PACIFIC SALMON COMMISSION
Selective Fishery Evaluation Committee
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Selective Fishery Evaluation Committee

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List of Acronyms

Ad Hoc SFEC	Ad Hoc Selective Fishery Evaluation Committee
ADF&G	Alaska Department of Fish & Game
CDFO	Canadian Department of Fisheries and Oceans
CoTC	Coho Technical Committee
CTC	Chinook Technical Committee
CWT	Coded-wire tag
DIT	Double Index Tag
DSWG	Data Sharing Committee Work Group
ETD	Electronic Tag Detection
FRAM	Fishery Regulatory Assessment Model
NCBC	North Central British Columbia
NMT	Northwest Marine Technology
NWIFC	Northwest Indian Fisheries Commission
ODFW	Oregon Department of Fish & Wildlife
PEF	Production Expansion Factor
PFMC	Pacific Fishery Management Council
PM	Proportional Migration
PSC	Pacific Salmon Commission
QMC	Quinault Management Center
RCWG	Regional Coordination Work Group
SEAK	Southeast Alaska
SFAWG	Selective Fishery Analytical Work Group
SFEC	Selective Fishery Evaluation Committee
SFM	Selective Fishery Model
USFWS	U.S. Fish & Wildlife Service
WDFW	Washington Department of Fish & Wildlife

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Executive Summary

Introduction

This report supplements the Interim Progress Report of the Selective Fishery Evaluation Committee (SFEC) on Mass Marking and Selective Fisheries provided to the Pacific Salmon Commission (PSC) in December 1998. This supplemental report provides information regarding mass marking and selective fisheries in four major parts: (1) chinook; (2) coho; (3) electronic tag detection capabilities; and (4) work schedules for the SFEC analysis and regional coordination work groups.

Chinook

Feasibility of Mass Marking.

The technology to mass mark chinook has become available with the development of equipment to automatically remove adipose fins and insert coded-wire tags (CWTs).

Production Proposed for Mass Marking.

As reported in January, WDFW has withdrawn its proposal to mass mark 1998 brood chinook production from Washington coastal facilities due to concerns regarding impacts to catch sampling programs in North/Central B.C. (NCBC) and Southeast Alaska (SEAK) and agency priorities for marking production from Puget Sound. WDFW and ODFW have provided proposals for mass marking of Puget Sound production and releases of lower Columbia River spring chinook. Agencies are reviewing potential impacts of the proposed marking schedule upon catch sampling programs in SEAK and NCBC.

Selective Fisheries.

WDFW has withdrawn a proposal to implement mark selective fisheries for chinook in Puget Sound beginning in 1999, but has indicated its intent to propose selective fisheries again in 2000.

Viability of the CWT system for Chinook.

The SFEC is unable to provide a definitive answer at this time as to whether or not the viability of the CWT system for chinook can be preserved under mass marking and selective fisheries. The SFEC has verified that the analytical procedures being developed to evaluate selective fisheries for coho using double index tagging (DIT) will not work for chinook. Alternative methods are under investigation and preliminary indications are sufficiently promising to warrant investment in further research. At present, the SFEC is focusing on the estimation of brood year cumulative impacts of selective fisheries for chinook by combining DIT with proportional migration algorithms. Current efforts are focused on determining if impacts of selective fisheries can be estimated using DIT under ideal conditions where perfect information on mass marking, natural and incidental

mortality rates, and fishery recoveries is available for analysis. As investigations proceed, the SFEC intends to evaluate the impacts of uncertainty on estimation methods.

To preserve the potential use of DIT to maintain the viability of the CWT program for chinook salmon, the SFEC recommends DIT for those stocks that would be expected to be significantly impacted by fisheries that are presently under consideration for mark-selective retention. A list of stocks proposed for DIT has been developed for Puget Sound and Columbia River chinook stocks. Canada should consider DIT for Southern B.C. chinook salmon stocks that would be impacted in Puget Sound mark selective fisheries.

Since catch sampling using electronic tag detection (ETD) equipment is not presently anticipated in Northern/Central British Columbia and Southeast Alaska, the implications of failing to implement electronic tag detection capabilities coast-wide for the viability of the CWT system are being examined.

Additionally, it is important to note that any selective fisheries for chinook prior to 2004 will be impacting one or more age classes that have not had the opportunity to be double-index tagged. There is no question this will seriously impair CWT analyses for chinook stocks of brood years 1994-1997, U.S. or Canadian that are vulnerable to harvest in those selective fisheries.

Coho

Mass Marking and DIT releases.

A list of mass marked 1996 brood coho production that are expected to contribute to 1999 fisheries has been provided for Washington, Oregon, and Southern British Columbia. Proposed mass marking schedules for 1997 brood coho for these regions are also presented in this report. There are no mass marking plans for Northern B.C. or Alaskan coho salmon stocks. A list of DIT stocks for 1996 brood releases of coho is included, as is a proposed list of double index tag groups for the 1997 brood.

Selective Fisheries.

Agency reports documenting results of the limited 1998 selective fisheries for coho are included in this report. Specific proposals for mark selective fisheries in 1999 were developed during the domestic planning processes but were not available for evaluation in time for this report. Given the timing of these processes, the opportunity for the SFEC to review and provide advice regarding specific proposals for selective fisheries prior to implementation will be extremely limited.

Viability of the CWT system for Coho.

The SFEC has initiated analysis of results of DIT experiments involving the 1995 coho salmon brood to determine the validity of assumptions underlying analytical procedures to estimate impacts of selective fisheries. In addition, the SFEC is in the process of evaluating variability and uncertainty regarding estimates of selective fishery impacts.

Potential problems with the capability of DIT-based procedures to estimate impacts of selective fisheries when significant sources of mortality (e.g., fisheries, predation) are not adequately sampled are identified in this report.

The SFEC has not been able to develop a means to allocate incidental mortalities to individual selective fisheries when multiple selective fisheries impact a stock. Losing this capability would impair the viability of the CWT system as defined in the 1995 report of the Ad-Hoc Selective Fishery Evaluation Committee (ASFEC). The SFEC has initiated research to investigate the capability of proportional migration algorithms to overcome this problem.

The SFEC has worked with the Data Sharing Committee to modify CWT reporting formats to accommodate the information required to report data on mass marking and selective fisheries.

Electronic Tag Detection

Some agencies continue to evaluate and field test equipment (tubes and wands) for electronic tag detection (ETD). Results indicate that ETD equipment is capable of detecting CWTs with a high degree of accuracy for coho and chinook salmon. Although some technical problems remain, it is expected that these can be readily resolved by working closely with the equipment manufacturer. The SFEC cautions, however, that ETD capabilities for chinook have not yet been tested under fully operational conditions and that ETD equipment has not yet been fully deployed within the limited range of mass marked coho production.

Work Schedules for the Selective Fishery Analytical Work Group (SFAWG) and the Regional Coordination Work Group (SFRCWG)

The SFEC is in the process of developing schedules for the analysis and regional coordination work groups to examine impacts of proposals for mass marking or selective fisheries. These schedules will attempt to integrate timing considerations involved in both PSC and domestic planning processes.

Chinook Salmon

1998 Brood Mass Marking Proposal From WDFW and ODFW

The technology to mass mark chinook has become available with the development of equipment to automatically remove adipose fins and insert coded-wire tags (CWTs). In November of 1998, WDFW and ODFW presented a proposal for mass marking 1998 brood releases of chinook salmon. Also included was a proposal for selective chinook fisheries in Puget Sound beginning in the spring of 1999. The SFEC reviewed the proposal and provided comments to the submitting agencies regarding concerns that commitments for electronic tag detection capabilities had not been made for north/central B.C. and Southeast Alaska fisheries, which would be impacted by mass marking of far-north migrating stocks. In January 1999, WDFW withdrew its proposal to mass mark coastal Washington hatchery production of chinook. A chinook mass marking and selective fishery implementation plan has been developed between Western Washington tribes and WDFW. This plan defines the terms of agreement for proceeding with mass marking Puget Sound chinook as proposed by WDFW for the 1998 brood production (Appendix 1). Under this agreement, WDFW has proceeded with mass marking of approximately 11 million fingerling and 2.5 million yearling chinook. Mass marking of approximately 2 million yearling spring chinook from lower Columbia River hatcheries in Washington has been completed (Table 1). Mass marking of ODFW's coastal and Columbia River basin chinook has proceeded as shown in Table 2.

Double-Index Coded-Wire Tagging Recommendations

Table 3 lists the PSC exploitation index stocks that are recommended for double index tagging (DIT) for the 1998 brood for chinook index stocks. Generally, DIT was recommended for stocks expected to be exploited in fisheries that are potential candidates for selective fisheries in 2001, e.g., Puget Sound sport fisheries. There were four exceptions to this approach: (a) where there were insufficient numbers of juveniles available for double index tagging (e.g., Stillaguamish Fall Fingerlings); (b) where there was no associated unmarked production (e.g., South Sound Fall Yearlings); (c) where all production was needed to meet conservation goals (e.g., White River springs in Puget Sound); and (d) where managers wanted all fish to be made available for potential mark-selective fisheries (e.g., Netsucca and Trask in Oregon).

After consultation with representatives from the various management agencies, four stocks have been added to the original list proposed for the Puget Sound region. Additionally, Lewis River spring chinook are to be used instead of Cowlitz River stock production in the Columbia River region.

There are also stocks in Southern British Columbia that would be impacted by potential selective fisheries, particularly Puget Sound sport fisheries. In order to retain the potential to collect future information needed to evaluate the impact of chinook selective

fisheries in Puget Sound, 1998 brood Chilliwack, Lower Shuswap and Cowichan stocks were double index tagged. Consideration should be given to identifying other southern British Columbia stocks that should be double index tagged.

Electronic Tag Detection

Washington

The NWIFC and USFWS conducted field studies in 1998 to evaluate the detection capability of hand-held wand detectors when sampling chinook (Appendix 2). The results of this limited field test indicate that the wand has the potential for detecting standard length, "new wire", coded-wire tags in adult chinook with a high degree of reliability. Wands successfully detected CWTs in 256 out of 258 tagged chinook (99.2%). The two tags that were missed were in larger fish.

Only adipose marked fish were sampled in the study. Although samplers were instructed to use standard sampling techniques, they were aware that the fish being sampled had a high possibility of possessing a tag. Thus detection rates observed in the study may not be representative of those that would be achieved by a technician sampling groups of fish with a low percentage of tags.

The WDFW conducted studies in 1998 (Appendix 3) which evaluated the reliability of wand detectors to detect "old" 1.1 mm coded wire tags (CWTs) and "new"[1] 1.5 mm CWTs in four year old chinook salmon.

The mean size of fish with undetected tags was significantly larger than the mean size of fish with tags the wands could detect. However, the sizes of fish with undetected tags fell within the range of sizes with detected tags. When a wand is used for CWT recovery, the possibility of recovered tags disproportionately representing fish smaller than 80 cm needs to be considered. This bias could be minimized by using "new" 1.5 mm wire and by careful use of the wand. An alternative approach to 1.5 mm wire would be to use the portable sampling detector (V-detector) for fish greater than 80 cm fork length.

Because of the study designs and the relatively low numbers of fish involved in these two studies, the researchers recommended further study in three general areas: (1) wands should be tested under actual fishery situations to evaluate the detection rate achieved by

[1] The magnetic moment of the "new" wire at 1.5 mm length is about 200% stronger than the "old" wire at 1.1 mm length (Northwest Marine Technology, pers. comm.). The ASFEC (1995) recommend 1.5 mm CWTs be used in coho salmon to increase the reliability of electronic detection. Chinook salmon are typically smaller when tagged than coho salmon so WDFW also tested whether survival to adult return and if tag loss was affected by using 1.5 mm CWTs compared to 1.1 mm CWT's. The WDFW study found no significant difference in tag loss or survival to four year old adults returning to the hatchery rack between the salmon tagged with different length CWTs. Wands detected 90.8% of the "old" 1.1 mm CWTs and 99.4% of the new 1.5 mm CWTs.

samplers in the field; (2) additional testing should be conducted on large fish to determine if results can be replicated; and (3) testing is recommended to determine a minimum acceptable CWT detection depth for wand use on chinook.

The SFEC recommends that agencies work with the wand manufacturer to establish a minimum detection depth standard to ensure that all wands will be capable to detecting single length tags in chinook.

Canada

The ability of the wands to identify tags in large sized chinook heads was tested in the 1998 northern troll fishery (Appendix 4). Wands successfully identified 96% of the standard length tags. The number of missed tags originating from the eye area suggests that samplers may not have been consistently sweeping this area of the head. Training should alleviate this problem and increase the tag recovery rate. Problems will be expected recovering ½ length tags and recovering tags from chinook exceeding 925 mm nose to fork length or 200 mm head length.

Viability of CWT Program For Chinook

Mass marking and selective fisheries will impact our ability to use CWTs. A viable CWT program is currently our only means to detect changes in salmon production due to exploitation or survival, or the combination of these.

As with coho salmon, tag groups with adipose fin clips (the mass mark) can no longer represent production, natural or hatchery, that is not mass marked if the tag group is subject to a selective fishery. A second tag group without an adipose fin clip can be added to represent the unmarked production. However, tags from these unmarked tag groups will not be recovered in selective fisheries. In order to estimate selective fishery mortalities, the two tag groups must be linked so that differences between the exploitation rates of the DIT groups can be used to estimate the selective fishery mortalities of the unmarked group. This is the basis for the DIT system that has been implemented for coho salmon.

The DIT system allows cohort analysis to be used to estimate total selective fishery mortalities of coho salmon if all sources of mortality are sampled. Cohort analysis is basically an accounting procedure which sums escapement and fishery recoveries and, using external estimates of natural mortality and other incidental mortalities (e.g. drop-off, sub-legal mortalities), provides estimates of recruits by age, marine survivals to age 2 and exploitation rates. For coho, analysis procedures assume that all natural mortality occurs prior to harvest in the final year of life. The failure to account for natural mortality within a year may introduce some bias in these estimates. However, for coho, the level of natural mortality is small, as they primarily return at age 3.

The question we are faced with is: will a similar DIT system work for chinook salmon? Chinook salmon is a multiple age species and is harvested at various stages of maturity.

Natural mortalities of this species between ages are presumed to be substantial (ranging from 10-50% depending on the age of the fish). For chinook, natural mortality and selective fishery mortality would be confounded so a simple comparison of the initial estimates of recruit abundance at age 2 would produce a bias in estimates of unmarked selective mortalities. The bias could be quite substantial.

The SFAWG is investigating the potential use of the Proportional Migration (PM) Model as a method for separating selective fishery and natural mortalities in DIT analysis for chinook (Comstock et.al. 1999). This method uses results of a cohort analysis on the marked tag group to estimate mortalities for the associate unmarked tag group. A cohort analysis is first carried out for the marked tag group. The PM model then performs a forward simulation using the CWT based estimates of mortalities generated for the marked tag group. The natural mortality rates are assumed to be identical to the rates used for the marked cohort analysis. The forward simulation attempts to estimate mortalities of selective fisheries on the unmarked group using the recoveries of unmarked fish, and changes to the mark to unmarked ratio, in non-selective fisheries and escapement.

Preliminary investigations into the PM model indicate that estimates of unmarked mortalities can be substantially improved (Comstock et.al. 1999).

Additionally, it is important to note that any selective fisheries for chinook prior to 2004 will be impacting one or more age classes that have not had the opportunity to be double-index tagged. There is no question this will seriously impair CWT analyses for chinook stocks of brood years prior to 1998, U.S. or Canadian, that are vulnerable to harvest in those selective fisheries. The earlier the fisheries are implemented, the more inadequately tagged/marked age classes will be encountered, and the more serious the problem.

Impact of lack of electronic sampling in Alaska and Northern/Central B.C.

Currently, Electronic Tag Detection (ETD) capabilities are expected to be in place only in Washington, Oregon, and Southern British Columbia. Some stocks of chinook salmon are also impacted significantly by fisheries in North/Central British Columbia and Southeast Alaska. Since there are no plans to sample catches in these regions using ETD, conventional catch sampling procedures based on visual inspection will recover and process all chinook with missing adipose fins, whether or not they have tags. Further, tags from unmarked fish from DIT groups would not be recovered.

Impact on DIT estimation.

In order to generate estimates of impacts of mark-selective fisheries using DIT, all sources of mortality must be adequately sampled using ETD equipment. Use of DIT groups depends on ETD to detect tags in unmarked fish. Currently there are no plans to use electronic gear in Alaskan and northern/central B.C. fisheries. The lack of recoveries for unmarked and tagged fish may present a problem in using DIT methods for estimation of selective fishery impacts. To begin evaluating the extent of the problem the distribution of tags recovered for the PSC CTC index tag groups is shown in Table 4

(CTC, 1999). Few recoveries of Puget Sound stocks are made in these northern fisheries. The Stillaguamish summer fingerlings are the only tag group with significant representation for 3 and 4 year olds, the dominant age classes recovered in these fisheries (Table 4). The lack of electronic sampling in northern fisheries will therefore not represent a problem for stocks being mass marked in 1999. However, once mass marking expands to stocks outside of Puget Sound this will be a problem and should be addressed by the SFAWG analysis workgroup.

Estimates of unmarked tag recoveries could be inferred from marked DIT recoveries if it can be assumed that there are no preceding selective fisheries on the tagged chinook salmon that are vulnerable to the non-EDT sampled fisheries. If this assumption does not hold, estimates of selective fishery impacts from DIT analysis will be biased. There is some evidence that suggests that fish which would be present in Puget Sound where mark-selective fisheries may operate, do not migrate to more northerly areas where ETD capabilities are not anticipated to be in place. Several tagging studies (VanHyning (1968), Godfrey (1968), and Healy (1991)) showed juvenile (mostly ages 2 and 3) chinook tagged in Oregon and Washington marine waters generally migrated only as far north as the middle of Vancouver Island. None of these tagged fish were subsequently recovered from Alaskan waters. Two fish were recovered as far north as Northern B.C. However, they were recovered five months after being tagged as 29 and 35 cm FL juveniles. Both were well below the minimum size limit for chinook in fisheries that are anticipated to operate under mark-selective retention regulations.

If fish that have been in an area/time period where a mark-selective fishery has taken place subsequently have limited or no movement into areas lacking ETD capabilities, then problems of estimating impacts of mark-selective fisheries on unmarked fish would be simplified. Methods to partition differences in DIT exploitation rates would still need to partition mortality due to natural causes and mark-selective fishing.

Impacts on catch sampling programs.

Impacts of mass marking of the stocks proposed by WDFW and ODFW for the 1998 brood year on catch and escapement sampling programs of Southeast Alaska and Northern/Central British Columbia are summarized below. For purposes of assessment, it was assumed that all production from these stocks was mass marked.

Alaska

The potential increase in the number of adipose clipped chinook processed for CWTs was estimated using data from 1990 to 1996 fisheries in southeast Alaska. The production expansion factor, or PEF (total production/marked production), was brood year specific and usually combined releases from several production sites into a single expansion factor. Puget Sound PEFs were calculated for WDFW facilities by region, brood year, and release age (1-fingerling; 2-yearling). Observed CWT recoveries in 1990-96 from those production facilities proposed for mass marking were expanded by their associated PEF. All observed CWT recoveries were expanded by 10% to account for a normal incidence of processed snouts that do not contain CWTs ("no-tag"). No additional

adjustments were made for changes in total number of releases and expected survival rates for the 1998 brood production.

In southeast Alaska, the proposed mass marking would have resulted in an average 14% increase in chinook snouts processed for CWTs in 1990-96 (Table 5). From 1990 to 1996, the ADF&G tag lab processed around 7,200 CWTs from chinook annually plus another 550 (7%) adipose fin clipped chinook without tags. At current tagging rates and production levels, it is estimated that the proposed WA & OR mass marking plans would result in ADF&G processing an additional 1,700 clipped chinook with no tags annually. It costs about $10 per fish to process heads sent to the tag lab, including sampling, shipping, finding the tag, decoding the tag, and entering the data to a database. The cost is about the same for fish with or without a tag, due to additional time spent looking for the tag. The additional heads would result in an additional $17,000 annual cost to the ADF&G sampling/tag lab programs.

Canada

The discussion below derives from a mark rate analysis based on recoveries of all WDFW chinook and ODFW spring chinook over the period 1989-1996 and production for the brood years associated with those recoveries, i.e., 1983-1993. Unassociated releases were included in the total released. Recoveries from other ODFW stocks and other agencies were not expanded. Observed recoveries of successfully decoded tags were expanded with a non-tag factor (lost pins, no data) by year and catch region.

Commercial Sampling: Preliminary estimates of mark rates, which would be encountered if all WDFW production and ODFW spring chinook production were marked (Table 6), indicate that visual sampling could continue to be used in North/Central Coast fisheries (Areas 1 - 10). There would be an increase in the number of heads taken in Prince Rupert, Queen Charlotte Islands and the Central Coast, but not enough to overwhelm the samplers or seriously impede their work. The cost of handling and shipping the heads to the dissection lab in Vancouver would increase by approximately 300%.

Although electronic detection would be required on the South Coast, recent chinook fisheries have been small enough in volume that wand detectors could adequately accommodate them. It is difficult to anticipate what impact the introduction of wand detectors would have on samplers' productivity, and therefore what additional staffing might be needed to maintain sampling rates at previous levels. Earlier estimates for implementation of electronic detection in sampling coho fisheries were for a 90% increase in costs. Because chinook fisheries are much smaller in volume, the increase would not likely be of the same order.

Recreational Sampling: Until now, Canada has depended on voluntary returns of heads from adipose-clipped chinook and coho to obtain coded-wire tags from recreational fisheries. This program is no longer viable for South Coast recreational coho fisheries because of the mass marking of coho. The existing creel survey is being extended in time and area to achieve a 10% sample of the fishery for both chinook and coho. Samplers'

responsibilities have been expanded to include using a wand detector to locate coded-wire tags in chinook and coho, removing the heads of tagged fish, observing mark and tag status of all fish, and recording the additional information related to these activities. To increase the number of chinook tags recovered, Canada planned to supplement the direct sampling of chinook with voluntary returns. The mass marking of Puget Sound chinook and potential selective fisheries in Washington mean that Canada will not be able to run a hybrid sport recovery program for chinook. The voluntary program will need to be phased out entirely on the South Coast over the next 2 years and replaced by direct sampling. Chinook tagging rates could be increased to partially ameliorate the reduction in coverage. To recover the same number of tags through increased marking rates and direct sampling as have been recovered through voluntary returns would increase marking costs by 2 ½ times (recent recoveries, based on 1994-1998, have averaged 25%). The voluntary head recovery program will be continued on the North and Central Coasts. It is not feasible to implement direct sampling in many of those areas.

Escapement Sampling: The impact on escapement sampling is indirect and results from Canada's requirement to double-index tag B.C. chinook stocks which may be intercepted in Southern US selective fisheries. Those hatcheries releasing tagged, unmarked chinook will be required to use electronic detection to sample returning fish for coded-wire tags. Girth measurements will be obtained from 1999 returns to determine whether it is feasible to use the R9500 tube detector supplemented by a wand (for fish which are too large for the R9500) at Chilliwack Hatchery. Wands will be adequate for the other DIT facilities (Shuswap and Cowichan).

Coho Salmon

Mass Marking

Canada

1996 Brood.
Mass marking of 1996 brood coho from Canadian hatcheries occurred as planned with few exceptions. Some minor stocks were not marked due to concerns about their stock status, and reduced numbers were marked at two hatcheries due to disease concerns. More fish were marked at other sites where more fish were available than expected. A total of 6.8 million adipose clipped coho were released in 1998. Details of mass marking and tagging are presented in Table 7.

1997 Brood.
Plans for marking of 1997 brood coho were to mark similar stocks and numbers as were marked for 1996 brood. The program was expanded to include two stocks on the West Coast of Vancouver Island. A total of 845 thousand Robertson Creek and 116 thousand Conuma River coho have been adipose clipped for release in the spring of 1999. Robertson Creek stock was double index tagged with 40 thousand ad-CWT and 40 thousand CWT-only. Marking is complete but final numbers are not available.

Washington

Planning for mass marking and selective fisheries is performed under the terms of a court-order between the State of Washington, treaty Indian tribes of Western Washington, NMFS and USFWS (Appendix 5).

1996 Brood.
WDFW began mass marking hatchery produced salmon with the 1995 brood of coho. In 1997, WDFW's goal was to mass mark 100% of the appropriate 1996 brood of WDFW hatchery coho. A significant investment in equipment and personnel was necessary. Ultimately, 94% of the proposed production was marked (Table 8). Most of the remaining fish were part of cooperative rearing programs with agreements to leave them unmarked.

