REPORT OF THE EXPERT PANEL ON THE FUTURE OF THE CODED WIRE TAG RECOVERY PROGRAM FOR PACIFIC SALMON

Panel Members

From within PSC "Family"

- John Clark, ADFG
- Gary Morishima, MORI-ko, WA
- Brian Riddell, DFO, BC
- Jim Scott, WDFW

From "Outside" PSC Family

- Rick Deriso, IATTC
- Carlos Garza, NMFS, CA
- David Hankin, HSU, CA (Chair)
- Carl Schwarz, SFU, BC

technical support from Marianna Alexandersdottir, NWIFC

REPORT PREPARATION PROCESS

- CWT Workshop: 7-10 June , 2004
  - Background papers and presentations specifically for the workshop. Materials can be found at the PFMC website

Example Topics: implications and impacts of mass-marking (MM) legislation and development of mark-selective fisheries (MSF); regional overview of CWT system; technical review of CWT system and its use in PSC fishery regimes; CWT program costs; applications of GSI in PSC salmon fisheries.

REPORT PREPARATION PROCESS

- Full Panel Meetings & Assignments– 18 October 2004; 14-15 January 2005; 13-14 May 2005
- Draft Report sent out to peer review – late June 2005
- All Peer Reviews Received – early September 2005; respond to peer reviews.
- Final Report – Released in mid-November 2005 (consensus document)
- Agency Comments – posted at PSC web site

PEER REVIEWERS

- Dr. Don Campton, USFWS (genetics)
- Dr. Peter Lawson, NMFS (fishery management, PFMC experience)
- Dr. Terry Quinn, UAK, Juneau (population dynamics, sampling theory)
- Dr. John Skalski, UW (statistics)
- Dr. Carl Walters, UBC (population dynamics, fishery management theory)

REPORT STRUCTURE

- Preface (2 pp)
- Part I: Background Information (20 pp)
- Part II: Executive Summary (18 pp)*:
  - Major Findings
  - Major Recommendations
  - Implementation Steps
- Part III: Justifications and Rationale for Part II (94 pp)
- Part IV: Technical Appendixes (70 pp)

*Provided in March PFMC packet

What Concerns Prompted The EP Report?

- 1. Deterioration in the CWT system itself
  - reduced ocean fisheries lead to reduced ocean CWT recoveries which in turn lead to increased uncertainty in expanded ocean fishery CWT recoveries;

Example: Substantial Reduction in Ocean Fishery Recoveries – Late 70's vs Late 90's

Iron Gate Hatchery (Klamath R.) Fall Chinook: CWT 06-61-01, 1976 BY, Oct. release of 191,000 fish						
Expanded Recoveries at Age						
Age 2		Age 3		Age 4		
Ocn	FW	Ocn	FW	Ocn	FW	Est. Age 4 Harvest Rate
6	1526	3314	913	3151	602	0.80*
Trinity River Hatchery (Klamath R.) Fall Chinook: CWT 06-61-05, 1977 BY, Oct release of 180,000 fish						
5	345	986	1491	856	610	0.58*

*VERY serious conservation concern revealed by CWT recovery data.

Example: Substantial Reduction in Ocean Fishery Recoveries – Late 70's vs Late 90's

Trinity River Hatchery (Klamath R.) Fall Chinook: CWTs 06-52-33 and 06-52-36, 1997 BY, June releases of 51,000 & 48,000 fish (experimental groups)						
Expanded Recoveries at Age						
Age 2		Age 3		Age 4		
Ocn	FW	Ocn	FW	Ocn	FW	Est. Age 4 Harvest Rate
0	29	29	351	10	114	0.081*
0	67	67	444	11	68	0.139*

* Modest positive bias – excludes any age 5 recoveries

What Concerns Prompted The EP Report?

- 1. Deterioration in the CWT system itself (cont.)
  - Historic & current areas with inadequate or non-existent sampling: freshwater “stray” escapement; freshwater recreational catch; ocean recreational catch (BC); some new fisheries are hard to sample.
  - reduced cooperation and support for the CWT system due to budget cuts and mass marking-related issues – example: inconsistent use of “wanding” in fisheries where substantial numbers of MM fish are present (AK, BC).

What Concerns Prompted The EP Report?

