH for Municipality of Anchorage, Project Management and Engineering.

Sandercock, F. K. 1991. Life history of coho salmon. Pages 395–445 [*In*] C. Groot, and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver.

# APPENDIX A: MONTHLY SAMPLING REPORTS, OCTOBER 2005 THROUGH SEPTEMBER 2006

**Project Update: Campbell Lake Fish Assessment**

**Sample Results from 10-06-05**

The first trapping session on Campbell Lake went very well. Twenty-six traps were set along 8 transects in the lake. A total of 83 coho (60mm - 152mm), 38 blackfish (60mm - 147mm) and 1 sculpin (51mm) were captured over a 24 hour period.

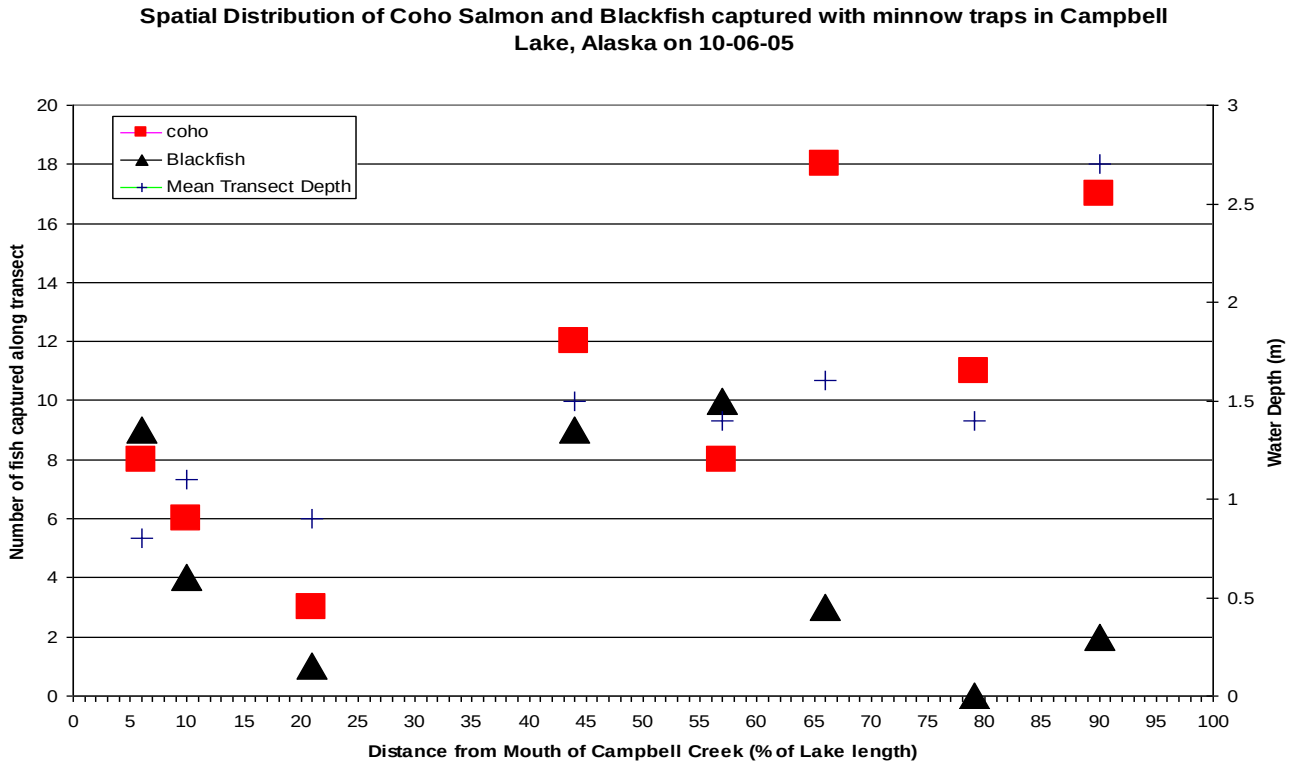
For this trapping session coho appeared to prefer deeper water (as deep as 6 meters) and were more prevalent in the lower half of the lake than the upper half. They did not demonstrate a preference for areas with higher macrophyte density. Blackfish were distributed more evenly along the lake, but appeared most prevalent in areas with denser macrophyte growth and shallower water with macrophyte density appearing to be the more dominant factor in site selection.

Macrophyte beds were mostly pondweed (*Potamogeton s.*) and were concentrated in the upper ¼ of the lake. Most of the lake's macrophytes have died off already. The remaining beds were senescing.

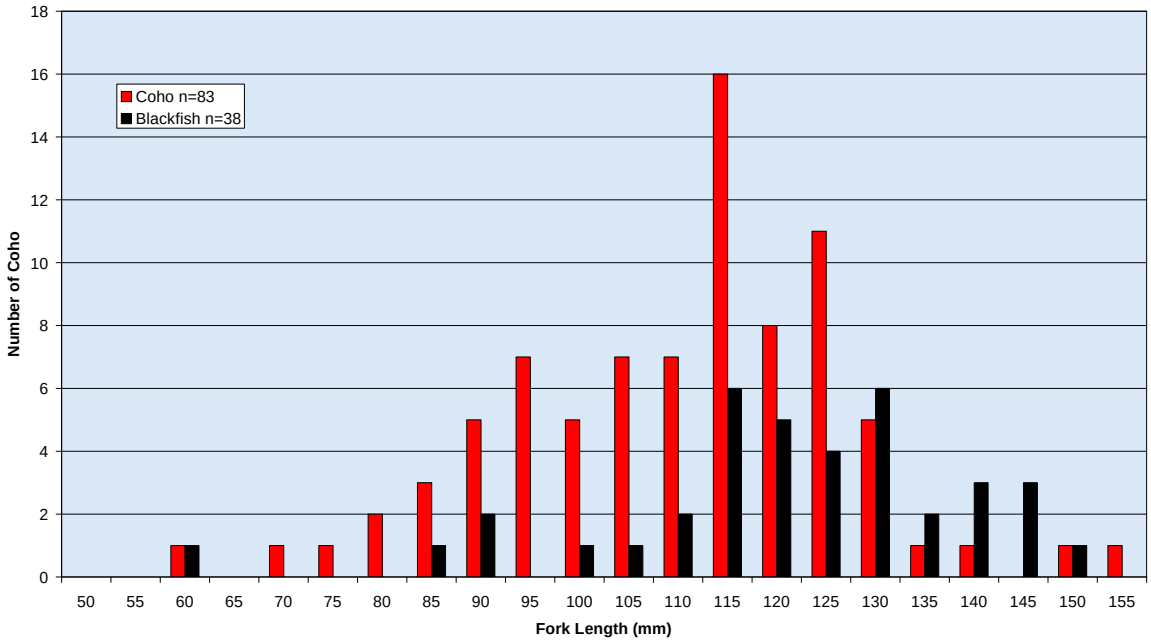
The lake was turbid during this sampling period. Visibility was about 1 meter. We did not do a sechi reading.

On the next trapping session (tentatively scheduled for 10-19 through 10-20) we will take extra time to assure that at least one trap along each transect is within the old stream thalweg. On this first foray we appeared to have missed it on most transects.

The following graphs summarize this trapping session.



**Length Frequency of Coho Salmon (*Oncorhynchus kisutch*) and Blackfish (*Dallia pectoralis*) in Campbell Lake on 10-06-05 Captured with Minnow Traps**



**Project Update: Campbell Lake Fish Assessment**

**Sample Results from 11-18-05**

The second trapping session on Campbell Lake was conducted on November 17 and 18. Ten traps were set under the ice along the 8 transects established during the first trapping session. Ten holes were drilled through the average 18 inches of lake ice. All traps were set along or within the old stream thalweg.

A total of 66 coho (75mm - 151mm), 38 blackfish (118mm - 153mm) and 1 Dolly Varden (125mm) were captured over a 24 hour period. Length frequency was similar between the first and second trapping sessions (Figures 1 and 2)

Catch-per-unit-effort was higher for coho during this session than the October trapping session (Figure 3), but this may reflect the concentration of traps in deeper water rather than an increase or concentration within the population. There was no discernable depth or spatial preference by coho or blackfish.

Macrophytes were observed only at the transect 3 site. Water clarity was excellent. Traps could be seen on the bottom in at least 1.6 meters of water. I would estimate a secchi disk to be visible at 2 or more meters.

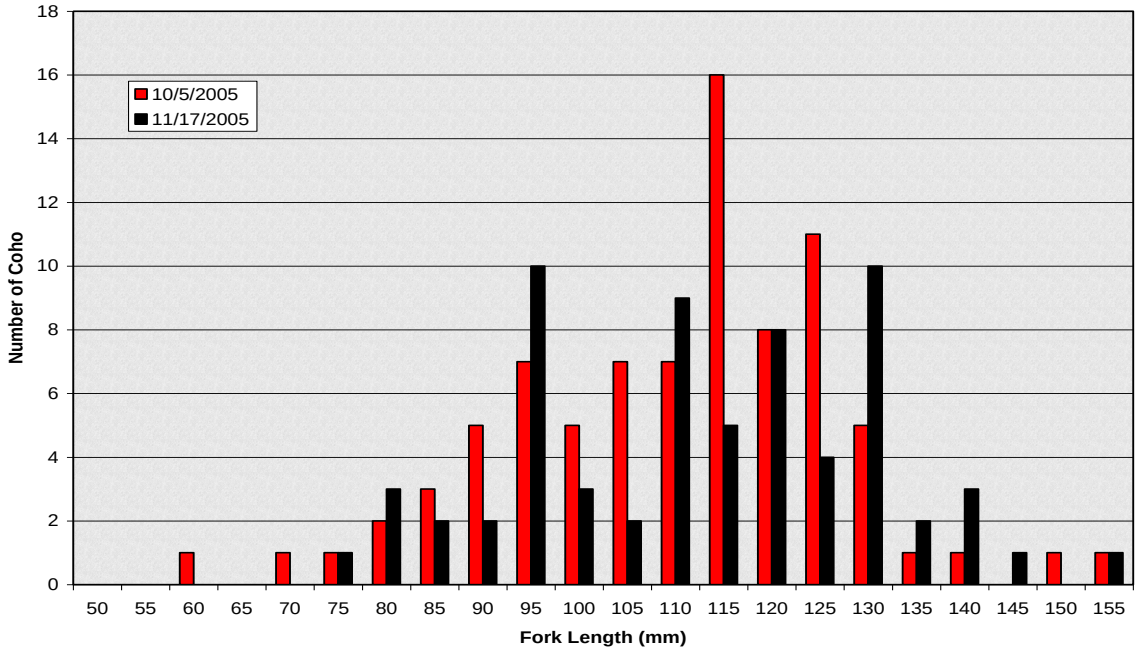
A water quality logger was deployed from 3:00 pm on 11-17 through noon the following day. The logger probe was suspended at a depth of 2 meters from the surface and about 1 meter above the bottom. Readings were taken every hour during the deployment period and were very consistent. The following are the average readings for each parameter:

| | |
|---|---|
| Water Temperature | 1.94$^{o}$ C |
| Conductivity | 176.0 S/cm |
| Total Dissolved Solids (TDS) | 0.1 g/L (grams/Liter) |
| Turbidity | 0.0 NTU |
| pH | 5.48 |
| Dissolved Oxygen (DO) | 10.66 |
| Percent Saturation of DO | 76.7% |

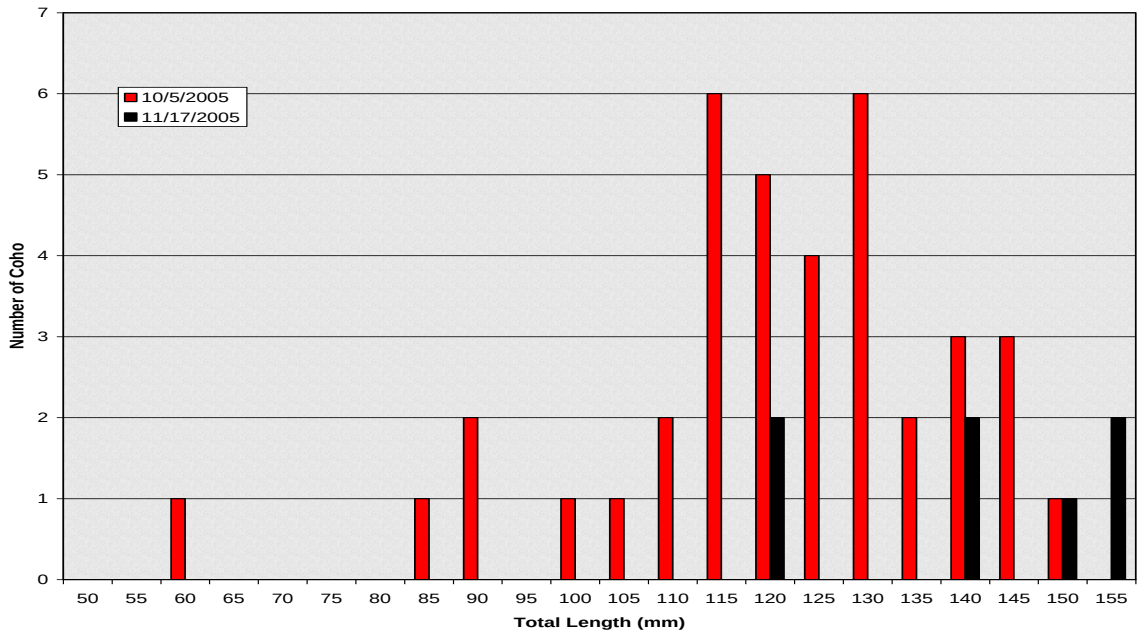
The above data are generally within expected ranges for the lake at this time. The pH appears low to me for a shallow lake that receives so much organic material. However, the conductivity level implies a low mineral content or a hardness of less than 15 mg/L as $CaCO_3$ (soft water). The dissolved oxygen level indicates that macrophyte decay is not affecting oxygen content, at this time, in any significant way.

On the next trapping session (tentatively scheduled for 12/19 through 12/23) we will set at least 2 traps per transect in the lake. A sharper auger will be employed to ensure this. We will also deploy the logger for a longer time period to collect data before and after the trapping session.

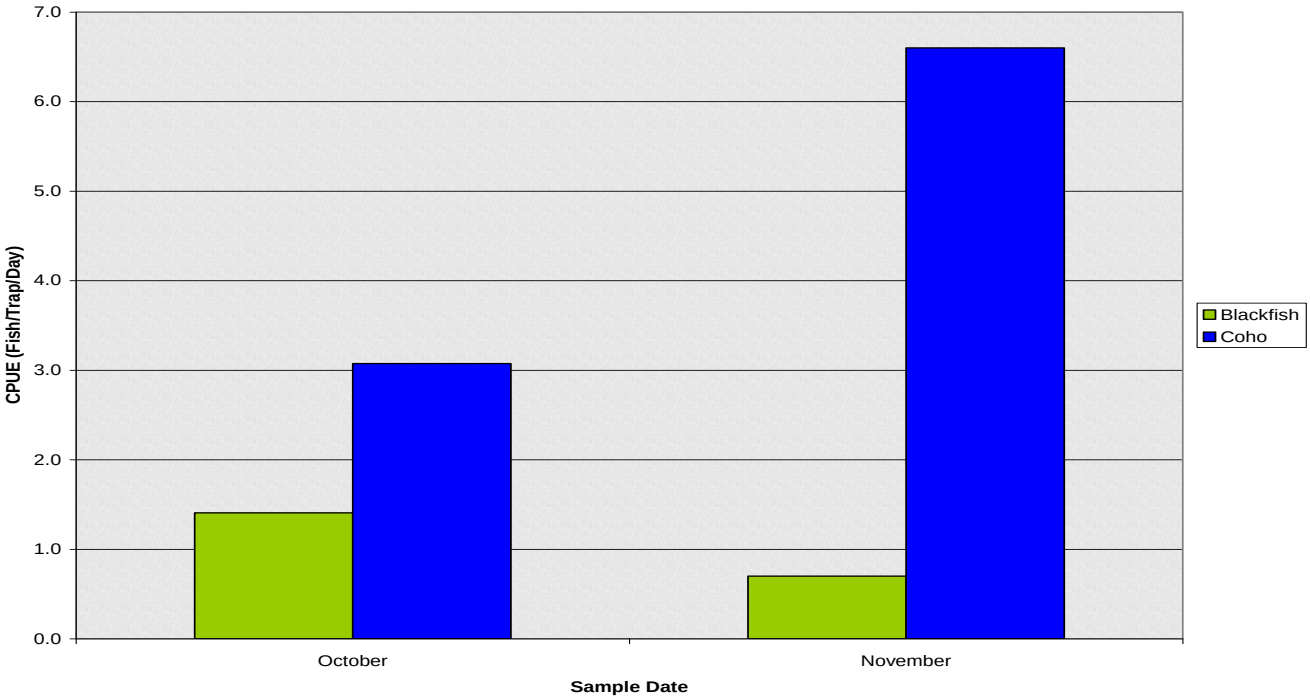
**Length Frequency of Coho Salmon (*Oncorhynchus kisutch*) Captured with Minnow Traps in Campbell Lake**




**Length Frequency of Blackfish (*Dallia pectoralis*) Captured with Minnow Traps in Campbell Lake**



**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005.**



**Project Update: Campbell Lake Fish Assessment**

**Sample Results from 12-21-05**

The third trapping session on Campbell Lake was conducted on December 20 and 21. Sixteen traps were set under the ice along 7 of the 8 transects established during the first trapping session. Depth along transect #1 was too shallow for setting a trap. Fifteen holes were drilled through the average 22 inches of lake ice. Traps were set approximately in the same locations as during the second trapping session along with locations in shallower stations.

A total of 16 coho (73mm - 123mm) and 4 blackfish (65mm - 138mm) were captured over a 24 hour period. Length frequency remained consistent with previous trapping sessions (Figures 1 and 2)

Catch-per-unit-effort was the lowest thus far (Figure 3), which may be expected as winter progresses and fish reduce their metabolism. All fish were captured in less than 2m of water which deviates from earlier trapping sessions where the highest catches per trap were from deeper sets.

Macrophytes were again observed only along transect 3. Water clarity was less than that observed in November. Traps could be seen on the bottom only at sites with 1 meter of water or less.

A water quality logger was deployed for 42.5 hrs from 3:00 pm on 12-20 through 09:30 am on 12-22. The logger probe was suspended at a depth of 4 meters from the surface and about 0.5 meter above the bottom. Readings were taken every 30 minutes and were very consistent during the deployment period. The following are the average readings for each parameter:

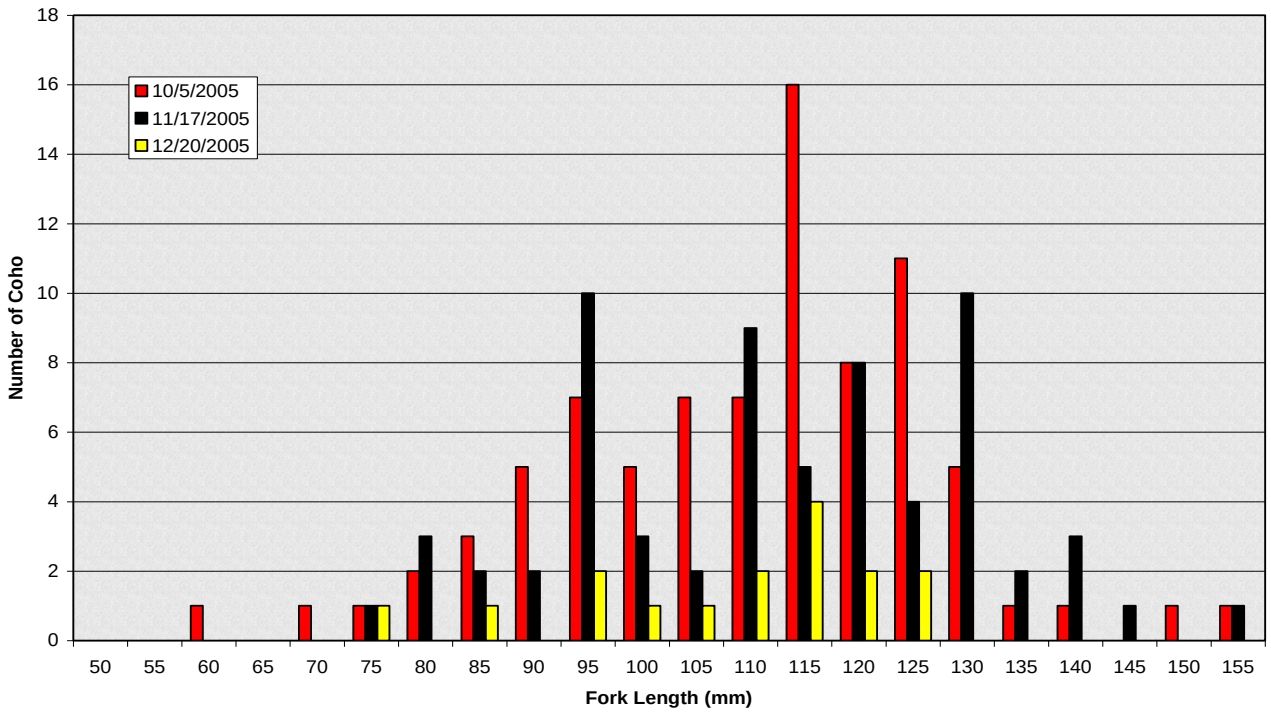
| | |
|---|---|
| Water Temperature | 3.87 C $^{o}$ |
| Conductivity | 390.0 S/cm |
| Total Dissolved Solids (TDS) | 0.25 g/L |
| pH | 5.12 |
| Dissolved Oxygen (DO) | 1.10 mg/L |
| Percent Saturation of DO | 8.3% |

The water quality probe was suspended along transect #8 in the portion of thalweg approximately 75m from the outfall. The low oxygen levels probably explain why no fish were collected in the deeper sets.

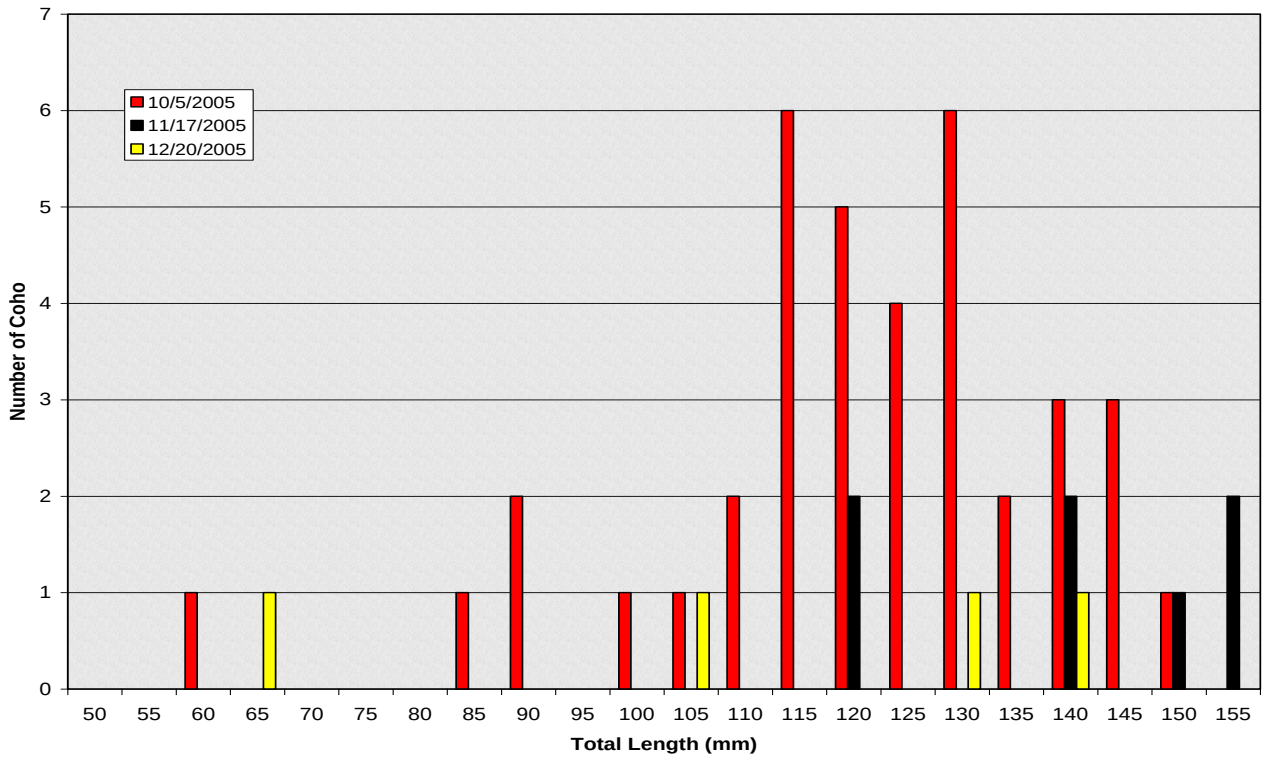
On 12-29 we went back to the lake and collected a DO and temperature profile at the deep site along transect #8 and at an averaged depth site along transect #5. Campbell Lake appears to have stratified with a weak thermocline between the 6 and 8 foot depth levels (Figure 4), which indicates flow through the lake may be insufficient for mixing to occur below that depth.