1997 Brood.
Mass marking of the 1997 brood of coho was fully implemented in 1998 with over 30 million Puget Sound, coastal and Columbia River fish being adipose marked (Table 9). The number to be marked was increased by new agreements, and by improved infrastructure for marking.

Treaty Indian and USFWS Production

Mass marking of 1996 and 1997 brood coho production from tribal hatcheries are summarized in Table 10 and Table 11, respectively. Approximately 2.5 million 1996 brood and 3.0 million 1997 brood have been marked.

Oregon Production

Mass marking results from 1996 brood coho production from Oregon coastal and Columbia Basin facilities are summarized in Table 12. In total, approximately 4.3 million coho were mass-marked, 3.16 million from Columbia and 1.16 million from coastal facilities. The number of 1997 brood production planned for mass marking is 5.3 million. Plans for mass marking of 1997 brood production are shown in Table 13.

Selective Fisheries

Canada

1998 Mark Selective Fisheries.
On May 21, 1998, David Anderson, Minister of Fisheries announced there would be no directed wild coho salmon fisheries and mandatory non-retention of coho for all areas of British Columbia, except for selected terminal areas on hatchery stocks.

In Canada, 1995 brood coho from some hatcheries inside the Strait of Georgia were mass marked with a left ventral clip. These fish were available as adults in 1998, and some terminal recreational fisheries were selective mark fisheries using the left ventral clip. The adipose clip was retained as the identifier of coded-wire tagged adult coho. Only jacks from the 1996 brood would have the adipose fin clip as a mass mark.

1999 Mark Selective Fisheries.
Continued concern for wild coho stocks meant there were limited opportunities for selective mark fisheries in 1999. Some selective mark fisheries were permitted in freshwater or marine areas adjacent to mass marked hatcheries. A missing adipose fin identified hatchery fish.

A pilot selective recreational fishery for hatchery coho was announced for portions of Johnstone Strait, during times and locations where the estimated impact on Thompson coho stocks is negligible. The Strait of Georgia creel survey will provide catch monitoring, with researchers sampling fish caught by anglers by using an electronic wand to determine if a coded wire tag, used for research purposes, is imbedded in the fish. The areas affected are: portions of Area 13, including the waters of Discovery Passage and Johnstone Strait from Shelter Point to Ripple Point on Vancouver Island and those waters between Quadra and Cortes Island. Also included are Nodales and Calm Channels and a portion of Bute Inlet south of Lawrence Point. As of September 1, the daily limit is two hatchery coho.

Washington/Oregon

1998 Selective Mark-Retention Fisheries.

In 1998, selective fisheries for marked hatchery coho (1995 brood) occurred along the coast in Willapa Bay, Grays Harbor, Area 1 and Buoy 10. Sampling programs on these fisheries are described below. No selective fisheries occurred in Puget Sound because the proportion of returning marked hatchery fish was too low for the 1995 brood. Several double-index tag groups were marked from the 1995 brood, and returned to fisheries and the hatcheries in Washington and Oregon in 1998 (Table 14 and 15).

The assumption underlying the use of DIT groups for estimation of selective fishery mortalities of unmarked fish is that the observed difference in total recoveries of marked and unmarked fish represents this mortality. The expected result is that a higher total number of marked fish would be recovered from fisheries and escapement. The size of the selective fisheries was not very large in 1998, with a total of 3 to 43 tagged and marked salmon from Washington DIT groups taken in selective fisheries (Table 14). However, for three out of the eight DIT groups, the number of recoveries (fisheries and escapement) of unmarked fish exceeded recoveries of marked fish. In two cases, Forks Creek and Salmon River, this difference was statistically significant ($p=0.06$).

A summary of sampler identification of clips in 1998 in Washington fisheries and hatcheries is shown in Table 16. The error rate ranged from 1% to 13%, with the higher rates being for unmarked fish being recorded as clipped and tagged fish. The error rates for unmarked fish were highest for Bingham Creek, Marblemount and Lewis River. This could be due to sampler error, to errors in marking at time of tagging or to naturally missing adipose fins.

The results in Table 16 point to potential problems in sampler and angler identification of mark status. If there is sampler error in identifying marked or unmarked fish, the mark ratio estimated for the sample will be biased. If there is an error at time of tagging, or naturally missing fins, then the tag group will not truly represent the marked (or unmarked) fish. Error in identifying fins, or naturally missing fins, contributes to mark recognition error on the part of anglers. The SFEC recommends that at the time of tagging the DIT groups should be sampled for error in marking or naturally missing fins. We also recommend that sampler training pay particular attention to the importance of correctly identifying the mark status.

1999 Proposals for Selective Fisheries in Washington/Oregon.

Proposals for coho selective fisheries in ocean and inside areas were discussed during the PFMC preseason planning processes. A modified version of the Fisheries Regulatory Assessment Model (FRAM) was used to analyze the expected impacts of the selective fishery proposals. Mark selective fisheries were implemented in ocean recreational fisheries off the Oregon and Washington coasts, in the Buoy 10 fishery in the Columbia River mouth, the Strait of Juan de Fuca and in Area 13 in South Puget Sound.

Sampling

Canada

Coho fisheries in British Columbia were severely curtailed in 1998, with non-retention of coho throughout the coast except in selected terminal areas. As a result, there was limited opportunity to test ETD equipment or to sample fisheries for tagged coho. Some testing of ETD equipment occurred at hatchery racks. In order to facilitate future sampling the Fisheries & Oceans Canada has purchased ten R9500 tube detectors and fifty hand held wand detectors.

Washington/Oregon

In order to recover coded-wire tags, all coho salmon CWT sampling programs in Washington and Oregon were converted to use ETD equipment. This involved the development of new sampling procedures, forms, and data processing.

Hatcheries

ETD equipment was used at all ODFW, WDFW and tribal hatcheries where adult coho returned. All returning fish were either scanned with a wand or put through a tube detector.

Spawning Grounds

Columbia River Tributary Sampling: WDFW hired samplers from October 1998 through January 1999 to sample spawning ground escapement from Lewis River to Bonneville Dam. Sampling Cedar Creek, a tributary to the North Fork Lewis River was emphasized because it is very productive for wild coho. Samplers estimated the number of hatchery marked versus unmarked adults returning by observing the numbers of coho with or without adipose fins. Samplers collected tissues for DNA analysis from unmarked coho returning to the Cedar Creek spawning grounds and to Cowlitz and Lewis River hatcheries to locate the origin of naturally spawning fish. Cowlitz and Lewis River hatcheries are the most likely source of strays to Cedar Creek. A program utilizing displaced fishermen monitored spawning grounds on tributaries downstream from the Lewis River. All samplers used EDT equipment to recover coded-wire tags.

ODFW samplers surveyed lower Columbia River tributaries from late November to January. Samplers used ETD equipment in the field or removed all coho snouts encountered for electronic detection in the lab.

Oregon Coast: Coastwide spawning ground surveys were conducted to estimate spawning populations of Oregon coastal natural coho and to assess the level of straying of hatchery fish. Sites surveyed included standard index sites to establish historic trends and randomly chosen sites for improved population estimation. Samplers recorded the presence/absence of the adipose fin-clip, which improved estimation methodology for hatchery fish straying rates. All coho carcasses were sampled electronically for CWT with wand detectors.

Sport Sampling

Puget Sound Sport Fisheries: In 1998, the goal for sampling Puget Sound sport fisheries was to sample 10% of the catch or 100 fish per area per month, whichever was higher. Additional samplers were necessary to increase the effort to this level. Data collection methods were revised so that four categories of mark status could be recorded: adipose-CWT, adipose clip only, CWT-only, unclipped-untagged. The 1999 WDFW sampling plan is attached in Appendix 6.

Columbia River tributary sport fisheries: These fisheries were also monitored, and fishermen were interviewed to estimate the number of fish released.

Columbia River Mainstem: ODFW samplers utilized wands to electronically detect tagged coho in the mainstem sport fisheries of the Columbia. Fisheries upriver of the estuary are primarily directed at chinook and coho catch was small.

Ocean Fisheries: The Ocean Sampling Program collected data during mark selective recreational salmon fisheries in Ocean Area 1, the lower Columbia River, Grays Harbor, Willapa Bay, and the Chehalis River in 1998. The WDFW and ODFW sampling plans for 1998 are attached in Appendices 7 and 8 and a report on the 1998 sampling is in Appendix 9. Data were collected through dockside interviews and catch inspection for all fisheries. An on-the-water observation program was started for the Ocean Area 1 and Columbia River fisheries.

During dockside interviews, the following information was collected: number of anglers fishing, area fished, number of each species of fish retained, number of retained salmon of each species missing the adipose fin, number of coded wire tagged salmon (through electronic detection), number of released salmon of each species (through angler interview), number of released salmon of each species missing the adipose fin. In 1998, the number of fish missing ventral fins was recorded in all Washington sport fisheries.

Data from the dockside sampling program are summarized in Table 17. In each area, at least 90% of the retained fish were adipose clipped, indicating a generally high compliance with the fishery requirements. The small percentage of adipose clipped coho that were released reflects the enthusiasm for retaining fish for consumption.

On-the-water observation occurred in Area 1 and in the Columbia River Buoy 10 fishery from charter boats and from a contracted boat observing private boat catch. Information was collected on the species, size, and presence of an adipose fin for all salmon observed hooked, and on whether the fish was retained or released. Data from this observer program have not yet been summarized for Area 1, but preliminary analysis suggests a rate of retained to released coho of about 1:1 in both fisheries. The Buoy 10 fishery was monitored during the 1998 selective fishing openings. This is a combined fishery with Washington and Oregon, and the total catch was estimated to be 3,175 coho (Table 18). In order to monitor the fishery anglers were interviewed and, during August, on-the-water observations were used to estimate the number of coho kept and released regardless of whether they were marked.

Substantial enforcement effort encouraged Oregon fishers to comply with the requirement to release unclipped coho. Compliance for Washington anglers was at 94% for private boat anglers and 96% for charter boat anglers, but was significantly lower (89%, p=0.02) for bank anglers.

Oregon Coastal: Comprehensive creel surveys were conducted on selective coho fisheries on the Rogue and Nehalem Rivers. ETD equipment was used on both systems for CWT recovery. Results from double index tagging studies will also be utilized in assessing fishing related impacts to marked and unmarked coho.

Commercial and Tribal Fisheries in Western Washington

ETD equipment was used for the CWT sampling of coho in all Western Washington commercial and tribal fisheries. A joint tribal/WDFW sampling workshop was conducted prior to the season to ensure standardization in sampling and data recording. The transition in sampling methods was successfully implemented. In a few cases there was some initial misunderstanding regarding the need to sample for the number of marks (a new data field) in the untagged fish. Samplers conveyed the fact that sampling using ETD equipment is a very strenuous activity, and the act of sampling now takes considerably longer than the traditional visual method.

Analytical Issues for Coho

The ASFEC published its report in 1995 evaluating the effects of mass marking and selective fisheries on the use of CWTs for estimation of tagged harvest, exploitation and survival rates. As a result of this report the double index tag system was instituted in order to maintain the viability of the coho salmon CWT database. The ASFEC Report identified some remaining questions as to the ability to maintain the viability of the CWT system for coho even with DIT. Some of these issues have been resolved; however, a satisfactory means to overcome several problem areas has not yet been developed.

Effect of discontinuing the volunteer sport program on the estimation of tagged harvest in sport fisheries.

One of the questions raised with regards to mass-marking and selective fisheries is the continuity of historical databases that relied upon voluntary tag returns. The SFAWG examined the consequences of changing the method of estimating CWT contributions to the sport fisheries in areas where voluntary recoveries and awareness factors have been used. Under mass-marking, voluntary tag returns and awareness factors can no longer be used. Only recoveries made from random (or direct) sampling of the sport fisheries can be used to estimate total tags recovered in a fishery. WDFW and CDFO have set the random sampling goals in marine sport fisheries to a minimum rate of 10%.

Kimura (1976) describes the estimation of CWT recoveries using awareness factors (P_A^{ij}) in order to make use of voluntary tag returns. A random sample in a time/area stratum

provides an estimate of total tags taken in the fishery $\hat{M}_{ij}$. Tag recoveries are also made in the random sample (r_s^{ij}) and the total number of tags still not observed is $\hat{M}_{ij} - r_s^{ij}$. A comparison of the number of tags anglers return voluntarily (r_v^{ij}) to the estimate of those not observed in the sampling program provides an estimate of the awareness factor;

$$P_A^{ij} = \frac{r_v^{ij}}{\left(M_{ij} - r_s^{ij}\right)}$$

where *i* refers to sampling area, and *j* to time period. The awareness factor is used to estimate total fishery tag recoveries using voluntary tag returns.

The random sample, or in-sample, method uses only tags recovered during random sampling of the sport harvest (r_s^{ij}). Total tags recovered are estimated from sample data by,

$$\hat{M}_{ij} = \frac{r_s^{ij}}{f_{ij}}$$

where f_{ij} refers to the sample rate.

These estimates are not independent. The estimate using the voluntary recoveries depends on random samples for estimation of the awareness factor. The awareness factor is estimated for Puget Sound by combining random sample data for all months in a year, providing one estimate of awareness for an area each year. Estimates of fishery recoveries made using both methods were compared for Puget Sound for the years 1997-1990 when sampling rates ranged from 0.5-60% of the landed catch (Table 19). The estimate of tagged harvest derived from voluntary sampling falls within the 95% confidence interval of the estimate of tagged harvest using the random sample recoveries alone, except for the month/areas where the random sampling fractions were very low.

Sampling rates

The sampling rates in the random sampling programs will increase. However, voluntarily returned tags will no longer be available. With the current system the number of tags handled is increased by the use of the voluntarily returned tags. This provides increased coverage of tag codes, increasing the probability of finding the less common codes under the assumption that the volunteer returns are representative of the tagged harvest. In a random sampling program with no voluntary returns the coverage may be decreased if the sampling rate is low.

Conclusion.

For coho salmon in Puget Sound, the continuity of the CWT-based database will not be adversely affected by using creel census results instead of voluntary tag recoveries This conclusion will also apply to any use of voluntary tags based on an awareness factor that is estimated from random sampling for that year and area.

Use of DIT groups for estimation of fishery mortalities

The DIT program was recommended by the ASFEC as a method of estimating total selective fishery mortalities for coho salmon. The DIT method relies upon comparison of exploitation rates for two tag groups, one with a mass mark, the other without. These two tag groups differ only in their mark status and selective fishery mortalities. DIT will provide unbiased estimates of initial cohort size and total selective fishery mortalities if all sources of mortality are represented in the cohort analysis, i.e. all fisheries are sampled and unbiased estimates of natural and incidental mortality rates are included.

A DIT group that represents untagged hatchery or wild production should fulfill two criteria:

1. Be representative of the untagged production in all pre-terminal fisheries, and also in terminal fisheries occurring before the last selective fishery
2. Have estimates of escapement to the hatchery and/or spawning ground.

There are several issues of which we need to be aware and that should guide the committee in evaluating proposed tagging and sampling designs for mass marking and selective fisheries:

1. If a fishery is not sampled, estimates of initial cohort size and exploitation rates are biased. This is, in fact, not a new problem. Unsampled mortalities will not be included in the reconstruction of a tag group back to initial cohort size, and therefore all the estimates of exploitation rates will be biased, as the denominator (cohort size) is biased.

    - If the unsampled fishery occurs before the first selective fishery, then the number of selective fishery mortalities will remain unbiased, as the marked to unmarked ratio for the DIT group has not yet been altered. However, the initial cohort size and exploitation rates for both marked and unmarked groups will be biased.

    - Once a selective fishery has occurred, the mark ratio has been altered. An unsampled fishery will result in a bias in the estimate of total selective fishery mortalities.

2. If auxiliary mortality estimates, such as natural mortality or drop off rates are biased, the effect is the same as that due to unsampled fisheries mentioned above. That is, the estimates of initial cohort size and exploitation rate will be biased.

3. The DIT groups used for the 1996 and 1997 coho salmon broods include one or two DIT groups per region. These groups must represent hatchery and wild stocks from all systems in the region with no DIT group. Once the stocks enter the terminal areas the DIT group and the non-DIT stocks may pass through different terminal fisheries. If there are no selective fisheries occurring in the terminal areas or in-river, and all

fisheries are sampled, the DIT group will still provide unbiased estimates of pre-terminal exploitation rates and initial cohort size. However, if terminal selective fisheries occur, the DIT group can only represent stocks that have the same harvest rates in all the terminal fisheries. The CWT estimate of terminal run will be biased for the unmarked DIT group, and estimates of terminal selective fishery mortalities will be needed to provide unbiased terminal run estimates.

In all of these situations the extent of the bias introduced in estimation of mortalities and exploitation rates for the unmarked stocks depends on the size of the unsampled fishery and the selective fishery.

Conclusion.

Unsampled fisheries and biased estimates of incidental fishing and natural mortalities will result in biased estimates of cohort size and exploitation rates. These problems exist to some extent in our current use of CWT data. However, due to the necessity of linking two tag groups in the DIT system to arrive at selective fishery mortalities for the unmarked tag group, this error could be much more important once selective fisheries are implemented. Proposals for selective fisheries should identify the need for ETD in those fisheries expected to exploit the DIT groups. If any fisheries are not to be sampled, then the proposal should provide information on how this missing information will be estimated, or if it will not be estimated, how this will affect estimates.

Estimation of fishery specific mortalities in selective fisheries with DIT system.

The ASFEC report recommended the use of the DIT system to estimate marked and unmarked cohort sizes, exploitation rates and survival rates. The DIT groups can be used to estimate the cumulative mortality of unmarked fish for all selective fisheries combined. The ASFEC was unable to develop a means to estimate fishery specific mortality rates. The SFAWG is currently evaluating the potential utility of the proportional migration (PM) model as a means to allocate impacts among multiple selective fisheries. This is being done using simulated fishery harvest of marked and unmarked fish from the ASFEC's selective fishery model (SFM). As with chinook, the preliminary results for this model are promising and work is continuing (Comstock, 1999).

Proposed Schedules for Workgroups

Analysis Workgroup

Chinook Salmon

Mass marking of chinook salmon has been implemented to some degree in Washington and Oregon. However, there are unanswered questions on the impacts of mass marking and selective fisheries on the CWT program and its use for estimation of exploitation rates. In addition, models used to evaluate chinook impacts in fisheries cannot evaluate selective fisheries. In order for the committee to evaluate proposals next year for further mass marking, and for eventual selective fisheries, these issues should be addressed, including:

1. The voluntary recovery program has provided a source of tag recoveries to supplement the small numbers of tags recovered in some sport fishery random sampling programs, particularly for chinook salmon. An important issue that should be addressed for chinook is the impact of discontinuing the voluntary tag recovery program.

2. Continue to develop the PM method for estimation of selective fishery mortalities for chinook salmon. The work done to date has indicated that the Proportional Migration Model may provide a method to use DIT for estimation of chinook salmon selective fishery mortalities. However, this evaluation needs to be extended and a determination made as to whether the PM model can be used. If the PM model proves to be satisfactory then a complete PM model would need to be developed, coded and tested. This work could not all be accomplished in this year, but should be completed prior to any selective fishery implementation.

3. Evaluate impact of selective fisheries on CWT estimation if northern/central B.C. and Alaska do not use electronic sampling gear. If Alaska and northern/central B.C. sampling programs do not use electronic sampling gear and selective fisheries are implemented, there will be no recoveries of unmarked and tagged chinook from the DIT groups in their fisheries.

4. Develop recommendations for evaluating selective fishery proposals for chinook.

5. Develop specifications for predictive management models for evaluation of impacts of selective fisheries on chinook salmon.

Coho Salmon

Although the first selective fisheries were implemented in 1998, and selective fisheries were implemented in 1999 in Washington and Oregon, there are still some outstanding tasks for the SFAWG to address for using DIT groups for CWT estimation for coho salmon.

1. A complete evaluation of the PM model for estimation of fishery specific selective fishery mortality is required. If this method proves to be satisfactory then a complete PM model would have to be developed, coded and tested before the analysis of 1999 CWT data for unmarked stocks could be carried out.

2. A report describing marking and sampling strategies that will achieve precision levels required to maintain a viable CWT system is needed. This work has been in progress for Puget Sound stocks, but a complete review has not yet been completed.

3. An analysis of the recoveries of DIT groups in selective fisheries in 1998 and 1999 is needed to evaluate the capabilities of the DIT system to maintain the viability of the CWT program.

Regional Coordination Workgroup

A proposed schedule for review of mass marking and selective fishery proposals is provided below. Due to the reliance on domestic planning processes in both Canada and the U.S., only a limited window of opportunity is available for review. Responsibilities for regional coordination will fall both on the Steering Committee of the SFEC and the regional coordination work group. The Regional Coordination Workgroup will provide a report to the full committee in January and the final report will be provided to the Commissioners in February.

1. **Coordinate and report on continuing research on electronic detection and mass marking technologies.** CDFO, NWIFC, ODFW and WDFW will submit a summary of research and testing done with electronic detection during the last year. This information will be completed along with the status of mass marking technology by the February 2000 PSC meeting.

2. **Develop CWT sampling procedures and programs for selective fisheries based on sampling recommendations of SFAWG.** A description of the data being collected under revised sampling protocols will be provided to the February PSC meeting.

3. **Recommend guidelines and/or time frames necessary to evaluate the success of the selective fisheries in conserving naturally spawning stocks.** On an annual basis the agencies that have used DITs will report recovery information based on preliminary catch and escapement data. DIT information will be used for evaluation of success by November 1 of the following year. Evaluating the success of selective fisheries in conserving naturally spawning stocks will require a long-term data base including escapement estimates.

4. **Review proposals for mass marking and selective fisheries.** The RCWG recommends that the steering committee receive proposals from agencies by November 1 of the year prior to implementation as stated in the Terms of Reference. This proposal should follow the format described in the Appendix of the Ad Hoc

SFEC report (ASFEC, 1995). These proposals should include information in relevant categories as shown in table below. The steering committee should then make assignments to the sub-committees for appropriate information needs for their overall review of the proposal.

Mass marking issues for each stock to be marked	Selective Fisheries
Numbers to be marked	*Where and when is the fishery planned?*
Is this an indicator group? What unmarked stocks does it represent? Will it be double index tagged?	*What is the expected mark ratio in the proposed selective fishery?*
	What stocks will be exploited in these fisheries?
What is the fishery distribution of the mass marked stock? Is there electronic sampling in all these fisheries? If not, what are the impacts on the sampling programs of untagged adipose fin clips and on CWT estimation with the DIT group.	*Are there representative DIT groups for all unmarked stocks that will be exploited?* Is there electronic sampling in the proposed fishery and all fisheries where the affected DIT groups are exploited?

5. **Identify and review relevant mass marking and selective fishery issues that may emerge during domestic consultation process.** The committee will serve a role for communication and advice to agencies when selective fisheries and mass marking issues are identified in the domestic processes.

6. **Provide the necessary liaison with the Data Standards Working Group of the Data Sharing Technical Committee to ensure that necessary modifications are made to PSC data exchange formats to maintain the integrity of the CWT system.** The Data Standards Working Group of the Data Sharing Technical Committee has incorporated most data elements related to mass marking, electronic sampling, and selective fisheries into the PSC data exchange format (Appendix 10). An item, which has been raised in the DSWG, but not discussed by the SFEC, is the need for a descriptive file detailing the locations and time periods where selective mark fisheries were conducted.

7. **Prepare an annual report summarizing mass marking statistics, index tag groups and sampling programs for marks and CWTs.** The agencies will supply these reports by the February PSC meeting.

Status of Electronic Tag Detection

Research studies continued in 1998 to evaluate the reliability of electronic tag detection equipment. Results of these studies are presented in Appendices 2 for Washington and Appendix 4 for Canada.

Wands

Northwest Marine Technologies (NMT) advertises that the detection range of hand-held wands is 3 cm for one and a half-length tags. The current version of the wand has the capability of being "balanced" for sensitivity at the NMT shop. According to NMT, wands manufactured after February 1998 were balanced at maximum sensitivity and this balancing leads to some wands that are extra sensitive generating false detections. NMT has indicated that it will balance wand detectors to enable them to consistently detect tags to its maximum depth in a consistent, reliable fashion without the unwarranted false signals. The SFEC recommends that agencies work with the wand manufacturer to establish a minimum detection depth standard to ensure that all wands will be capable to detecting single length tags in chinook.