- 2. Potentially serious consequences of MM and MSF for analysis and interpretation of CWT recovery data, especially for estimation of non-catch mortalities in MSF.
  - Is the “DIT” (Double Index Tagging) approach a magic bullet or not? Does it really work for Chinook salmon? Can we use this approach to estimate non-catch mortalities in individual MSFs?

What Concerns Prompted The EP Report?

- 3. Belief by some fisheries scientists that modern genetic methods could and would completely supplant the CWT system within a few years.
  - Recent PSC success in standardization of large coastwide Chinook salmon microsatellite baseline;
  - Current development of SNPs;
  - Successful in-season use of microsats to reduce harvest on weak stock (BC example)

Brief History of the CWT Program:

Introduced in early 1970's

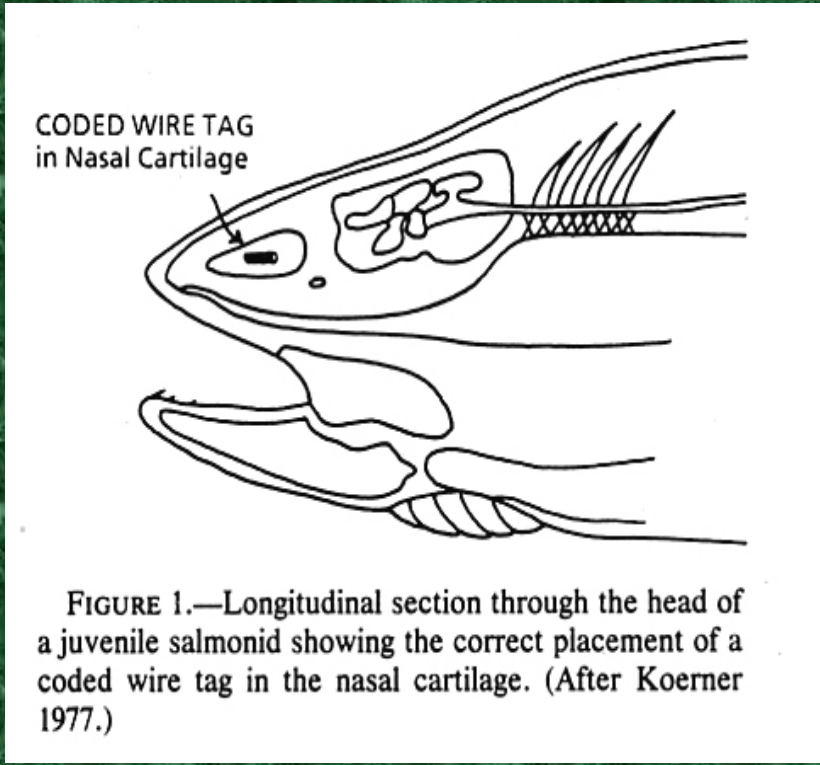
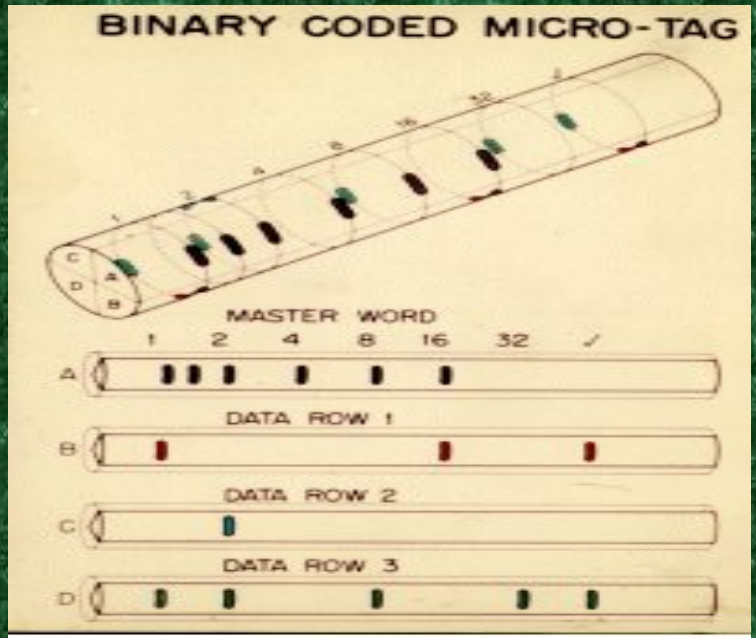


FIGURE 1.—Longitudinal section through the head of a juvenile salmonid showing the correct placement of a coded wire tag in the nasal cartilage. (After Koerner 1977.)



