RELIABILITY AND FEASIBILITY OF USING ELECTRONIC DETECTION FOR RECOVERY OF CODED WIRE TAGS IN COHO SALMON

Ad-hoc Selective Fishery Evaluation Committee

Pacific Salmon Commission

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EXECUTIVE SUMMARY

INTRODUCTION

Mass marking hatchery coho salmon (*Oncorhynchus kisutch*) with a visible external mark has been proposed as a tool to allow additional fishing opportunity while protecting wild coho stocks. The Pacific Salmon Commission (PSC) Ad-hoc Selective Fishery Evaluation Committee recommended the adipose fin as the best mark for hatchery fish (PSC, 1995). The report also recommended that electronic detection be used to identify those fish with a coded wire tag (CWT) since the adipose fin mark is currently sequestered as a flag for CWT marked fish and no other mark was determined adequate for an external identifier.

The report further emphasized the need to maintain the integrity of the coastwide CWT program as it is the most important stock identification technique used on a coastwide basis for chinook and coho management and research. Therefore, if mass marking with the adipose fin is to be implemented, electronic sampling will need to be integrated into existing CWT sampling programs.

For this approach to work, electronic detection equipment needs to be robust enough to withstand the rigors of the sampling environment and accurately detect the presence of CWTs. In addition, it must be feasible to process samples at acceptable rates in both commercial and recreational fisheries and at the hatchery rack.

There are currently two types of electronic detection equipment: a hand held unit (Wand), and a stationary unit containing a fish passage tube (R-8 tube). The feasibility and reliability of detecting CWTs with this equipment has not been extensively tested. Therefore, in 1996, studies were jointly conducted by Canada Department of Fisheries and Oceans (CDFO), Northwest Indian Fisheries Commission (NWIFC) and Washington Department of Fish and Wildlife (WDFW) to evaluate reliability and feasibility issues concerning electronic detection equipment for CWT recovery in coho salmon.

In addition, U.S Fish and Wildlife Service (USFWS) and Idaho Department of Fish and Game (IDFG) conducted an independent study in 1996 on the detection rates of the Wand and tube detector (R-8 and R-10 models). The study was done on B-strain steelhead returning to Dworshak National Fish Hatchery, Idaho.

A summary of that information follows. The primary focus is the research carried out by CDFO, NWIFC and WDFW on coho salmon. Individual reports are attached, including that for the USFWS/IDFG study on steelhead.

OBJECTIVES

The primary objectives of NWIFC and WDFW's 1996 studies were to:

1. Test the reliability of hand-held Wand and R-8 tube detection equipment in a variety of coho salmon fisheries and at hatchery racks.

    - Estimate the accuracy of CWT detection under field conditions.
    - Estimate the level of false detection.
    - Evaluate equipment durability.

2. Evaluate the feasibility of hand-held Wand and R-8 tube detection equipment in a variety of coho salmon fisheries and at hatchery racks.

    - Estimate sampling time required for particular equipment and situation.
    - Compare sampling time and effort to traditional visual method.

CDFO's 1996 testing focused on investigating logistical problems of integrating the R-8 tube detector equipment into processing lines at off-loading sites for the West Coast Vancouver Island Troll Fishery, and on determining the personnel requirements for this mode of electronic sampling. Additional testing was done at the hatchery rack following redesign of the sampling table.

The joint studies did not attempt a detailed analysis of the increase in costs (equipment and labor) that would be required to implement electronic CWT detection on a regional or coastwide basis.

METHODS

NWIFC and WDFW Studies: Sampling with and testing of hand-held Wand and R-8 detection equipment in Washington was carried out under a variety of conditions. Tribal CWT sampling studies included truck buyers, buyer boats, buying stations, processing plants, hatcheries, and spawning surveys. WDFW studies occurred in Washington terminal commercial net fisheries, coastal and Puget Sound recreational fisheries, and hatcheries.

Study procedures were similar between NWIFC and WDFW. Samplers were instructed to electronically test all fish for CWTs without visually noting whether the fish was adipose marked. In some of the sampling situations, returning fish included CWT groups with the adipose fin present, thus ensuring samplers did not key on adipose marked fish.

For each fish, the electronic detection status was recorded and the presence or absence of the adipose fin was observed and recorded. Snouts were removed from fish which tested positive electronically or were missing adipose fins and sent to a CWT recovery laboratory for processing. If no CWT was detected in the laboratory after positive detection electronically in the field, it was

determined to be a False Detection. If the snout contained a CWT, but was not detected electronically, it was classified as a Missed CWT.

CDFO Studies: Sampling studies in British Columbia were limited to the R-8 tube detector. Two different tables were constructed to receive and hold off-loaded fish and facilitate their passage into the R8 tube detector. The first table was tested at a commercial off-loading site at Ucluelet and found to require modifications. The redesigned second table was then evaluated at Chilliwack Hatchery. Both systems were designed to allow the insertion of the R-8 tube detector ahead of the fish grading operation. The impact of the new systems was assessed subjectively, while quantitative observations were used to measure throughput rates and the ability of the electronic equipment to detect CWTs and count samples.