R9500 and R8000 Detectors and Gates

The R9500 and R8000 Detectors (tubes) and Gates are performing well, and there are no known production issues to deal with. NMT has offered to upgrade all the R8 detectors to the more reliable R8000. R8 detector gates were recalled in the spring of 1998 and have been replaced with more reliable R8000 gates.

R Series Counters

The R Series Counter when properly calibrated has been shown to have an error rate less than half a percent (Phillipson et.al., 1998). Initially, the counters did experience problems related to water intrusion and a dysfunctional battery holder. NMT has informed agencies that all counters are being recalled. The modifications to the R Series counters include: installation of a long life battery; potting the entire internal electronics package; soldering of all the internal connections; and sealing the RTV box. There will be no user serviceable parts requiring operators to open the box for maintenance, nor any connections or contacts susceptible to water damage. The counters thus upgraded have shown no leakage after being submerged 72 hours.

References.

ASFEC, 1995. Pacific Salmon Commission Selective Fishery Evaluation. Pacific Salmon Commission. Vancouver B.C., Canada.

Comstock, R., C. Cook-Tabor and M.Alexandersdottir. 1999. A proportional migration (PM) model approach for cohort reconstruction of unmarked chinook salmon and coho salmon in selective fisheries. Manuscript. 30 pp.

CTC, 1999. Pacific Salmon Commission Joint Chinook Technical Committee Report. 1995 and 1996 annual report. TCCHINOOK (99)-2. March 19, 1999. PSC Vancouver B.C.

Godfrey, H. 1968. Review of information obtained from the tagging and marking of chinook and coho salmon in coastal waters of Canada and the United States. Fish. Res. Board. Can. MS Rep. Ser. 953:172p.

Healey, M.C. 1991. Life history of Chinook salmon (*Onchorynchus tshawytschal*). Pages 311-393 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press. Vancouver B.C.

Kimura, D.K. 1976. Estimating the total number of marked fish present in a catch. Transactions of the American Fisheries Society. Vol. 105 (6):664-668.

VanHyning, J.M. 1968. Factors affecting the abundance of fall chinook in the Columbia River. Ph.D. thesis. Oregon State University, Corvallis OR. 423pg.

Phillipson, K., R. Conrad and R. Olson. 1998. A field test of the counting accuracy of the CWT tube detector in the 1998 Area 5 sockeye fishery. Northwest Indian Fisheries Commission. Unplublished Report.

Tables

Table 1: Brood 1998 WDFW chinook mass marking plans for Puget Sound and Columbia River

Complex	Facility	Run	CWT		No CWT		Total
			Ad-clip	No Ad-clip	Ad-clip	No Ad-clip	
Columbia River							
Cowlitz	COWLITZ SALMON HATCH	Spring			912,000	3,025	915,025
Lewis	LEWIS RIVER [1]	Spring	75,000	75,000	850,000		1,000,000
Kalama	KALAMA FALLS	Spring			271,000		271,000
	Total		75,000	75,000	2,033,000	3,025	2,186,025
Puget Sound							
Dungeness	DUNGENESS	Spring	775,000			1,300,000	2,075,000
Green River	ISSAQUAH HATCHERY	Fall				2,117,204	2,117,204
	SOOS CREEK HATCHERY[1]	Fall	186,806	204,550	48,838	2,816,906	3,257,100
Hood Canal	GEORGE ADAMS[1]	Fall	223,343	225,350	2,010	3,017,618	3,468,321
Minter Creek	COULTER CREEK	Fall			1,269,229	24,771	1,294,000
	MINTER HATCHERY	Fall	13,496	302	2,039,927	27,375	2,081,100
	HUPP SPRINGS	Spring	300,000				300,000
Nooksack	KENDALL CREEK[1]	Spring	200,000	200,000		720,000	1,120,000
	SAMISH HATCHERY [1]	Fall	200,028	198,230	764	4,065,472	4,464,494
Puyallup	VOIGHTS CR HATCHERY	Fall	200,000		879,471	600,000	1,679,471
Skagit	MARBLEMOUNT HATCHERY [1]	Spring	325,000	75,000			400,000
	MARBLEMOUNT HATCHERY	Summer	200,000				200,000
Snohomish	WALLACE R HATCHERY	Fall			952,338	30,162	982,500
South Sound	CHAMBERS CREEK	Fall			297,210	155,295	452,505
	GARRISON HATCHERY	Fall			329,771	574,200	903,971
	MCALLISTER CREEK	Fall	79,782	873	1,057,507	35,238	1,173,400
	TUMWATER FALLS	Fall			2,654,459	962,147	3,616,606
	Total		2,703,455	904,305	9,531,524	16,446,388	29,585,672
	Statewide		2,778,455	979,305	11,564,524	16,449,413	31,771,697

[1] DIT groups

Comment. A DIT group of Nisqually fall fingerlings was released from Clear Creek Hatchery. No fall fingerling DIT group was released from Grovers Creek Hatchery.

Table 2: ODFW chinook mass marking plans for Coastal Oregon for broodyear 1998.

Release Site	Hatchery	Stock	Release Date	Release total	AdCWT	AdCWT (DIT)	CWT (DIT)	Ad only	Unmarked
Nestucca River	Cedar Creek	Nestucca R.	07/22/99	110,000	25,000			85,000	
Trask River	Trask Pond	Trask R.	08/01/99	220,000	25,000			195,000	
Wilson River	Trask Pond	Trask R.	08/07/99	25,000	25,000				
Trask River	Whiskey Creek	Trask R.	05/25/99	25,000				25,000	
Trask River	Whiskey Creek	Trask R.	06/10/99	20,000				20,000	
Trask River	Whiskey Creek	Trask R.	06/26/99	10,000				10,000	
Trask River	Whiskey Creek	Trask R.	07/18/99	10,000				10,000	
Trask River	Whiskey Creek	Trask R.	07/30/99	10,000				10,000	
Wilson River	Whiskey Creek	Trask R.	05/22/99	15,000				15,000	
Wilson River	Whiskey Creek	Trask R.	06/10/99	10,000				10,000	
Umpqua River, N Fk.	Rock Creek	Umpqua R.	10/01/99	145,000	25,000			120,000	
Umpqua River, N Fk.	Rock Creek	Umpqua R.	02/02/00	267,000	25,000			242,000	
Rogue River	Cole M. Rivers	Rogue R.	08/15/99	730,000	30,000			700,000	
Rogue River	Cole M. Rivers	Rogue R.	09/15/99	730,000		60,000	50,000	620,000	
Rogue River	Cole M. Rivers	Rogue R.	10/15/99	162,000	30,000			132,000	
Oregon Coastal Totals				2,489,000	185,000	60,000	50,000	2,194,000	
Columbia River									
Non-Mass Marked Releases									
Columbia River	Blind Slough			200,000	75,000				125,000
Columbia River	Tongue Point			250,000	50,000				200,000
Hood River, W. Fk.	Dry Run Bridge			98,000	98,000				
Hood River, M. Fk.	Round Butte			30,000	30,000				
Youngs Bay	Youngs Bay			450,000	75,000				375,000
Big Sheep Creek	Lookingglass			70,000					70,000
Deschutes River	Round Butte			328,000	328,000				
Imnaha River	Imnaha Pond			490,000	190,000				300,000
Lookingglass Cr.	Lookingglass			439,000	63,000				376,000
Catherine Cr.	Lookingglass			55,500	55,500				
Upper Grande Ronde	Lookingglass			2,500	2,500				
Lostine River	Lookingglass			54,000	54,000				
Umatilla River	Imeques			360,000	140,000				220,000
Mass Marked Releases									
Clackamas River	Clackamas			1,212,000	30,000	30,000	50,000	1,102,000	
Sandy River	Clackamas			350,000	25,000			325,000	
McKenzie River	McKenzie			1,005,000	40,000	50,000	50,000	865,000	
Molalla River	Willamette			107,000	25,000			82,000	
Santiam River, N. Fork	Marion Forks			667,000	30,000			637,000	
Santiam River, S. Fork	S. Santiam/Willamette			1,060,000	110,000			950,000	
Willamette River	Willamette/Dexter Ponds			1,491,000	60,000			1,431,000	
Willamette River-Net Pens	Willamette			505,000	505,000				
Columbia River Basin Totals				9,224,000	1,986,000	80,000	100,000	5,392,000	1,666,000

Note. Does not include fish from ODFW hatcheries that are subsequently transferred to hatcheries or release sites in other states, fish released into impoundments, or unfed fry released from STEP facilities. Rogue River DIT group sizes reported are maximums. May be decreased at a later date due to fiscal constraints.

Table 3: Chinook exploitation rate index stocks recommended for double index tagging for 1998 brood.

Puget Sound stocks:
Samish Fall Fingerlings George Adams Fall Fingerling South Puget Sound Fall Fingerling. This includes Green R. and Grovers Creek. Nisqually Fall Fingerlings Skagit Spring Yearling Nooksack Spring Fingerlings White River spring fingerlings [1] Skykomish summer fingerlings
Oregon Coast [2]
Tillamook Nestucca
Columbia River stocks:
Lewis River spring yearlings McKenzie and Clackamas spring yearlings
Canada
Chilliwack Lower Shuswap Cowichan

1 This group was not double index tagged for the 1998 brood due to a decision of the White River technical committee.

2 These groups were not double index tagged due to a decision by ODFW

Table 4: Distribution of expanded recoveries by fishery area of Pacific Salmon Commision chinook salmon exploitation rate index tag groups for Puget Sound (Averaged over broodyears in parenthesis).

Stock tagged		Proportion of tags recovered annually by fishery area averaged over brood years						Average Tags Recovered
		Alaska	N/C BC	WCVI/Strait	WA/OR Coast	Inside PS	Escapement	
Nooksack Spring Fingerling (81-92)	Age 2	0.0000	0.0000	0.1314	0.0154	0.0753	0.6113	46.1
	Age 3	0.0011	0.0220	0.4833	0.0057	0.2375	0.1671	164.3
	Age 4	0.0015	0.0032	0.3237	0.0049	0.1002	0.3998	169.9
	Age 5	0.0156	0.0000	0.0941	0.0000	0.0666	0.5736	19.7
Samish Fall Fingerling (85-92)	Age 2	0.0094	0.0488	0.3682	0.0776	0.1621	0.3339	296.4
	Age 3	0.0016	0.0166	0.3256	0.0592	0.3660	0.1595	1,158.6
	Age 4	0.0007	0.0071	0.2452	0.0462	0.3832	0.1749	1,265.3
	Age 5	0.0017	0.0000	0.1519	0.0430	0.4442	0.1449	92.9
Skagit Spring Yearling (81-87,90)	Age 2	0.0000	0.0000	0.0152	0.0000	0.5638	0.1484	8.5
	Age 3	0.0000	0.0623	0.3763	0.0153	0.2950	0.1602	183.8
	Age 4	0.0004	0.0366	0.2586	0.0145	0.2311	0.2770	230.5
	Age 5	0.0253	0.0000	0.0978	0.0091	0.1305	0.4646	32.8
Stillaguamish Summer fingerling (80-83,86-92)	Age 2	0.0045	0.1666	0.2413	0.0344	0.4636	0.0897	83.4
	Age 3	0.0176	0.1146	0.3765	0.0296	0.1982	0.1921	194.0
	Age 4	0.0804	0.0073	0.2544	0.0191	0.1917	0.3042	114.1
	Age 5	0.0179	0.0000	0.0000	0.0000	0.0952	0.4583	4.2
George Adams Fall Fingerling (74,75,78-81,85-92)	Age 2	0.0007	0.0398	0.2000	0.0137	0.4109	0.3350	88.3
	Age 3	0.0005	0.0177	0.2544	0.0901	0.4959	0.1414	311.4
	Age 4	0.0029	0.0077	0.2656	0.0762	0.3967	0.2509	311.4
	Age 5	0.0000	0.0000	0.2049	0.0277	0.3542	0.1632	20.8
Green River Fall Fingerling (78-92)	Age 2	0.0009	0.0470	0.2409	0.0263	0.4855	0.1996	124.7
	Age 3	0.0032	0.0357	0.2984	0.0465	0.3856	0.1806	473.6
	Age 4	0.0055	0.0184	0.2329	0.0401	0.3690	0.2341	564.5
	Age 5	0.0000	0.0254	0.1941	0.0304	0.3075	0.2926	72.1
Grovers Creek Fall Fingerling (81,92)	Age 2	0.0051	0.0194	0.1674	0.0322	0.4275	0.3484	169.3
	Age 3	0.0032	0.0088	0.2145	0.0766	0.2565	0.3737	649.5
	Age 4	0.0010	0.0026	0.1796	0.0512	0.1652	0.4672	438.1
	Age 5	0.0022	0.0000	0.1044	0.0071	0.1271	0.5592	18.3
Kalama -- Nisqually Fall Fingerling (79-92)	Age 2	0.0000	0.0109	0.1539	0.0224	0.4053	0.4075	100.3
	Age 3	0.0000	0.0225	0.2272	0.0817	0.5004	0.1094	236.8
	Age 4	0.0006	0.0073	0.2200	0.0573	0.4435	0.1536	195.6
	Age 5	0.0000	0.0058	0.1630	0.0651	0.3551	0.1757	16.8
Sth Puget Sound Fall Yearling (78-81,86-92)	Age 2	0.0000	0.0000	0.0000	0.0000	0.5661	0.3625	25.5
	Age 3	0.0000	0.0019	0.0532	0.0062	0.8246	0.0426	321.6
	Age 4	0.0000	0.0100	0.0789	0.0236	0.6157	0.1290	203.3
	Age 5	0.0102	0.0000	0.0976	0.0395	0.3164	0.1792	15.5
Squaxin Pens Fall Yearling (86-92)	Age 2	0.0000	0.0040	0.0040	0.0030	0.6968	0.1810	50.9
	Age 3	0.0000	0.0017	0.0381	0.0373	0.7866	0.0252	333.4
	Age 4	0.0000	0.0008	0.0973	0.0546	0.5751	0.0500	185.2
	Age 5	0.0000	0.0000	0.0664	0.0590	0.3159	0.1143	20.3
White River Spring Yearling 79-92	Age 2	0.0000	0.0000	0.0000	0.0000	0.2907	0.5093	22.5
	Age 3	0.0000	0.0016	0.0324	0.0070	0.6419	0.2172	227.8
	Age 4	0.0000	0.0052	0.0641	0.0202	0.4375	0.3230	147.2
	Age 5	0.0000	0.0000	0.0000	0.0406	0.2042	0.4052	13.2

Fishery areas:

Alaska	=	All Alaska troll, sport and net					
N/C BC	=	CENTRL N	CENTRL T	NORTH N	NORTH T	NTH/CENT S	
WCVI/Straits	=	FRASER N	GEO ST S	GEO ST T	J DE F N	JNST N	WCVI Troll, net and sport
WA/OR Coast	=	WA CST N	WASH CST S	WASH/OR T			
Inside PS	=	PGSDN S	PGSDO S	TERMN N	TERMN S	TPGSDN N	TPGSDO N

Table 5: Estimated Changes in Observed Adipose Mark Recoveries in Southeast Alaska Fisheries Under WA/OR Chinook Mass Marking Proposal based on observed values for 1990-1996.

OBSERVED ADIPOSE MARK RECOVERIES IN SOUTHEAST ALASKA SPORT, NET AND TROLL FISHERIES. [1]

State of Origin	1990	1991	1992	1993	1994	1995	1996	Total
AK	8,073	6,416	3,443	2,951	3,073	3,488	3,301	30,746
BC	2,343	3,178	2,620	2,262	1,939	1,003	590	13,935
ID	1							1
OR	1,282	724	271	568	400	296	367	3,907
WA	1,933	1,406	584	1,185	1,184	538	614	7,443
Grand Total	13,631	11,724	6,918	6,965	6,597	5,325	4,872	56,032

							AVERAGE
OR %	9.4%	6.2%	3.9%	8.1%	6.1%	5.6%	7.5%	6.7%
WA %	14.2%	12.0%	8.4%	17.0%	17.9%	10.1%	12.6%	13.2%
OR&WA total	23.6%	18.2%	12.4%	25.2%	24.0%	15.7%	20.1%	19.9%

(observed CWT recoveries were expanded by 10% to account for no-tags)

OBSERVED ADIPOSE MARK RECOVERIES IN SOUTHEAST ALASKA FISHERIES WITH 1998 BROOD OR&WA MASS MARKING. [2]

State of Origin	1990	1991	1992	1993	1994	1995	1996	Total
AK	8,073	6,416	3,443	2,951	3,073	3,488	3,301	30,746
BC	2,343	3,178	2,620	2,262	1,939	1,003	590	13,935
ID	1							1
OR	3,569	2,068	1,571	1,831	618	536	572	10,764
WA	2,564	1,542	864	1,411	1,198	624	748	8,951
Grand Total	16549	13204	8498	8455	6829	5651	5211	64,398

							AVERAGE
OR %	21.6%	15.7%	18.5%	21.7%	9.1%	9.5%	11.0%	15.3%
WA %	15.5%	11.7%	10.2%	16.7%	17.5%	11.0%	14.4%	13.9%
OR&WA total	37.1%	27.3%	28.7%	38.3%	26.6%	20.5%	25.3%	29.1%

% INCREASE DUE to WA/OR Mass Marking

	21.4%	12.6%	22.8%	21.4%	3.5%	6.1%	7.0%	13.6%

1 CWT recoveries were expanded by generic 10% no-tag rate to yield estimated adipose marks observed.
2 CWT recoveries from production groups proposed for 1998 OR-WA mass marking (update 12 Jan 1999) were expanded by juvenile mark expansion rate resulting in "100%" mark rate groups. Production equivalency factors (PEF) for the mass marked stocks were calculated from combining all releases from these facilities to create a composite brood year expansion factor which was applied to the observed CWT recoveries. For Puget Sound mass mark groups, the PEF for the regional production group (e.g. South Sound) was calculated from fingerling or yearling releases by race for WDFW facilities. Percent increase is calculated as if all contributing age classes were mass marked at the 1998 OR-WA proposed rate.

Table 6: Estimated Changes in Chinook Mark Rates in Canadian Commercial Fisheries with Mass Marking of ODFW Spring Stocks and All WDFW Stocks.

Sample location	Catch region														
	CN	**CTR**	**FGN**	**GSN**	**GSTR**	**JFN**	**JSN**	**NCTR**	**NN**	**NTR**	**NWTR**	**NWVN**	**SCTR**	**SWTR**	**SWVN**
BAMFIELD														0.11	
BELLA BELLA	0.03							0.00							
BELLA COOLA	0.11														
CAMPBELL RIVER				0.59	0.11	1.00	0.10				0.38		0.07		
COMOX/COURTENAY				0.14	0.12						0.06				
LAX-KW'ALAAMS									0.15						
MASSET									0.26	0.16	0.00				
NAMU	0.15						0.16	0.10	0.08	0.07	0.51		0.08	0.00	
NANAIMO/FRENCH CK			0.17	0.04	0.09	0.02	0.05				0.02		0.00		0.03
OFFSHORE/EXPORT	0.18		0.20	0.10	0.11	0.14	0.14	0.10							1.00
PORT HARDY	0.23	0.00			0.04	0.00	0.19	0.12	0.38	0.11	0.21		0.14	0.00	
PRINCE RUPERT	0.11					0.04	0.12	0.05	0.11	0.11	0.01		0.00	0.13	
SHEARWATER	0.08						0.00	0.07	0.00	0.02	0.02		0.00		
STEVESTON	0.09		0.04	0.30	1.00	0.35	0.13	0.06	0.13	1.00	0.33	0.11	0.30	0.30	0.27
TEST FISHERIES			0.03						0.02						0.04
TOFINO						0.12				0.06	0.32	0.10	0.43	0.28	0.00
UCLUELET						0.03				0.00	0.28	0.15	0.28	0.27	0.05
VANCOUVER	0.11		0.04	0.37	0.04	0.33	0.20		0.09	0.20	0.29	0.05	0.15	0.31	0.07
VICTORIA					0.09									0.06	
WINTER HARBOUR								0.05		0.21	0.22		0.14	0.08	
ZEBALLOS											0.14			0.13	
Catch region mark rate	**0.10**	**0.00**	**0.04**	**0.26**	**0.10**	**0.32**	**0.14**	**0.08**	**0.11**	**0.13**	**0.23**	**0.05**	**0.15**	**0.27**	**0.23**

Note. Based on recovery years 1989-1996 and production years 1983-1993 assuming 1998 proposed marking.

Table 7: 1996 Brood Mass Marked Coho Released by Canada in 1998

Project	Stock	Total Release	Untagged		CWT	
			Clipped	Unclipped	Clipped	Unclipped
Big Qualicum R	Big Qualicum	1,436,315	1,152,570	202,059	40,331	41,355
Capilano River	Capilano R	530,254	486,511	350	43,393	
Chapman Creek	Chapman Cr.	65,800	65,800			
Chehalis River	Chehalis R	1,171,184	1,135,488		35,696	
Chilliwack R	Chilliwack R	1,857,069	1,739,292	42,179	37,282	38,316
Goldstream R	Goldstream R	79,970	150	19,998	29,912	29,910
Inch Creek	Inch Creek	209,702	122,728	1,487	41,918	43,569
Inch Creek	Stave River	448,085	417,876		30,209	
Powell River	Lang Creek	58,067	37,902		20,165	
Puntledge River	Puntledge R	686,773	483,052	166,095	37,626	
Quinsam River	Quinsam R	1,466,392	748,954	614,778	62,582	40,078
Reed Point/Ioco	Capilano R	2,180	2,180			
Robertson[1]	Robertson	934,097		854,730	39,578	39,789
Sechelt	Maclean Bay	23,752	23,752			
Sliammon River	Sliammon R	26,723			26,723	
Trans Mountain	Capilano R	10,100	10,100			

[1] 1996 brood WCVI sites not mass marked

Table 8: 1996 Brood Mass Marked Coho at WDFW facilities.

Complex	Facility	CWT		No CWT		Total
		Ad-clip	No Ad-clip	Ad-clip	No Ad-clip	
Coast						
Grays Harbor	BINGHAM CR HATCHERY[1]	123,895	128,458	87,108	15,439	354,900
Grays Harbor	HUMPTULIPS HATCHERY[1]	79,321	74,509	1,011,061	16,309	1,481,200
Grays Harbor	LK ABERDEEN HATCHERY			31,888	651	32,539
Grays Harbor	SKOOKUMCHUCK PONDS			92,487	6,113	98,600
O&E[2]	OCEAN SHORES NET PENS			101,122	1,228	102,350
O&E	ABEREEN NET PENS			90,797	1,103	91,900
O&E	MERRYMAN PROJECT			18,644	1,201	19,845
O&E	SATSOP SPRINGS POND	38,868	1,882	374,435	29,835	445,000
O&E	SEA RESOURCES HATCHERY			46,950	1,452	48,402
O&E	WESTPORT NET PENS			147,607	1,793	149,400
Willapa	FORKS CREEK HATCHERY	73,187	502	494,427	50,788	618,904
Willapa	NASELLE HATCHERY			963,641	51,359	1,015,000
Willapa	NEMAH HATCHERY			475,077	17,523	492,000
Willapa	PORT OF WILLAPA AQUA			45,340	4,660	50,000
	Coastal Total	315,271	205,351	3,980,584	199,454	5,000,040
Columbia						
Cowlitz	COWLITZ SALMON HATCH			3,287,224	206,570	3,473,794
Elochoman	DEEP R NET PENS	29,474	239	176,851	1,786	208,350
Elochoman	ELOCHOMAN HATCHERY	73,622	1,399	1,341,452	24,458	1,440,931
Elochoman	GRAYS RIVER HATCHERY	29,510	397	126,858	1,280	158,045
Kalama	FALLERT CR HATCHERY	28,175		505,270	12,415	545,860
Kalama	KALAMA FALLS HATCHRY	28,107		944,080	45,413	1,017,600
Kalama	NORTH TOUTLE HATCHRY	30,221		987,586	101,993	1,119,800
Klickitat	KLICKITAT HATCHERY[1]	93,002	32,337	2,902,809	610,133	3,638,281
Lewis	LEWIS RIVER HATCHERY[1]	146,509	73,321	2,751,440	263,491	3,234,761
Washougal	WASHOUGAL HATCHERY	30,548	146	474,740	36,128	541,562
	Columbia River Total	489,168	107,839	13,498,310	1,303,667	15,378,984
Puget Sound						
Dungeness	DUNGENESS HATCHERY			844,006	33,294	877,300
Dungeness	SOLDUC HATCHERY[1]	71,336	74,425	695,561	30,768	872,090
Green River	ISSAQUAH HATCHERY			387,910	17,490	405,400
Green River	SOOS CREEK HATCHERY[11]	44,782	41,256	420,624	49,138	803,900
Hood Canal	GEORGE ADAMS HATCHRY	45,175		476,357	5,785	527,317
Minter Creek	FOX ISLAND HATCHERY			49,302	498	49,800
Minter Creek	MINTER HATCHERY	13,149		1,194,025	120,961	1,328,135
Nooksack	KENDALL CR HATCHERY[1]	88,333	46,564	163,124	247	298,268
Puyallup	VOIGHTS CR HATCHERY[1]	40,033	40,837	585,054	68,480	734,404
Skagit	MARBLEMOUNT HATCHERY[1]	43,347	46,155	167,241	2,357	259,100
Snohomish	WALLACE R HATCHERY[1]	46,251	46,094	202,405	5,250	300,000
South Sound	SOUTH SOUND NET PENS	49,585		1,793,975	663,140	2,506,700
O&E	POSSESSION BAIT POND	25,502	49	49		25,600
O&E	PUGET POWER SPAWNING			16,842	63	16,905
	Puget Sound Total	467,493	295,380	6,996,475	997,471	9,004,919
	Statewide	1,271,932	608,570	24,475,369	2,500,592	29,383,943

[1] DIT groups

[2] Outreach and Education

Table 9: Mass marking of the 1997 brood of coho at WDFW facilities.