Example of binary code used on coded wire tags. Notice the code is present on four sides of the tag.

The CWT is a small piece of magnetized wire (0.25 x 1.1 mm) which is implanted in the nasal cartilage of juvenile salmonids (Figure 1). Each piece of wire contains a code that uniquely identifies an individual group of fish (batch coding). (Now printed)

By late 70s: Development of a coast-wide CWT recovery system – PSMFC with lead coordination role.

- Adipose fin originally “sequestered” and used to identify fish possessing CWT;
- Randomized ocean fishery catch sampling at >= 20% rates, remove snouts of AD-clipped fish for processing;
- Hatcheries sampled at 100%;
- Attempts, varying in quality, made to estimate recoveries in FW fisheries, stray escapement, etc.

Late 70's – Independent development of Cohort Analysis methods –

- IF estimates of catches and escapements from all areas are available, and natural survival rates are assumed known, then the full cohort history can be reconstructed and at least the following can be estimated:
  - Age-specific maturation probabilities;
  - Overall age-specific ocean and freshwater fishery harvest rates;
  - Exploitation rates in individual fisheries;
  - Survival rates from release to age 2

By 2004: CWT System Summary statistics (Johnson, K. 2004)

- 54 state, federal, tribal and private entities in USA and Canada conduct CWT experiments – 1200 new codes annually;
- > 50 million juvenile salmon and steelhead tagged annualy (cost > $7.5 million);
- About 275,000 CWTs recovered each year (cost $12-13 million);
- Used for many purposes – evaluate success of hatchery practices; serve as proxy for fishery impacts on unmarked wild fish; ocean distributions.

Late 80s – Present:
Emerging Problems with the CWT System

- Increasingly complex fisheries & demand for CWT-based information at increasingly smaller scales – many more time-area fisheries;
- Reduced sampling rates in some fisheries and other areas, some new unreported commercial catches, and reduced ocean fishery recoveries;
- Mass Marking, recent MM legislation (2003), and Mark Selective Fisheries introduce new complications.

Mass Marking and Mark-Selective Fisheries

- In mass marking, ALL hatchery fish receive an adipose fin clip, but many (most) of these fish are released *without* CWTs:

"The United States Fish and Wildlife Service shall, in carrying out its responsibilities to protect threatened and endangered species of salmon, implement a system of mass marking of salmonid stocks, intended for harvest, that are released from Federally operated or Federally financed hatcheries including but not limited to fish releases of coho, chinook, and steelhead species. Marked fish must have a visible mark that can be readily identified by commercial and recreational fishers."

Achieving mass marking has required development of new (and expensive!) automated tagging technologies:

AutoFish System from Northwest Marine Technology is capable of automated removal of the adipose fin and/or insertion of a CWT. Each fish is sorted by size, clipped and/or tagged, and returned to the pond in about 5 seconds.

