RELIABILITY AND FEASIBILITY OF USING ELECTRONIC DETECTION FOR RECOVERY OF CODED WIRE TAGS AT HATCHERY RACKS

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INTRODUCTION

Mass marking of 1995 brood hatchery coho salmon (*Oncorhynchus kisutch*) for the purpose of selective fisheries in 1998 occurred at Washington Department of Fish and Wildlife (WDFW) facilities. The mass mark chosen was the adipose fin as recommended by the Pacific Salmon Commission (PSC 1995). The PSC report also recommended the use of electronic detection to detect coded wire tags (CWTs) since the adipose fin would no longer be a valid indicator of the presence of an internal CWT. The CWT system is the most important stock identification technique used on a coast-wide basis for chinook and coho management and research.

A joint research study was conducted by WDFW and Northwest Indian Fisheries Commission to evaluate electronic detection for CWTs in coho salmon. The work was funded under a Saltonstall-Kennedy grant. The purpose of this segment of the overall study was to evaluate the reliability and feasibility of electronic detection equipment at WDFW hatchery racks.

METHODS

Sampling Locations

Sampling was conducted from August 1996 to February 1997 at Puyallup hatchery in southern Puget Sound, Skykomish hatchery in northern Puget Sound, and Cowlitz hatchery in the lower Columbia River drainage. Each of these hatcheries had PSC index groups of 1993 brood coho salmon expected to return with standard length (1 mm) CWTs and adipose fin marks.

At Puyallup hatchery, in addition to a PSC index group of 1993 brood juveniles (40,097) released with CWTs and adipose fin clips there were two other groups tagged with CWTS but not adipose fin marked. One group (20,166) had 1.5 mm length CWTs and no adipose fin marks. The second group (20,395) had standard length CWTs and no adipose fin marks. The two groups without adipose fin marks were released so that upon return as adults, samplers would not bias their electronic sampling detection technique (i.e. trying harder to detect the CWT) because they saw the adipose fin was missing and therefore knew the chances of a CWT being present were greater.

The 1.5 mm length CWT group was released to see if the longer tags were detected at a

higher rate than 1 mm standard length CWT. The longer CWTs have a 1.5 times greater magnetic moment (Eckstrom 1997) than standard length CWT and therefore are easier to detect. The PSC Selective Fishery Report recommended 1.5 mm length CWTs be used to assure higher detection rates. Each of three CWT groups previously discussed had distinct tag codes. Both groups of the non-adipose marked fish were randomly sampled from the same population, tagged during the same time frame, and experienced identical rearing and release conditions after tagging. The index group was tagged three months prior to the non-marked groups.

At Cowlitz hatchery returning adult coho salmon are handled and sorted prior to spawning. To assure that samplers were not biasing their techniques by using the missing adipose fin as an indicator, 200 adults were tagged with CWTs but not adipose marked prior to spawning and sampling.

Sampling Techniques

Northwest Marine Technology (NMT) electronic tubular (R-8) and hand-held Wand CWT detectors were used to detect CWTs for 1996 Puyallup, Skykomish, and Cowlitz coho salmon hatchery rack returns. The R-8 detector measures 39 cm wide by 30 cm high and 1.37 m long including diverter gate and weighs 34 kg. The R-8 was placed on a hospital gurney measuring 63.5 cm wide and 96.5 cm high for ease of movement and positioning when sampling. The heigth of the gurney allowed the R-8 to be positioned directly next to a standard size fish tote on a 25° angle. The Wand measures 41 cm long by 13.5 cm diamater handle and weighs 575 g (1.3 lbs).

The proper use of the Wand CWT detector was demonstrated to 10 samplers who were responsible for sampling all coho salmon at the study sites. Each sampler was instructed to place the Wand in contact with the fish's snout and slide the Wand briskly in parallel strokes to the axis of the fish from the posterior edge of the eye to the anterior edge of the snout starting at one eye and ending at the other eye making sure to cover the entire area of the head (Figure 1). The easiest way to achieve thorough coverage was to hold the fish with the fingers inserted in the gills and the thumb placed on the operculum. Samplers were also cautioned about metal buttons, watches, zippers, etc. which could create a false signal from the Wand.