Complex	Facility	CWT		No CWT		Total
		Ad-Clip	No Ad-clip	Ad-clip	No Ad-clip	
Coast						
Grays Harbor	ABERDEEN NET PENS			292,432	5,968	298,400
Grays Harbor	BINGHAM CR HATCHERY[1]	75,449	74,782	513,433	10,736	674,400
Grays Harbor	HUMPTULIPS HATCHERY			1,256,490	73,150	1,329,640
Grays Harbor	LK ABERDEEN HATCHERY			15,054	546	15,600
Grays Harbor	WESTPORT NET PENS			192,780	11,220	204,000
Willapa	FORKS CREEK[1]	75,963	77,866	481,057	13,643	648,529
Willapa	NASELLE HATCHERY			1,010,214	71,386	1,081,600
Willapa	NEMAH HATCHERY			559,076	14,924	574,000
O&E	WESTPORT NET PENS			192,780	11,220	204,000
O&E	ABERDEEN NET PENS			292,432	5,968	298,400
O&E	SATSOP SPRINGS			516,248	9,752	526,000
	Coastal Total	151,412	152,648	5,321,996	228,513	5,854,569
Columbia						
Cowlitz	COWLITZ SALMON HATCH	87,250	626	4,116,648	36,136	4,240,660
Elochoman	ELOCHOMAN HATCHERY	86,077	1,334	590,650	17,126	695,187
Kalama	FALLERT CREEK	28,175	903	380,216	2,206	411,500
Kalama	KALAMA FALLS HATCHRY	29,739	296	880,803	10,175	921,013
Kalama	NORTH TOUTLE HATCHRY	31,502	0	646,992	21,385	699,879
Klickitat	KLICKITAT HATCHERY[1]	83,708	29,527	3,447,092	54,617	3,614,944
Lewis	LEWIS RIVER HATCHERY[1]	146,633	148,834	2,729,757	70,887	3,096,111
Washougal	WASHOUGAL HATCHERY	33,473	261	458,687	17,902	510,323
	Columbia River Total	526,557	181,781	13,250,845	230,434	14,189,617
Puget Sound						
Dungeness	SOLDUC HATCHERY[1]	73,132	59,568	420,815	21,985	575,500
Green River	ISSAQUAH HATCHERY		0	403,274	5,726	409,000
Green River	SOOS CREEK HATCHERY[1]	42,430	42,543	426,750	77,777	589,500
Hood Canal	GEORGE ADAMS	43,098	44,258	442,297	4,901	534,554
Minter Creek	MINTER HATCHERY		0	1,438,738	30,862	1,469,600
Nooksack	KENDALL CR HATCHERY[1]	35,208	33,824	236,439	14,529	320,000
Puyallup	VOIGHTS CR HATCHERY[1]	45,469	45,078	1,021,841	16,612	1,129,000
Skagit	MARBLEMOUNT	42,296	42,373	163,093	3,471	251,233
Snohomish	WALLACE R HATCHERY	45,303	45,476	200,562	116,571	407,912
South Sound	SOUTH SOUND NET PENS	44,743	357	1,903,795	34,880	1,983,775
South Sound	SKOOKUMCHUCK PONDS			99,261	1,819	101,080
O&E	PUGET POWER SPAWNING			42,262		42,262
	Puget Sound Total	371,679	313,477	6,799,127	329,133	7,813,416
	Statewide Total	1,049,648	647,906	25,371,968	788,080	27,857,602

[1] DIT Groups
[2] Outreach and Education

Table 10: Brood Year 1996 Tribal & USFWS Coho Smolt Releases and their CWT and Ad-Clip Status

Region and Hatchery	CWT			No CWT			Total		
	Ad-Clipped	Not Ad-Clipped	Total CWT	Ad-Clipped	Not Ad-Clipped	Total Not-CWT	Marked	Unmarked	Released
Coast									
Makah NFH	49,196	38,133	87,329	146,195	1,476	147,671	195,391	39,609	235,000
Quinault NFH [3]	83,313	82,697	166,015	969	521,221	522,190	84,287	603,918	688,205
Educket Creek	31,318		31,318	1,069	9,987	11,056	32,387	9,987	42,374
Salmon R [3]	73,928	98,473	172,401	2,602	499,997	502,599	76,530	598,470	675,000
Queets Supplementation		127,546	127,546		96,641	96,641		224,187	224,187
Strait									
Lower Elwha [3]	78,862	75,203	154,065	3,976	709,338	713,314	82,838	784,541	867,379
N Puget S									
Skookum Creek	51,168		51,168	309	2,320,060	2,320,369	51,477	2,320,060	2,371,537
Lummi Bay	50,917		50,917		1,148,400	1,148,400	50,917	1,148,400	1,199,317
Indian Slough (plant) [1]			0	101,200		101,200	101,200		101,200
Jim Creek	5,711	912	6,623	671		671	6,382	912	7,294
Tulalip Bay	31,456		31,456	171,352 [1]	588,192	588,192	31,456	588,192	791,000
Mid Puget S									
Elliott Bay Pens	50,143		50,143	764	302,164	302,928	50,907	302,164	353,071
Keta Creek	49,352		49,352	599	262,934	263,533	49,951	262,934	312,885
Agate Pass Seapens [1]	46,133		46,133	496,174		496,174	542,307		542,307
Upper Puyallup Plants	89,496		89,496	504		504	90,000		90,000
S Puget S									
Kalama Creek [3]	44,078	48,782	92,860	2,665	325,475	328,140	46,743	374,257	421,000
Clear Creek	43,083		43,083	5,380	589,537	594,917	48,463	589,537	638,000
Hood Canal									
Port Gamble Pens [1 3]	104,197	49,500	153,697	286,084	174	286,258	390,281	49,674	439,955
Quilcene Bay Pens [2 3]	42,377	44,859	87,236	76,096	61,937	138,033	118,473	106,796	225,269
Quilcene NFH [3]	45,411	40,861	86,272	267,065	98,866	365,931	312,476	139,727	452,203
TOTAL	970,144	606,966	1,577,110	1,563,674	7,536,399	9,100,073	2,533,818	8,143,365	10,677,183

[1] Coop with WDFW
[2] Coop with USFWS
[3] DIT Groups

Table 11: Projected BY 1997 Tribal & USFWS Coho Smolt Releases and their CWT and Ad-Clip Status (does not include South Sound Net Pens)

Region and Hatchery	CWT			No CWT			Total		
	Ad-Clipped	Not Ad-Clipped	Total CWT	Ad-Clipped	Not Ad-Clipped	Total Not-CWT	Marked	Unmarked	Released
Coast									
Makah NFH	40,000	40,000	80,000	140,000		140,000	180,000	40,000	220,000
Quinault NFH	80,000	80,000	160,000		410,000	410,000	80,000	490,000	570,000
Educket Creek				45,000		45,000	45,000		45,000
Salmon R [3]	75,000	75,000	150,000		450,000	450,000	75,000	525,000	600,000
Queets Supplementation	48,000		48,000	7,000		7,000	55,000		55,000
Strait									
Lower Elwha [3]	75,000	75,000	150,000		600,000	600,000	75,000	675,000	750,000
N Puget Sound									
Skookum Creek		50,000	50,000		1,100,000	1,100,000		1,150,000	1,150,000
Lummi Bay		50,000	50,000		1,100,000	1,100,000		1,150,000	1,150,000
Indian Slough (plant) [1]				100,000		100,000	100,000		100,000
Jim Creek		10,000	10,000					10,000	10,000
Tulalip Bay		50,000	50,000	50,000	650,000	700,000	50,000	700,000	750,000
Mid Puget Sound									
Elliott Bay Pens	50,000		50,000	450,000		450,000	500,000		500,000
Keta Creek	50,000		50,000	240,000		240,000	290,000		290,000
Agate Pass Seapens [1]	50,000		50,000	550,000		550,000	600,000		600,000
Upper Puyallup Plants	200,000		200,000				200,000		200,000
S Puget Sound									
Kalama Creek		50,000	50,000		250,000	250,000		300,000	300,000
Clear Creek		50,000	50,000		480,000	480,000		530,000	530,000
Hood Canal									
Port Gamble Pens [1 3]	50,000	50,000	100,000	300,000		300,000	350,000	50,000	400,000
Quilcene Bay Pens [2 3]	47,000	47,000	94,000		100,000	100,000	47,000	147,000	194,000
Quilcene NFH	47,000	47,000	94,000	356,000		356,000	403,000	47,000	450,000
TOTAL	812,000	674,000	1,486,000	2,238,000	5,140,000	7,378,000	3,050,000	5,814,000	8,864,000

[1] Coop with WDFW
[2] Coop with USFWS
[3] DIT Groups

Table 12. ODFW 1996 brood year hatchery coho mass marking

Hatchery	Stock	Release Site	AdCWT (Index)	AdCWT (DIT)	CWTonly (DIT)	Ad Clipped	Not Marked
Columbia River							
Non-Mass Marked							
Cascade	Tanner Creek	Umatilla River	53,550	25,967	26,833		1,499,697
Cascade	Tanner Creek	Yakima River	53,924	26,821	26,705		591,129
		Total	107,474	52,788	53,538		2,090,826
Mass Marked							
Big Creek	Big Creek	Big Creek	51,133			436,239	
Big Creek	Big Creek	Tualatin River	27,506			31,464	
Bonneville	Tanner Creek	Tanner Creek	42,292			859,840	87,159
Youngs Bay Netpens	Tanner Creek	Youngs Bay	25,672	29,469	29,990	495,057	
Youngs Bay Netpens	Clackamas R Early	Youngs Bay	103,114			427,357	
Tongue Point Netpens	Tanner Creek	Tongue Pt (Columbia R)	18,355			95,914	5,056
Blind Slough Netpens	Tanner Creek	Blind Slough (Columbia R)	24,607			112,314	7,074
S Fk Klaskanine	Klaskanine R	Klaskanine R, S Fk	26,787			502,820	
Sandy	Sandy R	Cedar Cr (Sandy R)	29,770	29,251	28,647	195,747	
		Total	**349,236**	**58,720**	**58,637**	**3,156,752**	**99,289**
Columbia River		**Total**	**456,710**	**111,508**	**112,175**	**3,156,752**	**2,090,826**
Coastal							
Nehalem	Nehalem River	Nehalem River, N Fk		49,044	49,427	90,309	
Trask	Trask River	Trask River	25,297			185,434	
Salmon River	Siletz River	Salmon River	24,902			88,012	7,887
Salmon River	Siletz River	Salmon R & Siletz R	27,047			239,695	
Fall Creek	Fall Creek	Fall Creek (Alsea River)	26,798	27,454	27,431	123,262	
Rock Creek a/	Rock Creek	Rock Cr (N Umpqua R)		54,392	29,407	88,421	
Butte Falls	Cow Cr (S Umpqua)	Umpqua R, S Fk	27,952			103,500	
Noble Creek (STEP)	Coos River	Noble Creek (Coos R)	26,861			51,627	
Butte Falls	Coquille River	Ferry Creek	26,065			31,015	
Cole Rivers	Rogue River	Rogue River		27,950	26,563	156,964	
Coastal		**Total**	**184,922**	**158,840**	**132,828**	**1,158,239**	**7,887**
Total Oregon		**Total**	**641,632**	**270,348**	**245,003**	**4,314,991**	**2,090,826**

Table 13. ODFW Projected 1997 brood year hatchery coho mass marking

Hatchery	Stock	Release Site	AdCWT (Index)	AdCWT (DIT)	CWT only (DIT)	Ad Clipped	Not Marked
Columbia River							
Non-Massed Marked							
Cascade	Tanner Creek	Umatilla River	53,000	28,000	28,000		1,459,000
Cascade	Tanner Creek	Yakima River	26,000	28,000	28,000		647,000
		Total	79,000	56,000	56,000		2,106,000
Mass Marked							
Big Creek	Big Creek	Big Creek	54,000			555,000	
Bonneville	Tanner Creek	Tanner Creek	52,000			1,165,000	
Youngs Bay Netpens	Tanner Creek	Youngs Bay	56,000			1,009,000	
Youngs Bay Netpens	Sandy R	Youngs Bay		26,000	26,000	163,000	
Youngs Bay Netpens	Clackamas R Early	Youngs Bay	103,000			427,000	
Tongue Point Netpens	Tanner Creek	Tongue Pt (Columbia R)	27,000			184,000	
Blind Slough Netpens	Tanner Creek	Blind Slough (Columbia R)	26,000			184,000	
S Fk Klaskanine	Klaskanine R	Klaskanine R, S Fk	21,000			537,000	
Sandy	Sandy R	Cedar Cr (Sandy R)	91,000	27,000	27,000	359,000	
		Total	**430,000**	**53,000**	**53,000**	**4,583,000**	
Columbia River		**Total**	**509,000**	**109,000**	**109,000**	**4,583,000**	**2,106,000**
Coastal							
Nehalem	Nehalem R	Nehalem R, N Fk		53,000	53,000	109,000	
Trask	Trask R	Trask R	26,000			162,000	
Salmon River	Siletz R	Salmon R & Siletz R		26,000	26,000	84,000	
Munsel Lake	Siuslaw River	Munsel Lake				5,000	
Rock Creek	Rock Creek	Rock Cr (N Umpqua R)		28,000	28,000	15,000	
Butte Falls	Rock Creek	Rock Cr (N Umpqua R)	28,000			43,000	
Butte Falls	Cow Cr (S Umpqua)	Umpqua R, S Fk	29,000			40,000	
Gardiner Creek	Smith River	Gardiner Creek				15,000	
Noble Creek (STEP)	Coos R	Noble Creek (Coos R)	26,000			96,000	
Butte Falls	Coquille R	Ferry Creek	28,000			30,000	
Cole Rivers	Rogue R	Rogue River		25,000	25,000	154,000	
Coastal		**Total**	**137,000**	**132,000**	**132,000**	**753,000**	
Total Oregon		**Total**	**646,000**	**241,000**	**241,000**	**5,336,000**	**2,106,000**

Table 14: Tags recovered from double index groups of 1995 brood coho at WDFW hatchery racks and in fisheries in 1998.

Hatchery	Number Released		Recoveries expanded for sampling rate								H_o: Marked – Unmarked (Δ) = 0		
			Selective fisheries		Escapement		Total		Standardized total [1]				
	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked	Δ	Z-statistic	p
Forks Creek	75,294	75,497	4	-	182	243	472	572	474	572	(98)	1.930	0.056
Salmon River (Queets) [2]	98,028	71,285	3	-	183	244	1,269	1,033	923	1,033	(110)	1.870	0.065
Humptulips [2]	79,072	79,142	4	-	219	269	543	595	543	595	(52)	1.460	0.150
Bingham Creek (Chehalis) 636157 & 636148 [3]	72,105	74,919	-	-	101	103	118	118	123	118	5	0.590	0.560
Bingham Creek (Chehalis) 636149 & 636150 [3]	72,120	72,340	24	7	781	852	1,058	1,008	1,061	1,008	53	1.038	0.302
Lewis River Hatchery	68,835	70,617	43	4	413	475	492	502	505	502	3	0.163	0.870
Marblemount (Skagit)	42,489	42,566	-	-	1,206	1,125	1,674	1,631	1,677	1,631	46	0.640	0.530
George Adams	45,786	45,242	-	-	197	184	338	291	334	291	43	1.030	0.310

1 Standardized to account for differences in number of tagged fish released in each group
2 Spawning ground recoveries included in escapement
3 Stream trap recoveries included in escapement

Source: WDFW and Quinault Department of Natural Resources.

Table 15: Preliminary summary of 1998 coho double index tag group returns to Oregon facilities.

Hatchery Release	Tagcode	Mark	Release	Freshwater Selective Harvest	Ocean Selective Harvest	Freshwater Creel Survey	Returns by Mark [1]		Reported As Jacks	Total Return	Survival [2]
				(Yes/No)	(Yes/No)	(Yes/No)	Expected	Unexpected			
Nehalem	71331	AD-CWT	25,458	Yes	Yes	Yes	48	0	0	48	0.19%
3/5-3/14 1997	91820	CWT	24,920				42	0	0	42	0.17%
Nehalem	91732	AD-CWT	25,715	Yes	Yes	Yes	88	0	0	88	0.34%
4/1-4/15 1997	91821	CWT	26,179				95	2	0	97	0.37%
Fall Creek	91735	AD-CWT	28,157	Yes	Yes	No	247	10	0	257	0.91%
5/15/97	91841	CWT	28,497				285	36	2	323	1.13%
Rock Creek	91811	AD-CWT	24,700	Yes	Yes	No	100	3	0	103	0.42%
4/4/97	91822	CWT	12,824				69	4	2	75	0.58%
Rock Creek	91812	AD-CWT	24,930	Yes	Yes	No	85	2	1	88	0.35%
4/28/97	91823	CWT	12,950				75	3	1	79	0.61%
Cole Rivers	71044	AD-CWT	26,907	Yes	No	Yes	322	14	6 [3]	342	1.27%
4/28/97	91808	CWT	26,609				419	7	0	426	1.60%
Sandy	91838	AD-CWT	29,337	Yes	Yes	Yes	196	7	0	203	0.69%
5/5/97	91842	CWT	28,662				294	23	0	317	1.11%
Umatilla	91805	AD-CWT	7,903 [4]	Yes	Yes	Yes	1	0	0	1	0.01%
Klaskanine	91809	CWT	7,802 [4]				7	0	0	7	0.09%
Umatilla	91753	AD-CWT	26,822	Yes	Yes	Yes	57	0	0	57	0.21%
Gnat Cr. 4/1/97	91810	CWT	27,376				104	0	0	104	0.38%

1 A small percentage of returning adult coho were reported with an unexpected adipose finclip status (i.e. tagcode data confirms the release was not adipose finclipped but the fish was reported adipose finclipped upon adult return).

2 Survival = (Total Return) /Release

3 5 of 6 sampled as jacks AD clipped, 1 non-clipped.

4 74% loss expected due to emergency tranfer durnig an ice storm.

Table 16: Error rates in identification of marked and unmarked DIT groups in Washington facilities in 1998.

Tag Group	Release Mark	Sampled Clip	Coastal Gillnet	Comm Seine	Estuary Sport	Fshwater Sport	Hatchery Rack	Mix Net & Seine	NonTrty Troll	Ocean Sport Not Selective	Ocn Spt Selective	Puget Sound Sport	Spawn. Ground	Stream Trap	Treaty Troll	Total
BINGHAM CR 1	Marked	Ad Fin Clp	2			9	690	1	1	4	9			64	2	782
		Unmarked					25									25
	Marked Total		0.0%			0.0%	3.5%	0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	3.1%
	Unmarked	Ad Fin Clp					110				1			4		115
		Unmarked	8				720			2	1			17		748
	Unm. Total		0.0%				13.3%			0.0%	50.0%			19.0%		13.3%
BINGHAM CR 2	Marked	Ad Fin Clp					47		4					53	2	106
		Unmarked					1									1
	Marked Total						2.1%		0.0%					0.0%	0.0%	0.9%
	Unmarked	Ad Fin Clp					2							1	1	4
		Unmarked	1				94			1				6		102
	Unm.Total		0.0%				2.1%			0.0%				14.3%	100.0%	3.8%
FORKS CREEK HATCHERY	Marked	Ad Fin Clp	44				171	1	1	4	2	3			2	228
		Unmarked	4				11									15
	Marked Total		8.3%				6.0%	0.0%	0.0%	0.0%	0.0%	0.0%			0.0%	6.2%
	Unmarked	Ad Fin Clp	2				11									13
		Unmarked	64				229			1					2	296
	Unm. Total		3.0%				4.6%			0.0%					0.0%	4.2%
GEORGE ADAMS HATCHRY	Marked	Ad Fin Clp					195	7		3		14				219
		Unmarked					2									2
	Marked Total						1.0%	0.0%		0.0%		0.0%				0.9%
	Unmarked	Ad Fin Clp					10									10
		Unmarked					174	4		2		14				194
	Unm. Total						5.4%	0.0%		0.0%		0.0%				4.9%
HUMPTULIPS HATCHERY	Marked	Ad Fin Clp	8	1			217	1	8	9	2		1		2	249
		Unmarked					2									2
	Marked Total		0.0%	0.0%			0.9%	0.0%	0.0%	0.0%	0.0%		0.0%		0.0%	0.8%
	Unmarked	Ad Fin Clp					9									9
		Unmarked	6				259			8			1		5	279
	Unm. Total		0.0%				3.4%			0.0%			0.0%		0.0%	3.1%
LEWIS RIVER HATCHERY	Marked	Ad Fin Clp		1		1	395			6	18					421
		Unmarked					11									11
	Marked Total			0.0%		0.0%	2.7%			0.0%	0.0%					2.5%
	Unmarked	Ad Fin Clp					55									55
		Unmarked	1				417			6	1	1	1			427
	Unm.Total		0.0%				11.7%			0.0%	0.0%	0.0%	0.0%			11.4%
MARBLEMOUNT HATCHERY	Marked	Ad Fin Clp					1187	65		11		53			5	1321
		Unmarked					13			1		1				15
	Marked Total						1.1%	0.0%		8.3%		1.9%			0.0%	1.1%
	Unmarked	Ad Fin Clp					107	7		5		6				125
		Unmarked					1015	73		8		33			5	1134
	Unm.Total						9.5%	8.8%		38.5%		15.4%			0.0%	9.9%

Table 17: Selective coho fishery data collected during dockside interviews with anglers in Washington's Area 1, Columbia River, Grays Harbor, and Willapa Bay fisheries in 1998.

Fishery	# Angler Trips	Total coho kept	AD clipped coho kept	Total coho released	AD clipped coho released
Area 1 (2 weeks)					
Dockside Observations	1,768	2,084	2,058	3,454	128
Estimate of Total Catch	4,697	4,373	4,297	7,162	288
Columbia River (8 weeks)					
Dockside Observations	8,284	1,378	1,306	824	70
Estimate of Total Catch	24,276	3,383	3,201	2,282	177
Grays Harbor (5 weeks)					
Dockside Observations	2,643	210	191	420	17
Estimate of Total Catch	8,538	699	629	NA	NA
Willapa Bay (7 weeks)					
Dockside Observations	1,620	125	118	48	0
Estimate of Total Catch	3,682	283	268	109	NA

Notes: Preliminary estimates of total catch and effort are also provided.

Table 18: Buoy 10 catch retention of coho by Washington and Oregon fishers in 1998.

	Washington			Oregon		
	Adipose clipped	**Adipose present**	**% Clipped**	**Adipose clipped**	**Adipose present**	**% Clipped**
Charter Boats	180	8	96	59	0	100
Private Boats	1,493	91	94	1,169	0	100
Bank Fishers	128	16	89	31	0	100
Total	1,801	155	94	1,259	0	100

Table 19. Estimates of tagged harvest in Puget Sound sport fisheries 1987-1990 using two methods using tags recovered by random sampling and using volunteer returns and awareness factors.

