

Using Bar Scanners and Tablets to Automate CWT Data Management

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Fisheries and Oceans Canada
Salmonid Enhancement Program
200-401 Burrard St.
Vancouver, B.C.
V6C 3S4

Report Prepared For:
Pacific Salmon Commission
Restoration and Enhancement Fund
600-1155 Robson Street
Vancouver, BC.
Canada V6E 1B5

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Introduction

A Salmonid Enhancement Program (SEP) hatchery may collect over 2,000 adult Chinook heads each year for dissection and recovery of coded-wire tags (CWTs). Each head is identified using an attached label (e-label in escapement samples), which in recent years includes a barcode as well as the numeric identifier (ID). Using the e-label ID, CWT data is linked to biological data, such as length, sex, thermal marks and genetic identification, for a given sampling stratum. The e-label IDs, and most of the biological data, are manually entered into the data management system at the hatchery. This is a process that requires substantial time and effort to ensure there are no errors associated with the manual data entry.

The Head Dissection Lab at J.O. Thomas (JOT) uses a barcode scanner to capture first a container label barcode with sample details, then the e-label's barcode, entering associated tagcode and dissection information in the CWT Recovery database (implemented in 2012). Data from the CWT Recovery database at JOT is exported to a file which is sent to the hatchery for importing into their data management system, using the e-label ID to link to the biological data. Errors related to manual entry of the e-label ID must be corrected before the file can be imported successfully at the hatchery.

Project Objectives

This project proposed to improve hatchery data management and reporting through the development of a hatchery protocol for automated sampling data collection with the purchase, testing and operationalization of barcode scanners in hatcheries where CWTs are recovered. Use of barcode scanners will enable hatchery staff to automate data capture and reduce errors from manual data entry.

Methods

The methodology for this project is described in Appendix B.

System Design and Equipment Purchase

The barcode scanner system in use at J.O. Thomas Head Dissection Lab was used as a template for the escapement sampling system design. The scanner in use at J.O. Thomas was borrowed and tested with the tablet purchased for this project.

The tablet was selected based on recommendations from Spius Creek Hatchery crew, who would be using it and were familiar with the Galaxy S3 tablet.

SEP staff at Regional Headquarters purchased numeric keypads and waterproof cases based on web reviews.

The sampling station at Spius Creek Hatchery was assessed for suitability for implementing electronic data collection during sampling.

Two systems were functional by June 2019 and were tested at the hatchery prior to use in brood stock collection. Testing in the dead pitch environment began on October 7.

Data Collection and Management

Copies of field sampling forms for Nicola River Chinook biological sampling were provided by Spius Creek Hatchery to format the MS Excel file on the tablet. Lookup tables were created for drop down lists, to facilitate data collection.

The field forms used in the dead pitch by DFO Stock Assessment were duplicated with the MS Excel data collection having header data in the top three rows, then a row of column headings with data below that.

One Drive accounts were set up by DFO IM&TS staff for data storage and access by the project team.

Brood Stock Sampling

Nicola River Chinook brood stock were sampled twice weekly after egg takes, from the first through the third weeks of October.

All devices were charged prior to sampling. Excel files for the stocks being sampled that day were loaded on the tablet from One Drive.

Paper files were managed in stock-specific binders, as in previous years.

Data was recorded first on paper, then on the tablet by the same sampler, on most days. One day, two samplers recorded data simultaneously, one on the tablet and one on the paper field form.

Dead Pitch Sampling

In the dead pitch sampling environment, the tablet was carried on a tether, with the keypad on the tablet used to record data (instead of an external numeric keypad). Nicola River Chinook dead pitch sampling was replaced with Lower and Middle Shuswap dead pitch sampling due to run timing and co-ordination challenges with dead pitch crews.

Results

Sampling Station Design and Modification

The sampling station at Spius Creek Hatchery was suitable for implementing electronic data collection during sampling with no modifications needed.

The equipment performed as expected. There were no issues with loss of power due to dead batteries during sampling during this project. The waterproof case for the tablet kept the computer dry and protected during use. The barcode scanner was rugged enough to work

consistently in the field environment. The e-label ID was consistently captured accurately by the barcode scanner on the first scan.

The air temperature was below zero during the dead pitch sampling so a stylus was used to record data on the tablet, allowing the sampler to wear warm gloves while recording data.

