Idaho Department of Fish and Game

# Dworshak Reservoir Quarterly Report

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Illustration by J.R. Tomelleri

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**Inside this issue:**



Figure 1. Dworshak Reservoir and Dam, and the North Fork Clearwater River.

**Points of Interest:**

- Brief discussion of entrainment problem at Dworshak.
- Testing shows underwater strobe lights reduced kokanee numbers near turbines by nearly 90%.
- Reservoir productivity sampling will continue, April—November, 2005
- Preparing strobe light installation plan.
- Installation of wireless Ethernet system for entrainment sampling slated for next quarter.

## Underwater Strobe Light Effectiveness Testing

At Dworshak Reservoir (Figure 1), it was estimated that 1.4 million kokanee (95% of the population) were lost through the dam in a period of 5 months in 1996 (Maiolie and Elam 1998). Thus, entrainment loss of kokanee has been established as the single most important factor contributing to variability in the population. In 1996, losses of kokanee were severe enough that they strongly affected the angler's success in subsequent years. Years with high discharge have correlated with lower kokanee survival (Figure 2) and therefore reduced populations in the reservoir (Maiolie and Elam 1993), When densities are high, Dworshak Reservoir becomes one of the best kokanee fisheries in the state, accounting for a harvest of over 200,000 fish annually. When densities are low, catch rates, harvest, and fishing effort are sharply reduced.

Physically screening Dworshak Dam to prevent fish losses would be very difficult because of high flows (Figure 3) and the large amounts of debris within the reservoir. Therefore, one major task of this project is to test behavioral avoidance devices to determine if kokanee, and other fish, can be deterred from the turbine intakes and effectively decrease entrainment.

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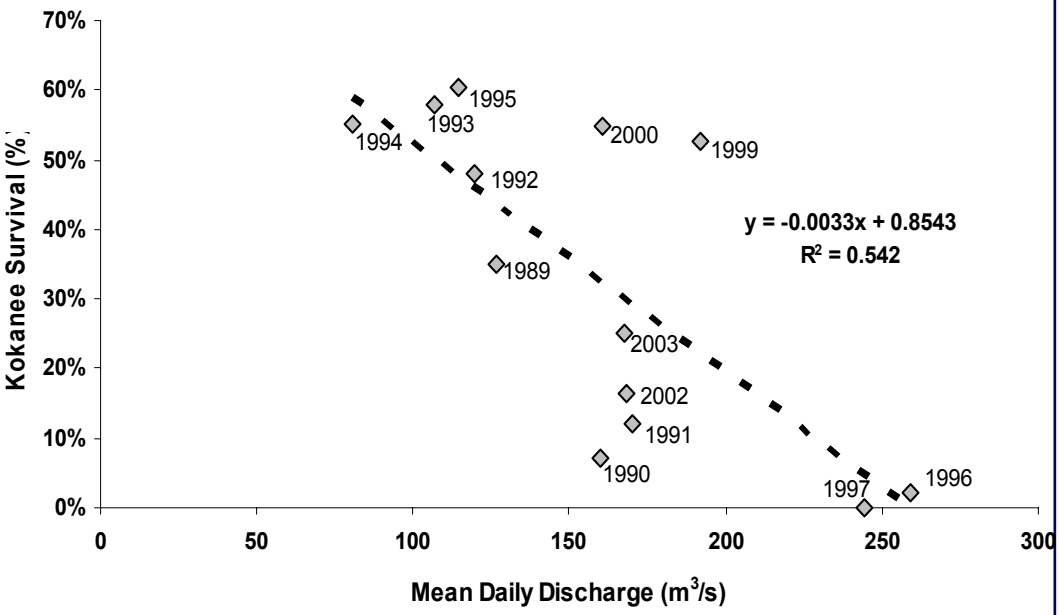


Figure 2. Relationship between the mean daily discharge ($m^3/s$) through Dworshak Dam between July 1 and June 30 and the estimated kokanee survival rates (%) from age 1 to age 2 based on July population estimation surveys, 1989 - 2003.