Year	Area	Month	Sample Fraction in random sample	Tags Recovered		Estimates of tags in fishery					
				Random sample	Voluntary return	Random Sample Estimate	SE	95% CI		CV	Awareness Factor Estimate
								Lower	Upper		
1990	6	1	95.5%	4	-	4	0	3	5	10.66%	4
1988	8	1	64.7%	3	1	5	2	2	8	34.30%	4
1989	8	5	64.0%	1	-	2	1	(0)	3	60.00%	2
1987	12	8	57.1%	1	-	2	1	(0)	4	65.47%	1
1987	8	6	55.4%	3	7	5	2	1	10	38.55%	20
1988	5	2	53.4%	3	-	6	2	1	10	39.41%	6
1988	10	6	47.8%	9	-	19	5	10	28	24.08%	18
1988	5	3	45.3%	3	-	7	3	1	12	42.72%	9
1987	9	6	44.2%	7	13	16	4	7	25	28.22%	40
1988	6	2	40.9%	6	-	15	5	6	24	31.37%	12
1987	6	4	40.0%	1	-	3	2	(1)	6	77.46%	2
1987	6	10	38.7%	69	46	178	17	145	211	9.43%	242
1987	6	3	37.0%	1	-	3	2	(2)	7	79.38%	2
1989	8	8	36.3%	15	3	41	9	25	58	20.60%	38
1988	6	1	36.0%	3	1	8	4	1	16	46.17%	9
1987	6	9	35.3%	182	37	515	31	455	576	5.96%	506
1990	6	6	34.8%	30	5	86	13	61	111	14.75%	97
1990	6	7	34.0%	37	19	109	15	80	137	13.35%	158
1988	6	9	33.0%	105	29	319	25	269	368	7.99%	363
1989	5	3	32.9%	6	-	18	6	6	30	33.45%	12
1990	8	7	32.6%	13	9	40	9	22	58	22.77%	49
1987	6	1	31.9%	1	1	3	3	(2)	8	82.53%	4
1988	8	6	29.9%	1	4	3	3	(2)	9	83.71%	10
1988	9	6	29.1%	14	14	48	11	27	69	22.50%	64
1987	5	4	28.3%	4	5	14	6	2	26	42.35%	27
1989	6	9	28.2%	175	47	620	40	542	698	6.40%	646
1990	9	7	27.5%	49	49	178	22	136	221	12.17%	262
1989	7	4	27.5%	2	2	7	4	(1)	16	60.23%	12
1987	10	9	27.4%	30	9	109	17	76	143	15.55%	122
1989	6	3	26.6%	7	-	26	9	10	43	32.38%	21
1988	7	4	26.0%	2	-	8	5	(1)	17	60.82%	6
1989	6	12	25.0%	1	-	4	3	(3)	11	86.60%	3
1990	13	4	25.0%	1	1	4	3	(3)	11	86.60%	6
1988	6	7	24.9%	65	16	261	28	206	316	10.75%	246
1996	5	8	24.2%	20	7	83	16	51	114	19.47%	-
1988	6	3	24.1%	1	-	4	4	(3)	11	87.10%	6
1990	11	12	24.1%	1	-	4	4	(3)	11	87.11%	3
1990	7	10	24.0%	1	2	4	4	(3)	11	87.19%	6
1987	5	9	23.4%	301	110	1,289	65	1,161	1,416	5.05%	1,390
1990	11	1	23.1%	4	5	17	8	2	32	43.85%	27
1989	9	5	23.1%	5	9	22	9	5	38	39.23%	42
1989	5	9	23.0%	320	156	1,390	68	1,256	1,523	4.90%	1,474
1987	6	2	23.0%	2	-	9	5	(2)	19	62.06%	6
1988	11	7	22.6%	3	5	13	7	0	27	50.81%	24
1989	11	7	22.0%	7	2	32	11	11	53	33.38%	28
1987	8	9	21.9%	36	17	165	24	117	212	14.73%	173
1988	5	7	21.8%	54	43	248	30	189	306	12.04%	308
1993	5	7	21.6%	104	24	481	42	399	563	8.68%	494
1989	6	8	21.6%	28	8	130	22	87	172	16.73%	113
1988	5	9	21.0%	188	77	895	58	782	1,009	6.48%	966
1987	6	7	20.8%	35	22	168	25	119	218	15.04%	178
1995	5	10	20.6%	17	3	82	18	47	117	21.61%	80
1988	9	5	20.6%	7	8	34	11	12	56	33.68%	44
1987	11	8	20.3%	7	11	34	12	12	57	33.74%	36
1996	5	9	20.3%	260	82	1,280	71	1,141	1,419	5.54%	-
1988	6	4	20.2%	13	1	64	16	33	95	24.77%	54
1989	9	8	20.2%	24	12	119	22	76	161	18.23%	101
1988	5	4	20.1%	4	4	20	9	2	37	44.70%	32
1988	8	8	19.7%	15	8	76	18	42	111	23.14%	69

Table 19: Estimates of tagged harvest in Puget Sound sport fisheries 1987-1990 using two methods (cont.)

Year	Area	Month	Sample Fraction in random sample	Tags Recovered		Estimates tags in fishery					
				Random sample	Voluntary returns	Random sample estiamte	SE	95% CI Lower	95% CI Upper	CV	Awareness Factor Estimate
1989	11	12	19.5%	1	5	5	5	(4)	14	89.70%	19
1989	6	4	19.4%	5	5	26	10	5	46	40.15%	40
1993	5	9	19.2%	13	5	68	17	35	101	24.93%	72
1990	11	8	19.1%	5	6	26	11	6	47	40.22%	44
1988	11	11	18.8%	2	1	11	7	(3)	24	63.74%	9
1995	5	5	18.7%	1	-	5	5	(4)	15	90.16%	5
1993	5	8	18.5%	109	40	589	51	489	688	8.65%	633
1988	5	6	18.5%	33	12	179	28	124	234	15.72%	179
1988	6	10	18.3%	41	35	224	32	162	286	14.12%	299
1987	5	3	18.2%	5	2	27	11	6	49	40.44%	28
1992	5	7	17.3%	266	109	1,539	86	1,370	1,707	5.58%	1,647
1989	5	4	16.9%	3	-	18	9	(1)	36	52.63%	12
1992	5	6	16.8%	65	33	387	44	301	473	11.31%	414
1990	10	9	16.5%	38	40	231	34	164	298	14.83%	257
1990	10	8	16.4%	17	14	104	23	59	149	22.18%	101
1987	9	9	16.3%	122	144	748	62	627	870	8.28%	837
1987	11	7	16.1%	5	22	31	13	6	56	40.96%	60
1995	5	9	16.1%	131	28	816	65	688	944	8.01%	901
1989	5	8	15.8%	118	78	745	63	622	868	8.45%	784
1988	11	8	15.8%	1	5	6	6	(5)	18	91.79%	18
1988	8	2	15.0%	4	6	27	12	3	51	46.11%	31
1988	9	10	14.7%	30	47	204	34	136	271	16.86%	231
1987	9	3	14.3%	1	2	7	6	(6)	20	92.58%	9
1988	9	8	13.9%	22	17	158	31	97	220	19.79%	119
1991	5	8	13.7%	249	121	1,813	107	1,604	2,022	5.89%	2,100
1987	6	6	13.4%	1	1	7	7	(6)	21	93.06%	8
1988	6	6	13.4%	6	2	45	17	11	78	38.00%	40
1989	6	7	12.9%	20	16	155	32	91	218	20.86%	177
1988	8	10	12.9%	5	8	39	16	7	70	41.73%	50
1995	5	4	12.9%	1	1	8	7	(6)	22	93.33%	12
1987	8	10	12.5%	13	10	104	27	51	157	25.94%	96
1990	5	7	12.2%	116	49	953	83	790	1,115	8.70%	942
1995	5	8	12.0%	1	3	8	8	(7)	24	93.83%	28
1990	9	6	11.9%	5	12	42	18	7	76	41.97%	51
1990	7	8	11.8%	2	3	17	11	(5)	39	66.40%	10
1990	8	10	11.4%	5	3	44	18	8	80	42.10%	39
1990	9	3	11.2%	1	11	9	8	(8)	25	94.21%	39
1990	6	10	11.1%	14	12	126	32	64	188	25.19%	130
1988	11	6	10.8%	4	2	37	17	3	71	47.22%	23
1987	13	7	10.3%	2	12	19	13	(6)	45	66.98%	58
1987	13	11	10.3%	1	4	10	9	(8)	28	94.73%	20
1992	5	8	10.2%	87	83	851	86	681	1,020	10.16%	1,020
1988	11	10	10.0%	11	26	109	31	48	171	28.60%	148
1992	5	3	9.9%	2	-	20	14	(6)	47	67.12%	12
1989	6	10	9.6%	25	27	260	49	163	357	19.01%	275
1988	5	8	9.4%	75	66	796	87	624	967	10.99%	739
1988	7	10	9.4%	6	5	64	25	15	113	38.86%	77
1990	6	9	9.4%	75	78	800	88	627	972	10.99%	817
1990	11	3	9.3%	1	-	11	10	(9)	31	95.24%	5
1988	11	5	9.1%	5	5	55	23	9	101	42.63%	40
1988	5	10	9.1%	32	34	351	59	235	467	16.85%	387
1988	10	7	9.1%	10	3	110	33	45	174	30.15%	80
1987	8	4	9.1%	1	2	11	10	(10)	32	95.35%	15
1990	7	7	9.1%	2	4	22	15	(7)	51	67.43%	18
1987	9	10	9.0%	42	81	465	68	331	599	14.72%	454
1987	5	10	8.9%	8	13	90	30	31	150	33.75%	126
1988	5	5	8.7%	6	4	69	27	16	122	39.02%	60
1989	7	10	8.6%	1	7	12	11	(10)	33	95.59%	32
1987	5	5	8.6%	1	-	12	11	(10)	33	95.61%	6
1990	11	5	8.2%	2	1	24	17	(8)	57	67.76%	15
1988	13	8	8.0%	1	4	12	12	(11)	36	95.90%	24

Appendices

Appendix 1. Implementation Plan for Chinook Mass Marking and Selective Fisheries

FINAL DRAFT AGREEMENT
IMPLEMENTATION PLAN:
Chinook Mass Marking and Selective Fisheries
June 16, 1999

I. General provisions

A. Purpose and intent. The purpose of this plan is to establish requirements for implementing programs for the mass marking by removal of the adipose fin of hatchery chinook, originating from Grays Harbor and northward, including Puget Sound, and for implementing fisheries that would selectively harvest marked fish in a manner that would affect management of fisheries resources subject to the authority and obligations of treaty tribes party to this plan.[1] The mass marking of chinook salmon intended for release from tribal facilities may only proceed upon agreement between the pertinent state, tribal and/or federal parties involved.

It is the intent of the parties to this plan to insure that mass marking and any selective fisheries for chinook are implemented in a manner that facilitates conservation of the chinook resource, benefits both treaty and non-treaty fisheries, and maintains a viable coastwide coded-wire tag (CWT) program. The parties intend to achieve the expected benefits of this new management strategy in a manner that is consistent with maintaining their ability to properly manage the chinook resource and with meeting other legal obligations of the parties.

No party may through a third entity, pressure or coerce, or attempt to pressure or coerce another party to mass mark hatchery production or support selective fisheries.

B. Parties. The parties to this plan are the Washington Department of Fish and Wildlife (WDFW), and the signatory Puget Sound and Washington coastal treaty Indian tribes, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS).

C. Plan amendments. The parties commit to modifying this plan as necessary, by agreement, in response to information gained from ongoing evaluations.

[1] Throughout this plan, the term "selective fisheries" means fisheries in which captured fish with a mass mark are differentially retained over unmarked fish, and the term "mass marking" means removal of the adipose fin; any other mass mark would require further discussion among the parties and possible modifications to this plan.

D. Plan duration. This plan will be reviewed by the parties no later than November 2004. As part of this review, the parties will reach agreement on whether it should be continued, modified, or terminated.

E. Dispute Resolution. The parties commit to good faith technical- and policy-level efforts, as described in the "Stipulation and Order Concerning Co-management and Mass Marking" dated April 28, 1997, to attempt to resolve in a timely manner any disputes that may arise in connection with this plan, prior to initiating legal actions arising from such disputes. The parties may also explore and employ other jointly agreed dispute resolution approaches. Where this implementation plan requires the parties to agree before taking action, the parties may, as an alternative, pursue the dispute resolution procedures described in the "Stipulation and Order Concerning Co-Management and Mass Marking" entered April 28, 1997 in U.S. v. Washington Subpro. 96-3.

F. NMFS and USFWS Participation. NMFS and USFWS will participate in good faith in the processes described in Section III paragraphs A through F, however, the processes described are primarily state and tribal processes. NMFS fishery management authority in the EEZ stems from the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et seq. and other federal laws, and NMFS and USFWS are not parties to this agreement for the purpose of these paragraphs. Implementation and ongoing adherence to this plan by NMFS and USFWS shall be subject to the availability of appropriate funds.

II. Mass Marking

Mass marking plans must be agreed to by the parties. Resolution of any disputes that may arise will be addressed pursuant to Paragraph I.E. Annual mass marking plans must be finalized by February 15th. Each party will provide its proposals for mass marking to the other parties by November 15th of each year, identifying which production will be mass marked, which stocks will be "double index" coded-wire tagged *(DIT)*, and the schedule for marking and tagging. Because sufficient time must be allowed to accommodate resolution of any disagreements, the parties will schedule their efforts so as to reach agreement by January 15th of each year. If agreements have not been reached by that date, the parties will initiate appropriate dispute resolution procedures to be completed by February 15th. Any mass marking still in dispute under these timelines will not begin until the dispute is resolved. Any proposed modifications of previously-agreed or established plans that affect which stocks would be mass marked or double index tagged, or the agreed proportions that would be mass marked, must be provided to the parties at least 30 days prior to the affected marking or tagging, and agreement reached (or disputes promptly resolved) to accommodate the proposed changes.

The marking of any stocks will not proceed until agreements are reached between WDFW and individual tribes in each region in which stocks will be marked and DIT.

C. The Pacific Salmon Treaty (PST) commits the United States and Canada to "maintain a coded-wire tagging and recapture program designed to provide statistically reliable data for stock assessments and fishery evaluations." Appropriate coordination with Canada is a critical element of maintaining the viability of the coastwide CWT program (a definition of a viable CWT program is provided in Paragraph 10.4 on pages 180-181 of the PSC's June, 1995 Ad-Hoc Selective Fisheries Evaluation Committee (AHSFEC) report; this definition is subject to further refinement among the parties per the PSC's Selective Fishery Evaluation Committee). In February 1998, the Pacific Salmon Commission (PSC) established policies and procedures for exchanging, evaluating, and coordinating mass marking and selective fisheries proposals. It also established a permanent bilateral Selective Fisheries Evaluation Committee (SFEC) to provide appropriate scientific advice to the PSC and the parties (Understanding of the Pacific Salmon Commission concerning Mass Marking and Selective Fisheries, February 1998). The PSC has developed and adopted a specific work-plan to identify and address technical feasibility issues to facilitate informed policy judgement on mass marking and selective fisheries. Accordingly, pursuant to their own needs and consistent with the PSC's February 1998 agreement and its SFEC's work-plan, the parties to this plan will:

(1) cooperate and coordinate their efforts with the PSC SFEC process and schedules;

(2) continue to provide staff participation on the PSC SFEC to conduct the necessary review of proposals, development of analytical tools, evaluation of selective fisheries, and coordination of marking and sampling and data reporting programs.

D. To meet the intent of the commitment under PST to maintain the viability of the coastwide CWT program, including providing for statistically reliable data for stock assessment and fishery evaluation, the parties shall develop, implement and maintain an agreed CWT sampling plan that includes:

(1) A minimum sampling rate of 20% unless otherwise agreed and in accordance with any applicable recommendations from the SFEC; and

(2) Implementation of an electronic detection plan that meets the objectives for CWT recovery.

In addition, prior to marking 1998 brood chinook stocks, WDFW will jointly develop with the tribes an agreed CWT sampling plan that:

(1) Describes the geographic range and starting dates for converting CWT sampling of chinook to electronic detection as needed to maintain the integrity of the CWT program; and

(2) Includes a commitment from the Canadian Department of Fisheries and Oceans (CDFO) to conduct the necessary electronic CWT sampling required by this sampling plan.

E. WDFW commits to modify its mass marking and selective fishery proposals, including the DIT system, consistent with the SFEC review and PSC's recommendations to ensure integrity of the coastwide CWT program. Such modifications must be agreed to by the parties prior to beginning or continuation of mass marking. Resolution of any disputes that may arise will be addressed pursuant to Paragraph I.E.

F. WDFW will be responsible for all reasonable increased costs incurred by the tribes required by this mass marking and selective fisheries plan. These envisioned costs specifically include:

(1) increased costs of CWT sampling in fisheries, hatcheries and on spawning grounds:
   a) providing CWT electronic detection equipment and accessories (e.g. tables, totes and hand counters)
   b) maintenance, repair or upgrade costs of the electronic equipment
   c) additional CWT sampling personnel.

(2) all direct costs of tagging tribal stocks identified as "double index" (DIT) groups

(3) costs of mass marking for any tribe that agrees to mass mark their hatchery production; WDFW will supply the necessary number of mass marking trailers(capable of meeting marking schedules with single daily shifts of crews), and cover the costs of the crews and trailer operators.

This responsibility will be met by providing funds to the tribes directly, by securing new, outside funding sources, and/or by providing equipment and direct technical assistance. NMFS and USFWS will explore opportunities they may have to assist the parties in meeting these obligations as well as other activities of this implementation plan. WDFW's obligations for costs incurred by a tribe (or tribes) will be reduced in the event the tribe(s) chooses to benefit from the mass marking program by conducting selective fisheries; the extent of the reduction in WDFW's obligations will be determined by the parties, taking into account the full range of benefits accruing to the affected parties due to selective fisheries.

G. When conducting mass marking, the parties will use hatchery culture, handling, and marking/tagging practices that will minimize mortalities caused by these activities.

III. Selective Fisheries

A. The parties understand that selective fishery options will be evaluated on their individual merits in the context of the elements of this plan; they are not assured simply because mass marking has occurred. Selective fisheries will be implemented in a manner that maintains the viability of the coastwide CWT system, and only if all the terms set forth below in Paragraphs B - L are met, unless the parties agree otherwise.

B. Selective chinook fisheries will be implemented only as part of agreed annual fishery management plans that address a broad range of chinook fisheries. Resolution of any disputes that may arise will be addressed pursuant to Paragraph I.E. These annual plans, which include defining levels of impact on chinook stocks of concern by all fisheries, will continue to be negotiated and agreed to through the so-called "North of Falcon" process, unless otherwise agreed by the parties. These plans will not require use of selective fisheries by any tribe, unless otherwise agreed by the parties, in order to meet spawning escapement objectives, treaty/non-treaty allocation standards, and inter-tribal and other harvest sharing objectives of the parties. Selective fisheries will only be implemented in a manner that meets treaty Indian fishing rights. Agreed methods for estimating stock and fishery exploitation rates for selective fisheries will be developed. This will include the ability to estimate stock exploitation rates, recruitment and marine survival rates for PSC indicator stocks and other stocks tagged by the tribes or state for management planning or evaluation purposes that are exposed to selective fisheries.

C. Proposals for selective fisheries will provide sufficient information to meet the needs described in Appendix C of the "Pacific Salmon Commission Selective Fishery Evaluation" report (June 9, 1995).

D. It is the intent of this section that established treaty/non-treaty principles concerning the allocation of harvestable salmon and the exercise of treaty rights will be adhered to. Unintended effects on individual treaty fisheries, including dislocation and/or disruption, could occur due to unforeseen circumstances of the mass marking and selective fisheries program. The parties will seek to minimize or eliminate such potential fishery effects and resolve any conflicts in the course of modeling, evaluation and planning efforts described herein. In particular, selective chinook fisheries can only be implemented as part of an overall management plan that takes into account the ESA listing for Puget Sound chinook and provides for treaty fisheries that will achieve their share of the harvest.

E. WDFW and the signatory Puget Sound tribes will develop agreed, comprehensive chinook management plans under the frameworks of existing court ordered salmon management and allocation plans, including without limitation the intertribal allocation agreements approved by the court in Subproceeding 86-5, or subsequent stipulations or orders of the court following the expiration of the current agreements. The plan will be implemented beginning with the May 1, 2000 to April 30, 2001 season. To meet this requirement, the parties will complete the tasks as described and scheduled in Attachment 1. The parties will encourage involvement by other interested managers to insure that coastwide coordination needs are met. Agreed chinook management plans developed under this provision shall be binding only to the

parties hereto absent further orders of the court. Comprehensive chinook management plans will include:

(1) rules for implementing annual fishing schedules, given expected abundance of wild stocks;
(2) definition of spawning escapement levels that would be achieved, on the average, and levels that would avoid unacceptable risks to stock health:
(3) fishing regimes (levels of exploitation) for treaty and non-treaty fisheries that are expected to achieve conservation and treaty sharing obligations, and meet inter-tribal and other harvest sharing objectives of the parties;
(4) procedures for evaluating performance of annually implemented fishing regimes toward meeting stated goals and objectives, and for modifying the plan accordingly, as may be appropriate;
(5) a habitat component that assesses habitat relative to performance standards and quantitatively estimates the relationship between habitat condition and production.

F. Preseason fishery planning and post-season stock assessments are highly dependent upon the use of management planning tools (models). Recognizing that selective fisheries introduce requirements beyond the capability of existing models, and desiring to minimize any impacts on existing analytical capabilities, the parties are committed to and will cooperatively develop, prior to the implementation of any selective fisheries, modified or new models with the capability of planning and assessing impacts of fishery regimes that include selective fisheries.

The parties will cooperatively develop, and reach agreement, on new models with the capability of planning and assessing impacts of fishery regimes that include selective fisheries. An inter-agency chinook Model Development and Evaluation Workgroup will be established to direct this cooperative model development. The parties will direct their representatives on the technical work group to jointly:

(1) develop specifications for models that would evaluate selective fisheries in regional planning forums,
(2) review the modeling choices for selective fishery management models and recommend a model to the parties.
(3) monitor the development of modified and new models and provide progress and final reports.
(4) participate in the processes of data preparation, model parameter specification, and model coding specific to data input and reporting that are necessary to complete any new model developed.
(5) complete model validation and model documentation in a timely manner so that interested parties (e.g., the Scientific and Statistical Committee of the Pacific Fisheries Management Council) can critically review new models before they are used.

G. The parties will continue to participate cooperatively in the Selective Fisheries Evaluation Committee (SFEC) established by the Pacific Salmon Commission (PSC).

H. Any party that authorizes a selective fishery will, itself, or in cooperation with other signatory parties, implement appropriate programs to monitor and evaluate its stock specific impacts. Each selective fishery will include a monitoring program sufficient to obtain valid estimates of retained catch, encounter rates, the percent of marked fish that are encountered but are subsequently released, and the percent of unmarked fish that are encountered and retained. Estimates of the proportion of marked fish caught in all fisheries will be made by February 15th of the following year. The parties will agree on estimates of release mortality rates prior to March 1st of each year.

I. Any party that authorizes a selective fishery will, itself, or in cooperation with other signatory parties, develop effective education and enforcement programs to insure compliance with its selective fishery regulations. This will be accomplished without adversely affecting fisheries enforcement capabilities in other areas. WDFW agrees to meet and review enforcement strategies with the tribes relative to the adequacy of the enforcement plans to ensure compliance with the regulations associated with a proposed selective fishery. If the parties disagree about the effectiveness of WDFW's proposed enforcement plans, the parties shall attempt to resolve such disputes as provided by Paragraph I, E.

J. WDFW will not diminish its priority for habitat protection as a consequence of non-treaty fisheries focusing on hatchery produced fish.

K. Estimates of non-landed fishery mortality caused by any fishery, including selective fisheries, will be accounted for in meeting conservation and allocation objectives.

L. Any party who mass marks hatchery production or who authorizes a selective fishery will provide a report to the other parties that describes the performance of said fisheries. The report provided to the PSC's SFEC regarding selective fisheries and mass marking may be used to satisfy this obligation.