On the next trapping session (tentatively scheduled for 01/19 through 12/20) we will again try to set at least 2 traps per transect if depth allows. We will also perform DO and temperature profiles along the lake while setting the traps.

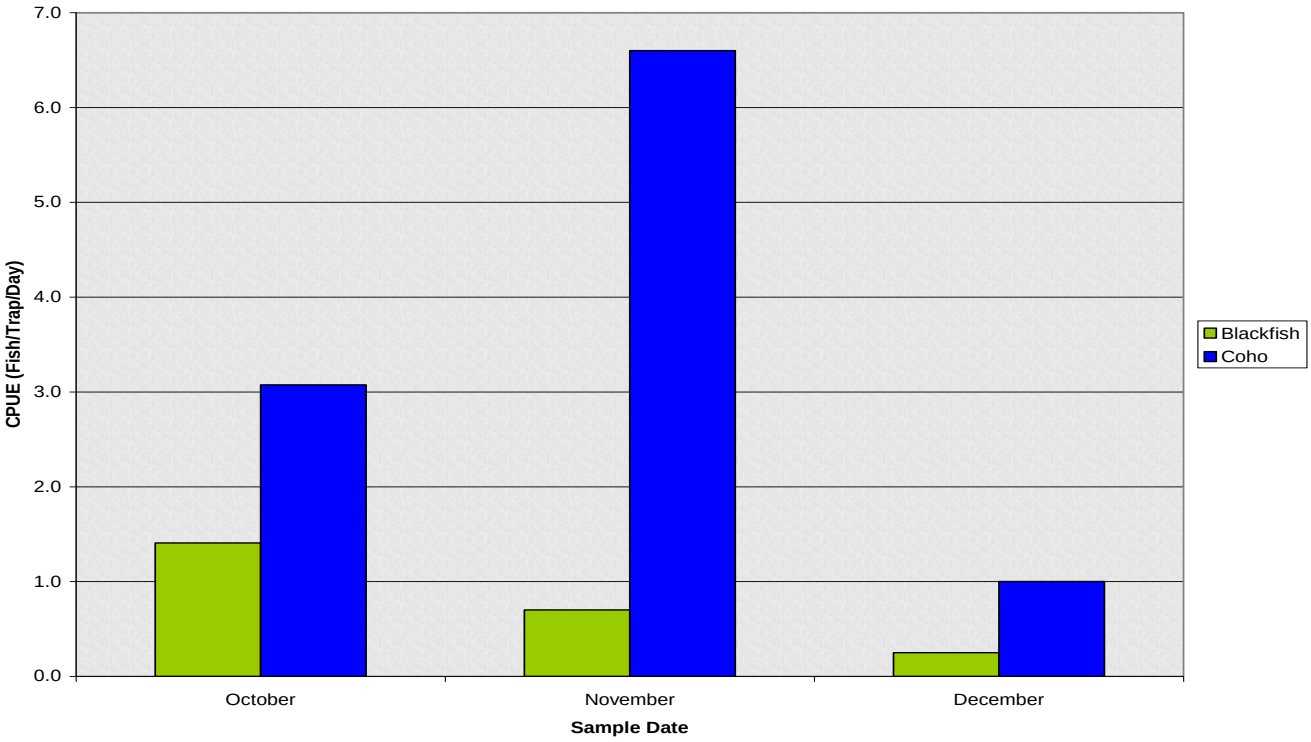
**Length Frequency of Coho Salmon (*Oncorhynchus kisutch*) Captured with Minnow Traps in Campbell Lake**



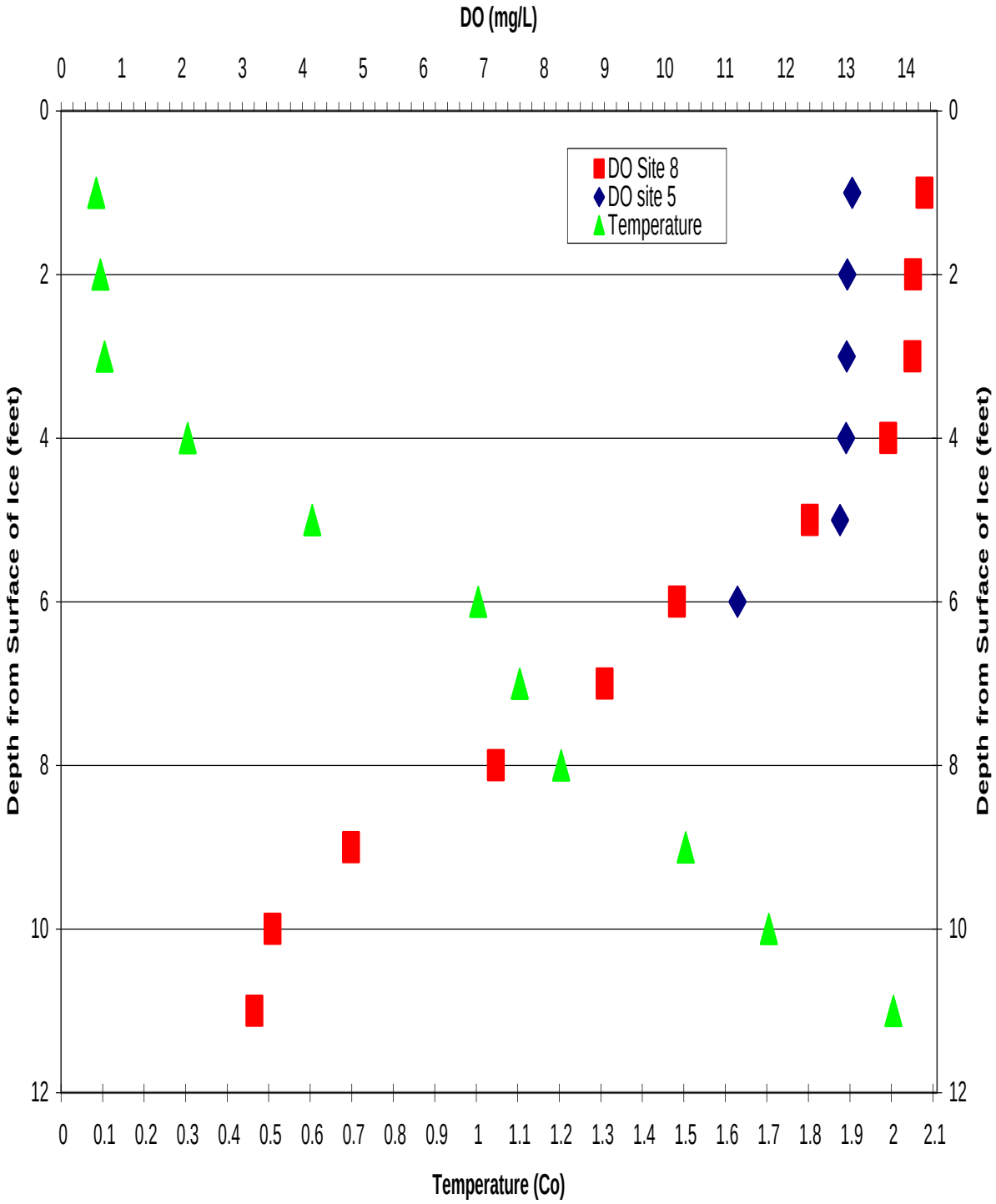

**Length Frequency of Blackfish (*Dallia pectoralis*) Captured with Minnow Traps in Campbell Lake**



**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005.**



Disolved Oxygen (DO) Profiles for Two Sites on Campbell Lake on 12-29-05. Ice Depth is 1.9 feet.



**Project Update: Campbell Lake Fish Assessment**

**Sample Results from 01-19-06**

The fourth trapping session on Campbell Lake was conducted on January 19 and 20. Only two traps were set under the ice along 2 of the 8 transects established during the first trapping session. Depths along transects #1 through #3 were too shallow for setting traps. Five holes were drilled through the average 33 inches (2.75 ft) of lake ice. The pull cord assembly broke after drilling the fifth hole and further trap setting was abandoned. Traps were set near the south shore of transect #4 and northern middle location of transect #5.

The two traps were pulled on January 20, and no fish were captured. Traps were baited with salmon eggs as usual and also with chemical light sticks.

The water quality logger was not deployed during this sampling period. We intended to instead, collect dissolved oxygen and temperature profiles at each station with a handheld meter. Unfortunately, the meter turned out to be defective and no data were collected on water quality.

The next trapping session is scheduled for 02/22 through 02/23). The ice auger has been repaired and a reliable meter will be obtained for the next sampling session. We will try to set at least 2 traps per transect from transect #4 through transect #8 if depth allows.

**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 02-22-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The fifth trapping session on Campbell Lake was conducted on February 22 - 23. Eight traps were set under the ice. Traps were set in 4 new locations and 4 established sites (Map). Trap depth ranged from 2.3 m to 6.4 m. Traps were baited with salmon roe.

A total of 10 holes were drilled through the ice. Ice depth was 32" (1.2 m). Depth of ice was consistent between all sites. The ice appeared softer at sites along the south shore of the lake.

Only two fish were captured during this session a coho and a blackfish. The blackfish was 155 mm total length and the coho was 118 mm fork length. The coho had several parasites or tumors under its skin above and behind its left pectoral fin. The coho's coloration was faded, but parr-like. Its scales were easily lost with handling.

We collected dissolved oxygen (DO) and temperature profiles at 6 sites and checked the DO at each trap site. DO at each trap location was 5 mg/L or greater. The DO profile improved from the outlet of the lake toward the head of the lake (Table 2 and Figure 1). The lake should support fish despite deoxygenation of the deeper holes in the lower lake.

Temperature data indicate that the lake is more stratified toward the outlet (Table 1 and Figure 2). Water temperature was colder at depth the further up the lake we sampled.

We observed the lake discharge over the weir. My best guess for discharge was between 20 to 35 cfs. The discharge water was turbid, but we were still able to see our traps between 1.5m to 2.0 m into the water.

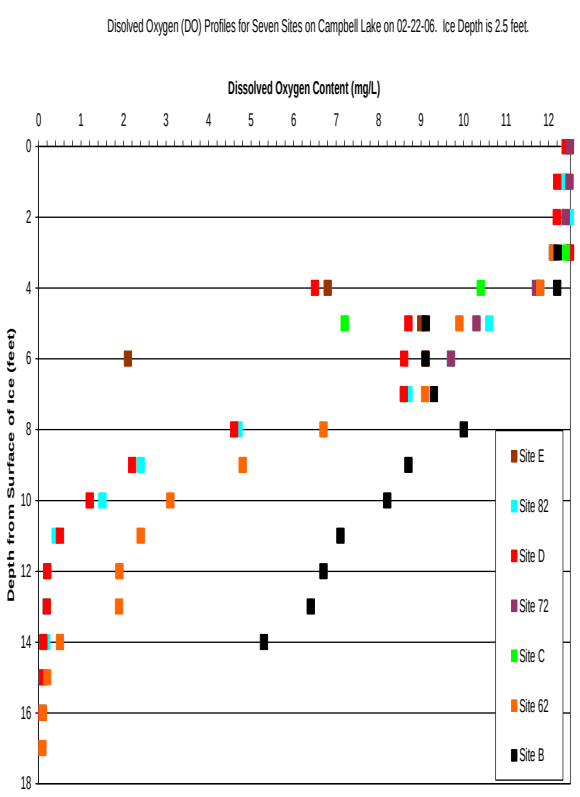
The next trapping session is scheduled for March 15 and 16. We will again collect DO and temperature profiles along the lake while setting the traps.

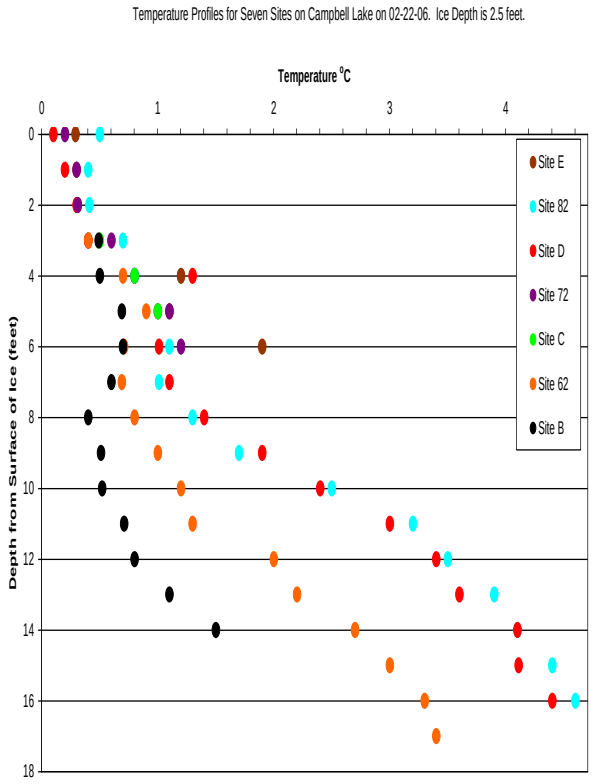
Temperature Profile Data for Campbell Lake, Alaska, February 22, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature °C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site E | Site 82 | Site D | Site 72 | Site C | Site 62 | Site 61 | Site B | Site 43 | Site A |
| 0 | 0.30 | 0.50 | 0.10 | 0.20 | | | | | | |
| 1 | 0.30 | 0.40 | 0.20 | 0.30 | | | | | | |
| 2 | 0.30 | 0.40 | 0.30 | 0.30 | | | | | | |
| 3 | 0.40 | 0.70 | 0.40 | 0.60 | 0.50 | 0.40 | | 0.50 | | |
| 4 | 1.20 | 0.80 | 1.30 | 0.80 | 0.80 | 0.70 | 0.80 | 0.50 | | |
| 5 | 1.10 | 1.00 | 1.00 | 1.10 | 1.00 | 0.90 | 0.80 | 0.70 | 0.60 | 0.50 |
| 6 | 1.90 | 1.10 | 1.00 | 1.20 | | 0.70 | | 0.70 | | |
| 7 | | 1.00 | 1.10 | | | 0.70 | | 0.60 | | |
| 8 | | 1.30 | 1.40 | | | 0.80 | | 0.40 | | |
| 9 | | 1.70 | 1.90 | | | 1.00 | | 0.50 | | |
| 10 | | 2.50 | 2.40 | | | 1.20 | | 0.50 | | |
| 11 | | 3.20 | 3.00 | | | 1.30 | | 0.70 | | |
| 12 | | 3.50 | 3.40 | | | 2.00 | | 0.80 | | |
| 13 | | 3.90 | 3.60 | | | 2.20 | | 1.10 | | |
| 14 | | 4.10 | 4.10 | | | 2.70 | | 1.50 | | |
| 15 | | 4.40 | 4.10 | | | 3.00 | | | | |
| 16 | | 4.60 | 4.40 | | | 3.30 | | | | |
| 17 | | | | | | 3.40 | | | | |

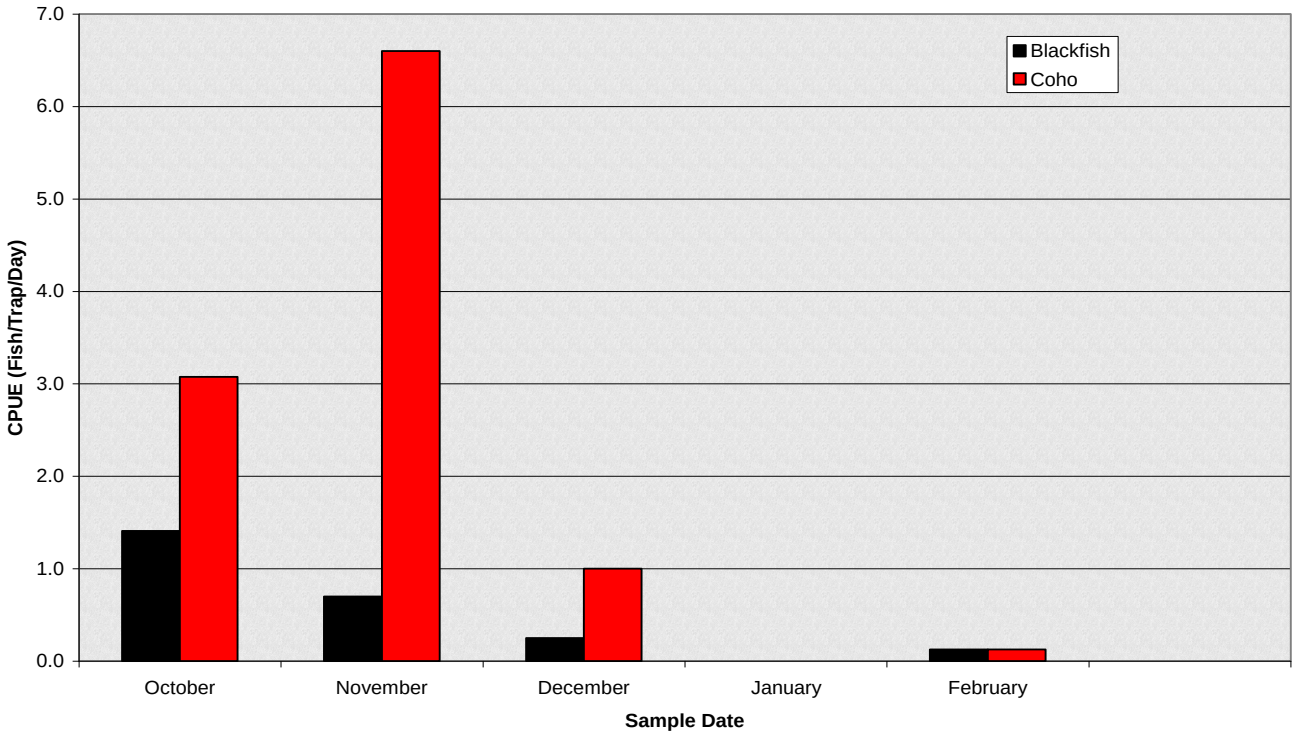
Dissolved Oxygen Profile Data for Campbell Lake, Alaska, February 22, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

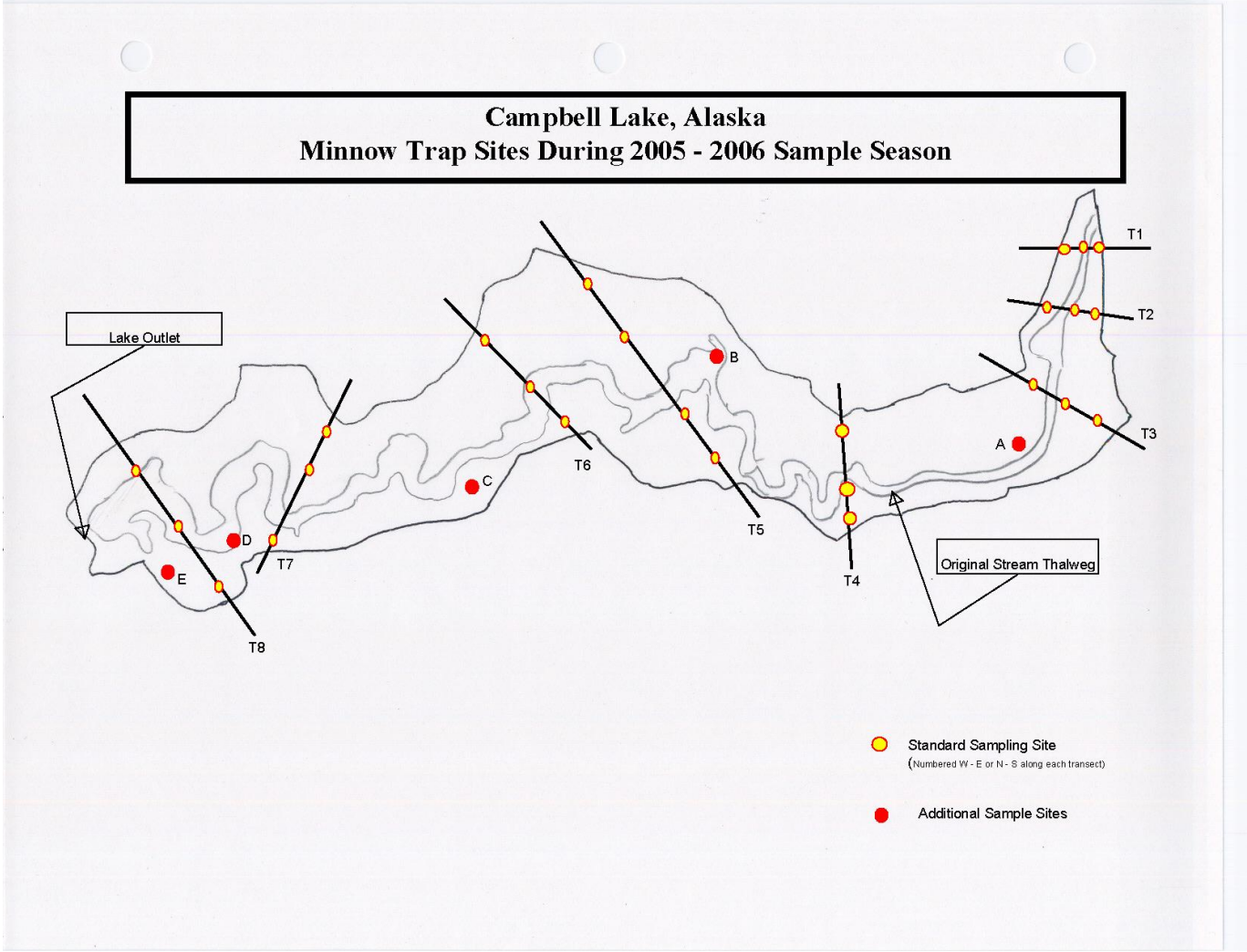
| DEPTH (Feet) | Dissolved Oxygen mg/L | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site E | Site 82 | Site D | Site 72 | Site C | Site 62 | Site 61 | Site B | Site 43 | Site A |
| 0 | 12.50 | 12.40 | 12.40 | 12.50 | | | | | | |
| 1 | 12.40 | 12.40 | 12.20 | 12.50 | | | | | | |
| 2 | 12.40 | 12.50 | 12.20 | 12.40 | | | | | | |
| 3 | 12.50 | 12.10 | 12.50 | 12.10 | 12.40 | 12.10 | | 12.20 | | |
| 4 | 6.80 | 11.80 | 6.50 | 11.70 | 10.40 | 11.80 | 12.00 | 12.20 | | |
| 5 | 9.00 | 10.60 | 8.70 | 10.30 | 7.20 | 9.90 | 12.00 | 9.10 | 9.20 | 11.00 |
| 6 | 2.10 | 9.70 | 8.60 | 9.70 | | 9.10 | | 9.10 | | |
| 7 | | 8.70 | 8.60 | | | 9.10 | | 9.30 | | |
| 8 | | 4.70 | 4.60 | | | 6.70 | | 10.00 | | |
| 9 | | 2.40 | 2.20 | | | 4.80 | | 8.70 | | |
| 10 | | 1.50 | 1.20 | | | 3.10 | | 8.20 | | |
| 11 | | 0.40 | 0.50 | | | 2.40 | | 7.10 | | |
| 12 | | 0.20 | 0.20 | | | 1.90 | | 6.70 | | |
| 13 | | 0.20 | 0.20 | | | 1.90 | | 6.40 | | |
| 14 | | 0.20 | 0.10 | | | 0.50 | | 5.30 | | |
| 15 | | 0.10 | 0.10 | | | 0.20 | | | | |
| 16 | | 0.10 | 0.10 | | | 0.10 | | | | |
| 17 | | | | | | 0.10 | | | | |




**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005 - 2006.**




Campbell Lake, Alaska
Minnow Trap Sites During 2005 - 2006 Sample Season
Lake Outlet
T1
T2
T3
T4
T5
T6
T7
T8
A
B
C
D
E
Original Stream Thalweg
Standard Sampling Site
(Numbered W - E or N - S along each transect)
Additional Sample Sites

**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 03-16-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The sixth trapping session on Campbell Lake was conducted on March 16 - 17. Ten traps were set under the ice. Traps were set mainly in the upper quarter of Campbell Lake where dissolved oxygen content and previous capture success indicated the best possible chances to capture fish. Trap depth ranged from 1.2 m to 2.1 m. Traps were baited with salmon roe.

