Final Project Report

COLDWATER RESISTIVITY COUNTER CALIBRATION

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EXECUTIVE SUMMARY

Nicola Tribal Association's (NTA) fisheries department, in partnership with InStream Fisheries Research Inc, and Upper Fraser Fisheries Conservation Alliance (UFFCA), was awarded funding to conduct the Coldwater Resistivity Counter (the Counter) Calibration project in 2007. As a result of suspected sensor damage to the Counter, and anomalous conductivity readings in the river water, the Counter could not be operated in 2007. Consequently permission was granted by the Southern Boundary Fund to extend the project end date to 2008, allowing for a re-focusing of project objectives and implementation of the field work in June 2008.

During the interval between 2007 and 2008 the project was re-focused and new objectives for 2008 were determined:

1. assess the feasibility of utilizing DIDSON technology as a stand-alone enumeration tool for spring chinook salmon entering the Coldwater River in the event that the Resistivity Counter experienced future problems similar to those encountered in 2007;
2. assess the feasibility of utilizing DIDSON technology to calibrate the Counter.

The Counter was started in 2008 with four of its eight "cells" operational. A long range DIDSON unit was rented from the Upper Fraser Fisheries Conservation Alliance (UFFCA) and was operated during the period June 4 to June 23, 2008. The unit was operated 24 hours per day over the three week time period.

The data collected by the DIDSON unit did not yield definitive information. There did not appear to be any images of chinook salmon during a time period when at least a few chinook should have been migrating upstream. The unit did, however, collect data on presence of fish approximately 35-40 cm in length. Conversely, the Counter provided data with various signal strengths during the same time period, some of which indicated there may have been chinook-sized fish migrating past the Counter. Post season data analysis by the NTA technologist with assistance from the Sound Metrics Corp. sonar technician provided solid information to form the basis of the "learning curve" that will lead to much more definitive results in a second season of operation.

ACKNOWLEDGEMENTS

Nicola Tribal Association would like acknowledge the following people and organizations for their contributions to this project:

- **Don McCubbing, InStream Fisheries Research Inc:** operator of the Resistivity Counter, provision of data, assistance with the project proposal.
- **Pete Nicklin, Upper Fraser Fisheries Conservation Alliance (UFFCA):** providing the DIDSON unit for the project, and aiding with the initial set up and operation of the DIDSON.
- **Brian Leaf, Paul Welch, Fisheries and Oceans Canada (DFO):** aiding in the initial set up and operation of the DIDSON.
- **Bill Hanot, Sound Metrics Corp:** aiding in footage review trouble shooting and recommendations to improve deployment of the DIDSON unit in a future project.

The project was largely funded by the Pacific Salmon Commission's Southern Boundary Restoration and Enhancement Fund. Supplementary funding and in-kind contributions were provided by the Nicola Tribal Association and its partners.

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INTRODUCTION

In 2007 the Nicola Tribal Association (NTA) received funding from the Pacific Salmon Commission Southern Boundary Restoration and Enhancement Fund (SBF) to work with Instream Fisheries Research Inc. (Instream) to investigate the use of DIDSON technology to assist with calibrating a Resistivity Counter (the Counter) that had been previously installed in the Coldwater River with SBF assistance.

In spring 2007 two problems were encountered with the Counter: apparently highly variable conductivity characteristics of the Coldwater River (ranging from 220 to over 300 us each day with changes of greater than 20 units every few minutes); and apparently malfunctioning Counter sensors possibly as a result of ice jams the previous winter. No data could be produced by the Counter in spring/summer of 2007 so application was made to the SBF to extend the length of the project contract to enable implementation in 2008.

As a result of further investigation after the postponement of the project, the NTA re-focused its project objectives to concentrate on investigating the feasibility of using DIDSON technology both as a device to assist with calibrating the Counter and as a stand-alone adult return assessment tool for the Coldwater River. With the change in focus from the initial 2007 objectives the radio telemetry portion of the project had to be postponed to a future year. The Counter site is the concrete apron of the NTA's fish fence, located approximately 0.90km upstream of the confluence of the Coldwater and Nicola Rivers. During construction of the fence apron the river bed immediately upstream of the apron was groomed, creating a uniform small cobble substrate where sonic devices can be used without obstructions or "shadow areas". When the Counter was installed in 2006 it was thought that standard video cameras could be used to calibrate fish images with signal sizes. However, turbid water and nocturnal migrating characteristics have prevented the use of video recording as a calibration tool.