Appendix 2. Detection of Coded-Wire Tags in Chinook Salmon with the "Wand" Detector

January, 1999

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Introduction

The Washington Department of Fish and Wildlife (WDFW) and the Oregon Department of Fish and Wildlife (ODFW) recently distributed a proposal regarding mass marking and selective fisheries for both coho and chinook salmon in 1999 (WDFW-ODFW, November 9, 1998). The proposed marking involves the use of the adipose fin clip for both species. This fin mark is now used to indicate mass marked hatchery coho salmon in Oregon, Washington and British Columbia, but the adipose mark is still reserved to indicate the presence of a coded-wire tag (CWT) in chinook salmon. Initiation of this proposal would necessitate that the chinook CWT sampling and recovery system be converted to electronic detection. The detection capability of CWT electronic sampling equipment, however, has not been extensively tested on chinook. Of particular concern is the capability of the hand held "wand" for detecting tags in larger chinook. Complicating the issue are the various types and lengths of wire being used. The "new wire" now being used for manufacturing tags has a stronger magnetic moment (i.e. higher detectability) than the "old wire" which is still present in some of the fish that are returning. The use of length-and-a-half tags, which have an even stronger magnetic moment, are now used in coho to ensure their detection with electronic equipment. It has recently been suggested that these longer tags could also be used in chinook. However, because many stocks of chinook are tagged as small fingerlings, some agencies believe that this longer tag would be too long for many of their stocks. The manufacturer of the wand, Northwest Marine Technology (NMT), guarantees a detection depth of 20 mm for single length tags (1.1 mm) and 30 mm for length-and-a-half tags (1.5 mm). Because of the large size of chinook heads, especially in the older age classes (i.e. age 4 and 5), it seems likely that a significant percentage of coded-wire tags would reside at a depth greater than 30 mm, where even length-and-a-half tags would not be detected. The purpose of this study was to measure the CWT detection rate of wands used on hatchery returns of chinook salmon tagged with standard length CWTs. A secondary purpose was to examine variability in the detection capability between wands.

Methods

Detection Rates: Wand detectors were tested in the fall of 1998 on adipose marked chinook returning to four hatcheries: 1) Nisqually Hatchery at Clear Creek, 2) Kalama Creek Hatchery, 3) Grovers Creek Hatchery, and 4) Makah National Fish Hatchery. Nisqually Hatchery at Clear Creek and Kalama Creek Hatchery are both operated by the Nisqually Tribe, and are located on the lower Nisqually River in south Puget Sound. Grovers Creek Hatchery is operated by the Suquamish Tribe and is located at the mouth of Grovers Creek, a stream on the Kitsap Peninsula that flows into mid-Puget Sound. Makah National Fish Hatchery (NFH) is operated by the U.S. Fish and Wildlife Service (USFWS) and is located on the Sooes River, which flows into the Pacific Ocean on the extreme north coast of Washington. All of the facilities have a history of tagging juvenile chinook and sampling adult returns for CWTs. All of the expected returning tag groups were originally tagged with standard length wire. Age 5 fish were tagged with "old wire", and age 2 – 4 fish were tagged with "new wire".

Sampling with the wand was conducted by Northwest Indian Fisheries Commission (NWIFC) or USFWS employees, using standardized detection methods established for this equipment. Only adipose marked chinook were used in this sampling. At the tribal hatcheries, the wand sampling only occurred on two days at each site, and only on groups of fish that were available at the time of sampling. Therefore, the sampling was non-random and the sampled fish do not reflect the size and age structure of those runs. Jacks were included in the sampling at two of the hatcheries. At Makah NFH, all marked adult chinook were sampled. After attempting detection with the wand, standard CWT sampling procedures were followed; each adipose marked fish was measured for fork length and the snouts were removed and placed in individual bags. The wand detection information was recorded on the individual head labels, which accompanied each snout. Recovery of CWTs was completed at the WDFW CWT laboratory (for the tribal hatcheries) or the Lacey USFWS dissection laboratory (for Makah NFH) using standard CWT recovery procedures.

Detection Depth Variability Between Wands: The variability in detection depth between six recently purchased wands was examined in a controlled laboratory test. One of the wands was used for the sampling at the Makah NFH. The methods used were similar to a previous wand test conducted by WDFW (Thompson and Blankenship, 1996). For this test a 1.5 mm tag was obtained from an adult coho snout. This tag was known to be from the latest type of wire, and cut from an NMT Mark IV tag injector. The tag was taped to a piece of plywood and a glass plate (15 cm x 30 cm x 3 mm thick) was placed over the tag. Plastic strips, approximately 1 mm thick, were placed on the sides of the glass to elevate it above the tag. The glass was raised in 1 mm increments (measurement were approximate) until the wand could no longer detect the tag consistently. The wand was used with the side of the wand tip placed on the glass. The wand was moved back and forth in both parallel and perpendicular strokes to the tag.

Results

A total of 319 marked hatchery chinook were sampled for CWTs with hand held wands. Dissection and recovery in the laboratory determined that 258 of the marked fish carried tags. Only one fish resulted in a "false positive", where a tag was indicated by the wand but was not actually present. Tag code information revealed the following age composition of the tagged fish: 34 of age 5; 87 of age 4; 75 of age 3; and 62 of age 2.

The results of the hatchery field tests are displayed in Table 1. As indicated, the wands were successful in detecting CWTs in 256 out of 258 tagged chinook (99.2%). Not surprisingly, the two tags that were missed were in larger fish. Additionally, neither missed tag was in the desired fatty area of the center of the snout. The fish from Kalama Creek was 4 years old and 91 cm in length. Although an exact depth measurement was not possible for the missed tag, the tag was located in fatty tissue behind one of the eyes. The fish from Makah NFH was 5 years old, 96.5 cm in length, and the tag was of the older style wire. The tag was found at a depth of 50 mm from the dorsal surface, just above the roof of the mouth. In the lab this tag was also missed by a Portable Field Sampling Detector (FSD) but was detected when the snout was passed through a "4 inch Tubular" detector (model TD 400 "cannon").

The results of the laboratory test for detection variability between equipment are shown in Table 2. Greater detection depth was found for all equipment when the wand was used in a parallel orientation to the tag. This maximum detection depth of the wands ranged from 38 to 44 mm.

However, variability in detection depth was only found when the wands were used in the parallel orientation. All equipment had a uniform detection depth of 37 mm when tested in the perpendicular orientation.

Table 1. Results of CWT Detections with the Hand Held Wand in 1998 Chinook Hatchery Returns.

Hatchery	Brood Year (age)	CWT Type	Mean Fork Length (cm)	# CWTs in Sample	# CWTs Missed with Wand	% CWTs Detected
Clear Creek	1994 (4)	1.1 mm, new wire	73.4	7	0	
	1995 (3)	1.1 mm, new wire	64.6	27	0	
	1996 (2)	1.1 mm, new wire	50.1	58	0	
				92	0	100.0
Kalama Creek	1993 (5)	1.1 mm, old wire	88.0	4	0	
	1994 (4)	1.1 mm, new wire	78.7	44	1	
	1995 (3)	1.1 mm, new wire	71.0	4	0	
	1996 (2)	1.1 mm, new wire	59.2	4	0	
				56	1	98.2
Grovers Creek	1993 (5)	1.1 mm, old wire	79.0	2	0	
	1994 (4)	1.1 mm, new wire	70.5	6	0	
	1995 (3)	1.1 mm, new wire	69.4	10	0	
				18	0	100.0
Makah NFH	1993 (5)	1.1 mm, old wire	87.3	28	1	
	1994 (4)	1.1 mm, new wire	87.7	30	0	
	1995 (3)	1.1 mm, new wire	74.1	34	0	
				92	1	98.9
			Totals =	258	2	99.2 [a]

[a] Unweighted mean for all fish sampled

Table 2. Detection distance of a 1.5 length coded-wire tag using six wand detectors and different stroke orientations.

Wand #	Parallel Orientation (mm)	Perpendicular Orientation (mm)
10277	38	37
10404 [a]	41	37
10423	44	37
10485	38	37
10573	44	37
10577	39	37
Mean distance =	40.7	37
Std. deviation =	2.8	0.0

[a] Wand used for sampling at Makah NFH

Discussion

The results of this limited field test indicate that the wand has the potential for detecting standard length, "new wire", coded-wire tags in adult chinook. However, because of the study design and the relatively low numbers of fish involved, we urge caution in the interpretation of these results. The intent of this testing was to measure the detection rate of a piece of equipment. As described in the methodology, only adipose marked fish were sampled. Although the samplers were instructed to use standard sampling techniques, the samplers knew that the fish being sampled had a high possibility of possessing a tag. These detection rates may not be indicative of the rates that would be achieved by a technician sampling groups of unmarked fish with a low percentage of tags. We therefore recommend testing of the wand in actual fishery situations to evaluate the detection rate achieved by samplers in the field. Only 121 of the total fish sampled were in the 4 and 5 year old age classes. These larger fish have the greatest potential for the wand missing tags. We therefore recommend that additional testing be conducted on large fish to see if these results can be repeated.

If wands are to be deemed an acceptable tool for detecting CWTs in chinook, their minimum detection depth will need to exceed the 20 mm depth guaranteed by the manufacturer. The results of our field tests indicate that the wands used may have detected standard length tags at depths much greater than 20 mm. It is unknown how the detection depth measured in the laboratory tests compares with detection depth in a salmon snout. However, the laboratory tests with a 1.5 mm tag resulted in a detection depth of 37 mm, for all of the wands, in the weakest orientation (perpendicular). Further testing is recommended to determine a minimum acceptable CWT detection depth for wand use on chinook. It would then be useful to have a standardized method for measuring individual wands, to ensure some uniformity in the detection capability of the equipment used by samplers.

References

Thompson, D. A. and Blankenship, H. L. 1996. Evaluation of Wand Coded Wire detector

Appendix 3. Returns of chinook salmon coded-wire tagged with 1.1 mm and 1.5 mm coded-wire tags and adult electronic detection.

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In Washington, anadromous salmon have historically been, and are still, economically and culturally important. However, many salmon populations have declined to the lowest levels ever recorded, resulting in drastic reductions in the sport and commercial fisheries. In 1993, the Washington State Legislature mandated mass marking of appropriate hatchery salmon to allow the possibility of selective fisheries for exploitation of healthy stocks, while protecting weak stocks. Excision of the adipose fin was chosen as the mass mark for hatchery fish because it is easily identified by anglers, the associated mortality is low compared to the excision of other fins, and it is inexpensive to apply (PSMFC 1992). In a selective fishery, anglers could retain salmon missing an adipose fin, but must release those with an adipose fin.

Before 1996, a missing adipose fin had signified the presence of an internal coded-wire tag (CWT). Sequestering the adipose clip to designate a hatchery reared fish therefore meant that the presence of a CWT could not be determined from this clip. Using a second fin clip, such as a right or left ventral clip to designate the presence of a CWT was unacceptable because of the high associated mortality. Therefore, electronic detection was chosen for recovering CWT salmon. Four tools are used to electronically detect CWTs: a portable hand-held wand, a V-shaped portable sampling detector, and two rectangular tunnel detectors, the R-8000 and the R-9500, all manufactured by Northwest Marine Technology. Recreational fisheries and fish recovered during spawning ground surveys generally will be sampled using the hand-held wand detector, and commercial fisheries and hatchery rack recoveries generally will be sampled using the tunnel detectors.

The standard length of a CWT is 1.1 mm. A portable wand detector can detect this tag from a distance of 20 mm. However, on a large salmon, the tag may be more than 20 mm from the surface, and could go undetected by the wand. The detection distance can be increased to 30 mm by using 1.5 mm CWT, and therefore decrease the number of missed tags. However, using a longer CWT could interfere with an internal compass, or damage the olfactory nerves and increase straying or reduce survival (Morrison and Zajac 1987, Morrison et al. 1990, Habicht et al. 1998). To further enhance detectability, "new" wire was manufactured with a stronger magnetic moment than "old" wire, such that the magnetic moment of the new 1.5 mm wire is about 200% stronger than that of the old 1.1 mm wire. The magnetic moment of 1.1 mm new wire is about 60% stronger than that of the old 1.1 mm wire (Northwest Marine Technology, pers. comm.)

This study had two objectives: first, to test whether using 1.5 mm CWT affects adult hatchery rack returns compared to 1.1 mm wire, and second, to test whether 1.5 mm CWT can be detected with greater accuracy than 1.1 mm CWT using a wand detector. Hatchery rack returns represent only part of the overall survival to adult. However, if the longer and larger magnetic moment tags reduced survival or increased straying, the effects would be measurable at the hatchery rack.

Methods

This study was done at Hupp Springs, Soos Creek and Kendall Creek hatcheries, all owned and operated by the Washington Department of Fish and Wildlife (WDFW). Hupp Springs and Soos Creek hatcheries are in South Puget Sound, Kendall Creek Hatchery is on the Nooksack River in North Puget Sound. At each hatchery, equal numbers of 1994 brood year chinook were simultaneously tagged with either old 1.1 mm or new 1.5 mm coded wire tags and marked with an adipose fin clip (Table 1). Standard WDFW procedures were used for tagging (Schurman and Thompson, 1990). The tagged fish were mixed into the same rearing vessel and reared until release as either yearlings or subyearlings. At 21 days after tagging, quality control checks were performed on about 1500 chinook from each study group to determine CWT loss and poor adipose fin clip rates. Release numbers were adjusted accordingly.

Table 1: Tagging and release parameters, 1994 brood year chinook.

Hatchery	Race	Tag Code	# Tagged Fish Released	Tag Type	Release Stage	Mean FPP Tagged	Mean Length Tagged (mm)	% Tag Retention
Hupp Springs	Spring	635828	127,094	1.1 mm, Old Wire	Subyearling	160	65	98.2
Hupp Springs	Spring	635833	127,786	1.5 mm, New Wire	Subyearling	160	65	98.8
Hupp Springs	Spring	635827	43,662	1.1 mm, Old Wire	Yearling	190	61	97.7
Hupp Springs	Spring	635832	44,094	1.5 mm, New Wire	Yearling	190	61	98.9
Soos Creek	Fall	635826	149,740	1.1 mm, Old Wire	Subyearling	92-248 (range)	77-56 (range)	98.5
Soos Creek	Fall	635831	150,986	1.5 mm, New Wire	Subyearling	92-248 (range)	77-56 (range)	99.1
Kendall Creek	Spring	635829	90,412	1.1 mm, Old Wire	Subyearling	180	62	98.8
Kendall Creek	Spring	635834	85,370	1.5 mm, New Wire	Subyearling	180	62	98.8
Kendall Creek	Spring	635830	82,544	1.1 mm, Old Wire	Yearling	140	67	99.8
Kendall Creek	Spring	635835	80,691	1.5 mm, New Wire	Yearling	140	67	99.4

At the three hatcheries in the fall 1998, returning adults were examined for CWT using a hand-held wand detector. If no CWT was detected, the fish was passed through an R9500 rectangular tunnel detector. In this way, the fish were sorted into three groups: CWT detected using only the wand, CWT not detected using the wand, but detected with the rectangular detector, and no CWT detected. All fish with CWT were measured, the sex noted, and the snout removed for CWT recovery. At Kendall Creek Hatchery, coded-wire tags from the first group of fish spawned was recovered by visual identification of fish missing their adipose fin because the electronic detection equipment was unavailable.

These 261 heads are included in calculations of the percent return. At Hupp Springs, one extra tag was recovered by visual identification of a fish missing its adipose fin.

Results

Tag Retention

There was no significant difference in tag retention between the old 1.1 mm wire and the new 1.5 mm wire at release ($t=0.31$, $p<0.05$). These retention rates help confirm the statement "WDFW and CDFO tagging supervisors believe that length-and-a-half CWTs can be easily placed in 60 mm (2.2 g) salmon" (SFEC 1995).

Tag Detection

On average, the wand detected 454/500 (90.8%) of the old 1.1 mm wire tags, and 500/503 (99.4%) of the new 1.5 mm wire tags it was exposed to (Table 2).

Table 2: Tag detections and adult returns. Because only the 1998 rack recoveries are currently available, the estimates of adult returns are preliminary. Superscript letters indicate where a chi-square analysis indicated a significant difference in hatchery rack returns at the 0.05 level between the fish tagged with 1.1 mm and 1.5 mm wire within each release type. NSD = no significant difference in hatchery rack returns.

Tag Code	Tag Type	Release Stage	# Detected with Wand	# Missed with Wand	% Detected	% Return
Hupp Springs, Spring Chinook						
635828	1.1 mm, Old Wire	Subyearling	37	0	100	0.03[NSD]
635833	1.5 mm, New Wire	Subyearling	42	0	100	0.03[NSD]
635827	1.1 mm, Old Wire	Yearling	6	0	100	0.01[a]
635832	1.5 mm, New Wire	Yearling	18	0	100	0.04[a]
Soos Creek, Fall Chinook						
635826	1.1 mm, Old Wire	Subyearling	77	19	80.2	0.06[NSD]
635831	1.5 mm, New Wire	Subyearling	102	1	99.0	0.07[NSD]
Kendall Creek, Spring Chinook						
635829	1.1 mm, Old Wire	Subyearling	327	27	92.4	0.54[NSD]
635834	1.5 mm, New Wire	Subyearling	334	2	99.4	0.53[NSD]
635830	1.1 mm, Old Wire	Yearling	7	0	100	0.02[b]
635835	1.5 mm, New Wire	Yearling	4	0	100	0.01[b]

The mean size of fish with undetected tags was significantly larger than the mean size of fish with tags the wand could detect ($t=9.24$, $p<0.001$). However, the sizes of fish with undetected tags fell within the range of sizes with detected tags (Figure 1). That is, there was no cut off after which a tag could no longer be detected, but as a fish grew larger, the probability of detecting its tag declined. Because males tend to be larger, the probability of missing a tag was significantly higher in males than in females ($\chi^2=28.246$, $p<0.001$).

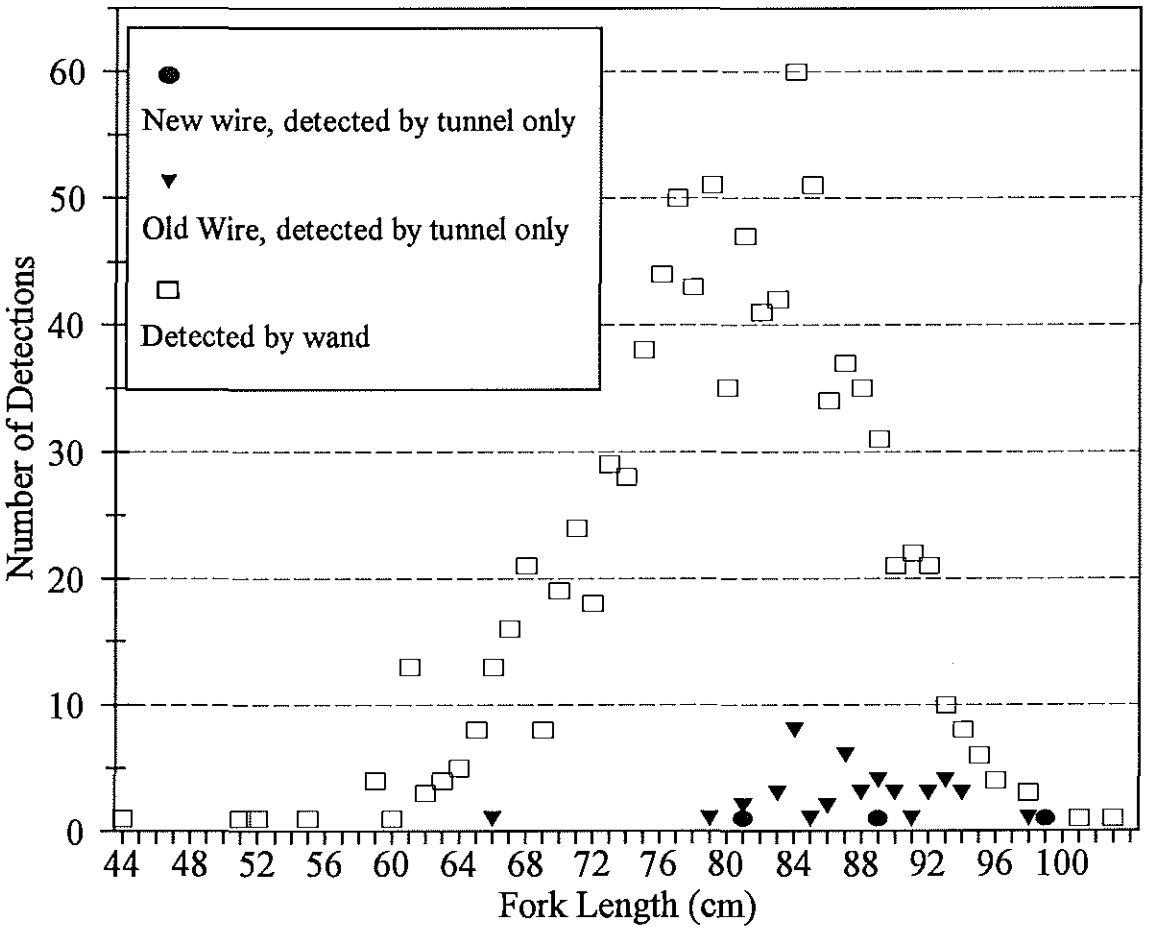

Figure 1: Fork lengths of fish detected by the wand or missed by the wand and detected by the rectangular tunnel detector. The mean size of the fish with missed tags was significantly larger than the mean size of fish with detected tags ($p=9.24$, $p<0.05$).

Hatchery Rack Returns

Hatchery rack returns were estimated by dividing the number of tags recovered at the hatchery racks in 1998 by the number of tags released. Because only one year of rack recovery data is available, these are preliminary estimates. For all hatcheries combined, preliminary tag recoveries (Table 2) show no significant difference in hatchery rack returns between fish tagged with old 1.1 mm wire compared to fish tagged with new 1.5 mm wire. Separately, significantly more Hupp Springs spring chinook released at age 1+ and tagged with new 1.5 mm wire returned than those tagged with old 1.1 mm wire. Conversely, significantly more Kendall Creek spring chinook released at age 1+ and tagged with old 1.1 mm wire returned than those tagged with new 1.5 mm wire. The yearling groups from Hupp Springs and Kendall Creek both had low return rates.

Discussion

The wand detected 91% of old 1.1 mm wire tags it was exposed to, and 99% of the new 1.5 mm wire tags. Thus, the stronger magnetic moment of the new wire improved detectability by about 8%. This improved tag detectability will result in a substantial number of tag recoveries when the total number of fish checked in a year is considered. The preliminary hatchery rack recoveries show that this improved detectability did not compromise chinook adult returns to the hatchery.

Because the wand was able to detect a CWT in the largest fish, it is likely that the techniques of the person using the wand plays a significant role in detection success, and that the correct technique is especially important for larger fish. When a wand is to be used for CWT recovery, the possibility of missed tags disproportionately representing fish larger than 80 cm needs to be considered. This bias will be greatly minimized by using the new, 1.5 mm wire and by careful use of the wand. An alternative approach to 1.5 mm wire would be to use the portable sampling detector for fish greater than 80 cm fork length.

References

Habicht, C., S. Sharr, D. Evans, and J.E. Seeb. 1998. Coded-wire tag placement affects homing ability of pink salmon. Trans. Amer. Fish. Soc. 127:652-657.

Morrison, J.K., C.L. Coyle and S.E. Bertoni. 1990. Histological effect of tagging chum and coho salmon fry with coded-wire tags. Prog. Fish. Cult. 52:117-119.

Morrison, J., and D. Zajac. 1987. Histological effect of coded-wire tagging in chum salmon. N. Am. J. Fish. Manage. 7:439-441.

PSMFC (Pacific States Marine Fisheries Commission). 1992. Mass marking anadromous salmonids: Techniques, options, and compatibility with the coded-wire tag system. PSMFC. Gladstone, Oregon.

Schurman, G. and D. Thompson. 1990. Washington Department of Fisheries' mobile tagging units: Construction and operation. American Fisheries Society Symposium 7:127-133.

SFEC. 1995. Pacific Salmon Commission selective fishery evaluation. Pacific Salmon Commission, Vancouver, B.C., Canada.

Appendix 4. Testing of Electronic Tag Detection Equipment By Fisheries & Oceans Canada in 1998

Wands:

Concerns were raised by field technicians about the sensitivity of the wands and inconsistency in performance. All wands are currently being re-tested and some may be returned to Northwest Marine Technology for sensitivity adjustment.

The ability of the wands to identify tags in large sized chinook heads was tested in the 1998 northern troll fishery. Heads from 354 adipose fin clipped chinook tested were collected and sent to the dissection lab for verification. The results are as follows:

Tag Status	Number	Wand Result	
No-Pins (31)	25	Correctly Identified	
	6	Incorrectly Identified	1 contained hook tip
Full Length CWT (311)	298	Correctly Identified	16 retrieved from the eye
	13	Not Identified	3 retrieved from the eye 10 from large heads
Half Length CWT (12)	7	Correctly Identified	5 retrieved from the eye, 4 of which were smaller heads
	5	Not Identified	4 retrieved from the eye 3 from large heads
Total	**354**		

The wand testing resulted in 96% of the full length, correctly-placed coded-wire tags being correctly identified. The relatively large number of missed tags originating from the eye area suggests that samplers may not have been consistently sweeping this area of the head. Training should alleviate this problem and increase the tag recovery rate. Problems will be expected recovering ½ length tags and recovering tags from chinook exceeding 925 mm nose to fork length or 200 mm head length.