A total of 13 holes were drilled through the ice. Ice depth was 36" (0.9 m). Depth of ice was consistent between all sites. There was about 10 cm of snow cover on the ice.

Nine fish were captured during this session six coho and three blackfish. The blackfish ranged from 95mm to 155mm total length and the coho ranged from 113mm to 145mm fork length. Coho length was in the upper 50% of the size range of all coho captured since October. One coho had a deformed back or scoliosis which can indicate genetic deformation, injury or vitamin deficiency. Coho coloration was faded, but parr-like. Scales were easily lost with handling.

Water temperature increased with depth as in February, but maximum water temperature only reached 2.2 $^{o}$C (Table 1). The water temperature profile became slightly warmer toward the lower lake (Figure 1), but was not as dramatic a difference as observed in February.

We collected dissolved oxygen (DO) and temperature profiles at 5 sites and checked the DO at each trap site. DO at each trap location was 5 mg/L or greater. DO profiles were uniform throughout the lake (Table 2). Campbell Lake was slightly more deoxygenated in March than it was in February (Figure 2). The lake retained adequate amounts of dissolved oxygen to support fish to a depth of six feet. In February that depth was eight feet.

Overall water discharge from Campbell Lake was lower in March than in February. Discharge was estimated at 9.5 cfs on March 16 compared to 30 cfs on February 22. The discharge water was also less turbid in March than February.

The next trapping session is scheduled for April 18 and 19. We will again collect DO and temperature profiles along the lake while setting the traps.

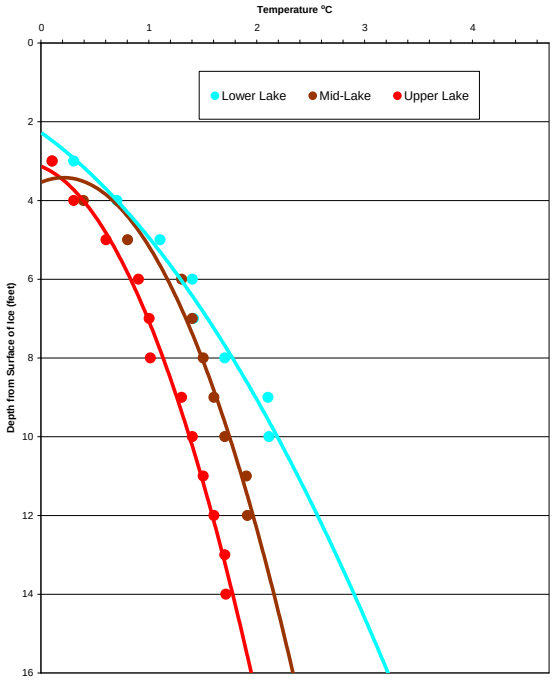
Temperature Profile Data for Campbell Lake, Alaska, March 16, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature °C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 82 | Site 62 | Site B | Site 3A1 | Site 31 | | | | | |
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | 0.30 | 0.10 | 0.10 | 0.10 | 0.00 | | | | | |
| 4 | 0.70 | 0.40 | 0.30 | 0.10 | 0.10 | | | | | |
| 5 | 1.10 | 0.80 | 0.60 | 0.20 | 0.30 | | | | | |
| 6 | 1.40 | 1.30 | 0.90 | 0.80 | 0.80 | | | | | |
| 7 | 1.40 | 1.40 | 1.00 | 1.00 | | | | | | |
| 8 | 1.70 | 1.50 | 1.00 | | | | | | | |
| 9 | 2.10 | 1.60 | 1.30 | | | | | | | |
| 10 | 2.10 | 1.70 | 1.40 | | | | | | | |
| 11 | | 1.90 | 1.50 | | | | | | | |
| 12 | | 1.90 | 1.60 | | | | | | | |
| 13 | | | 1.70 | | | | | | | |
| 14 | | | 1.70 | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |

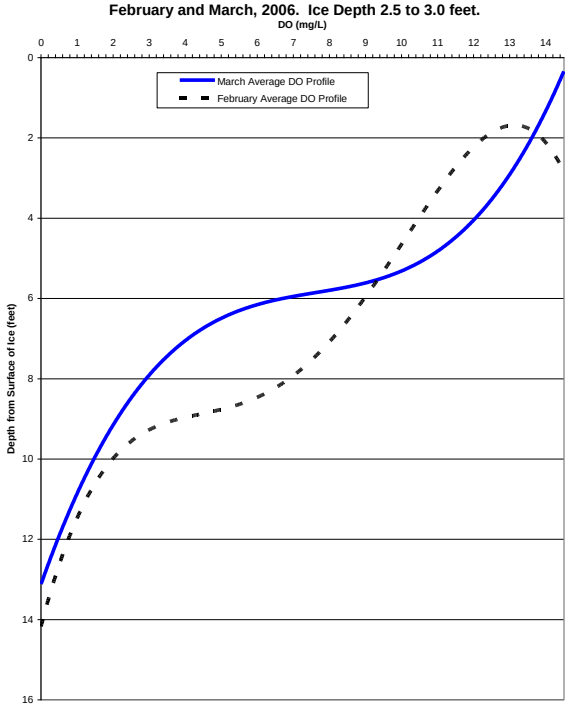
Dissolved Oxygen Profile Data for Campbell Lake, Alaska, March 16, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Dissolved Oxygen mg/L | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 82 | Site 62 | Site B | Site 3A1 | Site 31 | | | | | |
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | 13.10 | 12.90 | 12.60 | 12.70 | 12.70 | | | | | |
| 4 | 11.40 | 12.10 | 12.40 | 12.70 | 12.50 | | | | | |
| 5 | 9.70 | 11.30 | 11.00 | 12.10 | 10.60 | | | | | |
| 6 | 5.90 | 5.20 | 6.20 | 5.40 | 2.60 | | | | | |
| 7 | 3.70 | 4.20 | 4.80 | 2.40 | | | | | | |
| 8 | 2.20 | 2.90 | 4.70 | | | | | | | |
| 9 | 1.00 | 1.70 | 2.90 | | | | | | | |
| 10 | 1.20 | 1.00 | 1.40 | | | | | | | |
| 11 | | 0.40 | 1.10 | | | | | | | |
| 12 | | 0.40 | 0.60 | | | | | | | |
| 13 | | | 0.30 | | | | | | | |
| 14 | | | 0.60 | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |

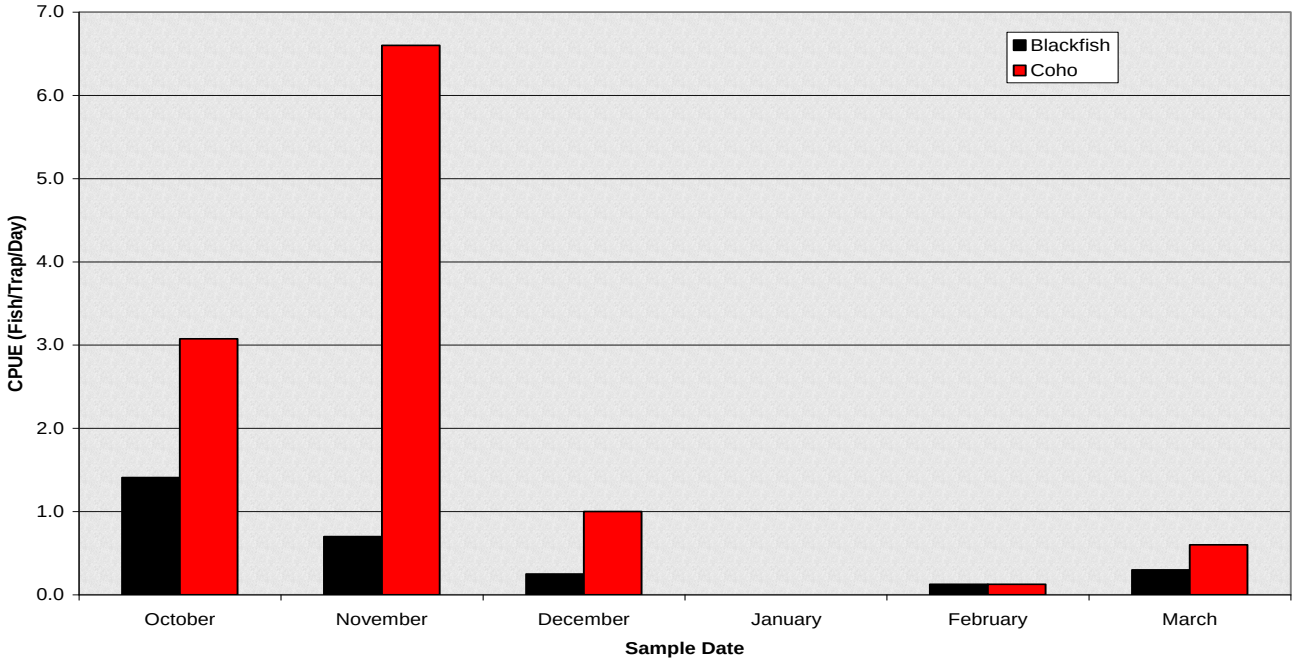
**Temperature Profiles for Three Sites on Campbell Lake on 03-16-06. Ice Depth is 3.0 feet.**

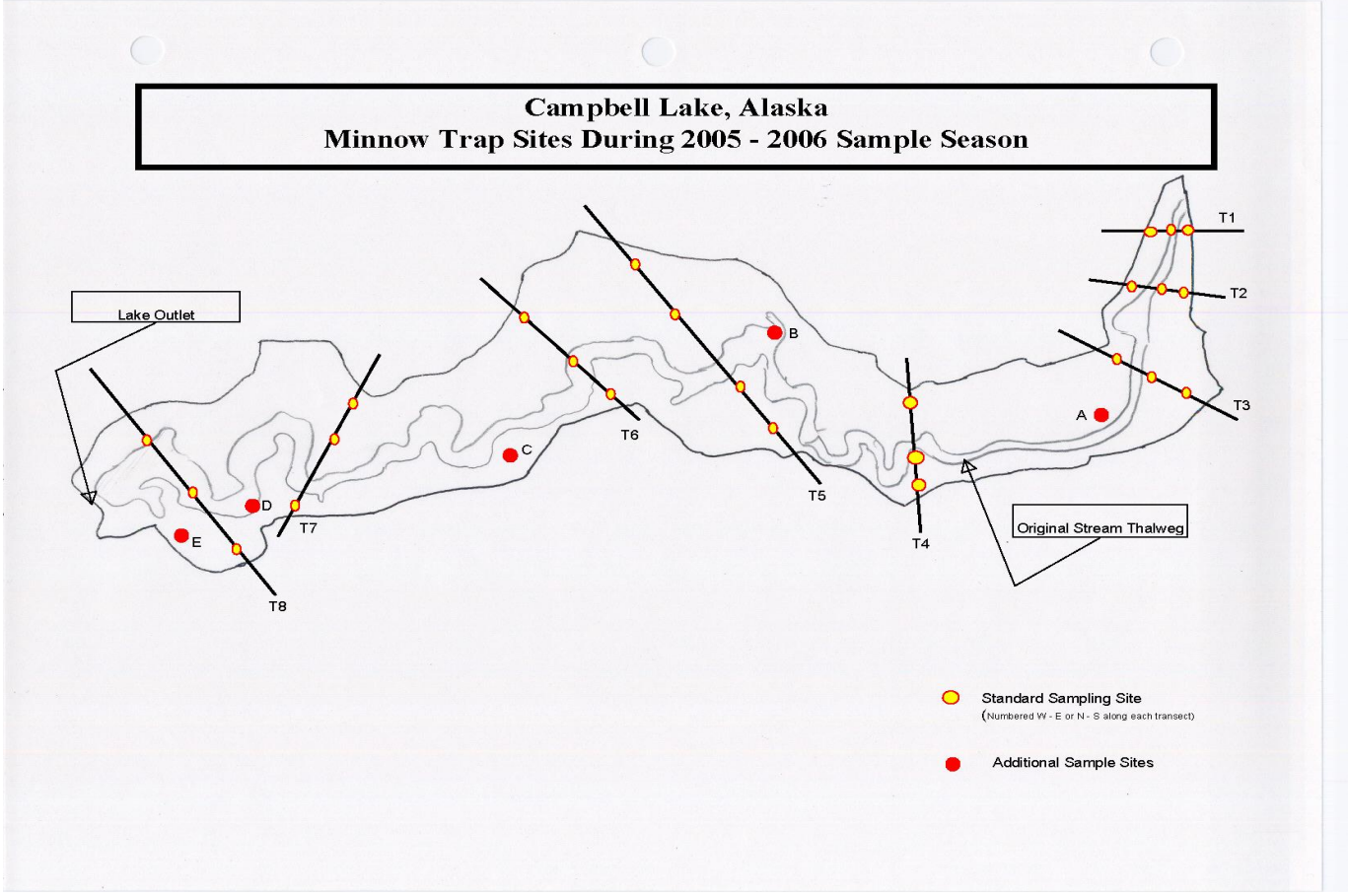



**Average Disolved Oxygen (DO) Profiles for Campbell Lake in February and March, 2006. Ice Depth 2.5 to 3.0 feet.**



**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005 - 2006.**



**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 05-19-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The eighth trapping session on Campbell Lake was conducted on May 18 - 19. Twenty-seven traps were set along 9 transects across the lake. Traps were baited with salmon roe.

Campbell Lake became ice free on May 9. Conditions were calm during this sampling.

Fewer fish than expected were captured during this sample period. Forty-one fish were captured in Campbell Lake during this session 11 coho and 30 blackfish. The blackfish ranged from 60mm to 142mm total length (mean 116mm)and the coho ranged from 65mm - 138mm fork length (mean 108mm). All coho except the two smallest ones captured near the head of the lake were smolt. A school of coho smolt was also observed near the end of the lake. All captured fish appeared healthy and robust.

Water temperature and Dissolved Oxygen (DO) were essentially uniform from lake surface to bottom. Water temperature was substantially higher (11.6 oC) in May versus April (3.5). That is a rapid increase in water temperature in just 4 weeks. DO's rebounded in the deeper portions of the lake after ice out.

Overall water discharge from Campbell Lake was similar to that observed in February. Discharge was estimated at about 50 cfs on April 18. Turbidity appeared to be the same as in April.

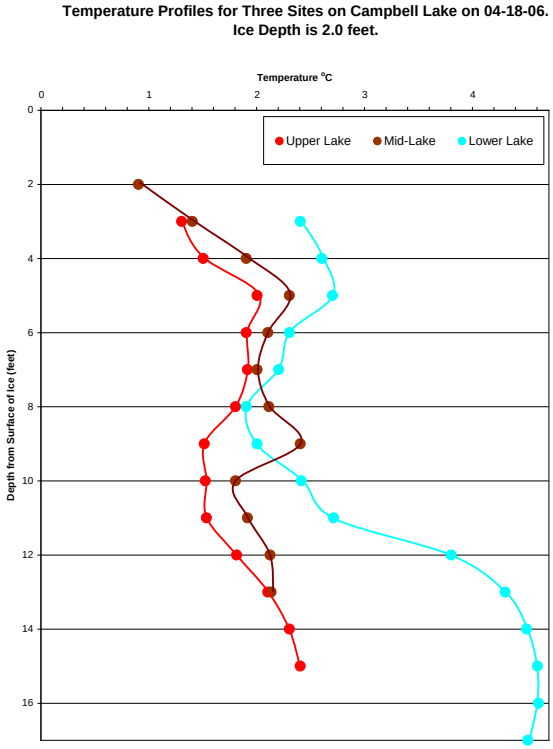
The next trapping session is scheduled for June 13 - 14. We will again collect DO and temperature profiles along the lake while setting the traps.

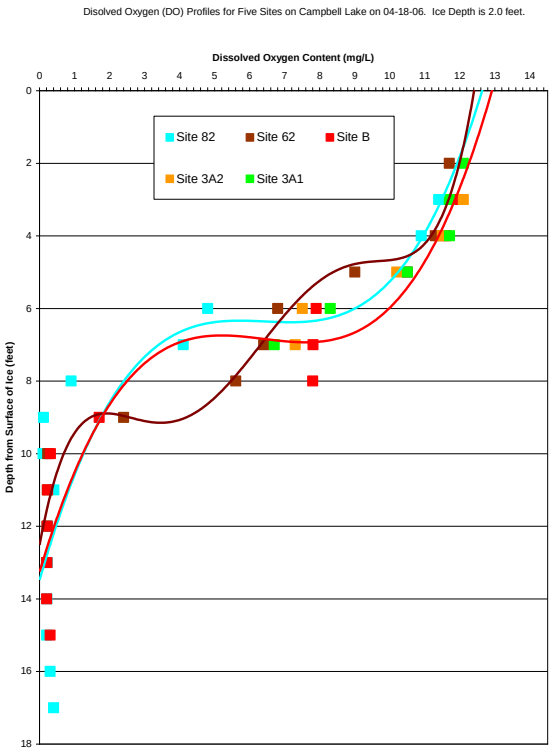
Temperature Profile Data for Campbell Lake, Alaska, April 18, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature °C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 82 | Site 62 | Site B | Site 3A2 | Site 3A1 | | | | | |
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | 0.90 | | | 0.30 | | | | | |
| 3 | 2.40 | 1.40 | 1.30 | 0.50 | 0.70 | | | | | |
| 4 | 2.60 | 1.90 | 1.50 | 1.00 | 0.70 | | | | | |
| 5 | 2.70 | 2.30 | 2.00 | 1.50 | 1.60 | | | | | |
| 6 | 2.30 | 2.10 | 1.90 | 1.70 | 1.70 | | | | | |
| 7 | 2.20 | 2.00 | 1.90 | 1.70 | 1.70 | | | | | |
| 8 | 1.90 | 2.10 | 1.80 | | | | | | | |
| 9 | 2.00 | 2.40 | 1.50 | | | | | | | |
| 10 | 2.40 | 1.80 | 1.50 | | | | | | | |
| 11 | 2.70 | 1.90 | 1.50 | | | | | | | |
| 12 | 3.80 | 2.10 | 1.80 | | | | | | | |
| 13 | 4.30 | 2.10 | 2.10 | | | | | | | |
| 14 | 4.50 | | 2.30 | | | | | | | |
| 15 | 4.60 | | 2.40 | | | | | | | |
| 16 | 4.60 | | | | | | | | | |
| 17 | 4.50 | | | | | | | | | |

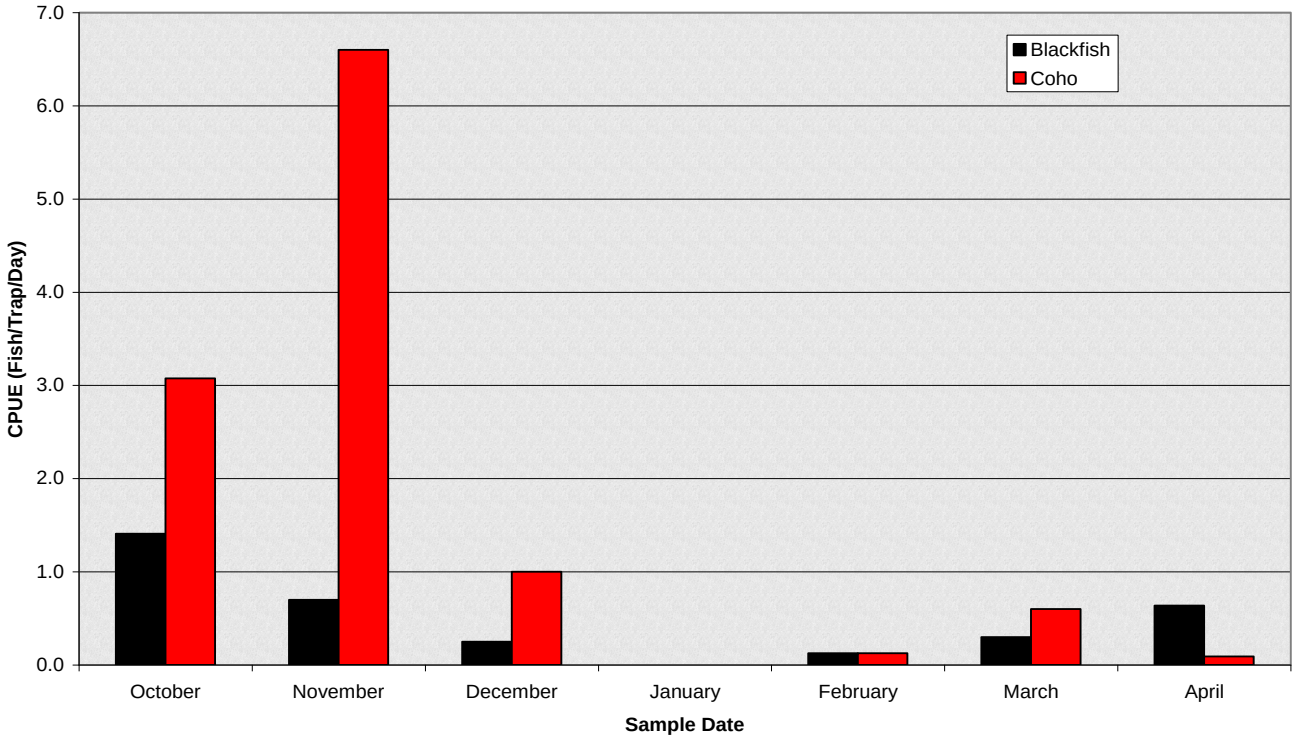
Dissolved Oxygen Profile Data for Campbell Lake, Alaska, April 18, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

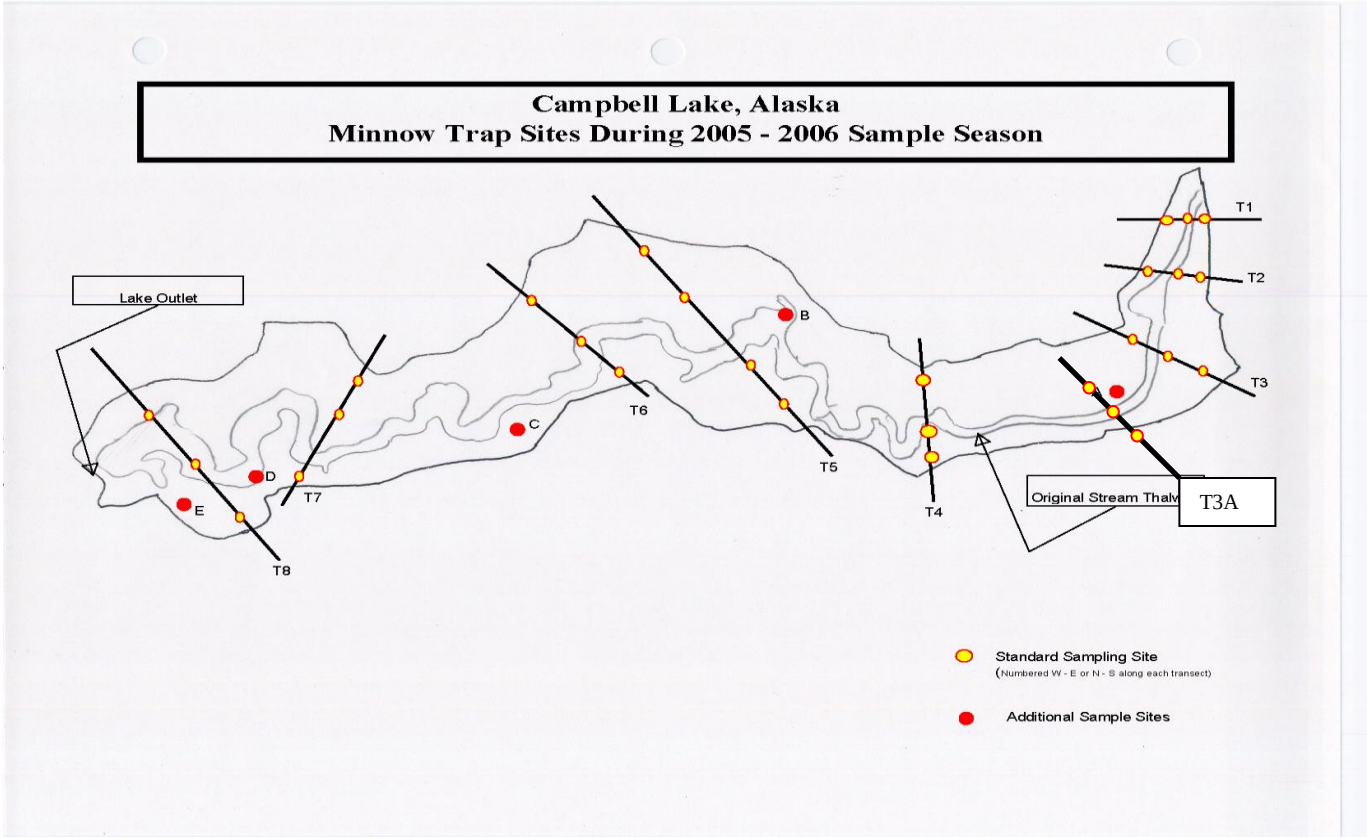
| DEPTH (Feet) | Dissolved Oxygen mg/L | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 82 | Site 62 | Site B | Site 3A2 | Site 3A1 | | | | | |
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | 11.70 | | | 12.10 | | | | | |
| 3 | 11.40 | 11.90 | 11.80 | 12.10 | 11.70 | | | | | |
| 4 | 10.90 | 11.30 | 11.60 | 11.50 | 11.70 | | | | | |
| 5 | 10.50 | 9.00 | 10.50 | 10.20 | 10.50 | | | | | |
| 6 | 4.80 | 6.80 | 7.90 | 7.50 | 8.30 | | | | | |
| 7 | 4.10 | 6.40 | 7.80 | 7.30 | 6.70 | | | | | |
| 8 | 0.90 | 5.60 | 7.80 | | | | | | | |
| 9 | 0.10 | 2.40 | 1.70 | | | | | | | |
| 10 | 0.10 | 0.20 | 0.30 | | | | | | | |
| 11 | 0.40 | 0.20 | 0.20 | | | | | | | |
| 12 | 0.20 | 0.20 | 0.20 | | | | | | | |
| 13 | 0.20 | 0.20 | 0.20 | | | | | | | |
| 14 | 0.20 | | 0.20 | | | | | | | |
| 15 | 0.20 | | 0.30 | | | | | | | |
| 16 | 0.30 | | | | | | | | | |
| 17 | 0.40 | | | | | | | | | |




**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005 - 2006.**




Campbell Lake, Alaska
Minnow Trap Sites During 2005 - 2006 Sample Season
Lake Outlet
T1
T2
T3
T3A
B
C
D
E
T4
T5
T6
T7
T8
Original Stream Thalw
Standard Sampling Site
(Numbered W - E or N - S along each transect)
Additional Sample Sites

**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 05-19-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The eighth trapping session on Campbell Lake was conducted on May 18 - 19. Twenty-seven traps were set along 9 transects across the lake. Traps were baited with salmon roe.