DIDSON technology can produce images of fish very similar to actual video images and can do so regardless of turbidity or lighting. The DIDSON technology provides a measurement tool that relates the image size on the screen to an actual length. It was thought that by operating the DIDSON in conjunction with and adjacent to the Counter (both are equipped with a 24 hour clock) a Counter signal could be matched to the corresponding DIDSON image and a length measurement could be obtained to match with the corresponding signal strength from the Counter. Thus over time and with sufficient data for comparison and statistical analysis, the DIDSON would assist with calibrating the Counter.

The revised objectives for the 2008 project therefore were:

1. Begin testing the feasibility of operating a DIDSON unit on the Coldwater River at the desired site.
2. Begin testing the feasibility of utilizing DIDSON technology to assist with calibrating the Resistivity Counter.

METHODS

The DIDSON sonar long-range unit was operated in conjunction with the Counter for a time period of three weeks, June 4 to June 23, 2008. This time period coincides with part of the migration period for earliest timed spring chinook, and is after the known immigration timing of steelhead.

Installation of the DIDSON occurred on June 3, 2008 with the help of Upper Fraser Fisheries Conservation Alliance (UFFCA) DIDSON biologist Pete Nicklin, and DFO staff Brian Leaf and Paul Welch. The DIDSON mounting apparatus consists of an adjustable aluminum step ladder modified to accommodate the sonar unit. In most applications the unit is usually placed right in the river bed, secured to the substrate using rebar and sandbags. At the Coldwater site the unit was mounted on a dimension lumber framework that was attached to the cement bulkhead for the fence apron. The DIDSON mounting apparatus was attached to the 2X4 frame using screws and ratchet straps (Figure1).

Figure 1: Set up for DIDSON unit. Aluminum, adjustable mounting apparatus of DIDSON unit was secured to fabricated 2x4 framework with screws and ratchet straps. A backup rope was tied to the DIDSON unit and secured to a large tree.

Before running test recordings to ensure correct deployment of the unit recording parameters had to be set in the sonar software. Recording parameters for DIDSON project in 2008/2009, for the conditions of the Coldwater River were:

- High Frequency setting
- Window length: 20.01m
- Window start: 0.42m
- Frame rate: 6/sec

Window length is the distance of the beam for recording. At the time of operation the wetted width of the river was 26m, so a 20.01m setting was chosen, as the next distance was 40.01m. This would create too much "noise" as the beam would be bouncing off the far bank. Window start is how far from the face of the lens the unit will record; 0.42m was selected. This would then give an even beam length through the river; approximately 3m on either bank would not be captured. It was suggested to install two weirs to project into the river 3m from each bank to ensure all fish migrating upstream would be "seen" by the sonar unit. Due to the river conditions at the time of operation, it was unsafe and nearly impossible to get out 3m from either bank so the weirs could not be installed. Frame rate is the number of frames recorded per second; 6/sec is similar to real time. The submerged DIDSON unit was directed straight across the river, with the top plate of the mounting brace submerged approximately 2 inches under, and parallel to the water surface. The unit was tested by dragging a "dummy fish" (pop bottle filled with sand and water). Using a rope the "fish" was thrown out and dragged through the beam; the image was captured in the test recording and the assisting biologists were confident that optimum placement had been achieved.

The Resistivity Counter consists of two counters, each recording data from four "cells". These cells are separated by metal bars (nine bars total). As a point of reference the DIDSON images showed seven of the metal bars (Figure 2). This helped to maintain orientation of the unit when placement had to be adjusted because of changing water levels. It also made it possible to correlate fish movement recorded by the Counter in a particular cell with corresponding data recorded by the DIDSON unit. To reduce the noise associated with the turbulence of the water around the sonar sending unit, a wall of sandbags was installed just upstream of the DIDSON to create calm waters and reduce noise.

Image recording commenced the following morning (June 4) at 9:00am and was completed on June 24, 2008 at 6:00am. The DIDSON unit recorded hour long files, 24 hours a day, for three weeks. While the DIDSON unit was operating NTA crews were on site 24 hours a day, acting as security. During the security shifts crews were responsible for ensuring that the unit remained in optimal placement for recording: the unit remained submerged, parallel to the water surface, and was shooting straight across to the far bank. If the unit needed to be adjusted recording was stopped, adjustments were completed, and recording commenced again. During operation the NTA's technologist visited the site each day and downloaded all recorded files onto an external hard drive. This freed up space on the DIDSON computer and ensured that the files would not be lost if the power supply was interrupted.

