Scope of Work

Feasibility of Using Long-Range DIDSON to Sample Adult Sockeye Salmon in the Wannock River

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Introduction

Owikeno Lake sockeye historically supported a commercial fishery of 500,000 to 1.5 million fish per year until returns became variable in the 1970s followed by declining production (McKinnell et al. 2001; Riddell 2004). Average catch declined significantly at that time exemplified by poor catches in 1970, 1974, and 1975. An adaptive management strategy was initiated in 1979 as an attempt to clarify some of the uncertainty about the productive capacity of Owikeno Lake (Walters et al. 1993). Total production declined markedly after the 1993 return, prompting development of a draft recovery plan (Holtby 2000) and recent implementation of several recovery initiatives (RSSEPS 2003). A commercial fishing ban has been in place since 1996 and only modest subsistence harvests by local Wuikinuxv fishers have continued. Estimates of sockeye returns to Rivers Inlet have increased in recent years (Riddell 2004; DFO unpublished data) providing optimism among interest groups that a fishery may be reinstated in the near future.

Historically, echo-sounding abundance estimates for Rivers Inlet sockeye (Goruk and Thomson 1988) have not correlated with escapement counts, with the lack of a statistical relationship likely due to variable fish movement rates throughout the Inlet, inclusion of fish species other than sockeye in the acoustic estimates, and errors in escapement estimation (Walters et al. 1993). A long-term program for indexing sockeye abundance in Rivers Inlet based on mobile hydroacoustic surveys has been recently implemented (Johnson et al. 2006a) to allow for in-season stock management. The value of the abundance indices for informing fish managers of stock status is weakened without a clear understanding of the abundance/escapement relationship. To develop this relationship we recommend testing the use of acoustics for estimating escapement in the Wannock River during the sockeye up-migration period.

Recent developments in sonar technologies has created the Dual-frequency Identification Sonar (DIDSON) system, which yields near-video quality streaming images of fish targets (Belcher and Lynn 2000). The DIDSON technology could be used for estimating escapement in the Wannock River, as preliminary data from the Wannock recently suggests (Johnson 2006). Rivers Inlet sockeye escapement estimates have historically been based on a variety of methods including visual counts along stream banks, visual surveys while drifting in boats, and beach seine and gill net sets (Walters et al. 1993). It is very likely that acoustic-based in-river escapement estimates would be more accurate and reliable than those provided by previously used techniques.

Objective

The primary objective of this project is to determine the feasibility of using a long-range (LR) DIDSON for sampling adult sockeye in the Wannock River, central coast BC. If the LR DIDSON is shown to be an effective tool for assessing sockeye passage, then future enumerations studies could be conducted to estimate full sockeye escapement on the Wannock River.

Methods

DIDSON

Within the past decade a new technology has emerged that has been demonstrated to effectively assess fish abundance and fish behavior in riverine habitats. The DIDSON, originally developed through funding by the U.S. Navy for harbor surveillance and recently made available for fisheries applications, has been successfully used to estimate abundance of up-migrating adult salmon in river systems at several locations including rivers in BC (Holmes et al. 2006), Alaska (Maxwell and Gove 2002) and California (Johnson et al. 2006b).

The DIDSON is essentially a multi-beam sonar system capable of capturing near-video quality streaming images of fish moving through its 29^o x 12^o field-of-view. The standard DIDSON unit can be used to image fish out to about 12 m operating at the high frequency (1.8 MHz) mode and to about 24 m at the low frequency (1.1 MHz) mode. A new long-range model DIDSON is capable of imaging fish out to 80 m at a frequency of 750 kHz.

Salmon counting applications with the DIDSON have been shown to be advantageous over split beam acoustic techniques due to its larger sample volume and imaging capabilities. Reverberation from bottom structure, entrained air, floating debris, and other environmental variables corrupt phase information with split beam systems and confound the ability to assess direction of fish travel (Maxwell and Gove 2002). The DIDSON overcomes these limitations since its the field of view is considerably larger than that of a typical split beam system, allowing for a much longer look at migrating salmon.

Study Site

The Wannock River, approximately 9.5 km long and between 80 to 100 m wide, is the only corridor that Rivers Inlet sockeye migrate up en route to Owikeno Lake. The relatively narrow Wannock River represents an opportunity to enumerate all upstream migrating sockeye and obtain reliable and accurate estimates of escapement.

Preliminary assessment of the feasibility for using DIDSON to count upstream migrating sockeye in the Wannock River indicated that this technique is a viable method for enumerating upstream migrants (Johnson 2006). The preliminary effort assessed several locations for potential DIDSON deployment and determined that the channel cross-section in front of the Eagles Nest Bed and Breakfast has favorable physical characteristics conducive for effective acoustic sampling (Figure 1). These features include a gradually sloping bottom and generally small and smooth substrate material.

