Using Hydroacoustic Techniques to Evaluate Fish Density and Distribution at Nearshore, Reef, and In-River Sites within the Puget Sound Region

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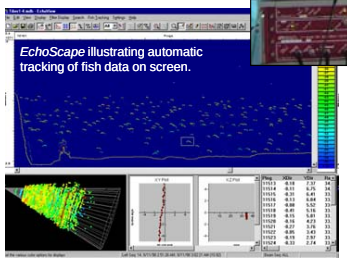
Introduction

Fisheries assessments are undertaken as a result of social and political pressures. Hydroacoustic sampling methods provide a powerful tool for evaluating fish density, behavior, and distributions in the marine environment, at in-river sites, and in associated lakes and tributaries. For over twenty years, Hydroacoustic Technology, Inc. (HTI) has been involved in a variety of monitoring projects in the Puget Sound and associated watersheds.


Model 241 Portable Split-Beam System


EchoScape illustrating automatic tracking of fish data on screen.

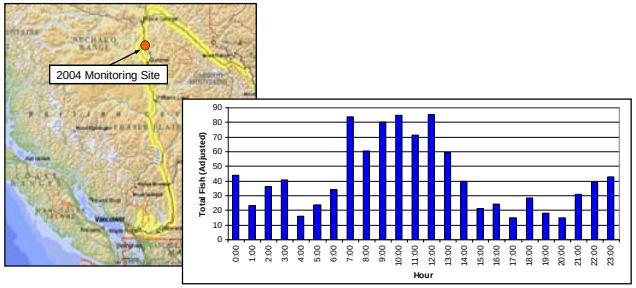
HTI

Hydroacoustic Technology, Inc. (or HTI) is a fisheries consulting firm specializing in using hydroacoustics to enumerate fish in rivers, lakes, and marine environments. HTI developed the first 200 kHz split-beam hydroacoustic system for the expressed purpose of monitoring adult salmon escapement in rivers (Johnston et al. 1993). The studies shown here used a *Model 241 Portable Split-Beam System*. The units are specifically designed for fisheries and plankton acoustic monitoring, particularly at remote sites, where their small size and ability to operate on 12 VDC power sources offer advantage. To date, *Model 240-Series Systems* have been used in over 100 major salmon escapement evaluations conducted in over 40 rivers in Alaska, the continental United States, Canada, and Europe.

HTI specializes in manufacturing a range of hydroacoustic (sonar) fisheries research equipment, including acoustic tags, acoustic tag receivers and active hydroacoustic systems. We conduct hydroacoustic research in oceans, lakes, and rivers, and at hydropower dams, estuaries, shipping locks, or anywhere an accurate assessment of fish abundance or behavior is required.

Estimating Sockeye Salmon In-River

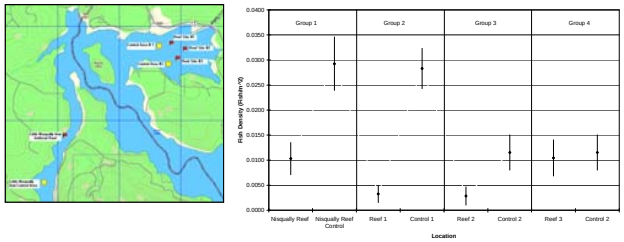
Under the Lheidli T'enneh Treaty, estimates of sockeye and chinook salmon run size are required for in-season harvest adjustments. In 2004, HTI conducted a feasibility study for evaluating different methods of counting sockeye in the Upper Fraser River. Estimates were made for daily densities of salmon, diel distribution, vertical distribution, range across the river (horizontal distribution), and fish size (target strength). Upstream-migrant salmon observed passing the site exhibited dedicated swimming behavior and did not appear to be holding or milling within the sampled area. The evaluated acoustic monitoring site on the Fraser River at Woodpecker, B.C. had site bathymetry that provided a feasible location for longer-term hydroacoustic monitoring of salmon escapement. The Lheidli T'enneh report concluded an operational sockeye counting system could rely on information from a combination of set-netting, DNA stock identification, and hydroacoustics.