Campbell Lake became ice free on May 9. Conditions were calm during this sampling.

Fewer fish than expected were captured during this sample period. CPUE was essentially the same as in December through April (Figure 3). Forty-one fish were captured in Campbell Lake during this session 11 coho and 30 blackfish. The blackfish ranged from 60 mm to 142 mm total length (mean 116 mm)and the coho ranged from 65 mm - 138 mm fork length (mean 108 mm). All coho, except the two smallest ones captured near the head of the lake, were smolt. A school of coho smolt was also observed near the mouth of the lake. All captured fish appeared healthy and robust.

Water temperature and dissolved oxygen (DO) were essentially uniform from lake surface to bottom (Tables 1 and 2). The lower end of the lake (site 112) was about 1.0 $^{o}$C warmer than the middle or upper sample sites. Water temperature was substantially higher (11.6 $^{o}$C) in May versus April (3.5 $^{o}$C) (Figure 1). That is a rapid increase in water temperature in just 4 weeks. DO's rebounded in the deeper portions of the lake after ice out (Figure 2). The lowest observed DO was 10.1 mg/L at 15 feet near the mouth of the lake.

Discharge from Campbell Lake was estimated at about 50 cfs on May 18. Water clarity was about average with traps visible at 3 feet.

Transects were re-numbered during this sampling to make all sampling data uniform (Figure 4). These transects will not change throughout the remainder of the study. The next trapping session is scheduled for June 13 - 14.

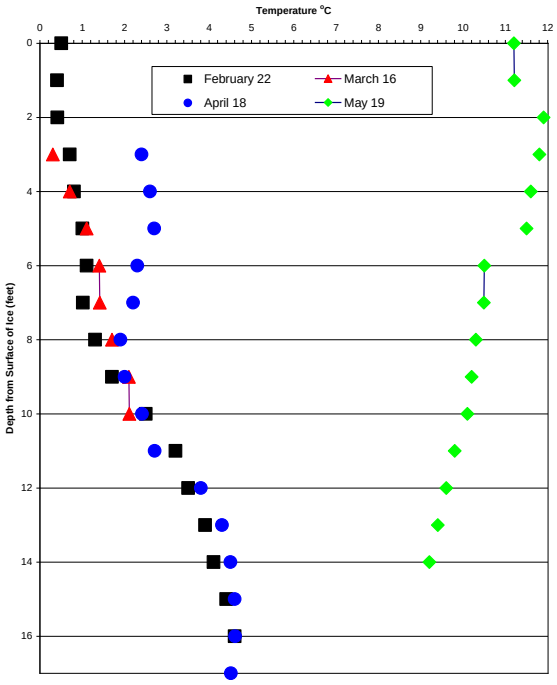
Temperature Profile Data for Campbell Lake, Alaska, May 19, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature $^{o}$C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 112 | Site 92 | Site 71 | | | | | | | |
| 0 | 11.20 | 10.80 | 10.60 | | | | | | | |
| 1 | 11.20 | 10.80 | 10.60 | | | | | | | |
| 2 | 11.90 | 10.80 | 10.60 | | | | | | | |
| 3 | 11.80 | 10.80 | 10.60 | | | | | | | |
| 4 | 11.60 | 10.80 | 10.60 | | | | | | | |
| 5 | 11.50 | 10.70 | 10.70 | | | | | | | |
| 6 | 10.50 | 10.70 | 10.70 | | | | | | | |
| 7 | 10.50 | 10.70 | 10.30 | | | | | | | |
| 8 | 10.30 | 10.70 | 10.30 | | | | | | | |
| 9 | 10.20 | 10.70 | 10.20 | | | | | | | |
| 10 | 10.10 | 10.60 | 10.20 | | | | | | | |
| 11 | 9.80 | 10.40 | 10.20 | | | | | | | |
| 12 | 9.60 | 10.20 | 10.10 | | | | | | | |
| 13 | 9.40 | 10.00 | 10.00 | | | | | | | |
| 14 | 9.20 | 10.00 | 9.70 | | | | | | | |
| 15 | | | 9.40 | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |

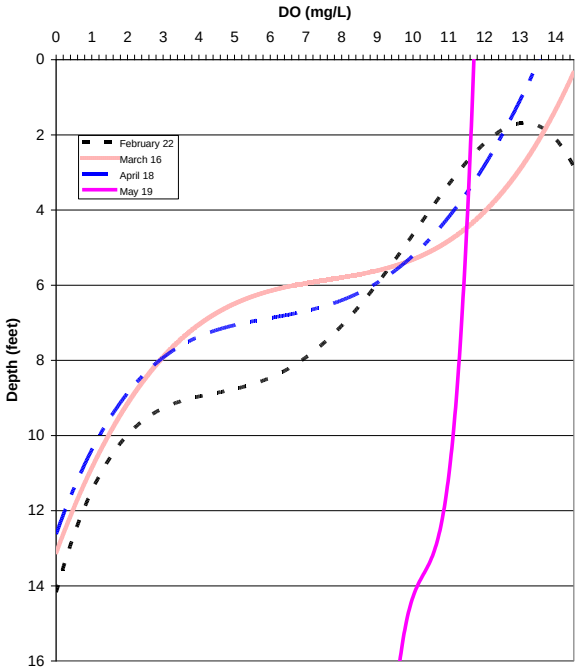
Dissolved Oxygen Profile Data for Campbell Lake, Alaska, May 19, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Dissolved Oxygen mg/L | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Site 112 | Site 92 | Site 71 | | | | | | | |
| 0 | 11.60 | 11.40 | 11.50 | | | | | | | |
| 1 | 11.60 | 11.40 | 11.50 | | | | | | | |
| 2 | 11.60 | 11.40 | 11.50 | | | | | | | |
| 3 | 11.60 | 11.40 | 11.50 | | | | | | | |
| 4 | 11.70 | 11.40 | 11.50 | | | | | | | |
| 5 | 11.50 | 11.40 | 11.50 | | | | | | | |
| 6 | 11.40 | 11.40 | 11.50 | | | | | | | |
| 7 | 11.40 | 11.40 | 11.40 | | | | | | | |
| 8 | 11.20 | 11.40 | 11.40 | | | | | | | |
| 9 | 11.10 | 11.40 | 11.40 | | | | | | | |
| 10 | 11.00 | 11.30 | 11.40 | | | | | | | |
| 11 | 10.70 | 11.10 | 11.40 | | | | | | | |
| 12 | 10.50 | 11.10 | 11.40 | | | | | | | |
| 13 | 10.40 | 10.90 | 11.30 | | | | | | | |
| 14 | 10.10 | 10.90 | 10.70 | | | | | | | |
| 15 | | | 10.30 | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |

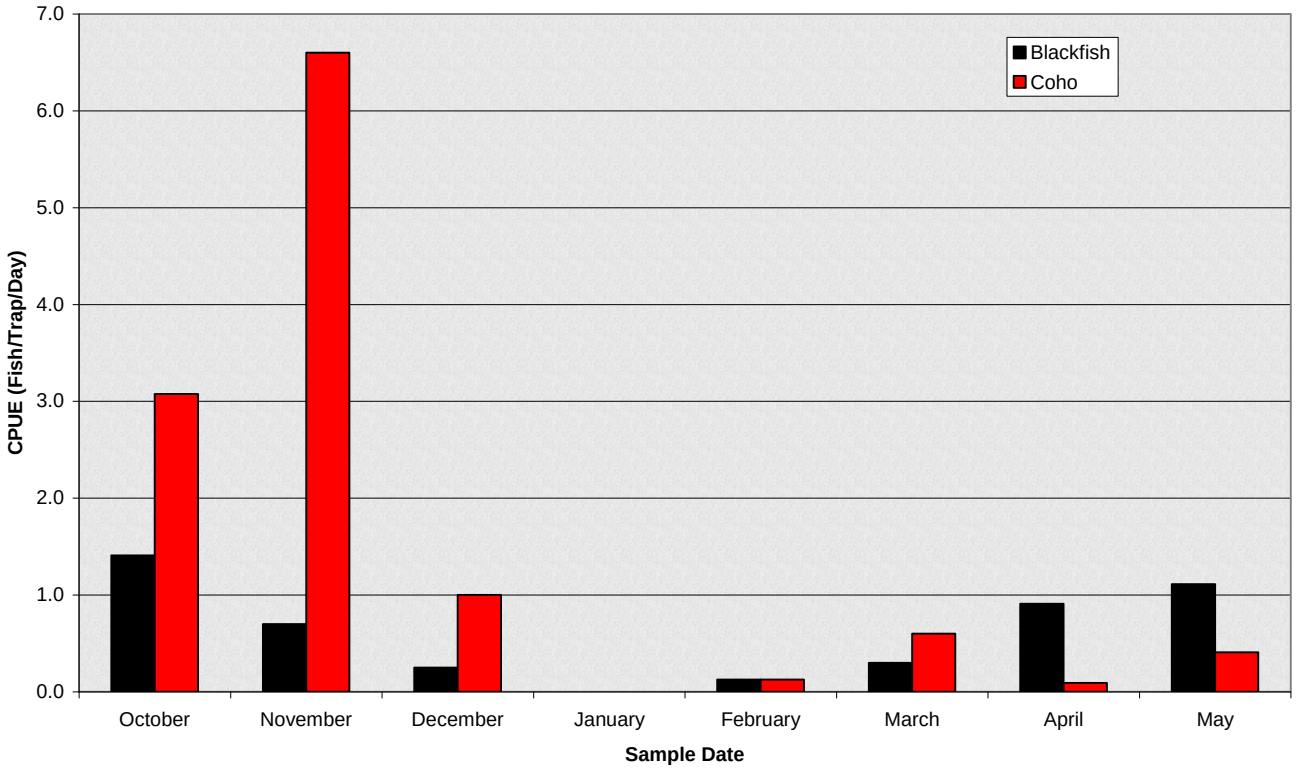
**Temperature Profiles at Lower End of Campbell Lake for February through May, 2006. Ice Depth was 1.5 - 3.0 Feet through April. Ice went out on May 9.**



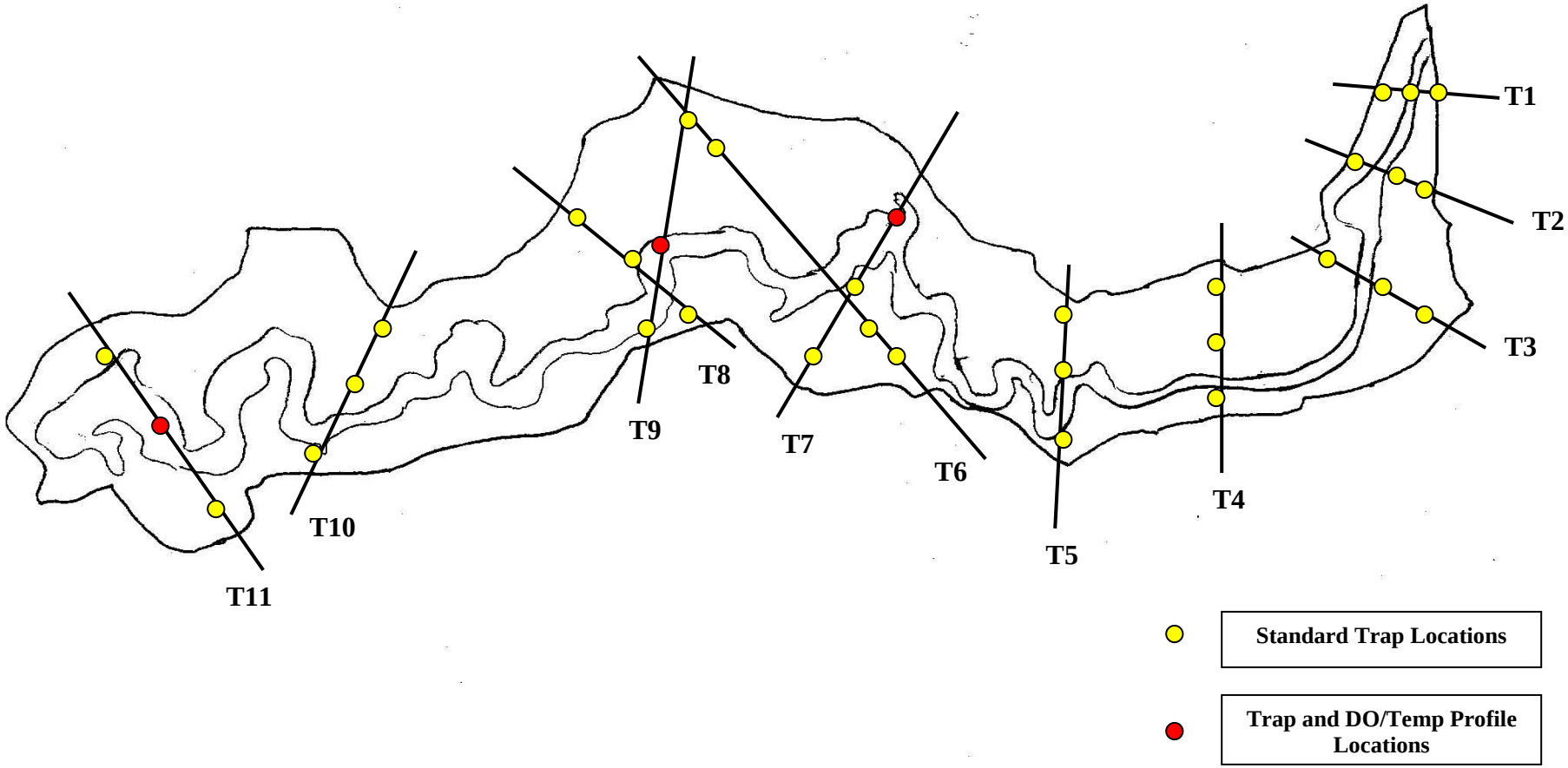

**Average Disolved Oxygen (DO) Profiles for Campbell Lake for February through May, 2006. Ice Depth 1.5 to 3.0 Feet through April. Ice went out on May 9.**

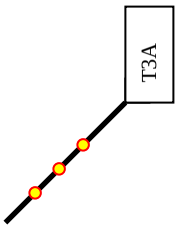



**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake, Alaska, 2005 - 2006.**



# Campbell Lake, Anchorage, Alaska
# Minnow Trap Sites during 2005 - 2006 Sample Season




T3A

**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 06-14-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The ninth trapping session on Campbell Lake was conducted on June 14 - 16. Twenty-five traps were set for 24 hours along 9 transects across the lake from June 14 - 15 (Map 1). Four traps were set along a 350 meter reach Campbell Creek above the first bike trail crossing from June 15 - 16. All traps were baited with salmon roe.

A total of 77 coho were captured in Campbell Lake. Fork lengths ranged from 54 mm to 129 mm and were noticeably smaller than previous samples (Figure 3). Mean length was 79.8 mm compared with mean lengths of 105.8 mm to 123 mm for all previous sample periods. CPUE increased and was the second highest after November (Figure 4).

Our sampling may not adequately represent the abundance of coho moving through or rearing in Campbell Lake during June. Coho could be seen feeding along the entire lake shore. Generally, our traps are set at least 10 to 20 meters from shore. Some traps are set against the shoreline. These traps had the highest catches of coho.

A total of 28 coho were captured in Campbell Creek. Fork lengths ranged from 65 mm to 122 mm and may represent 2 different cohorts of fish (Figure 3). Mean length was 100.6 mm. CPUE was the highest for any sampling set (Figure 4). Two Dolly Varden and one sculpin were also caught in the Campbell Creeks traps.

Only 10 blackfish were captured in Campbell Lake in June. They ranged from 67 mm to 151 mm total length (mean 115 mm). Size distribution was consistent with all other sampling periods (Figure 5). The 151 mm blackfish was sacrificed to see what was in its stomach. The stomach contained a stickleback. CPUE was lower in June than it was in April and May for blackfish (Figure 4).

Water temperature (Table 1) and dissolved oxygen (DO) (Table 2) were essentially uniform from lake surface to bottom. The lower end of the lake (site 112) was still about 1.0 $^{o}$C warmer than the middle or upper sample sites. Water temperature rose about 1.0 $^{o}$C since the May samples were collected (Figure 1). DO's were slightly lower than in May (Figure 2).

Discharge from Campbell Lake was estimated at over 200 cfs on June 14. Water clarity was about average with traps visible at 3 feet.

The next trapping session is scheduled for mid-July.

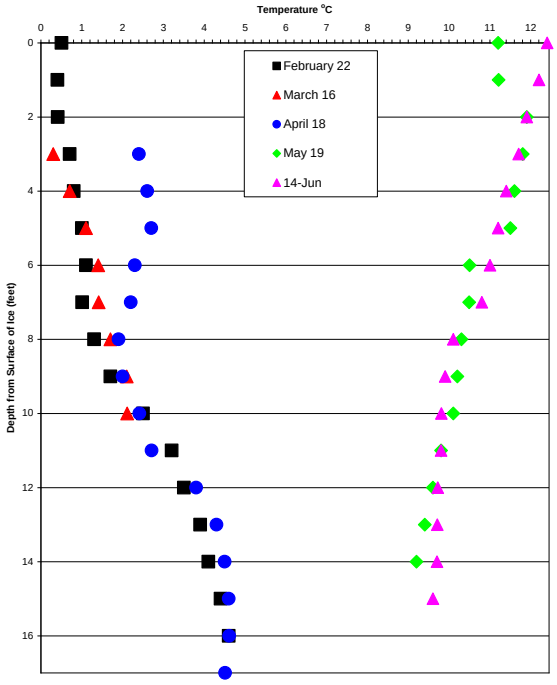
Temperature Profile Data for Campbell Lake, Alaska, June 14, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature °C | | |
|---|---|---|---|
| | Site 112 | Site 92 | Site 71 |
| 0 | 12.40 | 11.40 | 11.30 |
| 1 | 12.20 | 11.40 | 10.70 |
| 2 | 11.90 | 11.20 | 10.70 |
| 3 | 11.70 | 10.70 | 10.50 |
| 4 | 11.40 | 10.60 | 10.50 |
| 5 | 11.20 | 10.50 | 10.40 |
| 6 | 11.00 | 10.40 | 10.30 |
| 7 | 10.80 | 10.40 | 10.30 |
| 8 | 10.10 | 10.30 | 10.30 |
| 9 | 9.90 | 10.30 | 10.10 |
| 10 | 9.80 | 10.30 | 9.90 |
| 11 | 9.80 | 10.20 | 9.70 |
| 12 | 9.70 | 10.10 | 9.50 |
| 13 | 9.70 | 9.40 | 9.20 |
| 14 | 9.70 | 9.20 | 9.10 |
| 15 | 9.60 | | 9.10 |
| 16 | | | 9.00 |
| 17 | | | |

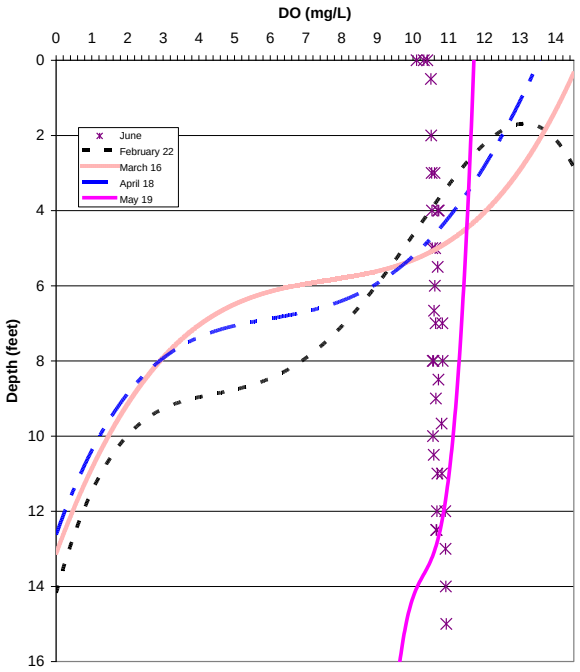
Dissolved Oxygen Profile Data for Campbell Lake, Alaska, June 14, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Dissolved Oxygen mg/L | | |
|---|---|---|---|
| | Site 112 | Site 92 | Site 71 |
| 0 | 10.50 | 10.70 | 10.40 |
| 1 | 10.60 | 10.70 | 10.50 |
| 2 | 10.70 | 10.60 | 10.50 |
| 3 | 10.70 | 10.60 | 10.50 |
| 4 | 10.70 | 10.60 | 10.50 |
| 5 | 10.80 | 10.60 | 10.50 |
| 6 | 10.80 | 10.60 | 10.60 |
| 7 | 10.80 | 10.60 | 10.60 |
| 8 | 10.80 | 10.60 | 10.50 |
| 9 | 10.60 | 10.60 | 10.60 |
| 10 | 10.70 | 10.60 | 10.70 |
| 11 | 10.70 | 10.60 | 10.80 |
| 12 | 10.70 | 10.60 | 10.90 |
| 13 | 10.70 | 10.80 | 10.90 |
| 14 | 10.70 | 10.70 | 10.90 |
| 15 | 10.60 | | 10.90 |
| 16 | | | 10.80 |
| 17 | | | |