The R-8 is a new piece of electronic detection equipment and all samplers were instructed to read the operating instructions. Each tote of coho salmon to be sampled was sprayed with

water which significantly reduced the fish sticking in the R-8. At each hatchery, fish were randomly sampled for the presence or absence of a CWT. A proto-type diverter gate which separates and counts tagged and untagged fish was used some of the time.

The snouts were removed from all fish that registered a positive detection at all hatcheries. Fork-length, adipose fin mark status, sex and type of electronic sampling equipment used for detection was recorded on an individual head label for each snout (Figure 2). All snouts were taken to the WDFW CWT recovery lab for processing. In the CWT recovery lab if a CWT was not detected using a NMT Field Sampling Detector the snout was exposed to a 6 kg magnet to re-magnetize a CWT in case it was present. The snout was subsequently passed through an NMT 15cm omni-directional tube detector. If no CWT was detected in the laboratory after a R-8 or Wand detected a tag at the hatchery, it was determined to be a false detection. False detection rates were calculated by dividing the number of false detections by the number of unmarked fish.

Wand Sampling Procedure

During Wand tests, 2 to 4 technicians would grab a fish from a tote of adult coho salmon and check for the presence of a CWT. If a CWT was detected the coho salmon was placed into one of two containers, one for adipose marked and one for non-adipose marked. If a CWT was not detected the coho salmon was handed to a sampler who would then run the coho salmon through the R-8. If the R-8 subsequently detected a CWT, the fish was marked with a label indicating the CWT was missed by the Wand and the sampler who missed the CWT. When a CWT was thought to have been missed by a sampler in the field, immediate feedback was given and wanding technique was discussed The number of fish, processing time, and number of Wands used were recorded for each tote.

R-8 Sampling Procedure

During R-8 tests 2 technicians would grab adult coho salmon from the tote and slide them through the R-8. If the diverter gate was used, two totes were set side by side to collect the tagged and non-tagged coho salmon. A sampler checked for adipose marks in the non-tagged tote. If a non-tagged adipose marked coho salmon was found, the fish was labeled with the

detection and fin clip status. When the diverter gate was not used, two samplers would pull out tagged coho salmon along with non-tagged adipose marked coho salmon. The number of fish, processing time, and number of samplers were recorded for each tote.

RESULTS AND DISCUSSION

Reliability

A total of 63,758 coho salmon were sampled for CWTs electronically with R-8s and Wands at three WDFW hatcheries (Table 1). The sample was weighted heavily towards Puyallup hatchery where 49,254 were sampled, followed by Skykomish with 8,493, and Cowlitz with 6,011. The detection rates were high for both the R-8 and Wand detectors. A total of 55,265 were sampled visually at Cowlitz and Puyallup hatcheries The combined detection rate for visual sampling was 98.9%, 100% for R-8 samples and 99.6% for Wands (Table 1).

False detection rates for visual, R-8 and Wand detectors were relatively low. The combined false detection rates for visual detection was 0.2%, Wands was 0.2% and 1.1% for R-8s (Table 1).

At Puyallup hatchery the Wand detection ratio of missed CWTs/CWTs present was similar whether standard length CWTs were in adipose fin marked (2/828) or unmarked adipose fin fish (1/434; Table 2). At Cowlitz hatchery all 200 adults CWT'd without adipose fin marks prior to spawning were subsequently detected with Wands. No 1.5 mm length CWTs sampled with Wands were missed (0/417) when compared to three 1.0 mm length CWTs that were missed (3/1262; Table 3). The two groups returning with different size CWTs (1.0 mm vs 1.5 mm) survived and returned to the Puyallup rack at the same rate (4.1%; Table 4).