Additional wand experimentation is currently ongoing in a deadpitch environment for coho. Results of this evaluation of wand use on decaying and gravel impregnated heads will be available in February 1999.

R9500 Tubes:

Testing of the newly developed R9500 equipment is being carried out at various enhancement facilities on Vancouver Island and in the lower Fraser Valley. The primary focus of field testing this year concerns the reliability of the diverter gate and counter developed by Northwest Marine Technology. Both of these pieces of equipment underwent major redevelopment and design work. Limited testing to date indicates that the R9500 tube detectors and diverter gates are performing as expected. The counter system however is less reliable and requires further testing and possibly replacement by NMT.

The R9500 equipment has a vent installed to accommodate pressure changes due to weather or altitude changes (especially during air transport). An attached desiccant cartridge prevents moisture from getting inside the machine and damaging the electronics. The manual states that "The desiccant dryer cartridge must be replaced routinely. Depending on the conditions of use, this may be as often as once a week or even more often". There are concerns about the associated costs for the cartridges ($6 US each), given that sampling conditions are always wet, and the fact that an unused machine in a hatchery dry lab required a cartridge change.

Installation of Equipment

Commercial:
There were no commercial fisheries directed at coho during the 1998 fishing season. Sampling the incidental coho catch was performed using hand held wand detectors. Design work on R9500 support systems at fish processing plants that could potentially receive mass marked coho is currently under way. However, construction and installation of support equipment to sample the commercial catch of coho is very much dependent on future fishing plans. Incidental catch in net fisheries will be sampled using stand-alone detectors or hand held wands.

Recreational:
The original sampling plan for 1998 was to electronically sample recreational catches during an expanded creel survey program. However, there was non-retention of coho in all areas of the B.C. coast, except in selected terminal areas on hatchery stocks. As a result, there was limited opportunity to test the use of the wands during creel surveys. Sampling in-river fisheries is continuing and results are not yet available.

Escapement:
In 1998, electronic detection was restricted to jack returns, mass marked with an adipose clip. Adult coded-wire tagged fish were visually identifiable by the adipose clip. Samplers used a variety of wands, R9500 tubes and v-detectors.

Four hatcheries on Vancouver Island received R9500 detectors to facilitate the development of support systems that will allow for the recovery of coded-wire tags from mass marked coho. Three facilities in the lower mainland are also undergoing design

studies to develop support systems for R9500 detectors. Two facilities that receive much smaller returns will rely on hand held wand detectors. Wand detectors will also be used during dead pitch sampling and at fences on both hatchery and wild indicator streams.

Appendix 5: Implementation Plan for Coho Mass Marking and Selective Fisheries.

IMPLEMENTATION PLAN:
Coho Mass Marking and Selective Fisheries
April 15, 1997

I. General provisions.

A. Purpose and intent. The purpose of this plan is to establish requirements for implementing programs for the mass marking by removal of the adipose fin of hatchery coho, originating from Grays Harbor and northward, including Puget Sound, and for implementing fisheries that would selectively harvest marked fish in a manner that would affect management of fisheries resources subject to the authority and obligations of treaty tribes party to this plan.[1] The mass marking of coho salmon intended for release from tribal facilities may only proceed upon agreement between the pertinent state, tribal and/or federal parties involved. It is the intent of the parties to this plan to insure that mass marking and any selective fisheries for coho are implemented in a manner that facilitates conservation of the coho resource, benefits both treaty and non-treaty fisheries, and maintains a viable coastwide coded-wire tag (CWT) program. The parties intend to achieve the expected benefits of this new management strategy in a manner that is consistent with maintaining their ability to properly manage the coho resource and with meeting other legal obligations of the parties. This plan replaces a mass marking and selective fisheries Memorandum of Understanding, signed by some of the parties to this plan, dated May 3, 1996.

B. Parties. The parties to this plan are the Washington Department of Fish and Wildlife (WDFW), the Puget Sound and Washington coastal treaty Indian tribes who signed the April 1997 stipulation to which this plan is appended (tribes), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS).

C. Plan amendments. The parties commit to modifying this plan as necessary, by agreement, in response to information gained from ongoing evaluations.

D. Plan duration. This plan will be reviewed by the parties no later than November, 2002. As part of this review, the parties will reach agreement on whether it should be continued, modified, or terminated.

[1] Throughout this plan, the term "selective fisheries" means fisheries in which captured fish with a mass mark are differentially retained over unmarked fish, and the term "mass marking" means removal of the adipose fin; any other mass mark would require further discussion among the parties and possible modifications to this plan.

E. Dispute Resolution. The parties commit to good faith technical- and policy-level efforts, as described in the "Stipulation and Order Concerning Co-management and Mass Marking" dated _____, 1997, to attempt to resolve in a timely manner any disputes that may arise in connection with this plan, prior to initiating legal actions arising from such disputes. The parties may also explore and employ other jointly agreed dispute resolution approaches.

F. NMFS and USFWS Participation. NMFS and USFWS will participate in good faith in the processes described in Section III paragraphs A through E, however, the processes described are primarily state and tribal processes. NMFS fishery management authority in the EEZ stems from the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et seq. and other federal laws, and NMFS and USFWS are not parties to this agreement for the purpose of these paragraphs. Implementation and ongoing adherence to this plan by NMFS and USFWS shall be subject to the availability of appropriate funds.

II. Mass Marking

A. Mass marking plans must be finalized annually by April 1 for coho which, due to fish culture considerations, must be tagged and/or marked in the spring, and by October 1 for those that can be tagged and/or marked in the autumn. Each party will provide its plans for mass marking to the other parties by February 1 of each year, identifying which production will be mass marked, which stocks will be "double index" coded-wire tagged, and the schedule for marking and tagging. Because sufficient time must be allowed to accommodate resolution of any disagreements, the parties will schedule their efforts so as to reach agreement by March 1 and September 1 of each year for spring and autumn groups, respectively. If agreements have not been reached by those dates, the parties will initiate appropriate dispute resolution to be completed by April 1 and October 1, respectively. Any mass marking being disputed in accordance with these timelines will not occur until the dispute is resolved. Any proposed modifications of previously-agreed or established plans that affect which stocks would be mass marked or double index tagged, or the agreed proportions that would be mass marked, must be provided to the parties at least 30 days prior to the affected marking or tagging, and agreement reached (or disputes promptly resolved) to accommodate the proposed change.

B. Those 1996 brood year hatchery coho groups listed in the attached Table 1 will be mass marked during the spring and summer of 1997.

C. The Pacific Salmon Treaty (PST) commits the United States and Canada to "maintain a coded-wire tagging and recapture program designed to provide statistically reliable data for stock assessments and fishery evaluations." Appropriate coordination with Canada is a critical element of maintaining the viability of the coastwide CWT program (a definition of a viable CWT program is provided in Paragraph 10.4 on pages 180-181 of the PSC's June, 1995 Ad-Hoc

Selective Fisheries Evaluation Committee (AHSFEC) report; this definition is subject to further refinement among the parties per Paragraph III.E.5, below). In January 1997, the Pacific Salmon Commission (PSC) agreed to establish procedures for exchanging, evaluating, and coordinating mass marking and selective fisheries proposals. It also agreed to establish a permanent bilateral Selective Fisheries Evaluation Committee (SFEC) to provide appropriate scientific advice to the PSC and the parties. The PSC has developed and adopted a specific workplan to identify and address technical feasibility issues to facilitate informed policy judgement on mass marking and selective fisheries. Accordingly, pursuant to their own needs and consistent with the PSC's January 1997 agreement and its SFEC's workplan, the parties to this plan will:

(1) cooperate and coordinate their efforts with the longer term process and schedule to be developed by the PSC;

(2) complete the following short-term technical tasks prior to the PSC's February, 1997 meeting:

  (a) review and finalize technical reports of 1996 field studies regarding efficacy of electronic detection technologies;

  (b) develop plans for evaluating 1995 and 1996 brood coho programs;

  (c) initially define fishery sampling program logistics and costs; and,

  (d) define plans for conducting additional field studies for 1997;

(3) develop, implement, and maintain agreed CWT sampling plans that provide for adequate sampling rates and, where necessary for CWT retrieval, electronic detection methods, to meet the intent of the commitment under the PST to maintain the viability of the coastwide CWT program, including providing for statistically reliable data for stock assessments and fishery evaluation.

D. WDFW will be responsible for reasonable increased costs incurred by the tribes required by this mass marking and selective fisheries plan. These envisioned costs specifically include providing for equipment use and maintenance, costs of marking and tagging operations, and increases in staff for CWT sampling, if any are required. This responsibility will be met by providing funds to the tribes directly, by securing new, outside funding sources, and/or by providing equipment and direct technical assistance. NMFS and USFWS will explore opportunities they may have to assist the parties in meeting these obligations as well as other activities of this implementation plan. WDFW's obligations for costs incurred by a tribe (or tribes) will be reduced in the event the tribe(s) chooses to benefit from the mass marking program by conducting selective fisheries; the extent of the reduction in WDFW's obligations will be determined by the parties, taking into account the full range of benefits accruing to the affected parties due to selective fisheries.

E. When conducting mass marking, the parties will use hatchery culture, handling, and marking/tagging practices that will minimize mortalities caused by these activities.

III. Selective Fisheries

A. The parties understand that selective fishery options will be evaluated on their individual merits in the context of the elements of this plan; they are not assured simply because mass marking has occurred. Selective fisheries will be implemented, if appropriate, according to the terms described below.

B. Selective coho fisheries, will be implemented only as part of agreed annual fishery management plans that address a broad range of coho fisheries. These annual plans, which include defining levels of impact on coho stocks of concern by all fisheries, will continue to be negotiated and agreed to through the so-called "North of Falcon" process unless otherwise agreed by the parties. These plans will not require use of selective fisheries by any tribe, unless otherwise agreed, in order to meet spawning escapement objectives, treaty/non-treaty allocation standards, and inter-tribal and other harvest sharing objectives of the parties. Selective fisheries will be implemented in a manner that meets treaty Indian fishing rights.

C. Proposals for selective fisheries will provide sufficient information to meet the needs described in Appendix C of the "Pacific Salmon Commission Selective Fishery Evaluation" report (June 9, 1995).

D. Unintended effects on individual treaty fisheries, including dislocation and/or disruption, could occur due to unforeseen circumstances of the mass marking and selective fisheries program. The parties will address such potential fishery effects and resolve any conflicts in the course of modeling, evaluation and planning efforts described herein.. It is the intent of this section that established treaty/non-treaty sharing principles will be adhered to.

E. WDFW and the Puget Sound tribes other than Makah will develop agreed, comprehensive coho management plans under the frameworks of existing court ordered salmon management and allocation plans, including without limitation the intertribal allocation agreements approved by the court in Subproceeding 86-5, or subsequent stipulations or orders of the court following the expiration of the current agreements. These plans would be partially implemented for Puget Sound stocks with the planning of 1998 fisheries. Full implementation of all elements would occur with the planning of the 1999 season. To meet this requirement, the parties will complete the tasks as described and scheduled in Attachment 1. Development of long-term coho management plans for coastal coho stocks may proceed separately. The parties will encourage involvement by other interested managers to insure that coastwide coordination needs are met. Agreed coho management plans developed under this provision shall be binding only to the parties hereto absent further orders of the court. Comprehensive coho management plans will include:

1. rules for implementing annual fishing schedules, given expected abundance of wild stocks;

2. definition of spawning escapement levels that would be achieved, on the average, and levels that would avoid unacceptable risks to stock health;

3. fishing regimes (levels of exploitation) for treaty and non-treaty fisheries that are expected to achieve conservation and treaty sharing obligations, and meet inter-tribal and other harvest sharing objectives of the parties;

4. procedures for evaluating performance of annually implemented fishing regimes toward meeting stated goals and objectives, and for modifying the plan accordingly, as may be appropriate;

5. an assessment and refinement of the definition of a viable CWT program (e.g., selection of indicator stocks, tagging levels, sampling rates, sampling methods) that provides for effective implementation, evaluation and assessment of this plan's objectives; and,

6. a habitat component that assesses habitat relative to performance standards and quantitatively estimates the relationship between habitat condition and production.

F. Preseason fishery planning and post-season stock assessments are highly dependent upon the use of management planning tools (models). Recognizing that selective fisheries introduce requirements beyond the capability of existing models, and desiring to minimize any impacts on existing analytical capabilities, the parties are committed to and will cooperatively develop, prior to the 1998 season, modified or new models with the capability of planning and assessing impacts of fishery regimes that include selective fisheries. It is recognized that there will be a one or two year transition period, during which modified versions of currently-available models (modified to accommodate evaluation of selective fisheries) will be replaced with new, improved models with updated capabilities, i.e., that more comprehensively improve analytical capabilities. Consistent with the foregoing, and to meet short term needs, the parties will revise, for review by July 1, 1997, the existing Fishery Regulation Assessment Model (FRAM). In addition, the parties will cooperate in the development and review of improved models for use in the longer term.

G. The parties will participate cooperatively in the Selective Fisheries Evaluation Committee (SFEC) established by the Pacific Salmon Commission (PSC). Working as the bilateral SFEC whenever possible, or independently as may be necessary to accomplish the parties' objectives in a timely manner (e.g.., if Canada chooses not to participate or is unable to participate sufficiently to meet the parties' time lines), the parties' will direct their representatives on the SFEC to:

1. evaluate all fishery and hatchery electronic sampling tests conducted during 1996, and provide a summary evaluation by February 15, 1997;

2. in 1997 initiate the development of CWT estimation methods for use under selective fisheries regimes;

3. evaluate any mass marking returns and selective fisheries conducted during 1997. Agency reports on these activities will be distributed to the SFEC by January 15, 1998. The SFEC will provide a summary evaluation of these activities by March 1, 1998;

4. Evaluate as necessary:

    a. proposed sample designs for testing sampling technology;
    b. new or improved methods for mass marking;
    c. adequacy of the CWT single and double index tagging program;
    d. implications of revisions in marking programs;
    e. sampling programs in selective fisheries, non-selective fisheries, and escapement;
    f. the performance of stock assessment models;
    g. the success of mass marking and selective fisheries in meeting identified objectives.

H. Any party that authorizes a selective fishery will, itself, or in cooperation with other parties, implement appropriate programs to monitor and evaluate its stock specific impacts. Selective fisheries will be monitored to obtain valid estimates of retained catch and encounter rates, and estimates of the proportion of marked fish caught in all fisheries will be made by February 1 of the following year.

I. Any party that authorizes a selective fishery will, itself, or in cooperation with other parties, develop appropriate education and enforcement programs to insure compliance with its selective fishery regulations.

J. WDFW will not diminish its priority for habitat protection as a consequence of non-treaty fisheries focusing on hatchery produced fish.

K. Estimates of non-landed fishery mortality caused by any fishery, including selective fisheries, will be accounted for in meeting conservation and allocation objectives.

Appendix 6. WDFW Sampling Plan for 1999 Puget Sound Selective Sport Fisheries.

Introduction

In order to minimize sport angler impact on weak wild coho salmon stocks, selective fisheries, where adipose marked coho are harvested while coho with the adipose fin intact are required to be released, are being proposed for various areas in Puget Sound. If such fisheries are approved, it is desirable to monitor fisheries in-season to determine how many salmon are being encountered, what percentage of coho encountered are marked, how many chinook are encountered relative to coho, and unmark retention error.

Conducting monitoring of this type will require new methods and additional resources. The existing sampling program, operating mostly at recreational boat launches, is not designed to measure all of these parameters.

Study Design

Objectives

1. Estimate the marked to unmarked proportion encountered in the fishery.
2. Estimate the number of coho released relative to the number of coho retained.
3. Estimate unmarked retention error.
4. Estimate the number of chinook encountered relative to the number of coho.

Sampling Strategies

A number of strategies will be employed to meet the sampling objectives. More than one strategy may be used by area to collect the necessary information. Not each strategy is equally suitable to reach all stated sampling objective. Fishing effort and success, the presence of charters, the cooperation of volunteers, etc., will determine which approach should be used to collect the necessary parameters. In areas with low coho catch, none of the strategies may provide enough information to get a good estimate of marked to unmarked ratios. In these areas, rather than spending resources on on-the water-monitoring, we will use sampling resources to get the best possible dock-side sample of baseline information, CWTs and unmarked recognition error (see details below).

1. **Dock-Side Interviews**: Several of the parameters mentioned above have been estimated for years using dock-side angler interviews, such as the number of coho released relative to the number of coho retained and the number of chinook encountered relative to the number of coho. Unmarked retention error can be estimated with this method, by recording the number of unmarked and landed coho observed dock-side during a selective fishery.

2. **Volunteer Trip Reports**: Anglers will be approached by WDFW with the request to fill out trip reports while fishing in selective fisheries. Volunteers will record the number of fish hooked up by species, the number of fish that drops off, the number of marked and unmarked coho, as well as legal and sub-legal chinook. Volunteer trip reports can be compared to dock-side sampling to evaluate how representative they are for an area.
3. **Charter-Boat Ride Alongs**: WDFW observers will record the outcome of each hook-up on a charter boat during a selective fishery. The following data will be collected: Date, area, species hooked, result of hook-up (fish landed, released, dropped-off), mark status, size (legal versus sub-legal), fish alive or dead at release. Any seabirds hooked or marine mammals encountered will also be documented. Sampling is conditional on a sufficient number of anglers fishing on charters. .
4. **On-The-Water Monitoring**: As a double check on dock-side sampling and voluntary trip reports an on-the-water monitoring program will be implemented when feasible by observing the outcome of individual angler encounters (anglers with a hooked up fish).
5. **Non-selective recreational fisheries:** Marked to unmarked ratios from non-selective fisheries could be compared to adjacent selective fisheries, when appropriate.

Sample Size

Since we do not have any prior record of the number of voluntary trip reports that can be obtained in an area, our goal will be to contact as many anglers as possible for the first year of selective fisheries. Our goal is to define a stratum as one week period for each fishery, but in some cases where samples are hard to obtain, strata may be combined to get the necessary sample size. It is apparent from prior years in-sample data and catch record card estimates that a goal of 100 samples per week will likely not be achieved in Areas 7, 8.1, 12 and 13, even when lumping several weeks. In these areas we will concentrate our resources on dock-side sampling.

For the on-the-water observation the sampling goal is set at a minimum of 100 salmon encounters per stratum (management regime). This sample size will provide a 95% confidence level at +/- 5-10% for the estimate of percent of salmon released.

Assumptions

The major assumptions necessary were:

1. The on-the-water sample of observed salmon encounters is representative of the fleet.
2. On-the-water samplers do not make records if the actual outcome of a hook-up is not observed. If an observer watches a freshly caught coho being handled but has not been present during the time when the decision was made to land the fish and

records the observation as a coho retention, the sample could be biased towards kept coho.

3. The presence of on-the-water observers did not change angler behavior.
4. On-the-water observers were able to correctly categorize each observed hook-up.
5. Volunteers filling out trip reports fish in a manner representative of the fishing fleet.
6. Volunteers can correctly identify salmon and mark status.

Estimating Marked to Unmarked Proportion of Coho

The marked to unmarked coho ratio, is the most important new information that will be collected for selective fisheries. An independent estimate of marked to unmarked ratios, can be applied to information of the numbers of coho released, collected during dock-side interviews, to compute estimates of marked to unmarked ratios of released coho.

Marked Coho Released = (Number of Coho Encounters * Proportion Marked) – Marked Coho Landed

Unmarked Coho Released = (Number of Coho Encounters * Proportion Unmarked) – Unmarked Coho Landed

All four strategies from above can be used to get an estimate of marked to unmarked ratios.

Strategy one, dock-side interviews, is not recommended at this time, because anglers may not recall the number of released marked and unmarked coho after the completion of a trip. Difficulties discerning species and mark status from a remote platform (observer boat), pose a problem to on-the-water monitoring. In many instances observers will have to rely on angler information. Volunteer observers will be our primary source of information in areas with low, spread-out angler effort and success. WDFW samplers working at standard sampling sites will ask anglers if they would volunteer to make records of their next fishing trip (and subsequent trips thereafter). Volunteers will record an entry for every fish hooked up. Volunteer trip reports will be compared to dock-side interviews and data from charter ride-alongs, test fisheries and on-the-water monitoring to evaluate how representative they are for an area. Another source of information about marked to unmarked coho ratios can come from non-selective fisheries in the vicinity of a selective fishery, e.g. southern area 11 ratios could be applied to area 13. Ratios from purse seine fisheries, if representative of the ratios in the sport fishery, can also be a source of data.

Table1

Area	Strategy	Comment
5	Trip Reports On-The-Water Monitoring Charter Ride-Alongs	
6	Trip Reports Possibly Charter Ride-Alongs	
7	Trip Reports	Low boat concentration. Sampling goal can likely not be achieved. Puget Sound Sampling will focus on dock-side interviews. A sampler will be stationed on the San Juan Islands.
8.1	Trip Reports	Low boat concentration. Sampling goal can likely not be achieved. Puget Sound Sampling will focus on dock-side interviews
8.2	Trip Reports Possibly Charter Ride-Alongs	
9	Trip Reports Possibly Charter Ride-Alongs	
10	Trip Reports Possibly Charter Ride-Alongs	
11	Trip Reports	
12	Trip Reports	Low boat concentration. Sampling goal can likely not be achieved. Puget Sound Sampling will focus on dock-side interviews
13	Trip Reports Ratios from non-selective fishery in Area 11.	Low boat concentration. Sampling goal can likely not be achieved. PSS will focus on dock-side interviews.

Estimate the Number of Coho Released

Information about the number of coho released has been collected for several years during dock-side interviews. This information is also collected during sampling methods 2-4. To determine which method will be used for an area see table one.

Estimate Unmarked Retention Error

Unmarked retention error occurs when anglers land unmarked coho during a selective fishery. A special effort will be made to get a good dock-side estimate of unmarked retention error to validate model inputs for the first year of selective fisheries in Puget Sound. Additional samplers will be available to boost dock-side sampling rates. Sampling goal will be 200 landed coho per area and month. Samples can be combined over time periods to achieve this goal.
Unmarked coho concealed by anglers that are aware of non-compliance will not be detected with dock-side sampling.

Estimate the Number of Chinook Encountered

Information about the number of chinook encountered has been collected for several years during dock-side interviews. This information is also collected during sampling methods 2-4. To determine which method will be used for an area see table one.

Appendix 7. WDFW Sampling Plan for 1999 Ocean Selective Sport Fisheries.

Introduction

In response to mass marking and possible selective fisheries, the OSP added an on-water observer program in 1996. A number of observation techniques have been employed, including (1) ride-alongs on charter boats, (2) observing private boat fisheries from a remote platform, and (3) collecting angler-completed trip reports. In 1999, should selective fisheries occur in the ocean, the OSP plans to implement an on-water observer program in the major coastal ports to collect information on mark ratios, drop-off rates, and species ratios from the sport fisheries, and a trip reporting program to collect these data from the non-treaty troll fisheries.

Goals

Goals of on-water monitoring and the trip reporting system:

1. To estimate the total encounter rate (marked plus unmarked) of coho in the selective fisheries.
2. To estimate the ratio of marked to unmarked coho encountered in selective fisheries.
3. To estimate the drop-off rate in selective fisheries.
4. To estimate the ratio of chinook to coho encountered.

Selective fishery specific goals of dockside sampling:

1. To estimate the unmarked coho retention rate in the selective fisheries.
2. To estimate released to kept coho ratios which can be compared to on-water data to generate an estimate of recall error.

Sampling Units and Sample Sizes

The standard unit of sample is one coho encounter to the boat for on-water monitoring, and one boat trip for dockside sampling and trip reporting.

A total of 100 samples are planned per stratum for on-water monitoring, with the goal being to define a stratum as a period of one statistical week per catch record card area. If samples are hard to obtain, however, the stratum definition may be adjusted to periods of two statistical weeks. This level of sampling should provide estimates within +/- 10% with a 95% confidence interval.

This is the first year that trip reports will be widely used, and sample sizes are difficult to set without prior sampling, so we intend for this season to collect as many trip reports as

possible. The goal is to analyze data using a maximum stratum definition of one statistical month per catch area.