RESULTS AND DISCUSSION

Reliability: Table 1 summarizes field tests in 1996 to determine CWT detection rates in coho by electronic sampling with the Wand and R-8 tube detector. Each agency pooled their respective results by sampling location type to determine the individual rows in the table. In addition, sampling location types were pooled in many cases. The sampling location type 'NWIFC Commercial' for the R-8 tube tests, for example, includes pooled results for truck buyers, buyer boats, buying stations and processing plants. Overall detection rates and false detection rates are presented as both weighted and non-weighted means.

CWT detection rates were very high for the Wand detector. A combined total of 42,903 coho salmon were sampled by NWIFC and WDFW with the Wand, with an observed mean CWT detection rate (non-weighted) of 97.0% (range: 85.2%-100%) across all sampled fisheries and sampling environments. The WDFW recreational sampling was an exception at 85.2% but the decrease was determined to have been caused by a single sampler (one of six) rather than equipment failure. If this value was dropped, the overall detection rate was 99.3%.

Detection rates for the R-8 tube detector were likewise very high (Table 1). A total of 47,235 coho were sampled by CDFO, NWIFC, and WDFW. The non-weighted mean detection rate for CWTs was 98.2% (range: 92.2%-100%). However, prior to pooling commercial sampling location types, NWIFC observed a 85.7% rate while sampling on a metal buyer boat. It was suspected that the environment affected the calibration of the R-8 tube detector's sensitivity (gain).

The mean false detection rate for all coho tests was 1.1% for the Wand and 1.5% for the R-8 tube (non-weighted means; Table 1). It was found that fish that had sediment on the skin (e.g. fish that had been in contact with a river bank, truck bed, or pavement) could cause false detections with the R-8 tube, and to a lesser extent with the Wand. The rates of false electronic detection were compared with false detection rates from visual sampling (adipose marked but untagged fish). Although the results were inconclusive, these rates appeared comparable.

USFWS and IDFG conducted an independent field test in 1996 on the reliability of the Wand and tube detectors (R-8 and R-10 models) to detect CWTs in steelhead returning to Dworshak NFH, Idaho. Detection rates were comperable to that seen in coho salmon. A total of 1,805 fish were sampled, and 174 had a CWT. The Wand detection rate was 98.3%, while the tube detection rate

was 99.4%. False positive detection rates were 0.5% for the Wand and 1.2% for the tube detectors.

Mechanical Problems: The Wand and R-8 detector equipment functioned well on the whole. However, a few equipment failures occurred with the Wand, requiring the units to be returned to the manufacturer. A few of the Wands also had minor problems with moisture corroding the battery contacts.

No substantive mechanical problems occurred with the R-8 tube detector. However, in noisy environments, the "beep" signal for a tagged fish often could not be heard. On two occasions, the R-8 power switch was hit and turned off by a fish being tossed through the tube. The absence of a standard calibration procedure also caused complications.

A prototype diverter gate with counters for tagged and non-tagged fish was shared by all three agencies. It worked relatively well but its construction was not durable enough for long term use and numerous problems occurred which limited its availability. Problems included shorting out due to moisture condensation in the cables and connectors, one way gate diversion design, double counting in some cases, and larger chunks of ice being counted as fish.

A list of recommended improvements for the Wand, R-8 tube detector, and diverter gate was forwarded to the manufacturer.

Feasibility: Practical use of the R-8 tube detector appeared limited to sites with level surfaces and clean, wet fish (e.g., processing plants, buying stations, and hatcheries). Because of its size (30x39x105 cm) and weight (34 kg), the R-8 tube detector was placed on a hospital gurney for portability. Calibration of the equipment is critical for both detecting tags and avoiding false detections. Use of the tube was not feasible at truck buyer sites for in-river fisheries.

The use of a diverting gate with the tube seems essential to realize any significant advantages over the Wand. The Wand, although slower, can be more universally used. The Wand requires no set up time or calibration and would probably be the method of choice in situations with low fish numbers and at undeveloped sites. The R-8 unit worked well in most hatchery rack situations while the Wand worked best in sampling recreational fisheries.

At WDFW hatchery racks, Wands sampled a little less than 600 fish/hour/person compared to 900 fish/hour/person with R-8 tube detectors equipped with a diverter gate. In WDFW fishery sampling, Wands required 1.5 to 3.3 times as long to sample as the visual method of sampling. The R-8 tube detector required 1.8 to 3 times as long as visual sampling. The variability was specific to sampling situations.

For NWIFC field studies, sampling rates with the Wand averaged 550 fish/hour/person. Sampling rates for the R-8 tube detector ranged from 450 (without diverter gate) to 725 (with gate) fish/hour/person. NWIFC sampling rates were derived by expanding results from samples of 100 fish. As such, it is unknown how long the rates would be sustainable by an individual sampler.