Bluetooth was used to avoid having electrical cords in the wet operating environment and to allow flexibility in sampling.

Testing and Comparison of Paper with Electronic

The MS Excel spreadsheet for the Nicola Chinook sampling at Spius Creek Hatchery worked perfectly but the spreadsheet for the dead pitch sampling in the Shuswap River was not set up in advance and was not able to collect standardized and consistent data.

In the Nicola Chinook egg take biodata, there was a discrepancy in tray numbers on September 9, with trays in stack 4 in the electronic data and no trays 4/1/1 through 4/1/6 (data for stack 3 then stack 5) on the paper data form. It appears that the electronic form is correct as eggs were loaded into tray 4/1/7 at the start of the next egg take.

The paper form didn't have columns for scale book data, so this data was entered in a new row below the fish data, in fields from Label # to DNA #2 Male, (5 columns), with quotation marks and dashes in the remaining columns, for the first two fish in the data only.

Legibility on the paper forms seemed to be the biggest source of error, for example 5's that looked like 3's (September 10). When there wasn't room on the form for longer numbers, the size of the writing became very small to fit in the cell e.g. e-label numbers. Abbreviations, which may not be standardized (they were at Spius Creek Hatchery), are often employed when recording data on paper, also due to space constraints, potentially leading to confusion in the data.

There were issues with the data in both the paper form and the data collected on the tablet in the dead pitch. Both forms were missing data fields, with otolith data being recorded in the comments field. Operculum tags and adipose clip status were recorded in the same data field (both paper and electronic). Fish length was measured in cm, requiring a decimal point, taking up space on the paper form and adding a keystroke in the electronic form. Header data was not completed in the dead pitch electronic data form. Coding for the data was not entered into lookup tables in the spreadsheet, so for example jacks were recorded as both "jack" and "male", and both "female" and "f", "jack" and "j" and "male" and "m" for sex. Sometimes caps were used and sometimes not.

Attributes were compared between paper record keeping and electronic data collection during CWT and biological sampling (Table 1).

Table 1. Comparison of paper and electronic data collection.

Attribute	Paper	Excel on Tablet
Cost	Low	Medium
System Maintenance and Durability	None	Replacement every 3-5 years?
User Learning Curve	Deceptive, not as simple as it may appear	Steeper, computer skills required
Environmental Sustainability	Good	Not good
Accuracy	<ul style="list-style-type: none"> • poor legibility • different codes for the same data • can become faint when scanned • typos 	<ul style="list-style-type: none"> • captures barcode data • glare from screen • copy/paste errors • system failure • typos • built in error checking • overwriting file/versioning
Efficiency	Twice the time and effort	Fast except when computer issues
Data Access	Access when scanned and emailed	Access to all users on shared drive
Data Security	Locked in file cabinet, entered into excel files	Saved to network via wifi connection
Archiving	Paper and scanned electronic	Backup electronic files, printed paper copies

Conclusions

This pilot project was implemented without problems in the existing sampling environment.

Based on the attributes compared for the two methods of data capture, automated data management is more expensive, and requires more maintenance and more computer skills than paper-based data capture, but is generally more efficient and should be more accurate if the data file is properly set up.

Staff at Spius Creek Hatchery were trained and became comfortable using the barcode scanner. The benefit of not re-entering sampling data from paper into electronic format for sharing with other data users was well received. The cost of becoming familiar with the tablet was not significant, since most hatchery staff are comfortable using smart phones, which have similar functionality to the tablet. One day there was confusion synchronizing the barcode scanner with the tablet, but once the instructions were referenced and the correct sequence of actions was taken, it worked as expected.

The dead pitch sampling automated data capture could have been more accurate and efficient with lookup data fields and all data columns included in the data sheet prior to sampling. Lookup

fields can carry a definition so users can hover the cursor over the code to see a definition (which is also helpful if the column header isn't frozen when the user scrolls down).

The efficiency of not entering data from paper forms into a computer after sampling is completed, combined with legibility issues on paper data forms, contribute to making automated electronic data capture a more accurate and preferred method for data management, both in the hatchery and in the field. Including error checking or code definitions in the data fields would improve accuracy further.

A video of sampling of Nicola River Chinook at Spius Creek Hatchery using the tablet and scanner was made and is available. It can be presented in June 2020 at the Annual Watershed Enhancement Managers Regional Meeting.