# Underwater Strobe Light Effectiveness Testing (continued…)

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Many previous studies have achieved good success at affecting the behavior of different species of fish with the use of strobe lights, in a number of different conditions. Strobe light testing for this project was first conducted off-site in 1997 in Spirit Lake and Lake Pend Oreille, and again in 1998 on Lake Pend Oreille (Figure 3). In 1998, kokanee avoided the strobe lights for the entire night and remained 30 to 136 m away from them in the open water environment of Lake Pend Oreille (Maiolie et al. 2001). Lights were found to be even more effective during winter (the season of highest entrainment losses) when water clarity was higher.

We have continued our on-site testing strobe lights to determine their effectiveness at repelling kokanee away from Dworshak Dam, specifically progressing to testing in front of two discharging turbine intakes simultaneously (Figure 4). We tested two sets of nine strobe lights flashing at a rate of 360 flashes/min. One set of lights was placed in front of turbine intake one

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Figure 3. Underwater strobe lights (Flash Technologies, Inc.) used in effectiveness testing at Dworshak Dam.

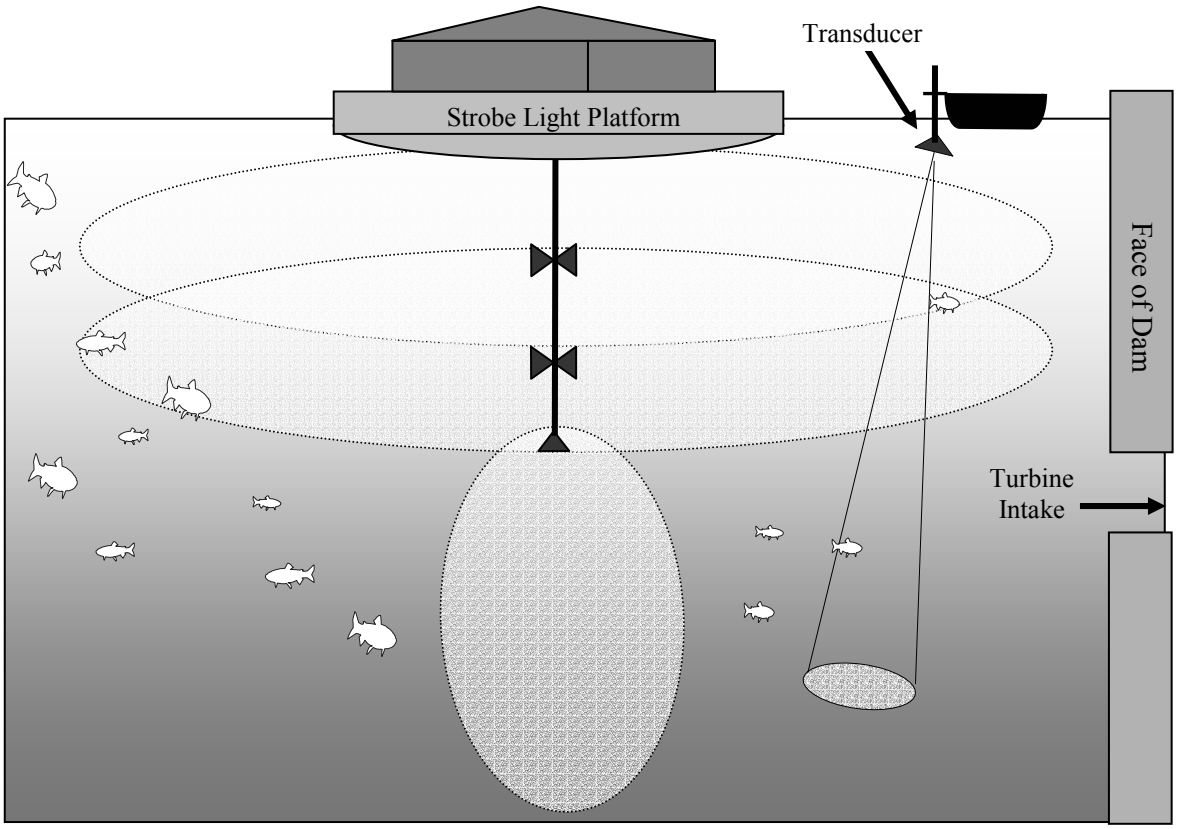


Figure 4. Diagram of strobe light and hydroacoustic equipment setup during testing of strobe light effectiveness to deter kokanee away from discharging turbine units.