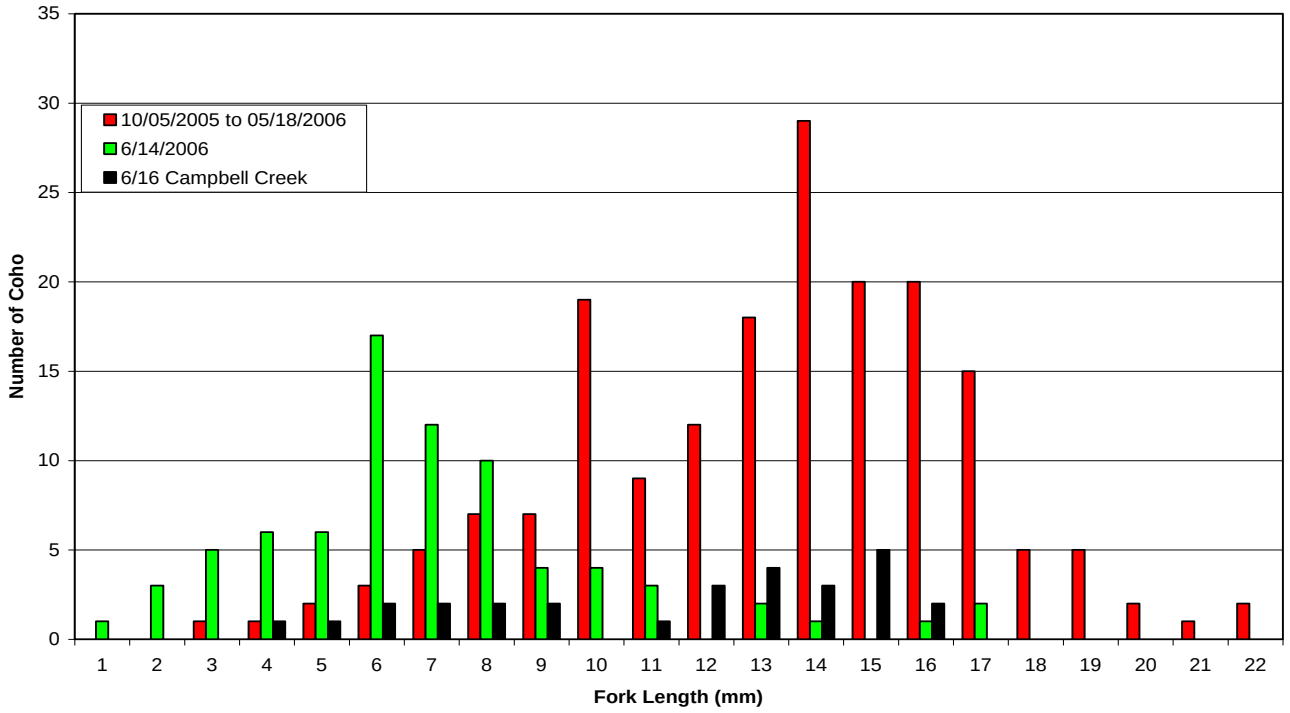
**Temperature Profiles at Lower End of Campbell Lake for February through June, 2006. Ice Depth was 1.5 - 3.0 Feet through April. Ice went out on May 9.**



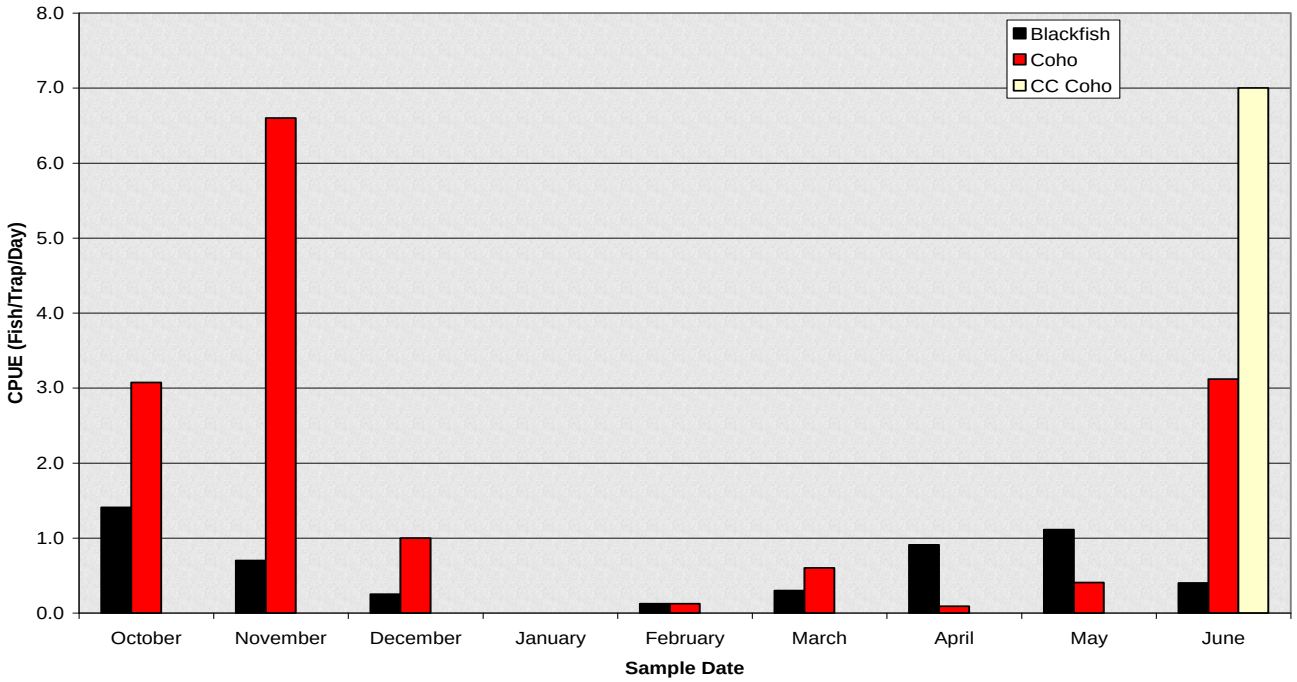

**Average Disolved Oxygen (DO) Profiles for Campbell Lake for February through June, 2006. Ice Depth 1.5 to 3.0 Feet through April. Ice went out on May 9.**



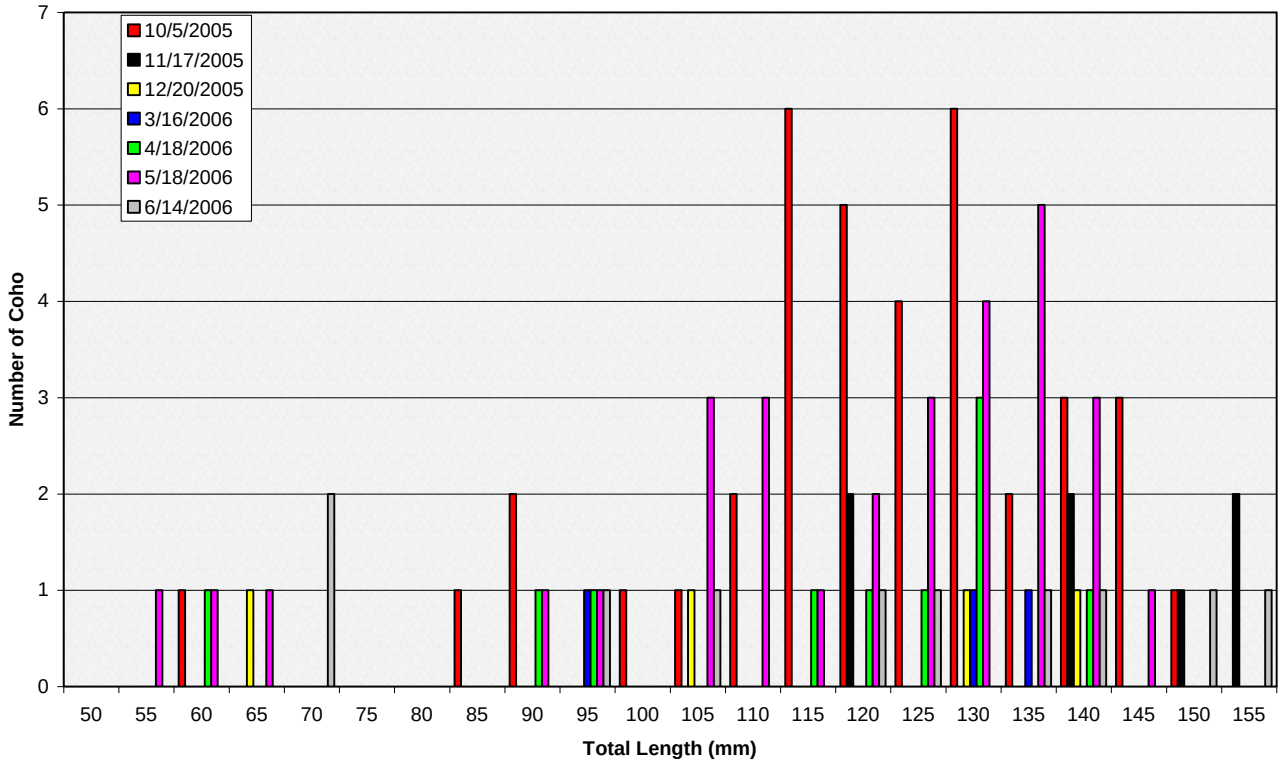
**Summary of Juvenile Coho Salmon (*Oncorhynchus kisutch*) Length Frequency from Minnow Traps set in Campbell Lake from 10/05/2005 to 05/18/2006 and on 06/14/2006, and in Campbell Creek on 06/15/2006.**



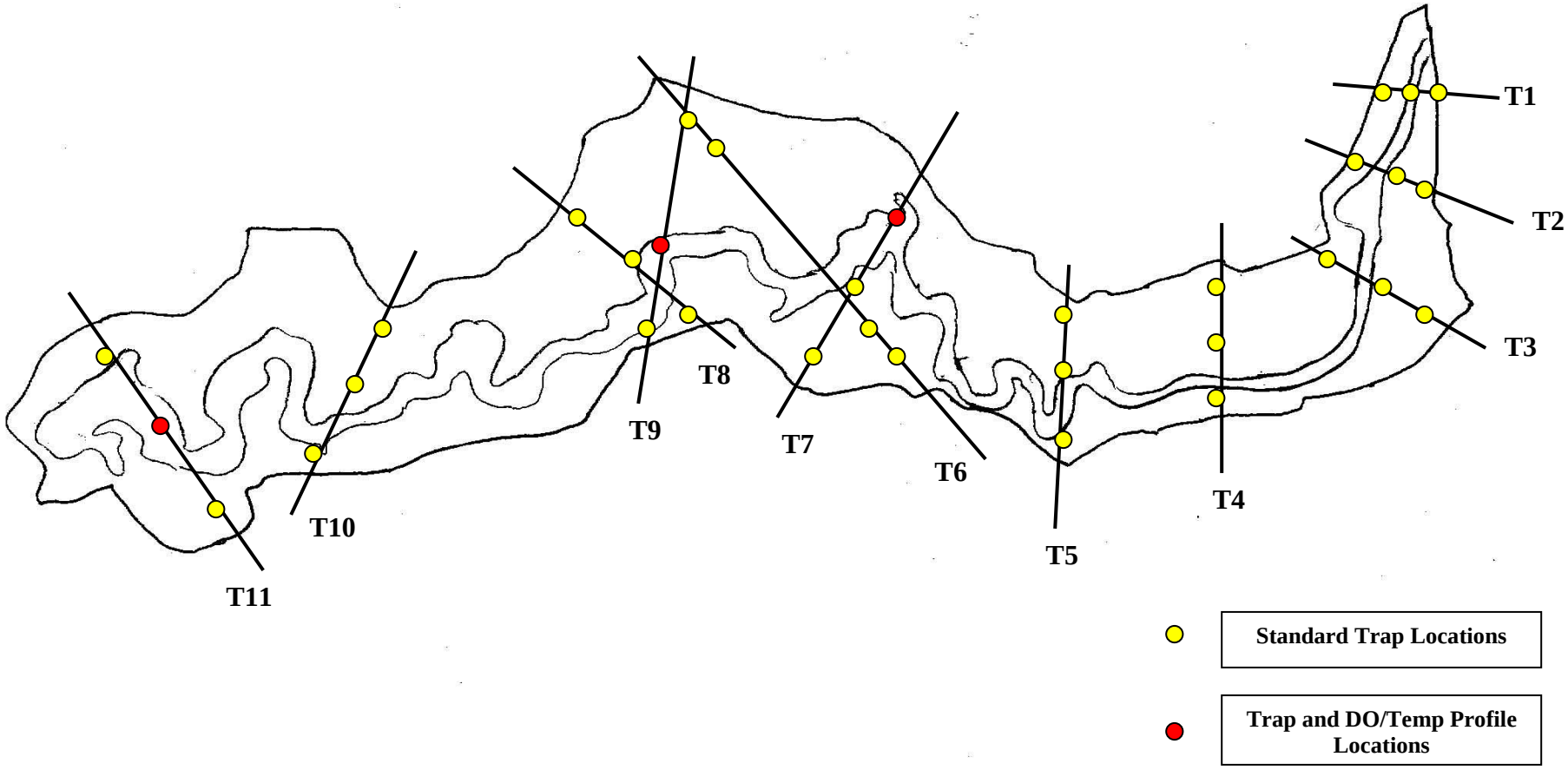

**Catch-Per-Unit-Effort for Coho Salmon and Blackfish in Minnow Traps set in Campbell Lake and Campbell Creek, Alaska, 2005 - 2006.**



**Length Frequency of Blackfish (*Dallia pectoralis*) Captured with Minnow Traps in Campbell Lake**



# Campbell Lake, Anchorage, Alaska
# Minnow Trap Sites during 2005 - 2006 Sample Season



**Project Update: Campbell Lake Fish Assessment**
**Sample Results from 07-12-06 through 07-14-06**

Mark Somerville and Megan Marie
ADNR Office of Habitat Management and Permitting

The tenth trapping session on Campbell Lake was conducted July 12 through 14. Twenty-seven traps were set for 24 hours along 9 transects across the lake from July 12 - 13 (Map 1). Four traps were set along the lower reach of Campbell Creek above the first bike trail crossing from July 13 - 14. All traps were baited with salmon roe.

The big news is that we finally caught chinook salmon fry and lots of them. A total of 221 were captured in Campbell Lake. Fork lengths ranged from 39 mm to 77 mm (Figure 4) and mean length was 57.4 mm. All the chinook salmon fry appeared to be young-of-the-year. All fry were captured in only 4 traps along the west shore at the head of the lake where there was a noticeable current from Campbell Creek.

A total of 64 coho salmon were captured in Campbell Lake. Fork lengths ranged from 44 mm to 122 mm (Figure 3) and mean length was 84.9 mm. Length frequency indicated no distinct age cohorts which is unusual for coho samples collected from Campbell Lake thus far. CPUE for coho salmon dropped slightly from June to July (Figure 7). Juvenile salmonids, presumably coho salmon, were observed near the dam at the mouth of Campbell Lake and were passing over it.

Only 15 blackfish were captured in Campbell Lake in July. They ranged from 76 mm to 147 mm total length (mean 111.6 mm) (Figure 5). Size distribution was consistent with all other sampling periods.

Macrophyte growth was substantial between June 14 and July 12. On June 14 macrophytes were just beginning their summer growth, but were still sparse across the lake. On July 12 macrophyte growth was extensive with both pond weed and coontail emerging at the water surface. Large algal mats were formed within the coontail beds Some of these mats were the size of small cars.

Coho and chinook salmon avoided the dense macrophyte beds while Alaska blackfish showed no particular preference for macrophyte density (Table 1). Macrophyte beds were assigned a relative density of zero (no macrophytes within about 2 meters of the trap location), sparse (macrophytes covering about 25% - 50% of the bottom), moderate (macrophytes covering at least 50% of the bottom), and thick (macrophytes covering between 75% and 100% of the bottom). There was no obvious preference for smaller fry versus large fry occupying areas with different densities of macrophyte cover.

**Table 1. Percent occurrence of fishes captured with minnow traps in Campbell Lake with reference to macrophyte density.**

| | Percentage of Occurrence | | |
|---|---|---|---|
| Macrophyte Density | Coho salmon | King salmon | Alaska blackfish |
| Zero | 20 | 23 | 27 |
| Sparse | 67 | 77 | 27 |
| Moderate | 13 | 0 | 13 |
| Thick | 0 | 0 | 33 |

A total of 34 coho salmon were captured in Campbell Creek. Fork lengths ranged from 43 mm to 130 mm (Figure 6). Mean length was 81.6 mm. CPUE was similar between June and July (Figure 8).

Seven chinook salmon were captured in Campbell Creek. Fork lengths ranged from 48 mm to 90 mm. Mean length was 66.9 mm, slightly higher than for chinook salmon fry captured in Campbell Lake.

Seven Dolly Varden were also captured in Campbell Creek. Fork lengths ranged from 100 mm to 160 mm. Mean length was 128.9 mm.

Water temperature (Table 2) and dissolved oxygen (DO) (Table 3) were essentially uniform from lake surface to bottom. The lower end of the lake (site 112) was still about 1.0 $^{o}$C warmer than the middle or upper sample sites. A narrow thermocline appeared to be present between 4 and 6 ft (Figure 1) which is unusual for such a shallow lake. Water temperature rose about 6.0 $^{o}$C from June 14 to July 12. DO's were essentially the same as in June (Figure 2).

Discharge from Campbell Lake was estimated at over 200 cfs on July 12. Water clarity was about average with traps visible at 3 feet.

The next trapping session is scheduled for mid-August.

Temperature Profile Data for Campbell Lake, Alaska, July 12, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Temperature $^{o}$C | | |
|---|---|---|---|
| | Site 112 | Site 92 | Site 71 |
| 0 | 18.30 | 17.40 | 17.10 |
| 1 | 18.30 | 17.40 | 17.10 |
| 2 | 18.10 | 17.30 | 16.80 |
| 3 | 18.00 | 17.20 | 16.60 |
| 4 | 16.70 | 16.60 | 16.40 |
| 5 | 15.90 | 15.30 | 15.20 |
| 6 | 15.40 | 15.10 | 14.70 |
| 7 | 14.90 | 14.90 | 14.50 |
| 8 | 14.70 | 14.80 | 14.30 |
| 9 | 14.50 | 14.70 | 14.30 |
| 10 | 14.40 | 14.30 | 14.20 |
| 11 | 14.30 | 14.20 | 14.10 |
| 12 | 14.30 | 14.20 | 14.10 |
| 13 | 14.10 | 14.10 | 14.10 |
| 14 | | 14.10 | 14.00 |
| 15 | | 14.00 | 14.00 |
| 16 | | | 14.00 |

Dissolved Oxygen Profile Data for Campbell Lake, Alaska, July 12, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake.

| DEPTH (Feet) | Dissolved Oxygen mg/L | | |
|---|---|---|---|
| | Site 112 | Site 92 | Site 71 |
| 0 | 10.30 | 10.20 | 10.50 |
| 1 | 10.30 | 10.20 | 10.50 |
| 2 | 10.50 | 10.30 | 10.60 |
| 3 | 10.50 | 10.30 | 10.70 |
| 4 | 11.40 | 10.80 | 10.70 |
| 5 | 11.70 | 11.90 | 11.20 |
| 6 | 11.20 | 12.00 | 11.30 |
| 7 | 11.20 | 12.10 | 11.20 |
| 8 | 11.30 | 12.10 | 11.20 |
| 9 | 11.30 | 12.00 | 11.20 |
| 10 | 11.20 | 11.80 | 11.20 |
| 11 | 11.30 | 11.70 | 11.30 |
| 12 | 11.40 | 11.70 | 11.30 |
| 13 | 11.60 | 11.70 | 11.30 |
| 14 | | 11.70 | 11.30 |
| 15 | | 11.70 | 11.30 |
| 16 | | | 11.30 |

**Figure 1. Temperature profiles for the lower end of Campbell Lake from February through July, 2006.**

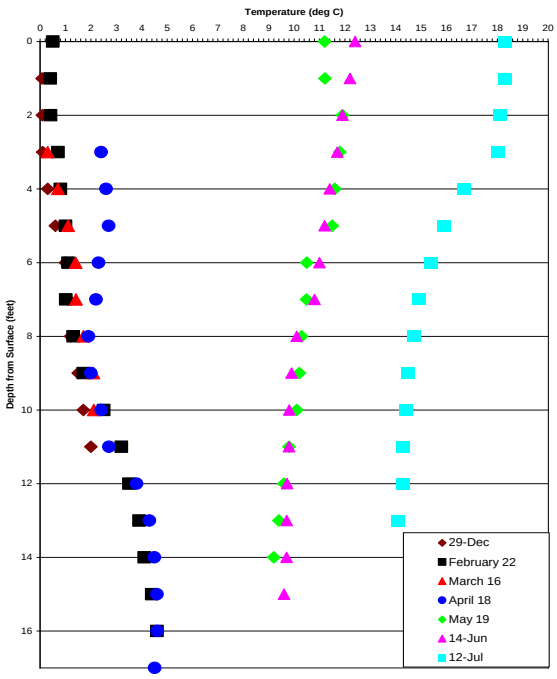



**Figure 2. Dissolved $O_2$ profiles for the lower end of Campbell Lake from February through July, 2006.**

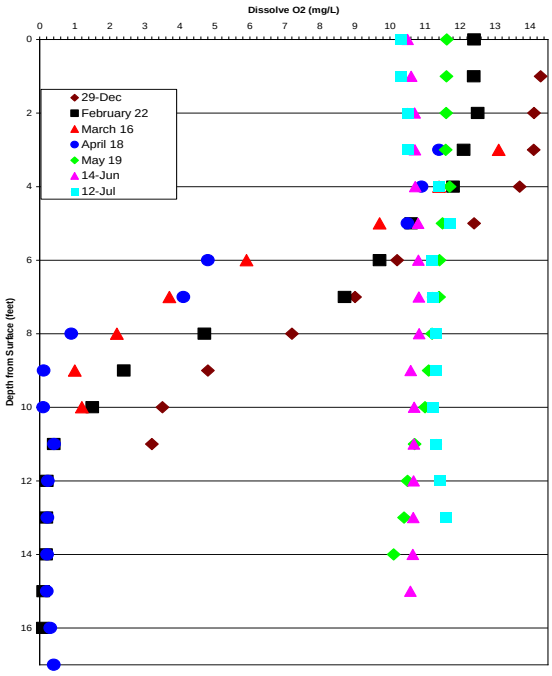



**Figure 3. Summary of length frequency for coho salmon captured with minnow traps in Campbell Lake from October, 2005 through July, 2006.**