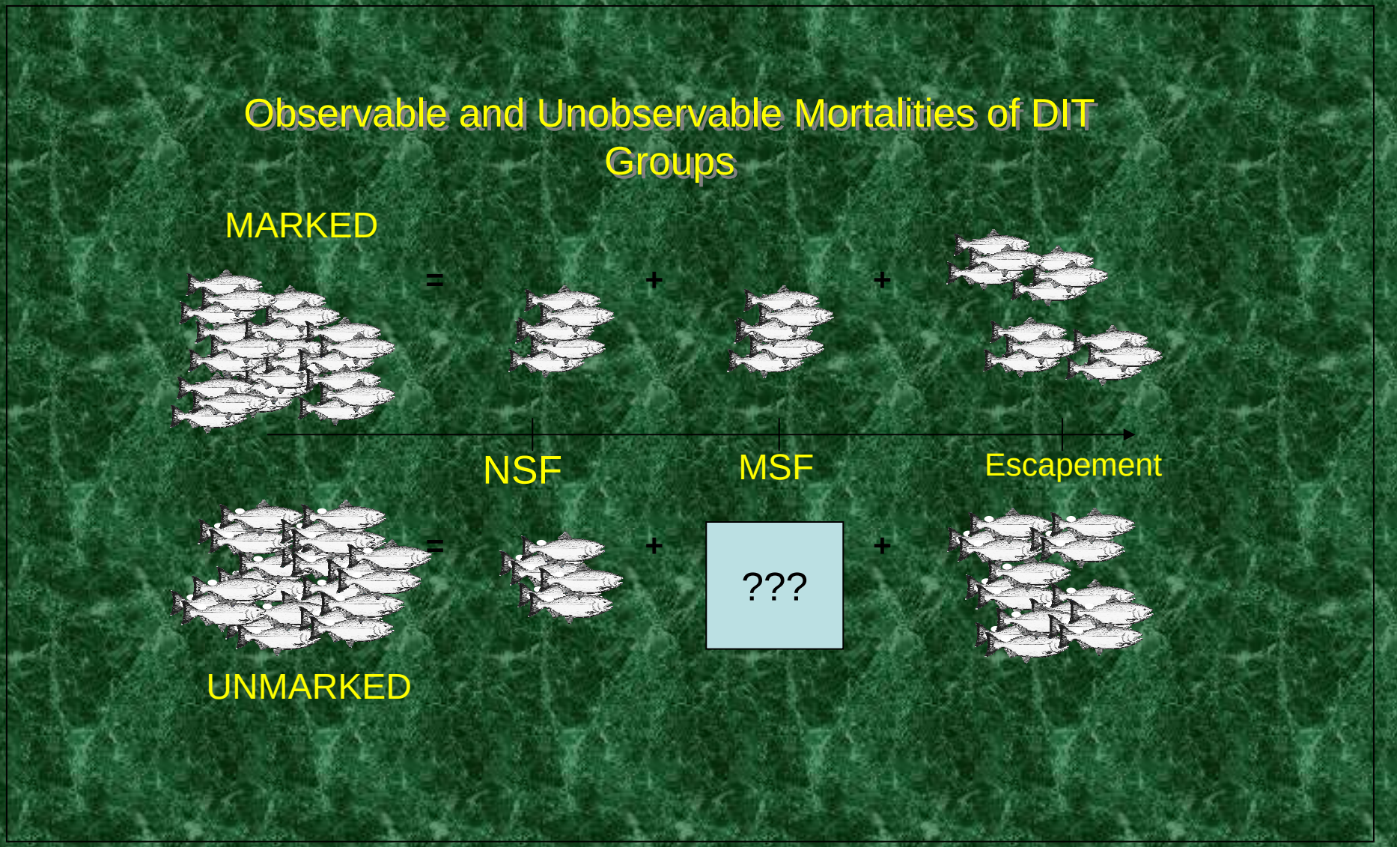
Mass Marking also introduces new complications wrt sampling catches and escapements for CWT'd fish because now not all ad-clipped fish have CWT and it would be impractical to collect heads from all AD-clipped fish to search for non-existent CWTs.

Wand and tube CWT detectors

Other complications from MM and MSF

- In mark-selective fisheries (MSF), only ad-clipped (known hatchery) fish may be retained, theoretically leading to reduced fishing mortality on weak (e.g., ESA-listed) natural stocks.
- BUT – there must also be some"non-catch" hook & release mortality on unmarked (natural) fish in MSF.
- Recovery patterns of CWT'd hatchery *indicator stocks* have routinely been used to infer exploitation rates experienced by associated natural stocks.
- With MSF, recovery patterns of marked hatchery fish are no longer the same as the associated unmarked natural stocks.

DIT - Double Index Tagging: Two groups receive CWT, but only one group is AD-clipped.



MAJOR FINDINGS of the Expert Panel:

Importance of and Problems with the Existing CWT System

- 1. No obvious viable short-term alternative to the CWT system – agencies must continue to place primary reliance on CWTs for at least the next 5 years.

- 3. Since inception of PST, quality and quantity of CWT recovery data have deteriorated while increased demands have been placed on these data to provide protection for natural stocks at risk.