Both the R-8 and Wand functioned well during the sampling at WDFW hatchery racks. No malfunctioning problems occurred. On two occasions a fish being passed through the R-8 tunnel inadvertantly missed the opening and bumped into the power switch which turned the R-8 off. The problem was noticed immediately because the power indicator light was off on the R-8. Problems were experienced initially with the R-8 diverter gate. The first few times it was used, it would sporadically quit working. It was sent back to the manufacturer (NMT) who replaced a switch and cable where moisture was causing an electrical short. After being returned with a waterproof switch and cable, the diverter gate worked well.

Feasibility

Electronic detection of CWTs proved feasible at WDFW hatchery racks with R-8s and Wands. The R-8 proved to be a more desirable detection method because of its ability to more effeciently process large numbers of fish that were associated with hatchery rack sampling. At WDFW hatcheries, fish are typically sold to a contract buyer as surplus or spawned carcasses. The fish are delivered to the buyer in totes after being counted and sampled for biological information and CWTs. Sampling fish electronically for CWTs at hatchery racks thus involves sampling from a tote full of fish to an empty tote.

The sampling rate of fish/hr/person sampling tote to tote required about 1.5 times as long with Wands as with R-8s. The average rates were 576 and 900 respectively. The R-8 sampling rate assumes a diverter gate is being used. Wands also required more physical strength in that the procedure for wanding a fish was to pick it up with one hand while holding the Wand with the other hand. Sampling with an R-8 allowed a fish to be picked up with both hands.

For small numbers of fish (less than 100) the Wand might be a more desirable piece of equipment simply because of its portability. For this evaluation however, individual samplers wanded several thousand fish/day on several occasions. It was observed that some samplers held the Wand near the middle of the Wand as opposed to the far end like a hammer. This approach balanced the Wand better and was less tiring.

The R-8 placed on a hospital gurney is fairly portable and can be moved from place to place by one person if the ground is smooth enough to push a gurney. If the ground is rough, two persons are required to carry the R-8 (34 kg) on a gurney.

R-8 sampling should be considered as a quality control option for CWT detection at hatchery racks with or without selective fisheries. In previous double sampling examinations, both WDFW and Canada Department of Fisheries and Oceans (CDFO) observed missed CWTs from the visual sampling method of missing adipose fins at hatchery racks. The rates for missed marked fish approximated 25% for each agency.

Table 1. Results of 1996 WDFW hatchery rack sampling for coded-wire tags with electronic detection equipment and visual inspection.

R-8 SAMPLING

Sampling Location Site	Fish Sampled	Known CWTs	CWTs Detected	CWTs Missed	False Detections		Detection Rate %	False Detection Rate %
Puyallup Hatchery	24,695	770	770	0	219		100	0.9
Skykomish Hatchery	2,595	345	345	0	51		100	2.3
Totals	27,290	1,115	1,115	0	270	Mean[1]	100	1.1

WAND SAMPLING

Sampling Location Site	Fish Sampled	Known CWTs	CWTs Detected	CWTs Missed	False Detections		Detection Rate %	False Detection Rate %
Cowlitz Hatchery	6,011	126	126	0	3		100	0.1
Puyallup Hatchery	24,559	828	826	2	46		99.8	0.2
Skykomish Hatchery	5,898	705	699	6	9		99.1	0.2
Totals	36,468	1,659	1,651	8	58	Mean[1]	99.6	0.2

VISUAL SAMPLING

Sampling Location Site	Fish Sampled	Known CWTs	CWTs Detected	CWTs Missed	False Detections		Detection Rate %	False Detection Rate %
Cowlitz Hatchery	6,011	126	124	2	9		98.4	0.2
Puyallup Hatchery	49,254	1,598	1,587	11	116		99.3	0.2
Totals	55,265	1,724	1,711	13	125	Mean[1]	98.9	0.2

[1]Mean not weighted

Table 2. Standard length coded wire tags returning to Puyallup hatchery in 1996 detected by Wands with adipose fins present and adipose fins absent.