The preliminary assessment indicated that a standard DIDSON unit could be used to sample sockeye out to the middle of the thalweg from the north shore, as this distance is about 20 m from shore (Figures 1 and 2) and a standard unit can sample out to a maximum of 24 m. In order to achieve full cross-coverage sampling of the Wannock River, a LR DIDSON could be deployed on the south shore and used to sample from the shore out to the middle of the thalweg. This distance is approximately 60 m (Figures 1 and 2), well within the LR DIDSON maximum range of 80 m.

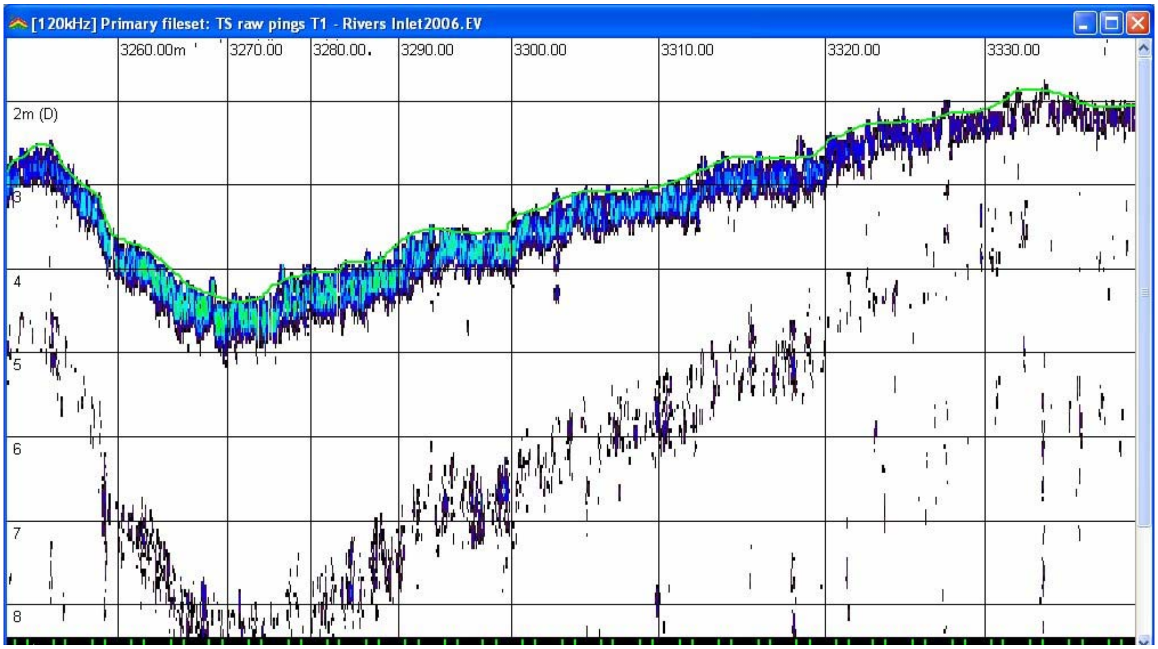

Figure 1. Cross-sectional channel profile of the Wannock River near the Eagles Nest Bed and Breakfast. The north shore is on the left and the perspective is looking upstream. Profile data were collected by Wuikinuxv Fisheries using a SIMRAD split beam system.

LR DIDSON Testing

Evaluating the efficacy of using a LR DIDSON for assessing sockeye passage in the Wannock River will involve two to three days of DIDSON deployment and data collection to determine if a suitable sampling location could be found on the south shore. The DIDSON would be deployed from a pole mount and aimed out towards the center of river with a slight grazing angle to allow for imaging the substrate throughout the entire out-range sampling volume. Numerous iterations of relocating the pole-mounted DIDSON will be required before finding a location whereby 60 m of out range could be achieved. The suitable sampling location will require that large boulders are not in the field of view where they would obscure the ability of the DIDSON to image fish at a given range. Additionally, an optimal site would be characterized by a gradually sloping bottom contour that would prevent fish from being undetected by passing under the sampling beams. It will likely take some time to find a location that possesses these critical features.

Once a suitable sampling location is found along the south shore, we will take a GPS reading and record the latitude/longitude coordinates in a field notebook to ensure that the site could be easily located for future enumeration studies. While the LR DIDSON is deployed at the site, we will map the sample volume by dragging sockeye sized surrogate targets or lead weights across the field of view from a Wuikinuxv Fisheries boat. This exercise would help determine the effective sampling volume of the DIDSON deployment and highlight any apparent gaps in coverage. The sample volume mapping effort will be recorded for later analysis, interpretation and reporting.