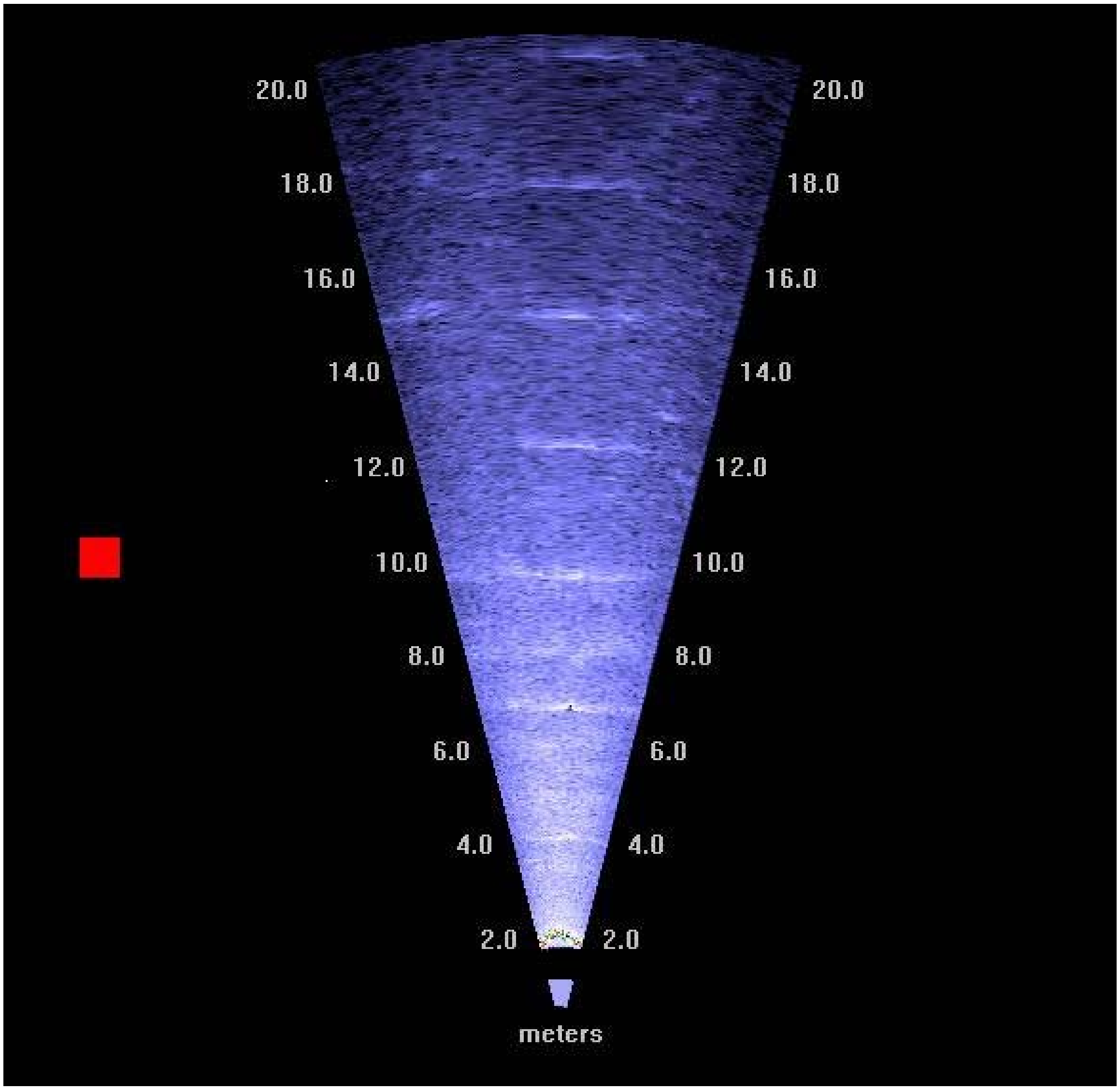

Figure 2: Snapshot of a DIDSON file. The brightness of the file is the "noise" from turbidity and turbulence. Note the seven lines, the metal bars separating the Counter cells which were used as reference for DIDSON placement and during data analysis.

The reviewing of the DIDSON files could not be conducted until September 2008 because of other work commitments. InStream Fisheries Research Inc. provided NTA with a list of all upstream fish movements during the operation of the DIDSON. Only upstream movements were analyzed because the study site is conducive to positive upstream movement of immigrating adult chinook to deeper areas of the river. Both the Counter and DIDSON units record data by use of a 24 hour clock making it easy to match corresponding files from either unit. The data from the Counter gave the date, time, signal size, and which Counter cell the movement was recorded in. The technologist began by selecting the movements that produced the largest signal size; the larger the Counter signal size, the larger the fish, potentially. The corresponding DIDSON file was found and could be viewed in an accelerated speed (48 frames/sec) to reach the time period that matched the Counter data. Once this time was reached the footage was slowed down in order to inspect the data and observe if the DIDSON had captured the fish. Once the fish was in the screen the footage was paused, and the toolset for measuring fish length was used to determine if it was a chinook/steelhead, or other indigenous fish species. The file date and time, and result were then recorded.