Diel upstream-migrant salmon distribution at the Upper Fraser River - Woodpecker sampling site from August 18 - 25, 2004.

Fish Density at Reef Sites

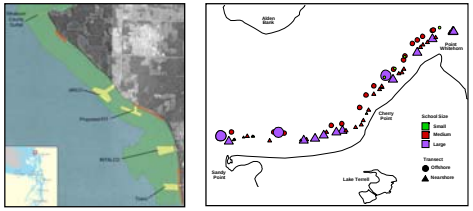
From 2000 through 2004, HTI conducted fisheries evaluations in an effort to monitor artificial reef structures designed to improve fish rearing habitat in Alder Lake, WA. A series of four reefs were built, each consisting of a series of 4 ft. by 4 ft. square modules constructed of steel reinforcing bar and populated with branches and brush to provide cover. Three control sites were selected adjacent to the reefs. The results indicated no difference between reef and control sites, but increasing fish densities were observed at two of four evaluated reef sites over time. Observed differences in fish densities were assumed to be due to the habitat effects of the reef structures, although other factors, such as changing population densities of stocked pelagic fish, may have impacted comparisons over time.



Observed mean fish density and surrounding 90% confidence interval for each surveyed artificial reef location and corresponding control area on Alder Lake, August 7-8, 2003.

Herring School Distributions Near-Shore

HTI conducted studies for the Gateway Pacific Terminal at Cherry Point, near Blain, WA, with Shapiro and Associates, Inc. Concerns were raised regarding the effect of a proposed cargo terminal structure on nearshore migration and distribution of spawning Pacific herring (*Clupea harengus pallasi*). Baseline fisheries assessments of the site were conducted using a series of mobile hydroacoustic transects from April through May of 2004, during historic peak herring spawning activity for the area. Overall, the highest fish densities and population sizes were to the north of the proposed terminal site, along the inshore transects between Cherry Point and Point Whitehorn, with a second area of elevated herring school density located to the south of the proposed site. There were some variations in density and population size between daytime and nighttime studies.



Overall relative herring school-size distributions (Task 1) for the entire Cherry Point 2004 study period (all nine surveys combined), based on the forward-sampling transducer, April 26–May 17, 2004.

Summary

The studies described here demonstrate that hydroacoustic methods are a useful sampling tool with high spatial and temporal resolution for monitoring fish populations and evaluating stocks at risk in the Puget Sound Georgia Basin. Hydroacoustic techniques are complimentary to other regional sampling methods currently in use, and these techniques are especially valuable where comprehensive, real-time results are required for effective fisheries management.

Advantages of Hydroacoustic Sampling Techniques include:

- Cost-Effectiveness
- Estimates for Multiple Fish Parameters
- Real-Time Results Acquiring Large Datasets
- Digital Samples can now be Saved to a Computer's Data Files
- Results are Easily Subdivided for Spatial and Temporal Comparisons at Multiple Scales

Limitations of Hydroacoustic Sampling Techniques include:

- Lack of Species Identification
- Relative Complexity

Target species where swim behavior and survival information is needed can be studied using HTI acoustic tags and receiver systems.

References (See also: http://HTIsonar.com)

Nealson, P. A. and B. D. McFadden. 2004. Feasibility of Riverine Hydroacoustic Techniques to Monitor Adult Salmon Passage in the Upper Fraser River. HTI Project 1708.

Nealson, P. A. and J. W. Horchik. 2004. Hydroacoustic Evaluation of Fish Density and Distribution at Artificial Reef Sites in Alder Lake, Washington During August 2004: Year 5 - Post-Deployment Assessment. HTI Project 1294.

Nealson, P. A., S. E. Damm and J. W. Horchik. 2004. Hydroacoustic Evaluation of Herring School Distribution Near Cherry Point, Washington in Spring 2004. HTI Project 1689.