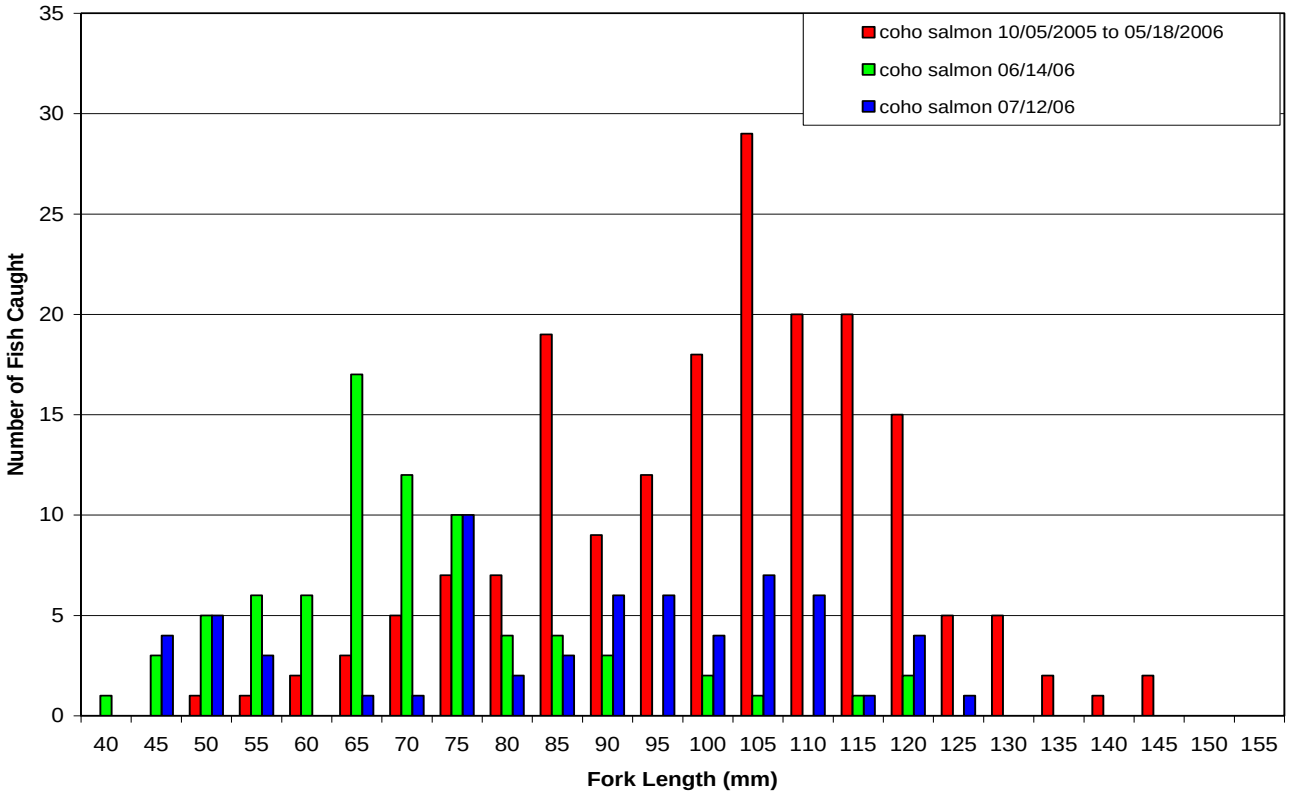


**Figure 4. Length frequency of chinook salmon captured with minnow traps in Campbell Lake**

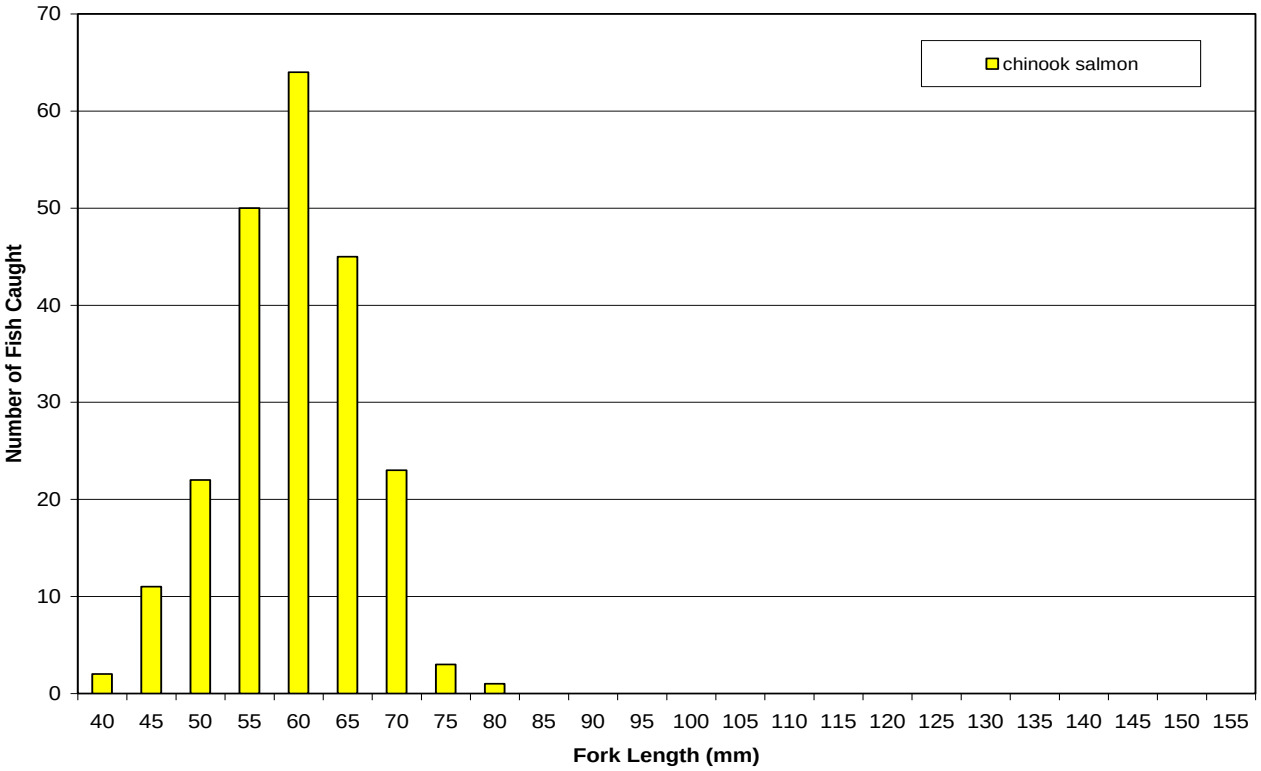



**Figure 5. Summary of length frequency for Alaska blackfish captured with minnow traps in Campbell Lake from October, 2005 through July, 2006.**

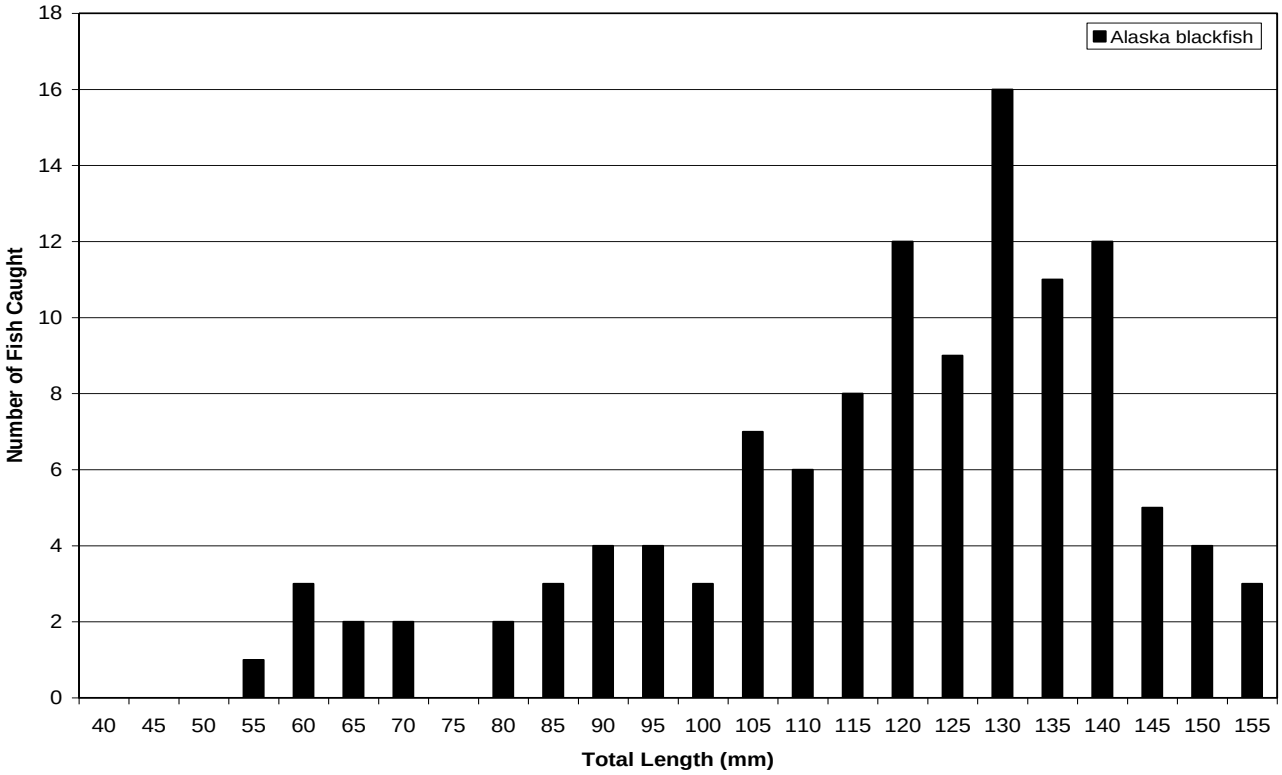


**Figure 6. Length frequency of coho salmon captured with minnow traps in lower Campbell Creek.**

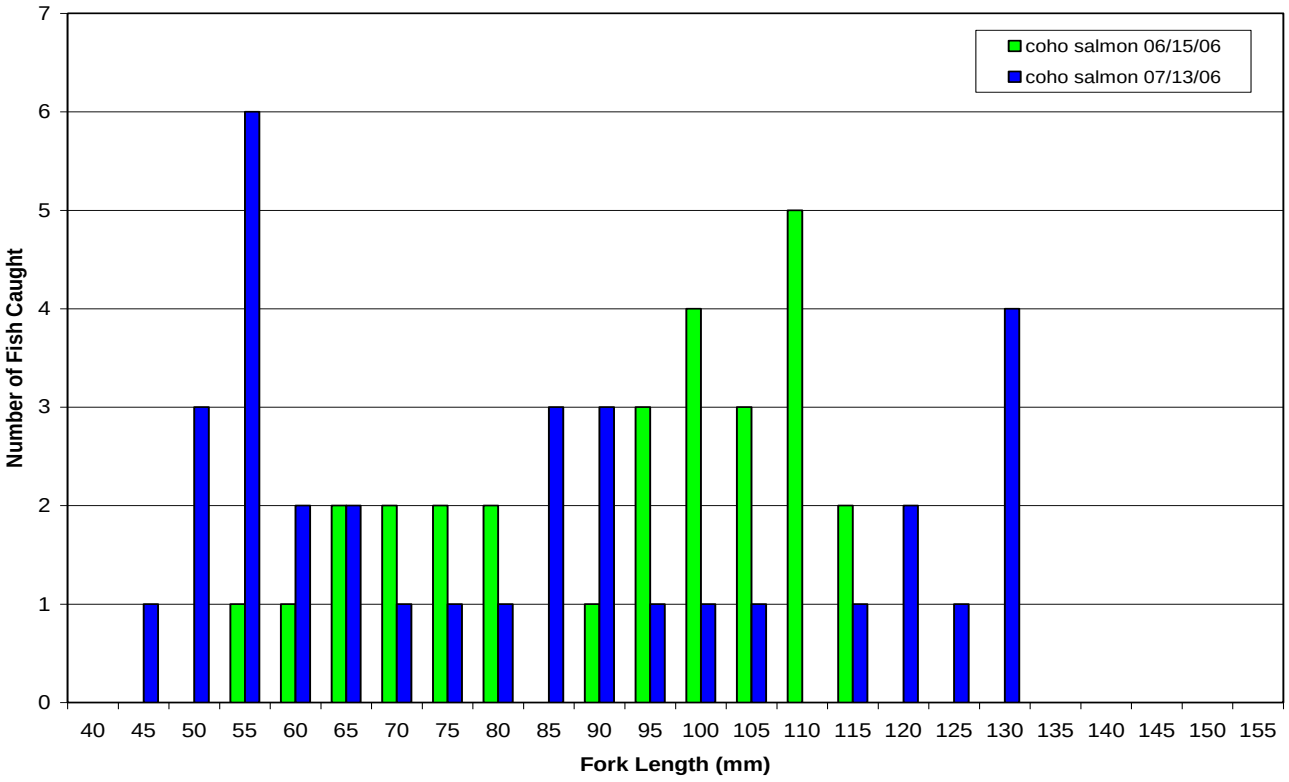



**Figure 7. Catch-per-unit-effort (fish/trap/day) for fish captured with minnow traps set in Campbell Lake during 2005 and 2006.**

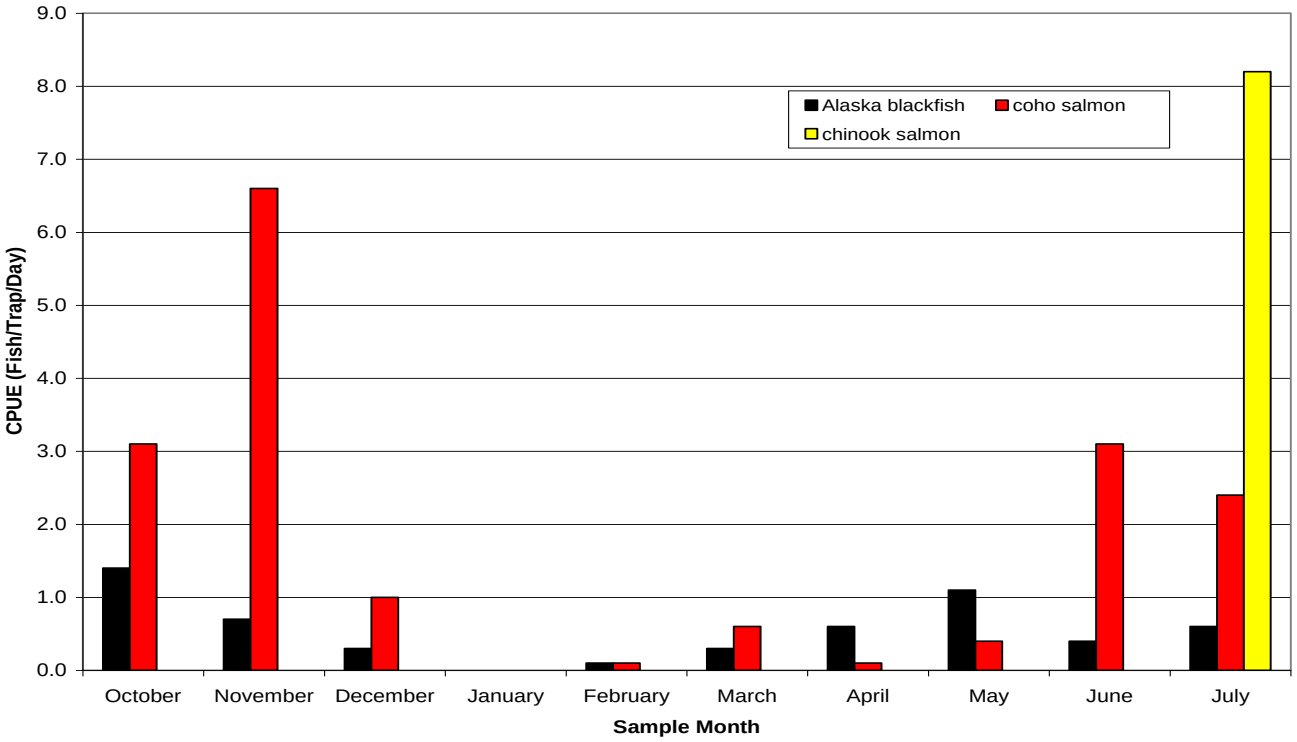
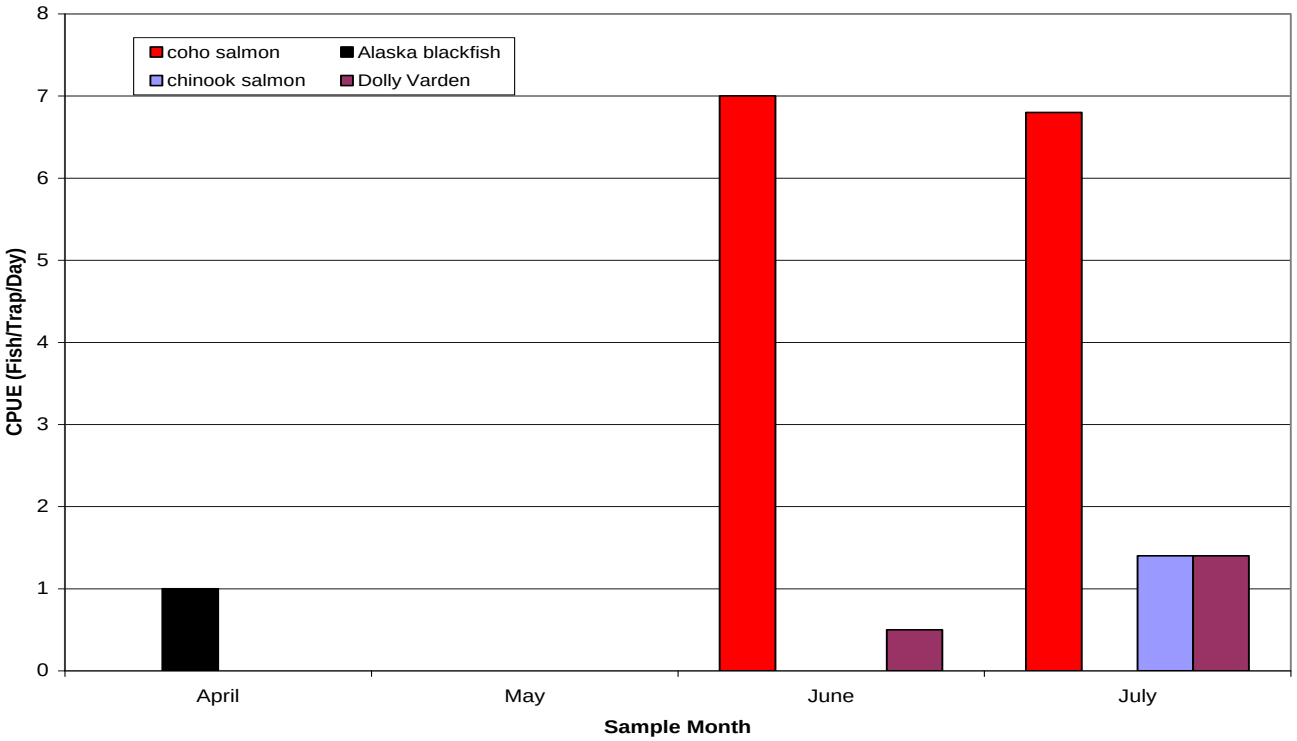
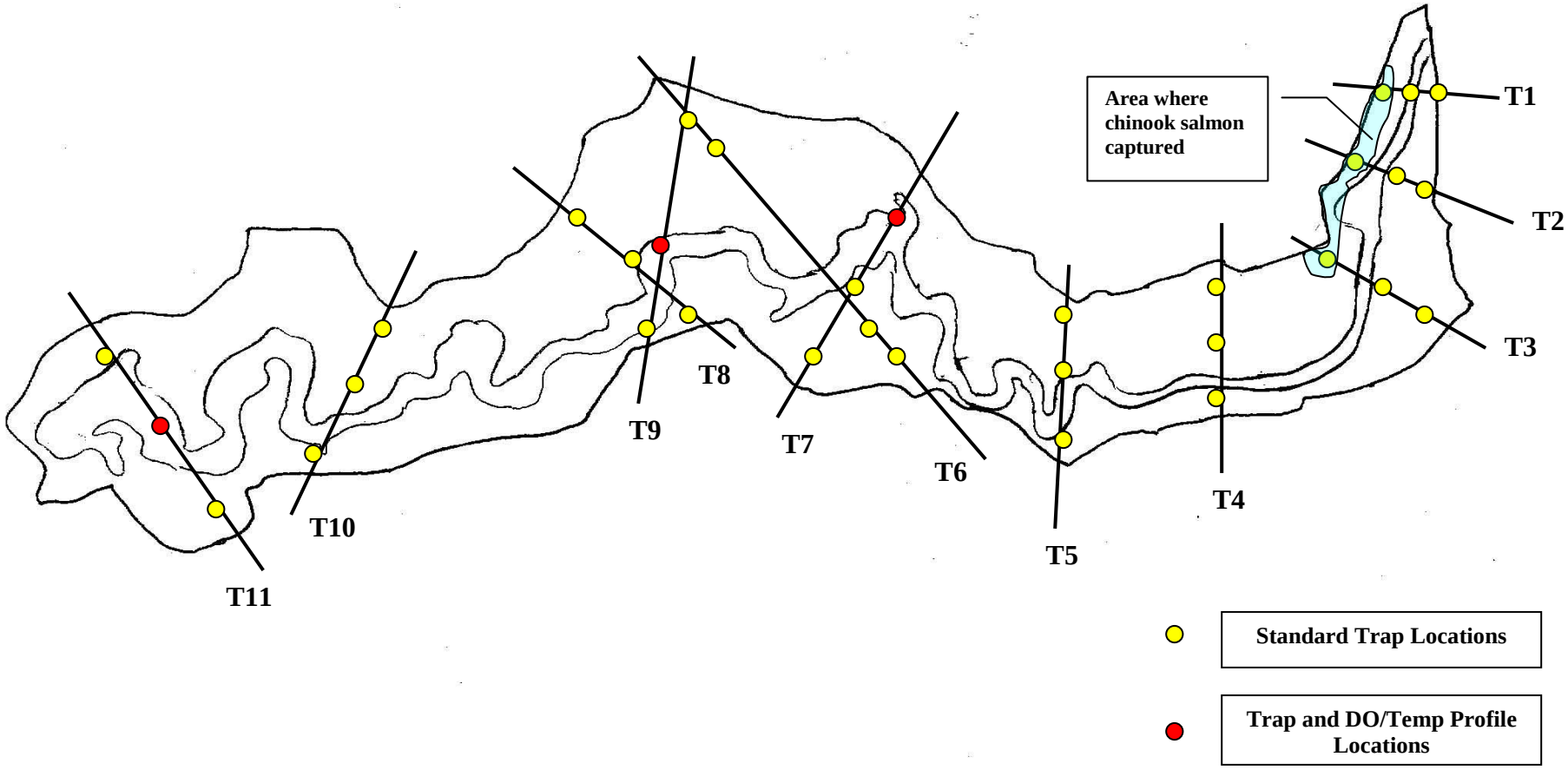


**Figure 8. Catch-per-unit-effort (fish/trap/day) for fish captured with minnow traps set in lower Campbell Creek during 2006.**



# Campbell Lake, Anchorage, Alaska
# Minnow Trap Sites during 2005 - 2006 Sample Season



**Project Update: Campbell Lake Fish Assessment**
**Sample Results from August 30 and 31, 2006**

Megan Marie and Tammy Massie
ADNR Office of Habitat Management and Permitting

On August 30th and 31st, we conducted fish sampling on Campbell Lake. Twenty-seven traps baited with salmon roe were set for 24 hours along 9 transects across the lake. Traps were not set along the lower reach of Campbell Creek due to high water levels in the creek.

A total of 16 chinook salmon fry were captured. Fork lengths ranged from 45 mm to 75 mm (Figure 4) and mean length was 59 mm. All the chinook salmon fry appeared to be young-of-the-year. Chinook fry were captured in 4 traps along the west shore at the head of the lake where there was a noticeable current from Campbell Creek. These are the same areas where chinook salmon fry were captured during the July trapping session

A total of 100 coho salmon were captured during this trapping session. Fork lengths ranged from 40 mm to 140 mm (Figure 3) and mean length was 99 mm. CPUE for coho salmon increased from July to August and was closer to the numbers of coho that were seen in June (Figure 6).

Only 18 blackfish were captured in August ranging from 75 mm to 135 mm total length (mean 103 mm) (Figure 5). Size distribution was consistent with all other sampling periods.

Macrophyte growth was extensive with both pond weed and coontail emerging at the water surface. Distribution of macrophyte beds throughout the lake remained similar to July but densities increased in some areas. Macrophyte beds were assigned a relative density of zero (no macrophytes within about 2 meters of the trap location), sparse (macrophytes covering 25% - 50% of the bottom), moderate (macrophytes covering at least 50% of the bottom), and thick (macrophytes covering between 75% and 100% of the bottom). The number of fish captured in areas of thick macrophyte cover was very low compared to the rest of the lake. The data from July and August suggest that coho and chinook salmon avoid the thick macrophyte beds while Alaska blackfish show no preference for macrophyte density.

**Table 1. Occurrence of fishes captured with minnow traps in Campbell Lake relative to macrophyte density, July and August 2006**

| | Percentage of Occurrence | | | | | |
|---|---|---|---|---|---|---|
| | Coho salmon | | King salmon | | Alaska blackfish | |
| Macrophyte Density | 12-July-06 | 31-Aug-06 | 12-July-06 | 31-Aug-06 | 12-July-06 | 31-Aug-06 |
| Zero | 20 | 42 | 23 | 38 | 27 | 50 |
| Sparse | 67 | 6 | 77 | 0 | 27 | 17 |
| Moderate | 13 | 47 | 0 | 56 | 13 | 22 |
| Thick | 0 | 5 | 0 | 6 | 33 | 11 |

Water temperature (Table 2) and dissolved oxygen (DO) (Table 3) were essentially uniform from lake surface to bottom. The lower end of the lake (site 112) was still about 1 $^{o}$C warmer than the middle or upper sample sites. Water temperature was about 8$^{o}$C lower at the surface compared to July 12. Temperature and DO profiles were very similar to the profiles from June (Figures 1,2).