RESULTS

Resistivity Counter

During the three week study period, files supplied by Instream showed a total of 177 upstream movements. 17 of these movements had a signal size greater than 60, which potentially indicated adult chinook salmon.

DIDSON

During the three week operation of the DIDSON unit, a total of 477 hours of data were recorded. The "footage" (the data display is similar to video) for the time periods coinciding with the large signals recorded by the Counter was reviewed. Difficulty was experienced in discerning fish images in the DIDSON footage; no images of chinook sized fish could be found. However, positive identification of smaller fish images (approximately 40 cm in length) was made. These fish entered the beam window but rather than migrating upstream they were seen to be milling in the vicinity of the downstream edge of the apron. One other positive image identification was made: on June 12 at 0611 hours an otter swam upstream through the beam window and was coincidentally observed visually from the stream bank by the NTA technologist.

DISCUSSION

Once review of the DIDSON files began it became apparent that there was excessive “noise” in the data. This noise was created by turbulence and the reflection of the bubbles on the surface of the water. This made it very difficult to discern fish movements. Assistance was requested from Sound Metrics to analyze the files. Selected files were sent to their technician who was able to analyze the data and find some fish presence. On his advice, the files were viewed at an accelerated frame rate which made it possible to see some fish, although no adult chinook sized fish could be found. The Sound Metrics technician concluded that the low quality of recorded files was at least partially due to incorrect deployment of the DIDSON unit (set at too shallow an angle) for the requirements of the Coldwater River during spring freshet.

The (un-calibrated) Resistivity Counter indicated a potential count of 17 chinook migrating upstream during our study period. However, our DIDSON data did not yield any chinook sized fish during the relevant time periods. The DIDSON may have missed three of the 17 Counter signals because of their location in relation to the DIDSON window beam, but the reason for the lack of images for the other fourteen is unknown.

During DIDSON footage review a number of smaller fish (whitefish and/or suckers) were observed milling about on the downstream edge of the apron. These fish periodically swam up and down stream and moved sideways across the Counter cell. It may be possible to speculate that a group of these smaller fish (approx. 40cm) may, on occasion, result in a larger signal size that could be thought to be a chinook or steelhead. However, Instream Research Inc. (Don McCubbing) are well known experts in resistivity counter technology and the analysis and interpretation of signals and data produced by this technology – and little doubt has been expressed about the validity of the large signal sizes recorded by the Counter during the study period.

It should be noted for the record that one NTA member who lives near the Coldwater River and regularly monitors it did not see a chinook in the lower Coldwater (IR #1) until June 24 2008 (after our study period). The precise timing of chinook immigration is not known for any one year, and 2008 would be no exception. However, extensive experience with chinook reconnaissance and brood capture for the Spius Creek Hatchery program provides solid evidence that chinook migrate into the Coldwater River both before and after spring freshet.

RECOMMENDATIONS

2008 was a feasibility and "learning curve" year. The use of DIDSON technology as a means to assist calibration of the Resistivity Counter, and as a stand-alone spawner immigration assessment tool, should continue to be investigated by building on the lessons learned in 2008:

1. The NTA will need to dedicate appropriate staff time to enable "real time" review of DIDSON data on a daily basis in order to make timely corrections and adjustments to the unit if they are needed.
2. A concentrator lens should be purchased for the DIDSON unit. A concentrator lens will narrow the vertical beam width, helping to eliminate surface noise (bubbles) and providing cleaner, easier to view files.
3. Rather than have the DIDSON unit parallel to the water surface as recommended in 2008, it should be aimed down 6-7 degrees to reduce noise created by turbulence; this will also create cleaner files, making for easier review and analysis.
4. Expand the range of experienced technical assistance retained to aid in deployment and start-up to ensure correct operation of the unit.

APPENDICES

APPENDIX 1: Financial Summary of Project Expenditures

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Expenditure Type	Estimated costs per PSC submission	Estimated costs per funding submission	Actual costs for PSC portion of the project	Actual costs for NTA portion of the project
Wages and benefits		4,968	11,787	
Consultant fees	7,000	9,000	2,731	4,816
Project site costs	19,600	20,850	4,488	
NTA Corporate Services Fee	2,660	2,660	2,660	
	29,260	37,478	21,666	4,816