# Dworshak Reservoir Productivity Survey

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and the other in front of turbine intake two. The density and distribution of kokanee, were monitored with a split beam echosounder. We then compared fish counts and densities during nights when the lights were flashing to counts and densities during nights without the lights on. On five nights between January 27th and February 23rd, fish counts averaged 5 fish and densities averaged 21 fish/ha when no lights were present (Figure 5). Mean counts dropped to 0.5 fish and densities dropped to 3 fish/ha when the strobe lights were turned on during five other nights of sampling. These declines in counts (90%) and densities (87%) were statistically significant (Table 1). There appeared to be no tendency for fish to habituate to the lights during the night. Test results indicate that two sets of nine lights may be sufficient to repel kokanee away from both discharging turbines.

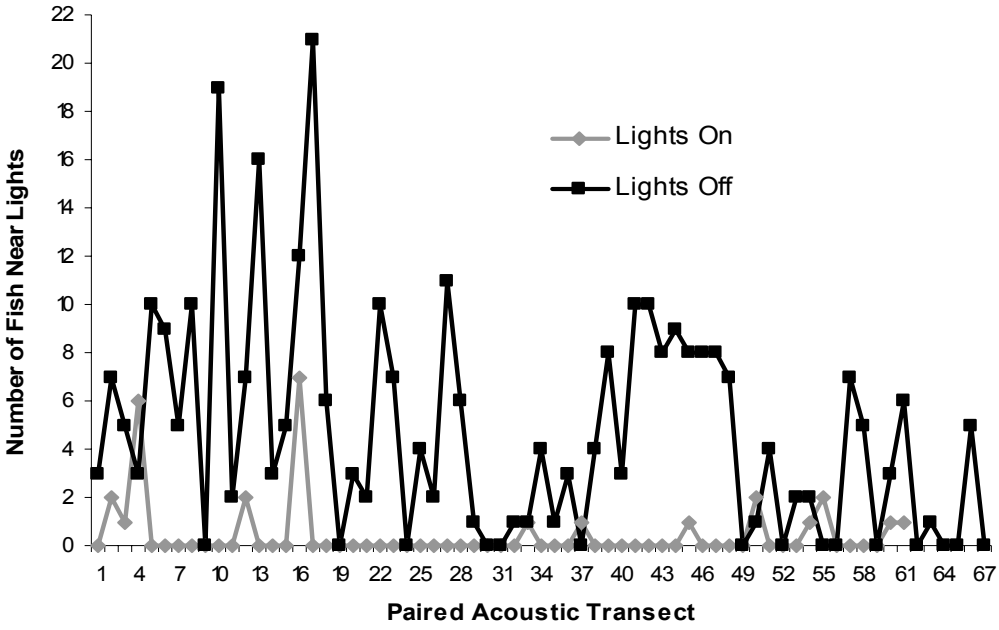
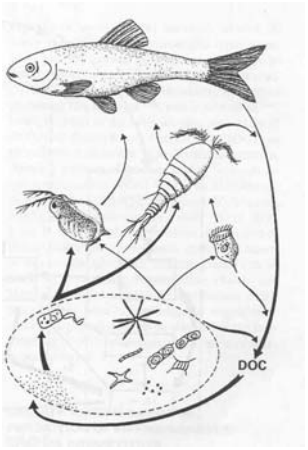



Figure 5. Number of fish near turbine units one and two, for control (lights off) and test (lights on) mobile hydroacoustic transects, Dworshak Reservoir.