Discharge from Campbell Lake was much higher than in July. Rainfall for the month of August was 4.43 inches higher than normal (http://arh.noaa.gov). Water clarity was below average with traps visible at 18 to 24 inches.

The next trapping session is scheduled for late September. The September trapping session will be the last sampling before the lake is drawn down in October. We plan to set 4 traps weekly in lower Campbell Creek prior to, during, and after the lake drawdown.

| Table 2. Dissolved Oxygen Profile Data for Campbell Lake, Alaska, August 31, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake. | | | |
|---|---|---|---|
| | Dissolved Oxygen mg/L | | |
| DEPTH (Feet) | Site 112 | Site 92 | Site 71 |
| 0 | 9.60 | 10.10 | 10.20 |
| 1 | 9.60 | 10.10 | 10.20 |
| 2 | 9.70 | 10.20 | 10.20 |
| 3 | 9.70 | 10.20 | 10.30 |
| 4 | 9.80 | 10.20 | 10.30 |
| 5 | 9.80 | 10.20 | 10.30 |
| 6 | 9.80 | 10.20 | 10.30 |
| 7 | 9.80 | 10.20 | 10.30 |
| 8 | 9.80 | 10.20 | 10.30 |
| 9 | 9.90 | 10.20 | 10.30 |
| 10 | 9.90 | 10.20 | 10.30 |
| 11 | 9.90 | 10.20 | 10.30 |
| 12 | 9.90 | 10.20 | 10.30 |
| 13 | 9.90 | 10.20 | 10.30 |
| 14 | 9.90 | 10.20 | 10.30 |
| 15 | | | 10.30 |

| Table 3. Temperature Profile Data for Campbell Lake, Alaska, August 31, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake. | | | |
|---|---|---|---|
| | Temperature $^{o}$C | | |
| DEPTH (Feet) | Site 112 | Site 92 | Site 71 |
| 0 | 10.30 | 9.20 | 8.80 |
| 1 | 10.20 | 9.00 | 8.60 |
| 2 | 10.10 | 8.80 | 8.50 |
| 3 | 9.80 | 8.70 | 8.40 |
| 4 | 9.70 | 8.70 | 8.40 |
| 5 | 9.60 | 8.60 | 8.30 |
| 6 | 9.60 | 8.60 | 8.30 |
| 7 | 9.60 | 8.50 | 8.30 |
| 8 | 9.50 | 8.50 | 8.30 |
| 9 | 9.50 | 8.50 | 8.20 |
| 10 | 9.50 | 8.40 | 8.20 |
| 11 | 9.50 | 8.40 | 8.20 |
| 12 | 9.50 | 8.30 | 8.20 |
| 13 | 9.40 | 8.30 | 8.10 |
| 14 | 9.30 | 8.30 | 8.10 |
| 15 | | | 8.10 |

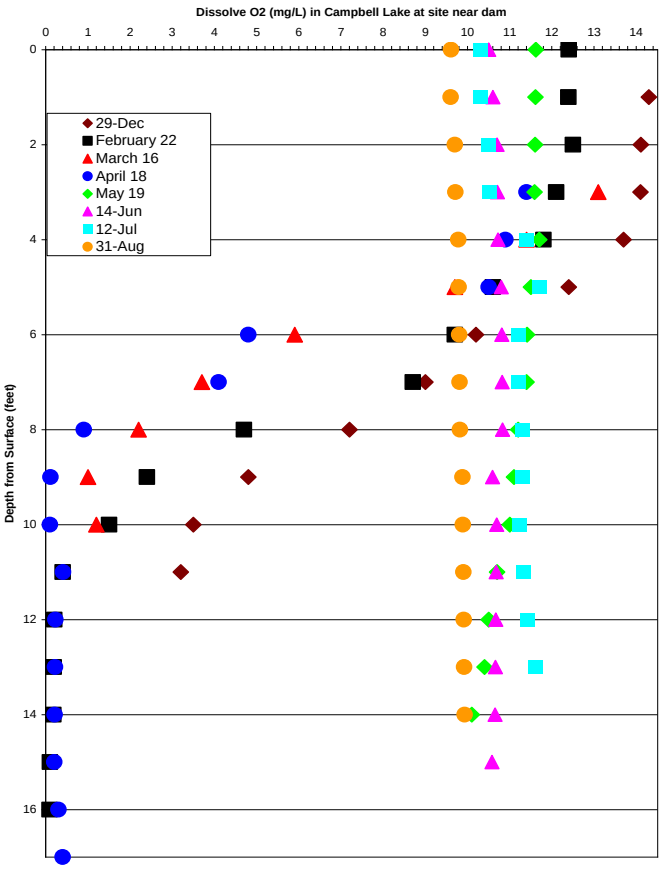



**Figure 1. Dissolved $O_2$ profiles for the lower end of Campbell Lake from December 2005 through August, 2006.**

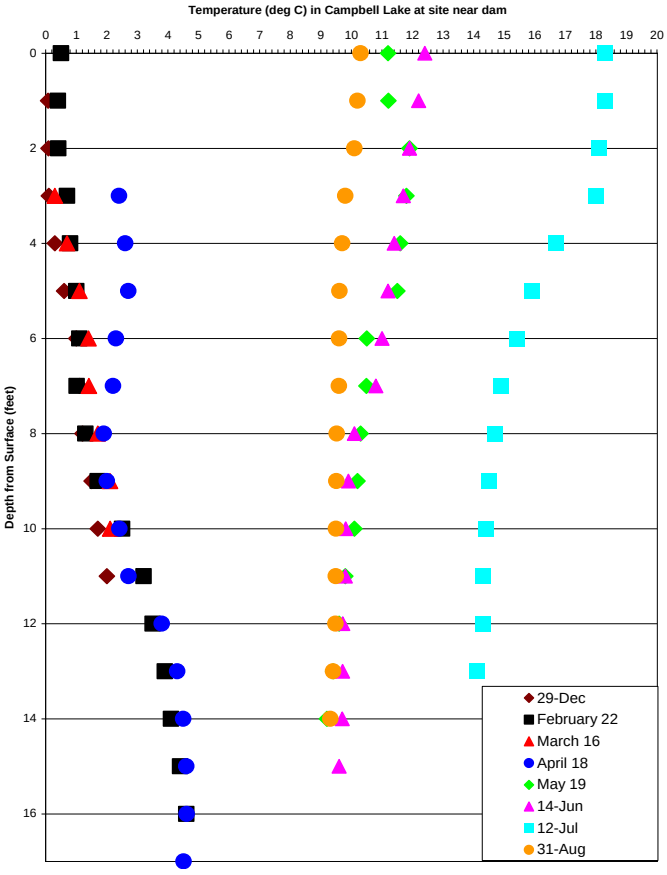



**Figure 2. Temperature profiles for the lower end of Campbell Lake from December 2005 through August, 2006.**

**Figure 3. Length frequency of coho salmon captured with minnow traps in Campbell Lake**

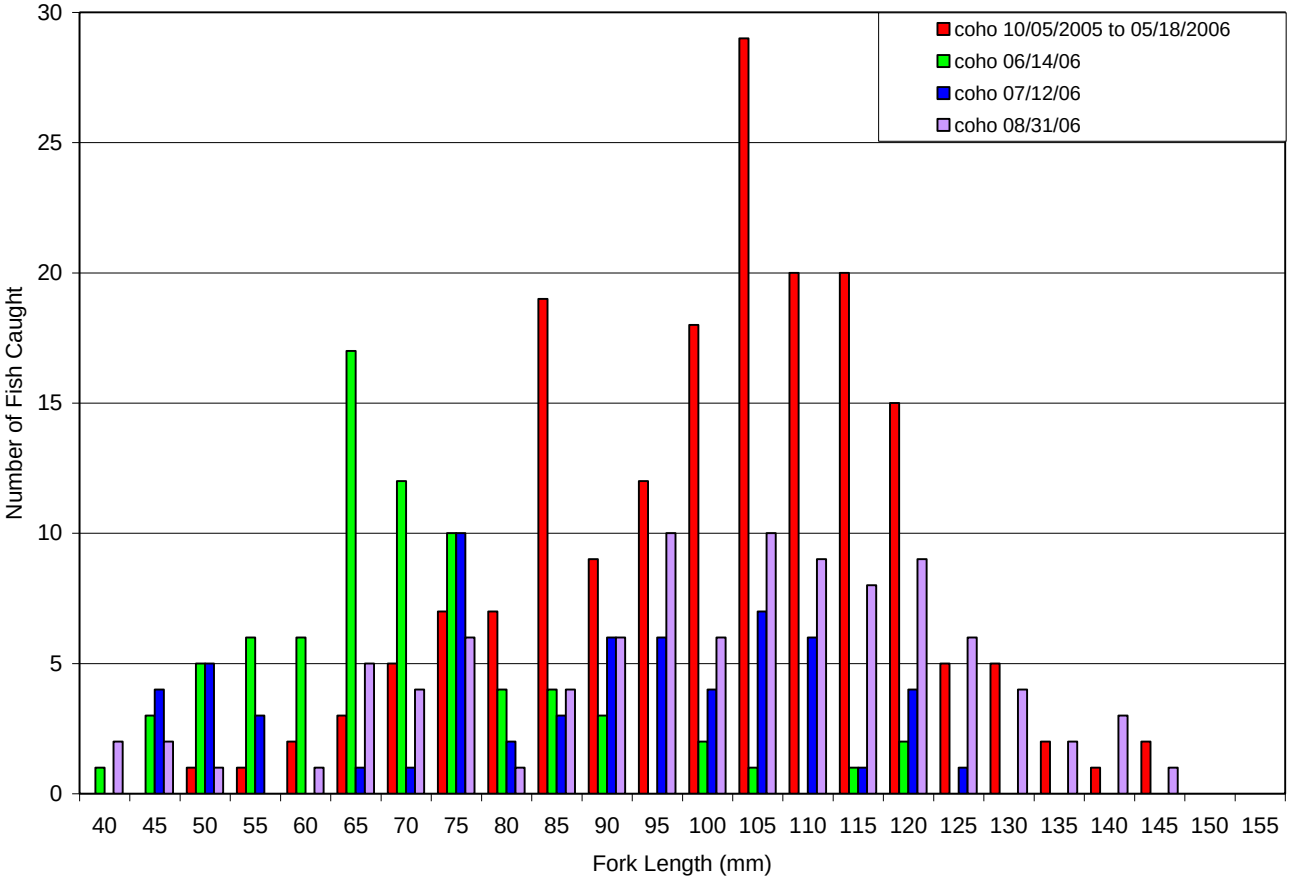



**Figure 4. Length frequency of chinook salmon captured with minnow traps in Campbell Lake**

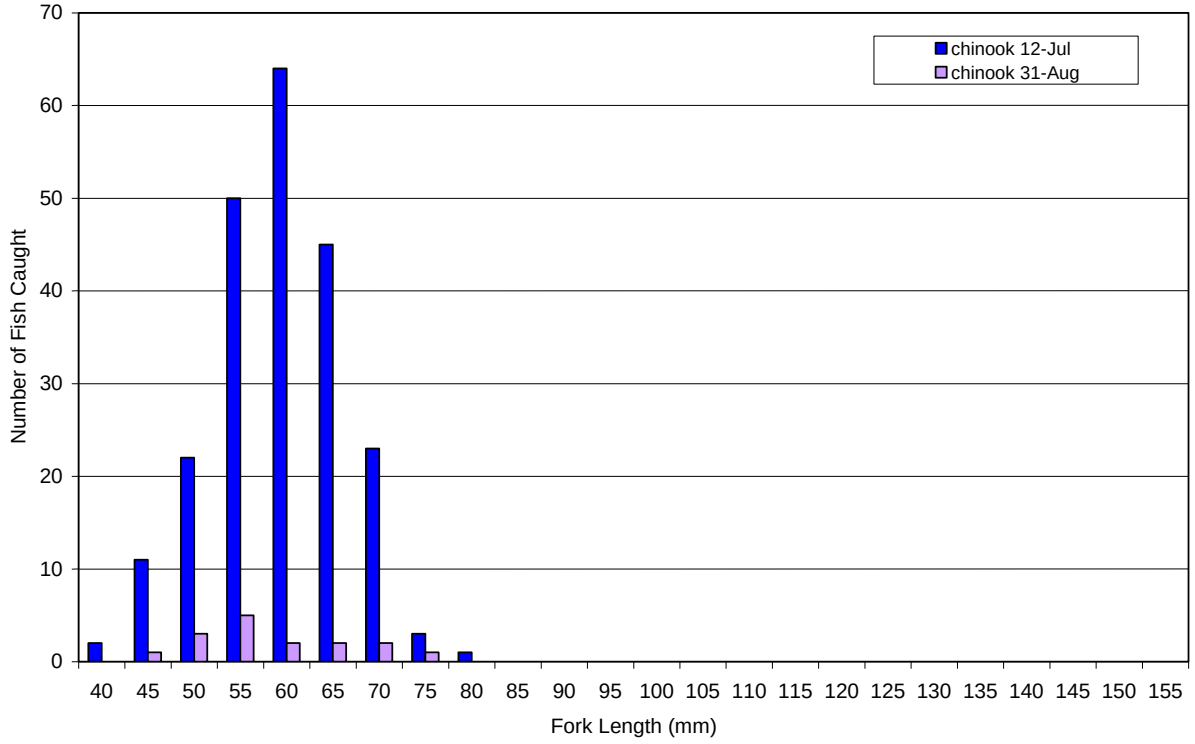


**Figure 5. Length frequency of Alaska blackfish captured with minnow traps in Campbell Lake from October, 2005 through August, 2006.**

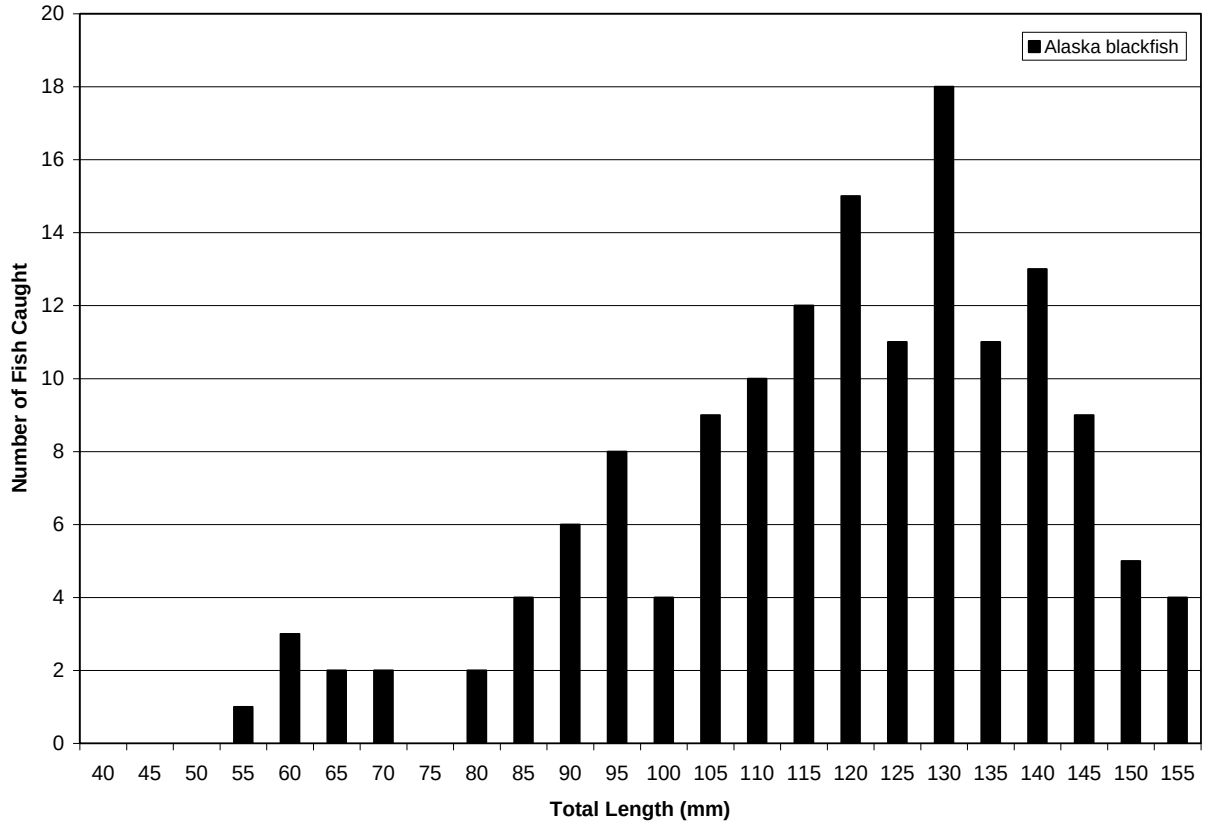
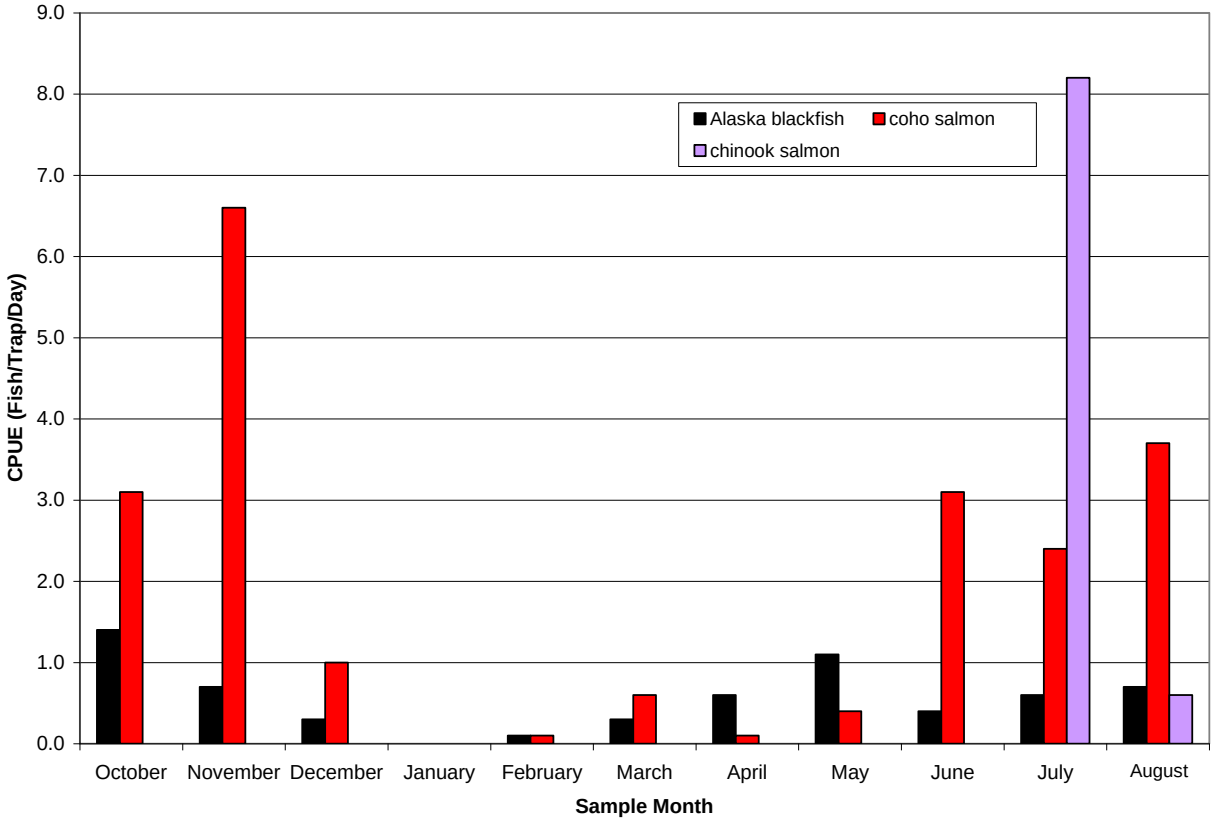
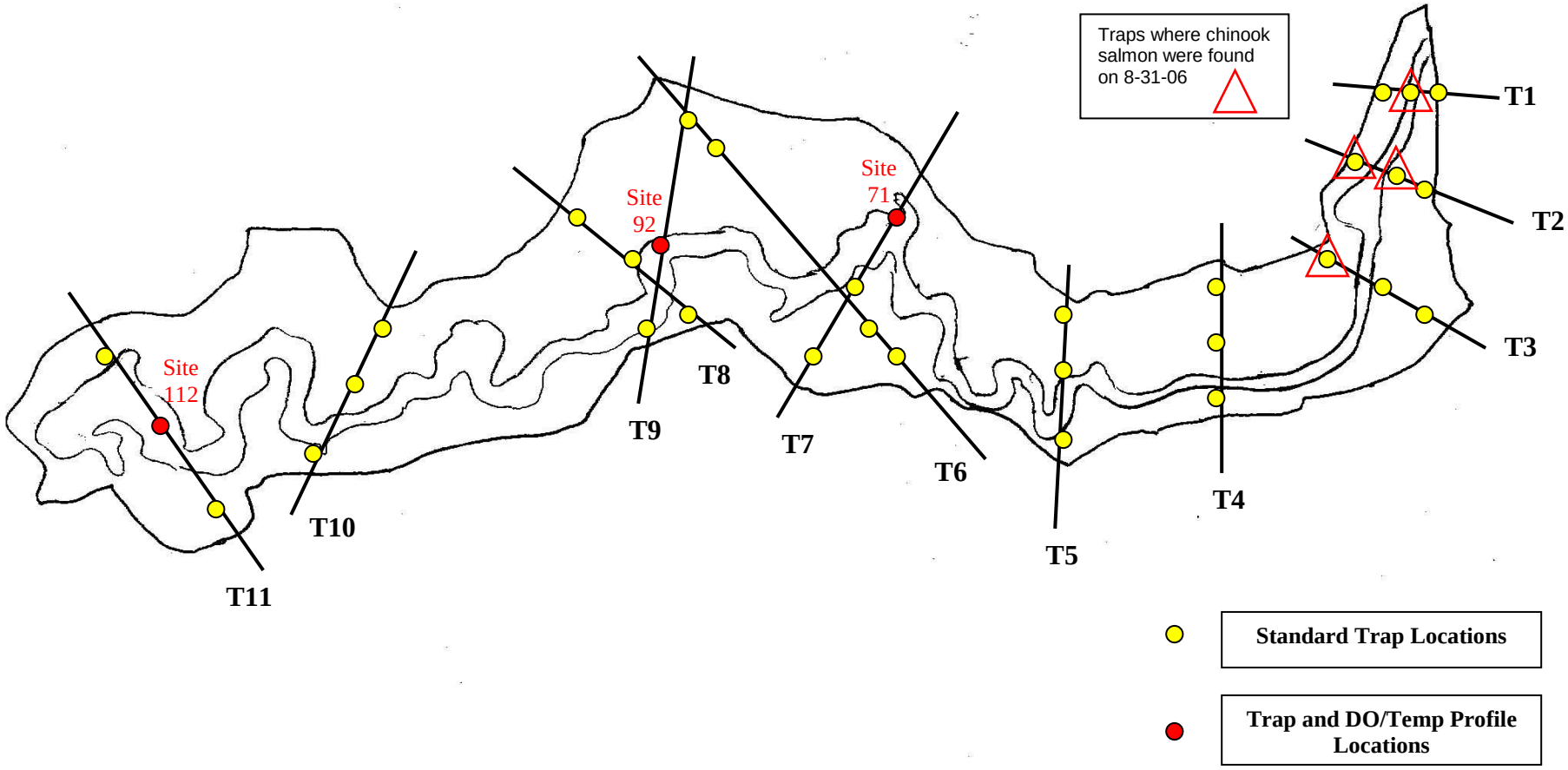



**Figure 6. Catch-per-unit-effort of fish captured with minnow traps in Campbell Lake during 2005 and 2006.**



# Campbell Lake, Anchorage, Alaska
# Minnow Trap Sites during 2005 - 2006 Sample Season



**Project Update: Campbell Lake Fish Assessment**
**Sample Results from September 25 -26, 2006**

Megan Marie and Tammy Massie
ADNR Office of Habitat Management and Permitting

On September 25th and 26th, we conducted fish sampling on Campbell Lake. Twenty-seven traps baited with salmon roe were set for 24 hours along 9 transects across the lake. Four traps were set in the lower reach of Campbell Creek. The data from Campbell Creek will be presented in a later report.