The number of fish sampled at Spius Creek Hatchery in a day is relatively small, compared with larger production hatcheries. Scaling up the automated data capture methodology to other hatcheries will require a learning curve for staff and change in culture to accept the new technology, however the benefits of increased efficiency and accuracy will make the transition worthwhile.

APPENDIX I. 2019 Financial Expenditures Summary

Details of expenditures registered in the DFO financial system at fiscal year-end.

Funding Total	\$ 8650.00
2 x Rechargeable Bluetooth Numeric Keypad - Portable Slim 34-Key Wireless Pad Compatible with PC Android iOS Tablets MacBook	\$ 186.80
Samsung Galaxy Tab S3 9.7" 32GB Android N Tablet With Qualcomm APQ 8096 Quad-Core Processor - Black	\$ 594.67
Samsung Galaxy Tab S3 9.7" 32GB Android N Tablet With Qualcomm APQ 8096 Quad-Core Processor - Black	\$ 578.50
2 x ARMOR-X LIMITED Samsung Galaxy Tab S3 9.7 Ultimate waterproof Case w/ Handstrap, Shoulder Strap and Car Charger	\$ 189.94
2 x Adesso NuScan 4100B Bluetooth Scanners	\$ 383.98
Total Costs	\$ 1933.89
Balance (refunded to PSC)	\$ 6716.11

APPENDIX II. Method for Using Barcode Scanners to Automate CWT Data Management in Escapement

System specifications

Samsung GalaxyTab S3:

<https://www.bestbuy.ca/en-ca/product/samsung-samsung-galaxy-tab-s3-9-7-32gb-android-n-tablet-with-qualcomm-apq-8096-quad-core-processor-black-sm-t820nzkaxac/10589705.aspx>

Armour-X protective case:

<https://www.armor-x.com/mx-s3-bk-samsung-galaxy-tab-s3-9-7-t820-t825-ip68-ultimate-waterproof-case-w-handstrap.html>

With a numeric keyboard:

<https://m.bestbuy.ca/en-ca/product/rechargeable-bluetooth-numeric-keypad-portable-slim-34-key-wireless-pad-compatible-with-pc-android-ios-tablets-macbook/13484535>

Adesso NuScan 4100B - Wireless 1D Barcode Scanner

https://www.staples.com/adesso-bluetooth-antimicrobial-ccd-1d-handheld-barcode-scanner-black-yellow-nuscan-4100b/product_2499648

Data forms

Users will agree on the data format, codes and definitions to be used in the data form, which will be designed in MS Excel, using lookup tables for all standard codes. Definitions of codes should be easily accessible when entering data. A standard field form for recording CWT data in escapement has been developed by the SEP Planning and Assessment Unit.

Hatchery testing

Hatchery staff will test the system prior to sampling season.

1. Test charging equipment and document charge times
2. Test data capture with the database format, ensuring auto-save is turned on
3. Test transfer of files, via Wi-Fi and email
4. Set up and test One Drive, to back up files to the cloud via Wi-Fi
5. Test import of tagcode recovery data files back to the hatchery database

Protocols for setup, calibration and use of the automated system

1. Turn the tablet on, and log on.
2. Load the excel file on tablet
3. Record header information and date
4. Ensure Bluetooth is enabled
5. Pair the scanner with the tablet.
6. Scan the setup barcodes. Clear the memory of the scanner.

A video demonstrating usage and documenting steps in the process is available.

Adult sampling and data capture

1. Adults will be sampled in groups of 10, by sex if possible.
2. Samplers will measure POH in mm, collect scales, otoliths and DNA samples, with data being recorded into the tablet.
3. E-labels will be affixed to the 10 fish, and a sampler will scan them into the tablet.
4. Snouts will be removed and stored in covered buckets, and stored in a freezer at the end of the day.
5. Files from the scanner will be sent daily to biologists and hatchery staff distribution list.

Submission of heads with barcode labels to J.O. Thomas head dissection lab

1. At the end of the season label and ship heads to JOT, as per CWT Sampling Guidelines.
2. Phone JOT to advise of sample shipment details.

Data integration of CWT codes from JOT with hatchery data system

1. Files with CWTs and e-labels will be emailed to hatchery staff and biologists.
2. Sort, copy and paste the tagcodes into the hatchery sample file (future plans are to import files).