Group	Numbers Present	Numbers not Detected by Wands
1.0 mm CWT with Adipose Mark	828	2
1.0 mm CWT without Adipose Mark	434	1

Table 3. Comparison of detection rates for standard length (1.0 mm) and 1.5 length (1.5 mm) coded wire tags with Wand electronic detection at Puyallup Hatchery in 1996.

Group	Numbers Present	Numbers Not Detected by Wands
1.0 mm CWT	1,262	3
1.5 mm CWT	417	0

Table 4. 1996 Puyallup hatchery rack returns of standard length (1.0 mm) and a 1.5 length (1.5 mm) coded wire tags.

Group	Number Released	Number Recovered at Puyallup Hatchery	Percent Survival To Puyallup Hatchery
1.0 mm CWT	20,395	842	4.1
1.5 mm CWT	20,166	823	4.1

Figure 1. **Location of coded wire tags (shown as an x) in 350 spring chinook salmon returning to the Cowlitz hatchery in 1995. Lines show Wand detection path when searching for coded wire tags.**

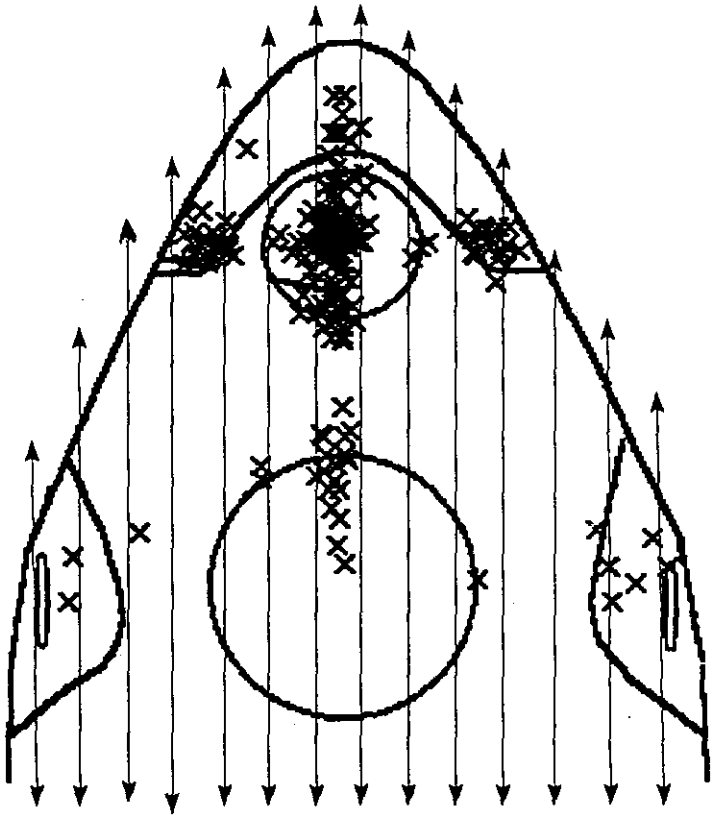
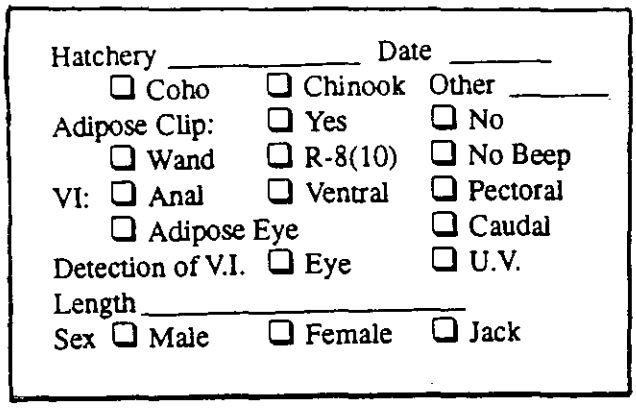


Figure 2. Individual head label used for electronic detection study.



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