A total of 3 chinook salmon fry were captured in Campbell Lake. Fork lengths ranged from 75 mm to 95 mm (Figure 4) and mean length was 85 mm. All the chinook salmon fry appeared to be young-of-the-year. Chinook fry were captured in 3 traps along the west shore at the head of the lake. These are the same areas where chinook salmon fry were captured during the July and August trapping sessions.

A total of 91 coho salmon were captured during this trapping session. Fork lengths ranged from 39 mm to 157 mm (Figure 3) and mean length was 113 mm. CPUE for coho salmon increased from July to August and was closer to the numbers of coho that were seen in June (Figure 6).

A total of 41 blackfish were captured in September ranging from 50 mm to 175 mm total length (mean 120 mm) (Figure 5). Size distribution was consistent with all other sampling periods. There were two instances when captured blackfish appeared much larger than the trap openings. We suspected the blackfish had consumed smaller fish while in the trap. This was confirmed in one trap as a blackfish was found with half of a salmonid fry (~60mm) sticking out of its mouth (Figure 7).

Macrophyte growth was extensive with both pond weed and coontail emerging at the water surface. Distribution of macrophyte beds throughout the lake remained similar to August but densities increased in some areas. Macrophyte beds were assigned a relative density of zero (no macrophytes within about 2 meters of the trap location), sparse (macrophytes covering 25% - 50% of the bottom), moderate (50% -75%), and thick (75% and 100%). The data from July and August suggested that coho and chinook salmon avoid the thick macrophyte beds while Alaska blackfish show no preference for macrophyte density. September's data did not suggest the same habitat preferences as July and August, but this may be due to increased macrophyte densities in some areas.

**Table 1. Occurrence of fishes captured with minnow traps in Campbell Lake relative to macrophyte density, July – September 2006**

| Macrophyte Density | Percentage of Occurrence | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coho salmon | | | King salmon | | | Alaska blackfish | | |
| | 12-Jul | 31-Aug | 26-Sept | 12-Jul | 31-Aug | 26-Sept | 12-Jul | 31-Aug | 26-Sept |
| Zero | 20 | 42 | 32 | 23 | 38 | 33 | 27 | 50 | 34 |
| Sparse | 67 | 6 | 7 | 77 | 0 | 0 | 27 | 17 | 15 |
| Moderate | 13 | 47 | 13 | 0 | 56 | 0 | 13 | 22 | 15 |
| Thick | 0 | 5 | 48 | 0 | 6 | 67 | 33 | 11 | 36 |

Water temperature (Table 2) and dissolved oxygen (DO) (Table 3) were essentially uniform from lake surface to bottom. The lower end of the lake (Site 112) was still about 1 $^{o}$C warmer than the middle or upper sample sites. Water temperature was about 2$^{o}$C lower at the surface compared to July 12. Temperature and DO profiles for the lower end of the lake are shown in Figures 1 & 2. Discharge from Campbell Lake was nearly as high as it was in late August. Water clarity was below average with traps visible at 18 to 24 inches.

This trapping session was the last sampling before the lake is drawn down. Drawdown is tentatively scheduled to begin on October 20th. We have set 4 traps weekly in lower Campbell Creek since September 26th and we will continue trapping in the creek during and after the lake drawdown. We will report this data in mid-November.

Temperature Profile Data for Campbell Lake,

| Dissolved Oxygen Profile Data for Campbell Lake, Alaska, September 26, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake. | | | |
|---|---|---|---|
| | **Dissolved Oxygen mg/L** | | |
| DEPTH (Feet) | Site 112 | Site 92 | Site 71 |
| 0 | 10.70 | 11.00 | 11.00 |
| 1 | 10.70 | 11.00 | 11.00 |
| 2 | 10.70 | 11.00 | 11.00 |
| 3 | 10.70 | 11.00 | 11.10 |
| 4 | 10.60 | 11.00 | 11.10 |
| 5 | 10.60 | 11.00 | 11.10 |
| 6 | 10.60 | 11.00 | 11.10 |
| 7 | 10.60 | 11.00 | 11.10 |
| 8 | 10.60 | 11.00 | 11.10 |
| 9 | 10.60 | 10.90 | 11.10 |
| 10 | 10.60 | 10.90 | 11.20 |
| 11 | 10.60 | 10.90 | 11.20 |
| 12 | 10.60 | 10.90 | 11.10 |
| 13 | 10.60 | 10.90 | 11.10 |
| 14 | 10.60 | 10.90 | 11.10 |
| 15 | 10.60 | | |

| Alaska, September 26, 2006. Sites are Numbered or Lettered from the Inlet to the Outlet of the Lake. | | | |
|---|---|---|---|
| | **Temperature $^{o}$C** | | |
| DEPTH (Feet) | Site 112 | Site 92 | Site 71 |
| 0 | 7.70 | 7.20 | 7.00 |
| 1 | 7.80 | 7.20 | 7.00 |
| 2 | 7.80 | 7.20 | 7.00 |
| 3 | 7.80 | 7.20 | 7.00 |
| 4 | 7.80 | 7.20 | 6.90 |
| 5 | 7.80 | 7.20 | 6.90 |
| 6 | 7.80 | 7.20 | 6.90 |
| 7 | 7.80 | 7.20 | 6.90 |
| 8 | 7.80 | 7.20 | 6.90 |
| 9 | 7.80 | 7.20 | 6.90 |
| 10 | 7.80 | 7.20 | 6.90 |
| 11 | 7.80 | 7.20 | 6.90 |
| 12 | 7.80 | 7.20 | 6.90 |
| 13 | 7.80 | 7.20 | 6.90 |
| 14 | 7.80 | 7.20 | 6.90 |
| 15 | 7.80 | | |

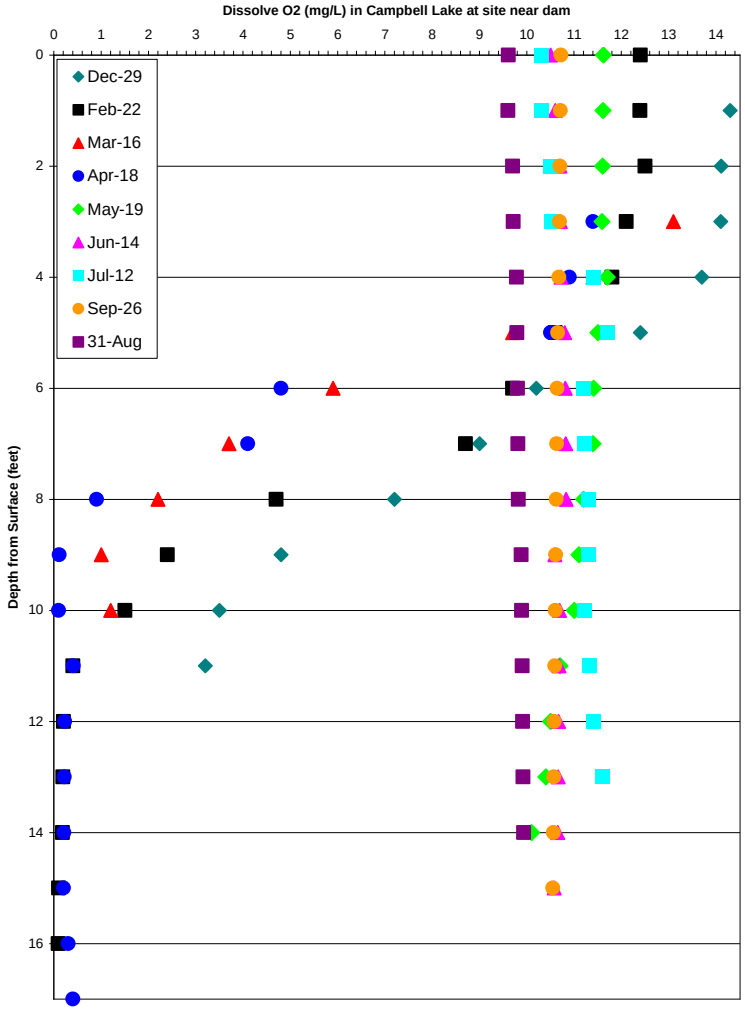



**Figure 1. Dissolved $O_2$ profiles for the lower end of Campbell Lake from December 2005 through September, 2006.**

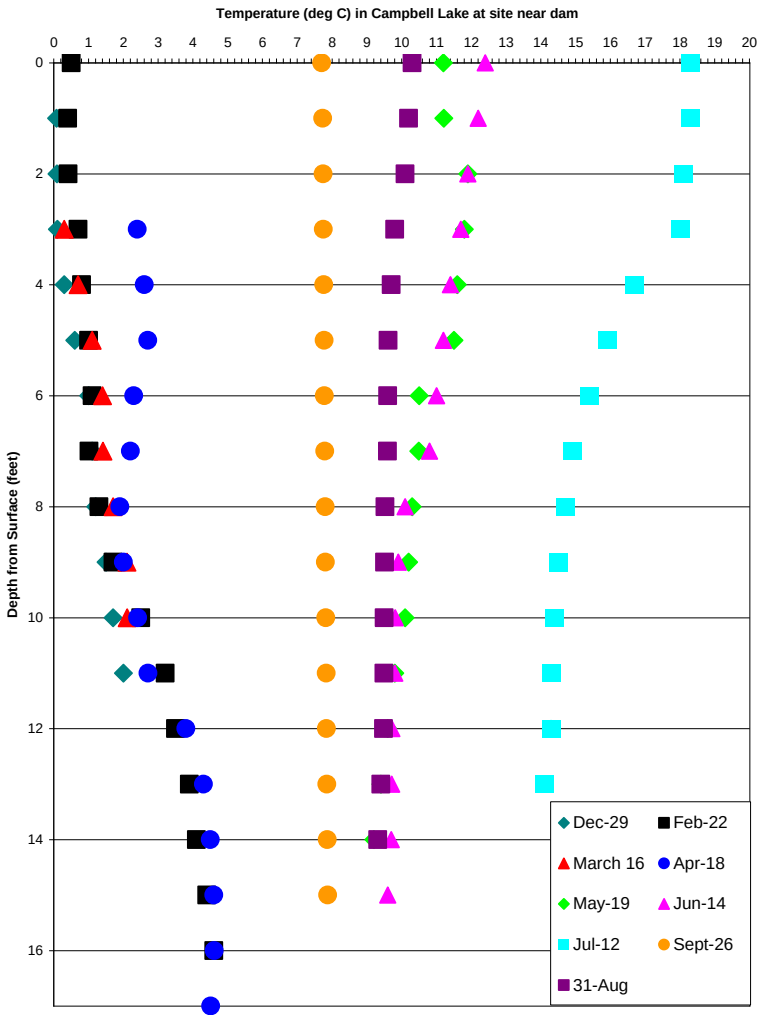



**Figure 2. Temperature profiles for the lower end of Campbell Lake from Dec. 2005 through Sept. 2006.**

**Figure 3. Length frequency of coho salmon captured with minnow traps in Campbell Lake**

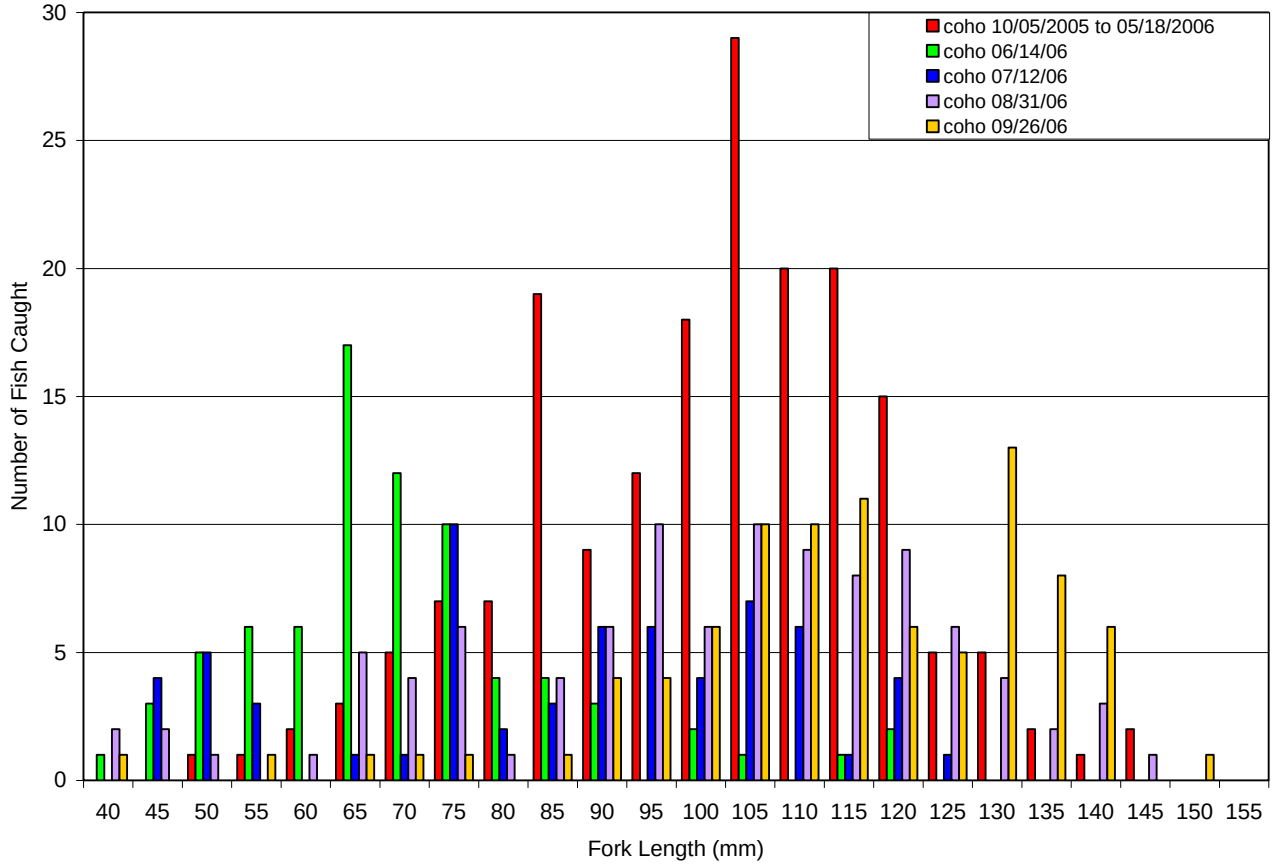



**Figure 4. Length frequency of chinook salmon captured with minnow traps in Campbell Lake**

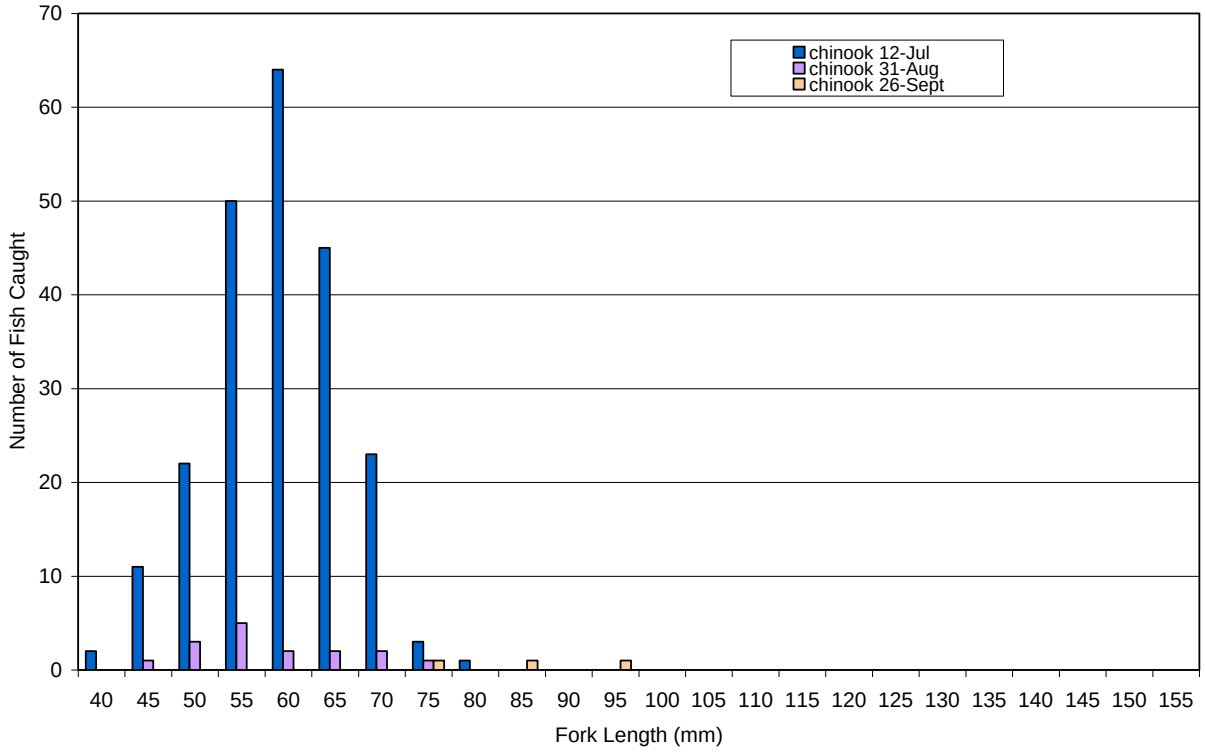


**Figure 5. Length frequency of Alaska blackfish captured with minnow traps in Campbell Lake from October, 2005 through September, 2006.**

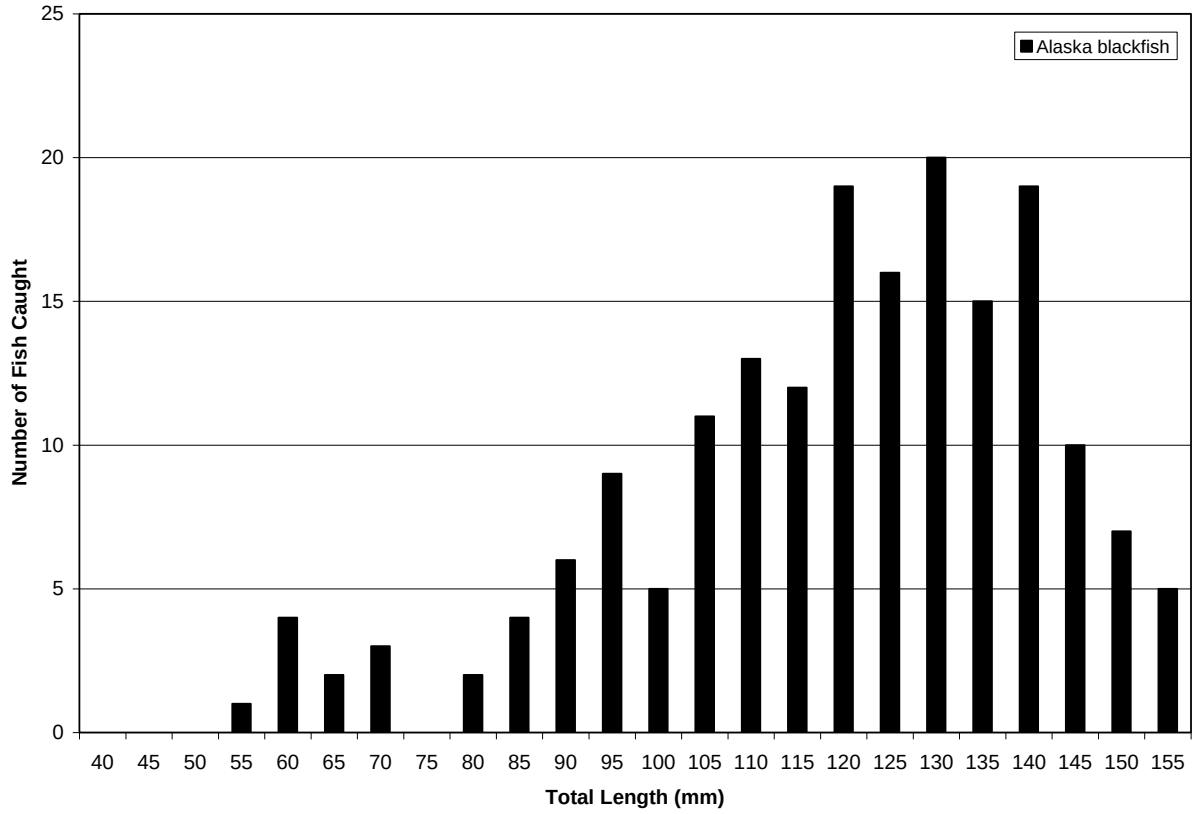



**Figure 6. Catch-per-unit-effort of fish captured with minnow traps in Campbell Lake during 2005 and 2006.**

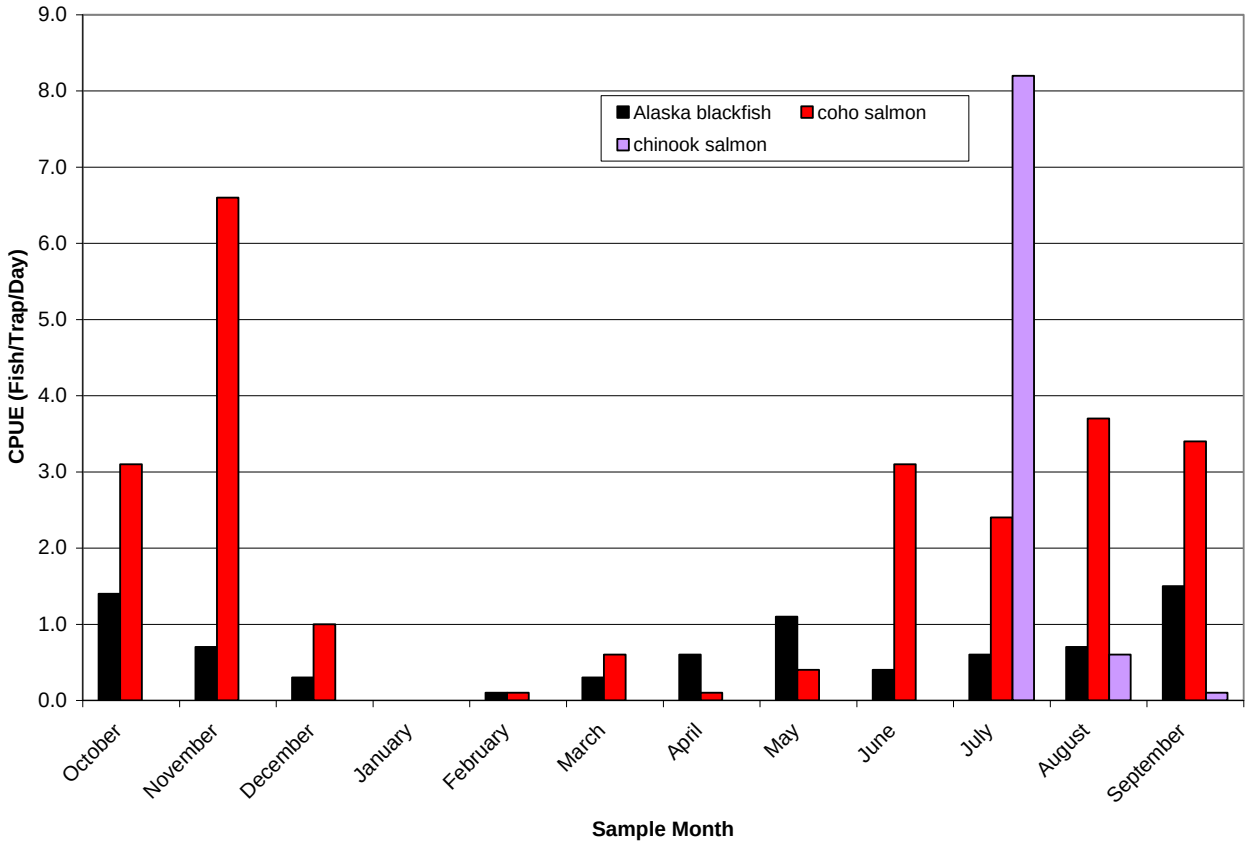


**Figure 7. Alaska blackfish with partially digested salmonid in mouth, Sept. 26, 2006.**

# Campbell Lake, Anchorage, Alaska
# Minnow Trap Sites during 2005 - 2006 Sample Season