Table 1. Mean traces (# of fish) and fish density (# per acre) in a 190 ft by 243 ft area directly upstream of the intake openings of the turbine units one and two of Dworshak Dam, on ten paired nights, January 26 – February 24.

| Sample Dates | Replicate (#) | Mean Traces (# of Fish) | | | Mean Fish Density (# per acre) | | |
|---|---|---|---|---|---|---|---|
| | | Ctrl | Test | Decrease | Ctrl | Test | Decrease |
| Jan 26-27 | 1 | 7.1 | 0.9 | 87.0% | 15.1 | 2.9 | 80.9% |
| Jan 28-29 | 2 | 6.4 | 0.5 | 91.5% | 11.3 | 1.0 | 91.4% |
| Feb 2-3 | 3 | 3.3 | 0.1 | 95.7% | 5.9 | 0.3 | 94.9% |
| Feb 4-5 | 4 | 4.1 | 0.2 | 94.3% | 5.9 | 0.4 | 92.3% |
| Feb 23-24 | 5 | 2.5 | 0.6 | 77.4% | 4.9 | 0.9 | 81.2% |
| | **Mean** | **4.6** | **0.5** | **89.7%** | **8.6** | **1.1** | **87.2%** |

## Reservoir Productivity Survey




This spring we resumed monthly limnological sampling throughout Dworshak Reservoir as we had done last year (see 1st quarter report, 2005). However, this year funding for this work is being provided by the U.S. Army Corps of Engineers, not BPA. This research is being conducted to assess the relationship between the kokanee population and nutrient concentrations in Dworshak Reservoir. Specifically we want to re-evaluate how changes in reservoir productivity (nutrients and zooplankton) influence annual kokanee population stability (density, length-at-age, growth, and survival), especially compared to historic data. Kokanee feed almost exclusively on zooplankton (microscopic crustaceans) in the pelagic area (open water) of the reservoir, and zooplankton feed on phytoplankton, which rely on nutrients in the water.

A total of nine limnological stations are being sampled monthly from April through November. Three stations in each of three sections of Dworshak Reservoir (lower, mid, and upper-reservoir). At each station, dissolved oxygen, turbidity (water clarity), and temperature measurements are taken with a water quality meter. In addition, zooplankton are sampled with a plankton net and water samples are collected using a Kemmerer bottle. Water samples are analyzed for nitrate nitrogen ($NO_3$); orthophosphorus (OP) and total phosphorus (TP); and chlorophyll *a*. In the laboratory, zooplankton are identified, counted, and recorded as organisms/liter of water sampled.

In the future, dissolved nutrients and zooplankton densities will be compared to kokanee growth to determine if we have some predictive capabilities.

## Next Quarter's Activities

During the next quarter, we will continue entrainment assessment sampling. We will finish writing the 2004 annual report and continue analysis and interpretation of entrainment echograms.

We will also be preparing a recommendation plan to permanently install underwater strobe lights as a measure to reduce fish entrainment through Dworshak Dam. This plan will be submitted to the U.S. Army Corps of Engineers, whom we're hoping will find funds and resources to implement this technology we've proven to be an effective deterrent to fish entrainment.

Lastly, we will be installing a wireless ethernet system on Dworshak Dam. This system will allow us to control the echosounder and transducer (sonar), and transmit the data collected during entrainment sampling by the echosounder to a data collection computer over a mile away at our Ahsahka field office.

## Internet Links to more info:

**Are you looking for past quarterly and annual reports concerning Dworshak Reservoir research?**

They can be found on Idaho Fish and Game's website at (**http://fishandgame.idaho.gov./cms/tech/reports/**). Click on the **Fisheries** link, type '**Dworshak**' into the space to the right of the magnifying glass on the upper right of the screen, and click on the green arrow 'Go' button.

**Questions and comments on Dworshak Quarterly reports should be addressed to:**

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