CDFO's field tests demonstrated that two samplers were able to achieve throughput rates of up to 800 fish/hour, but without responsibility for all the activities normally associated with sampling[1]. Rates were adequate for low to medium volume off-loads but not high volume commercial fishery landings.

SUMMARY

The electronic Wand and R-8 tube equipment reliably detected CWTs in coho at mean detection rates of 97% and 98%, respectively. However, modifications to the detection equipment could be made to increase its efficiency. Several modifications have been suggested to the manufacturer who has agreed to make the changes prior to the 1997 sampling season (see Attachment 8).

Replacing the current method of visual sampling for CWTs with electronic sampling would involve significant increases in sampling time and effort. In electronic sampling, each fish has to be lifted and often moved to be tested. Adaptations in processing plants (e.g. customized tables) should be considered to eliminate the need to lift and move each fish. The increases in time, handling, and movement of fish will undoubtedly be met with some resistance by commercial buyers, processors, and hatchery managers.

Although limited paired testing was conducted, use of the R-8 tube may approximately double the time required to sample fish, and use of the Wand may double or triple the amount of time required for sampling. In order to maintain current sampling rates, increases in sampling staff will be required in many situations, and especially in high volume situations. The addition of a properly working diverter gate and counter will greatly increase the efficiency of the R-8 tube detector and thus reduce the number of samplers needed. As such, the gate and counter are essential components for R-8 tube detector systems designed for high volume landing sites.

Consideration should be given to other logistical problems encountered during the 1996 season and potential solutions incorporated for testing during the 1997 season. Additional Wands and fully equipped R-8 tube dectectors (diverter gates and counters) should be made available to sampling staff to familiarize them with the different equipment and their respective attributes. Sampling supervisors will then be able to determine which piece of equipment is best suited for a particular site and volume of fish as well as the level of staffing required.

Future testing in commercial fisheries should incorporate the diverter gate, and be designed to determine the reliability of both the gate and counter. Methods of achieving higher throughput rates are required for a number of commercial sites, some of which will also present space limitations, not yet addressed.

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[1]These activities include interviewing fishers, identifying and sequestering clipped fish, counting fish of each CWT species, obtaining length measurements and scale samples, removing heads from clipped fish, and recording data pertaining to the entire sample and individual recoveries.

ATTACHMENTS

1. CDFO study: Report on the 1996 tests to electronically detect coded-wire tags.

2. NWIFC study: Evaluation of electronic detection for coded-wire tags in coho salmon *(Oncorhynchus kisutch).*

3. WDFW study: Reliability and feasibiliity of using electronic detection for recovery of coded wire tags at the hatchery rack.

4. WDFW study: Electronic coded-wire tag detection equipment study during 1996 coastal recreational fishery.

5. WDFW study: Electronic coded-wire tag detection equipment study during the 1996 treaty coho fishery.

6. WDFW study: Electronic coded-wire tag detection equipment study during the 1996 Puget Sound recreational fishery.

7. USFWS and IDFG study: Detection rate comparison of tube and wand coded wire tag detectors on B-stain steelhead at Dworshak National Fish Hatchery, spring 1996.

8. Letter from Northwest Marine Technology, Inc. referencing commitments to upgrade electronic detection equipment.

Table 1. Results of 1996 sampling for CWTs in coho using the electronic Wand and R-8 Tube Detector equipment.

WAND TESTS

Sampling Location Type	Fish Sampled	Known CWTs	CWTs Detected	CWTs Missed	False Detections		Detection Rate (%)	False[2] Detection Rate (%)
NWIFC Hatchery	2594	670	667	3	28		99.6	1.5
NWIFC Commercial	1967	131	131	0	9		100.0	0.5
NWIFC Escapement Survey	154	85	82	2	0		97.6	0.0
WDFW Hatchery	35,417	1,657	1,649	8	58		99.5	0.2
WDFW Commercial	1,614	78	78	0	12		100.0	0.8
WDFW Recreational	1,157	61	52	9	39		85.2	3.6
Totals	42,903	2,682	2,659	22	146	Wt. Mean	99.1	0.4
						Non-Wt. Mean	97.0	1.1

R-8 TUBE TESTS

Sampling Location Type	Fish Sampled	Known CWTs	CWTs Detected	CWTs Missed	False Detections		Detection Rate (%)	False Detection Rate (%)
CDFO Hatchery	3,183	77	76	1	39		98.7	1.2
CDFO Commercial	12,150	457	457	0	11		100.0	0.1
NWIFC Hatchery	1187	194	194	0	28		100.0	2.8
NWIFC Commercial	2833	154	142	12	57		92.2	2.1
WDFW Hatchery	26,476	770	770	0	270		100.0	1.1
WDFW Commercial	1,406	80	79	1	26		98.8	1.9
Totals	47,235	1,732	1,718	14	431	Wt. Mean	99 2	0.9
						Non-Wt. Mean	98.2	1.5

[2] False Detection Rate: Percent of untagged fish where equipment indicated a detection but no tag was found during lab dissection.

$$\frac{\text{\# false tag detections}}{\text{\# untagged fish}} \times 100$$