MAJOR FINDINGS: Issues raised by Mark-Selective Fisheries

- 6. Mass Marking (MM) and Mark-Selective Fisheries (MSF) together pose serious threats to the integrity of the CWT system. The PSC has been alerted to these threats since at least 1991. In particular:

  A. Recovery patterns of adipose-clipped fish no longer indicate recovery patterns for unmarked natural stocks;

  B. Significant practical and statistical issues are raised by the need to find Ad+CWT fish when many MM fish are released with Ad clip only.

MAJOR FINDINGS: Issues raised by Mark-Selective Fisheries

- 7. For coho and chinook salmon, it appears possible to estimate total non-catch mortalities at age in all MSFs from a full cohort analysis of paired DIT (double-index tagged) releases.

However, we could not derive an unbiased method to allocate total non-catch mortalities over a set of MSFs.

MAJOR FINDINGS: Issues raised by Mark-Selective Fisheries

- 9. Concerns have been expressed regarding "reliability in practice" of electronic wanding of salmon for presence of CWTs, but all evidence brought to our attention suggests that wanding is reliable. *(except for half tags – CDFG comments)*

- 10. Impacts of MSF will be variable & stock-specific. Management agencies have not yet developed a framework to address the increased uncertainties that would result from significant MSFs.

MAJOR FINDINGS: Existing & Future Technologies

- 11-12. Existing technologies (otolith thermal marking & genetic stock identification (GSI) methods) can complement the CWT system, but cannot replace it.

- 17. Over the next several years, we believe that SNPs (single nucleotide polymorphisms) will replace microsatellite markers as the genetic tool of choice. Reasons include ease of standardization and reduced costs.

MAJOR FINDINGS: Existing & Future Technologies

- 18. A novel genetic method, termed full parental genotyping (FPG), has been presented as an alternative to coded wire tagging. An empirical demonstration is needed to validate promising theoretical results.

- 19. Some existing or emerging electronic technologies might theoretically replace the CWT (e.g., PIT tags, RFID tags). Future technological improvements may reduce size and cost of such tags.

COMMENT (from Panel Chair)

- None of the identified future genetic or electronic technologies provide a clear fix to the problem of estimating fishery-specific non-catch mortalities to unmarked (natural) fish subjected to more than one MSF;
- Small natural stocks pose the most difficult problems;
- It is important to find an external identifier for fish bearing CWTs, for fish FPG'd prior to release, or (perhaps less so) for fish bearing electronic tags.

MAJOR RECOMMENDATIONS: Most Relevant to the PFMC

- 3. Develop new guidelines for CWT release group sizes and for fishery and escapement sampling rates based on explicit criteria for precision of estimates and based on current fishery regimes.

- 6. Explore & evaluate band-recovery-like, state space, or shared effects modeling approaches to allow improved estimation of exploitation rates, survival rates, and maturation probabilities from CWT recoveries for multiple cohorts.

MAJOR RECOMMENDATIONS: Coordinated Research

- 12. Design and conduct new experiments to evaluate use of alternative external marks for identification of fish bearing CWTs.
  - External marks (e.g., ventral fin clips) appear to generally decrease survival from release to age 2, but (from the CWT analysis perspective) it is more important to know if there is a persistent survival effect past age 2.

MAJOR RECOMMENDATIONS: Coordinated Research

- 14. The PSC should support an immediate evaluation of a transition from GSI based on microsatellites to GSI based on SNPs.

  – Such a transition would be best directed by a multi-jurisdictional agency, such as the PSC, to coordinate broad, multi-agency collaborations and to develop provisions for timely exchange of tissue samples.

MAJOR RECOMMENDATIONS: Coordinated Research

- 15. The PSC should support or fund a "proof-of-concept" empirical validation of the Full Parental Genotyping (FPG) method for use in management of Pacific salmon fisheries.
  - The validation should be for chinook salmon and should include support for further development of SNPs, the genetic marker used for FPG.

MAJOR RECOMMENDATIONS: Coordinated Research

- 16. A feasibility study should be conducted to determine how PIT, RFID or other electronic tags might be used to generate data suitable for full cohort reconstruction (i.e., theoretically, to replace the existing CWT system). Such a study should include estimates of costs and availability of tagging and detection technology.