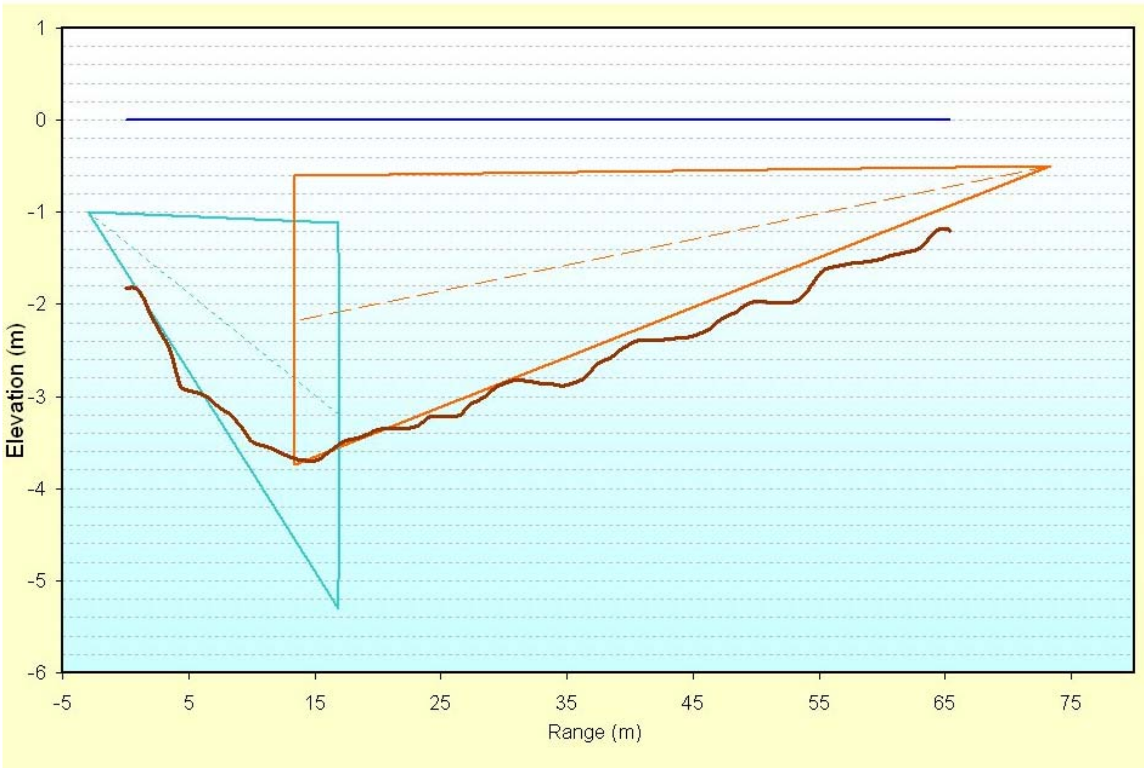

Figure 2. Conceptual diagram showing approximate locations of sampling beams from DIDSON units located from each shoreline. From the north shore (left side of plot), a standard DIDSON (maximum sampling range = 24 m) unit could be used to cover the volume from shore along the bottom to the channel. From the south shore a long-range DIDSON (maximum sampling range 80 m) could be used to cover the volume from shore along the bottom to the channel. Graphic modified from original figure courtesy of Don Degan, Aquacoustics, Inc.

Testing Schedule

The schedule for feasibility testing of the LR DIDSON is largely driven by the availability of the unit itself. The US Fish and Wildlife Service's office in Fairbanks, AK has agreed to lend out their LR DIDSON to conduct this work. However, since the Service needs it back for a study later in the summer, it will not be available during the July-August time period when sockeye salmon migrate up the Wannock River. As a result, we propose to conduct this test over the course of 2 - 3 days in mid June, 2007.

Personnel

This feasibility study will be lead by Mr. Peter Johnson, Sr. Research Scientist with LGL Limited. Mr. Johnson and has over 10 years experience as a field project manager. The focus of much of Mr. Johnson's salmonid research has been fish passage investigations at hydropower and flood control projects. Responsibilities included budgeting, staffing, field logistics, training, data collection, data analysis, reporting, and presentation. Mr. Johnson has extensive experience using DIDSON for assessing salmon passage and behavior on the Columbia River (OR/WA), Lake Washington (WA), and Mill Creek (CA). Additionally, Mr. Johnson managed the 2006 Rivers Inlet Echosounding project funded by the Pacific Salmon Commission and DFO. He is very familiar with the installation, operation, and troubleshooting of acoustic systems, and is experienced with acoustic data processing software applications.

Mr. Johnson will be supported by a local fisheries technician with the Wuikinuxv Band. The technician will aid with the DIDSON deployments, field of view mapping exercise and logistical support.

Budget

The estimated total cost for this proposed feasibility study is $9,500 CND. This cost includes seven days of Sr. Scientist labor ($900/day) and three days of technician labor ($200/day) as well as meals and lodging costs associated with a 4-day stay in the Wuikinuxv Village. Also included in the cost estimate is one round trip flight to Rivers Inlet from Portland, OR, DIDSON shipping costs from Fairbanks, AK to Rivers Inlet and back, and two 12-volt batteries to be used as a power supply for the DIDSON.

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