Assumptions

1. The on-water sample of observed salmon encounters is representative of the fleet.
2. On-water samplers do not record the outcome of a hookup if it is not observed. (Ie. An observer watching a freshly caught coho being handled but who was not present when the decision was made to land the fish could bias the sample towards kept coho if the observation is recorded.)
3. The presence of on-water observers does not change angler behavior.
4. On-water observers are able to correctly categorize each observed hookup.
5. Volunteers completing trip reports fish in a manner representative of the fishing fleet.
6. Volunteers are able to correctly identify salmon and mark status.

Methods

A number of strategies will be employed to meet the selective fishery monitoring goals:

1. **Dockside interviews:** Dockside interviews will be used in all major coastal ports (Neah Bay, La Push, Westport, and Ilwaco) in both sport and troll fisheries to estimate the unmarked coho retention rate and released to kept coho ratios.
2. **Volunteer trip reports:** Anglers will be approached by WDFW staff and requested to complete a trip report while fishing in selective fisheries. Volunteers will record the date, area fished, number of anglers aboard the vessel, species hooked, result of hookup (fish kept, released, or dropped off), mark status, and size (legal vs. sublegal). These trip reports will be used in Neah Bay, La Push, Westport, and Ilwaco in both sport and troll fisheries, and will be compared with on-water observation and dockside data post-season.
3. **Charter boat ride-alongs:** WDFW observers will ride along aboard charter boats, collecting the following data for each encounter on the boat: date, area fished, species hooked, result of hookup (fish kept, released, or dropped off), mark status, size (legal vs. sublegal), and whether the fish was alive or dead if released. Any seabirds hooked or marine mammals encountered will also be documented. This method will be employed in Ilwaco and Westport, and possibly Neah Bay during the sport fisheries.
4. **Remote platform on-water monitoring:** From a contracted WDFW vessel, the observer will collect data by observing hookups in the private boat sport fishery. The data collected is the same as above. There are difficulties determining species and mark status from a remote platform, and observers may have to rely on angler information for these data. This method will be used in Neah Bay.
5. **Non-selective fisheries:** Marked to unmarked ratios from non-selective fisheries could be applied to adjacent selective fisheries, when appropriate.

Appendix 8. 1999 Monitoring Program for Selective Ocean Coho Salmon Fisheries off the Central Oregon Coast from Cape Falcon to Humbug Mountain

INTRODUCTION

Coho salmon have traditionally been the dominant species in Oregon coastal salmon fisheries and the primary target species of the recreational fisheries. Coastal recreational fisheries originated in the bays at the mouths of numerous coastal rivers that supported healthy wild runs of coho, chinook and steelhead. With the advent of better and safer boats and harbor facilities in the late 1940's and early 1950's, recreational fishers increasingly ventured out of bays into nearshore ocean waters. During the 1960's hatchery production at numerous locations along the Oregon coast and along the Columbia River and its tributaries was expanding. By the late 1960's more than half of the combined coho production from the Oregon coast and the Columbia River, known as the Oregon Production Index (OPI), originated from hatcheries.

Effort and harvest on OPI coho in ocean recreational fisheries on the Oregon coast peaked in 1976 when more than 530,000 angler days were recorded and more than 500,000 coho salmon were harvested. However, by the late 1970's production from both wild and hatchery coho populations entered a period of decline. Although effort and harvest remained fairly high in the fisheries through the 1980's, a combination of overharvest, degradation of freshwater habitat, and declines in ocean survival conditions culminated in a collapse of wild coho populations in the early 1990's. In 1994 all ocean recreational fisheries off the Oregon Coast were closed to the retention of coho. Coho retention has been permitted in the ocean recreational fishery off the mouth of the Columbia River since 1995 but since 1998 retention of coho in that fishery has been limited to finclipped hatchery fish only. In August of 1998, OCN coho in the Oregon Coast Evolutionarily Significant Unit (ESU) north of Cape Blanco were listed as threatened under the Federal Endangered Species Act. Wild and hatchery coho populations in Washington have experienced similar but less precipitous declines.

In response to the dramatic decline in natural coho populations, the State of Oregon initiated the Oregon Coastal Salmon Restoration Initiative, now known as the Oregon Plan for the Restoration of Salmonids and Watersheds (Oregon Plan). This aggressive conservation plan combines scientifically sound actions with grass roots public involvement and participation. The Plan relies heavily on the cooperative efforts of local, state, and federal agencies and the private sector for success. Salmon restoration in the plan focuses on three broad risk categories: 1) harvest management, 2) interactions between hatchery and wild populations, and 3) riparian and instream habitat.

The harvest management portion of the Oregon Plan is predicated upon using measures of parental spawning escapement and marine survival as criteria for constraining harvest rates. The Plan calls for marking 100% of hatchery coho production to facilitate the

distinction of wild fish from hatchery fish in juvenile and adult population monitoring activities and in any selective fisheries. Anticipating this need to distinguish hatchery from wild fish, the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW) instituted mass marking of hatchery coho beginning with the 1995 brood that returned as adults in 1998.

Selective fisheries were conceived as a means of providing the recreational and commercial fishers access to surplus hatchery production while minimizing fishery impacts on wild fish. The Pacific Fishery Management Council (PFMC) adopted an initial experimental selective recreational fishery for the Oregon coast off the mouth of the Columbia River in 1998 and again in 1999. In addition, the Council adopted an experimental selective fishery from Cape Falcon to Humbug Mountain in 1999. The fish and wildlife commissions of Oregon and Washington adopted regulations for selective harvest of finclipped coho in the Columbia River Buoy 10 estuary fishery in 1998 and again in 1999.

This operational plan is specific to the experimental selective ocean recreational fishery approved by the PFMC for the central Oregon Coast from Cape Falcon to Humbug Mountain in 1999. The fishery is scheduled to begin on July 10. The season will follow a cycle of 2 days open and 2 days closed. The selective fishery closes on either July 31 or when the quota of 15,000 landed finclipped coho is met, which ever comes first. Each angler may retain two salmon per day. All retained coho must have a healed adipose finclip and be a minimum of 16 inches long; retained chinook and steelhead must be at least 20 inches long. Each angler may use a maximum of 2 single point barbless hooks.

Although the central Oregon Coast selective fishery is expected to harvest 15,000 finclipped hatchery fish, it is anticipated that the combined effects of hook and release and drop-off will result in fewer than 500 mortalities among OCN coho that will be encountered by the fishery. Successful implementation of a quota based selective fishery on the central Oregon Coast to minimize impacts on OCN coho but permit the harvest of finclipped hatchery fish is predicated on the following assumptions: 1) precise, real time estimates of the total harvest by species and fishing period are available; 2) anglers are willing and able to recognize and release unmarked wild fish while retaining marked hatchery fish; 3) the proportions of unclipped fish and clipped fish in the total harvest is known; 3) wild fish are encountered less frequently than hatchery fish in the fishery; 4) encounter rates on OCN coho do not vary significantly by catch areas within the proposed Central Oregon Coast selective fishery; and 5) wild fish that are encountered and released have a known and relatively high survival rate.

The validity of the first four of these assumptions was tested during similar quota based fisheries on the first adult returns of mass marked coho in 1998. Results from analysis of data collected from dockside and onboard census and sampling programs during the 1998 selective fishery off the mouth of the Columbia River enabled the PFMC and state agencies to manage for a harvest quota. They also enabled agencies to test assumptions about clip rates and compliance rates that are used to model selective fishery opportunities in 1999. Historic coded wire tag data are available to test the assumption of

OCN spatial homogeneity. The only one of the five major assumptions listed above that remains untested is the one regarding hooking mortality rates among fish that are captured and released and fish that are caught but drop off the hook prior to being landed.

The PFMC has initiated a major review of available literature on the subject of hooking mortality. While results differ among many of the studies being reviewed, one common thread among several of the more recent ones is that hooking mortality rate is related to hook wound location and that hook wound location may be related to fishing method and gear. Hook wound location, fishing method, and fishing gear will be important variables that will likely be used to estimate fishery specific hooking mortality in the future.

In 1999, ODFW and WDFW will continue to coordinate data collection activities on selective ocean and estuary coho fisheries at the mouth of the Columbia River. Additionally, ODFW will implement a similar sampling strategy for the selective fishery scheduled for the Oregon coast. Both programs will provide precise, real time estimates of catch by fishing period and port; estimates of encounter, retention, and drop-off rates for clipped and unclipped fish; estimates of the rate of angler compliance with finclip regulations; gear and fishing method profiles by fishery; and profiles of hook wound location among retained fish in each fishery. This operational plan outlines dockside and at sea sampling methods for collecting these data in 1999. The plan also outlines analytical procedures to be used and timelines for completion of data collection, analyses, and reports.

GOALS AND OBJECTIVES

1. Estimate the catch for each two day fishery opening and port in the 1999 selective fishery on the Central Oregon Coast within $\pm$ 0.05 of the true value 95% of the time.
2. Estimate the proportions of marked and unmarked coho encountered in ocean selective fisheries for each statistical week and ocean catch area such that the estimates are within $\pm$0.05 of the true proportion at least 80% of the time.
3. Estimate the encounter, drop-off, and retention rates for coho salmon among charter vessels, for each statistical week and catch area such that the estimated rates are $\pm$0.05 of the true rates at least 80% of the time.
4. Report the rate of angler compliance with finclip retention regulations for the entire fishery within $\pm$0.05 of the true proportion at least 80% of the time.
5. Estimate non-landed hooking mortality for unclipped fish that are caught and released and for fish that are hooked but drop-off.
6. Evaluate the efficacy of using data from dockside sampling to estimate mark and encounter rates by comparing dockside results to those based on at-sea observations.
7. Estimate proportions of fishing method and gear type combinations used in the fishery within $\pm$ 0.05 of the true proportion 90% of the time.
8. Estimate the proportions of hook wounds that occur at defined locations on the bodies of landed coho within $\pm$0.05 of the true proportion 90% of the time.

In addition, data from the dockside-sampling program will be used in ODFW's ongoing census program to produce inseason catch and effort estimates for each open fishing period.

STUDY DESIGN

Data for this study will be collected by dockside samplers, samplers aboard charter fishing vessels, and by Oregon State Police (OSP) officers. Detailed descriptions of dockside sampling methods can be found in the 1999 Ocean Sampling Project Procedures Manual (ODFW 1999a).

Dockside Observer Program

Dockside observers will collect effort and catch information through observations of vessels as they exit the port enroute to fishing areas and through stratified, random interviews and catch inspections conducted on fishing boats as they return to the dock at the end of an angling day. (Schindler et al. 1998). Samplers will be stationed at all major ports on the Oregon coast. Figure 1 shows catch areas and major ports on the Oregon coast including ODFW plans for the distribution of samplers.

Dockside observers will sample the fishery for the following data for each boat type (charter or private), fishing period, port, and catch area; 1) the number of boats and the number of anglers per boat; 2) catch per boat by species, 3) the number of coho and chinook salmon retained and the number released per boat, 4) angling gear and methods. Landed salmon from each fishing period , port, and catch area will also be sampled for coded wire tags, length, and weight.

Onboard Observer Program

Charter vessel operators in each catch area will be solicited to voluntarily provide space onboard their boats for ODFW employees. A minimum of six charter vessels will be sampled during each open day of fishing; two from the Tillamook Bay area, two from the Newport/Depoe Bay area, and two from the Bandon/Charleston area. Samplers will be deployed on additional boats as available.

Onboard samplers will collect the following data for each fishing period and catch area: 1) number of anglers per boat, 2) the number of hooked salmon by species; 2) the number of salmon landed and retained by species and size, 3) the number of salmon by species that are released and, among the coho released, the number with adipose fins and the number that are of sub-legal length, 4) hook wound location on landed salmon, and 5) angling gear and methods. In marine areas with high concentrations of private sport boats or marine catch areas with minimal space available on charter vessels, ODFW or OSP vessels may be utilized as observation platforms to collect data on the private fishing fleet. However, based on the response from charter operators in the selective fishery off the mouth of the Columbia River in 1998, securing space for an observer on

vessels during 1999 should not be a problem, particularly in ports such as Garibaldi, Newport, and Depoe Bay where charter operations are most numerous.

Assuming a coho encounter rate of 1.5 coho encountered per charter angler trip and an effort level of eight anglers per charter vessel, a minimum sample size of 96 coho encounters per week and catch area should be achievable by two observers per catch area for the duration of the fishery. Depending on angler success and effort levels, supplemental permanent staff will be scheduled to achieve encounter rate sampling goals.

Oregon State Police Observations

OSP will collect information on illegal retention of coho with adipose fins as part of their regular angler interview and catch inspection procedures.

DATA COLLECTION

During the selective fishery for coho on the central Oregon Coast, dockside and onboard observer data will be collected on every day the fishery is open. Approximately 20%-40% of all boats returning to a port is sampled. Sampling is distributed through the day in approximate proportion to the rate at which boats return. The dockside sampling levels are designed to achieve catch and effort estimates that are $\pm$ 0.05 of the true catch 95% of the time. While CWT recovery is also a goal of the sampling program, the small catch quota for the selective fishery will limit our ability to recover tags in numbers sufficient to make meaningful estimates of the portions of the harvest contributed by specific hatcheries. All interview and sampling data will be recorded in handheld data entry computers or on standardized ODFW data forms.

Fishing Effort

Boat and angler days are stratified by private versus charter and by fishing period, port, and catch area. The total number of private and charter boats that participate in the fishery is from daily boat tallies at every port. Angler days per fishing period are the number of boat-days times the average number of anglers per boat for the fishing period based on dockside sampling of returning boats.

Boat Counts

Private fishing vessels that participate in the ocean recreational fishery all originate from ports in the protected coastal bays. Observers enumerate these boats as they exit ports. Daily exit traffic of private fishing boats destined for the ocean is usually completed by mid-day. Exit counts conducted by ODFW observers are typically done for five hours beginning just before dawn. In other ports, a variety of methods are used to estimate private boat effort including: boat trailer and empty slip counts, boat launch counts, harbor boat hoist records, and bar crossing counts. Charter boat days are estimated from interviews of charter boat companies and their tallies of charter boat trips by trip type

Details of exit count procedures for specific ports can be found in the 1999 Ocean Sampling Project Procedures Manual (ODFW 1999a).

Angler per Boat

The average number of anglers per boat is estimated from interviews of a subset of boats that return to port each day when fishing is concluded. Interviews are stratified by boat type (i.e. private versus charter).

Catch

Catch by species, boat and angler data are from daily dockside interviews of private and charter vessels when they return to port on days open to fishing.

Encounter, Drop-off, Retention, and Finclip Rates

Observers aboard charter vessels will use methods similar to those used to sample the 1998 Columbia River Ocean Area selective coho fishery (Burner 1999). Data will be recorded for each observed boat including: 1) the number of fish hooked per angler, 2) the number of fish that escape after being hooked but before being brought to the boat (drop-offs), 3) the number of clipped and unclipped coho brought to the boat, 4) the number of fish with adipose clips retained and the number of unclipped coho released, and 4) the number of sub-legal fish retained and released.

During angler interviews, dockside observers will collect anecdotal accounts of the number of fish hooked, the number of drop-offs, and finclip rates among released fish and they will inspect catches for undersized and unclipped coho that have been illegally retained.

CWT and Average Size Data

All landed coho that are inspected during dockside interviews will be sampled for coded wire tags. Due to mass marking of hatchery coho, electronic detection equipment will be used to indicate the presence or absence of coded wire tags. All fish with coded wire tags are sampled for length. Additionally, a random subset of fish from the landed catch will be sampled for paired length and weight data.

Fishing Gear

Fishing method and gear data are from dockside interviews of private and charter vessels when they return to port. Gear will be characterized by method similar to those described by the NRC (1998) (i.e. trolling or mooching), number of hooks, weighting technique, visual attractor, and lure or bait used. Each dockside sampler will include questions about gear in at least 10 interviews per day. Gear profile data from observers on charter vessels will augment data from random dockside surveys.

Hooking Wound Location

Onboard observers will closely observe and inspect as many landed salmon as possible for hook wounds and will record wound location by standardized locations (Table 1, Wertheimer 1988).

Compliance With Selective Retention Regulations

Dockside port samplers will record the incidence of non-finclipped coho landed as a measure of the compliance rate with the selective fishing regulations. Uniformed port samplers are primarily responsible for the collection of fishery data and enforcement responsibilities are secondary. Due to their high profile, limited ability to search a vessel, and predictable sampling schedule, ODFW port samplers are unlikely to sample a high proportion of the illegal coho retention in the fishery. Therefore, estimates of compliance rates based solely on ODFW dockside interviews are likely biased low.

OSP is planning to put a high priority on the monitoring of 1999 ocean selective fisheries and will conduct a variety of patrols to enforce the regulations and assess compliance (Scroup 1999 and Torland 1999). Combining the monitoring efforts of ODFW and OSP in the 1998 selective fishery off the mouth of the Columbia River resulted in thousands of angler contacts and reliable estimates of compliance. Similar coordination is planned for the 1999 ocean selective fisheries.

DATA ANALYSIS

The method for making initial estimates of catch and effort will stratify by fishing period and port and follow historic ODFW analysis procedures for coastal recreational fisheries. Variance estimates for estimated proportions and numbers are from methods outlined in Snedecor and Cochran (1980). Analyses that stratify by catch area and statistical week will occur postseason and the methods are not detailed in this plan.

Fishing Effort

The total number of type t (i.e. private versus charter) boats participating in each fishing period i and port j, B_{tij}, is the total of the exit count for the port and fishing period times a sampling expansion factor. The mean sampling expansions for each port and the associated variance are estimated from historic data as follows:

$$\phi_{ij} = \frac{F_{ij}}{f_{ij}} and \qquad (1$$

$$\bar{\phi}_{ij} = \frac{\sum \phi_{ij}}{k} \qquad V\left[\bar{\phi}_{ij}\right] = \frac{K-k}{Kk}\left(\frac{\sum (\phi_{ij} - \bar{\phi}_{ij})^2}{k-1}\right) \qquad (2$$

where:

F_{ij} = exit counts for a full day for boat type t in port j.

f_{tj} = exit counts for a five hour sampled period beginning at dawn for boat type t in port j.
k = sample days.
K = total number of days of fishing during the season.

Therefore, total number of boats of type t in fishing period I at port j is:

$$B_{tij} = \bar{\phi}_{tj}\delta_{tij} \tag{3}$$

Where:

δ_{tij} = actual exit counts for boat type t, fishing period i, and port j.

The average number of anglers per boat, fishing period, and catch area and associated variance are:

$$\bar{a}_{tij} = \frac{\sum_k a_{tijk}}{b_{tij}} \qquad V(\bar{a}_{tij}) = \left(\frac{\sum_k (a_{tijk} - \bar{a}_{tij})^2}{b_{tij} - 1}\right)\left(\frac{B_{tij} - b_{tij}}{B_{tij} b_{tij}}\right) \tag{4}$$

where:

a_{tijk} = number of anglers in fishing period i, and port j, on the k^{th} type t boat.
b_{tij} = number of type t boats sampled in fishing period i in port j.

Hence, the total number of anglers for fishing period i and port j and associated variance are:

$$A_{tij} = \bar{a}_{tij}\bar{\phi}_{tj}\delta_{tij} \qquad V[A_{tij}] = (\delta_{tij})^2\left[\bar{a}_{tij}^2 V[\bar{\phi}_{tj}] + \bar{\phi}_{tj}^2 V(\bar{a}_{tij}) + V(\bar{\phi}_{tj})V(\bar{a}_{tij})\right] \tag{5}$$

Catch Per Effort and Total Catch

The average catch per type t boats sampled for fishing period i and port j and associated variance are:

$$\bar{c}_{tij} = \frac{\sum c_{tij}}{b_{tij}} \qquad V(\bar{c}_{tij}) = \left(\frac{\sum (c_{tij} - \bar{c}_{tij})^2}{b_{tij} - 1}\right)\left(\frac{B_{tij} - b_{tij}}{B_{tij} b_{tij}}\right) \tag{6}$$

where:

c_{tij} = the sum of coho caught by sampled anglers on type t boats in fishing period i and port j.

Hence, total catches for boat type *t*, fishing period *i*, and port *j* and associated variance are:

$$C_{tij} = \bar{c}_{tij}\bar{\phi}_{tj}\delta_{tij} \qquad V[C_{tij}] = (\delta_{tij})^2\left[\bar{c}_{tij}^2 V[\bar{\phi}_{tj}] + \bar{\phi}_{tj}^2 V(\bar{c}_{tij}) + V(\bar{\phi}_{tj})V(\bar{c}_{tij})\right] \tag{7}$$

The total catch in fishing period *i* for type *t* boats in all ports, C_{ti}, is the sum of catches for fishing period *i* from all ports.

Estimates of Encounter, Drop-off, Retention, and Finclip Rates

The estimated encounter, and drop-off rates for salmon, and retention rates for legal sized finclipped salmon and associated variances for *k* boats of type *t* that are sampled in fishing period *i* and catch area *j* are:

$$\bar{e}_{tij} = \frac{\sum_k e_{tijk}}{b_{tij}}, \qquad V(\bar{e}_{tij}) = \left(\frac{\sum_k (e_{tijk} - \bar{e}_{tij})^2}{b_{tij} - 1}\right)\left(\frac{B_{tij} - b_{tij}}{B_{tij} b_{tij}}\right) \tag{8}$$

$$\bar{d}_{tij} = \frac{\sum_k d_{tijk}}{b_{tij}}, \qquad V(\bar{d}_{tij}) = \left(\frac{\sum_k (d_{tijk} - \bar{d}_{tij})^2}{b_{tij} - 1}\right)\left(\frac{B_{tij} - b_{tij}}{B_{tij} b_{tij}}\right) \text{and} \tag{9}$$

$$\bar{l}_{tij} = \frac{\sum_k l_{tijk}}{b_{tij}}, \qquad V(l_{tij}) = \left(\frac{\sum_k (l_{tijk} - \bar{l}_{tij})^2}{b_{tij} - 1}\right)\left(\frac{B_{tij} - b_{tij}}{B_{tij} b_{tij}}\right) \tag{10}$$

respectively where:

- e_{tijk} = observed encounters (coho landed or released) aboard charter vessel *k* in fishing period *i* and catch area *j*,
- d_{tijk} = drop-offs observed aboard charter vessel *k* in fishing period *i* and catch area *j*,
- l_{tijk} = landed and retained coho observed aboard charter vessel *k* in fishing period *i*, and catch area *j*.

The total number of encounters, drop-offs, retained fish, and finclipped fish for boat type *t*, fishing period *i* and catch area *j* and the associated variances are therefore:

$$E_{tij} = \bar{e}_{tij}\bar{\phi}_{tj}\delta_{tij} \qquad V[E_{tij}] = \delta_{tij}^2\left[V(\bar{e}_{tij})\bar{\phi}_{tj}^2 + \bar{e}_{tij}^2 V(\bar{\phi}_{tj}) + V(e_{tij})V(\bar{\phi}_{tj})\right] \tag{11}$$

$$D_{tij} = \bar{d}_{tij}\bar{\phi}_{tj}\delta_{tij} \qquad V[D_{tij}] = \delta_{tij}^2\left[V(\bar{d}_{tij})\bar{\phi}_{tj}^2 + \bar{d}_{tij}^2 V(\bar{\phi}_{tj}) + V(d_{tij})V(\bar{\phi}_{tj})\right] \tag{12}$$

$$R_{tij} = \bar{l}_{tij}\bar{\phi}_{tj}\delta_{tij} \qquad V[R_{tij}] = \delta_{tij}^2\left[V(\bar{l}_{tij})\bar{\phi}_{tj}^2 + \bar{l}_{tij}^2 V(\bar{\phi}_{tj}) + V(l_{tij})V(\bar{\phi}_{tj})\right] \text{ respectively.} \tag{13}$$

The proportion and the variance of the proportion of legal sized adipose finclipped coho among legal sized coho encountered and brought to the boat are:

$$r_{tij} = \frac{m_{tij}}{e_{tij} - d_{tij} - s_{tij}} \qquad V[r_{ij}] = \frac{(e_{tij} - d_{tij} - s_{tij}) - m_{tij}}{(e_{tij} - d_{tij} - s_{tij})m_{tij}}(r_{tij}(1 - r_{tij})) \qquad (14)$$

where:

m_{ij} = the observed number of legal sized coho with adipose finclips that encountered and brought to the boat in fishing period i and port j.

s_{tij} = the number of sublegal size coho brought to the sampled boats type t in fishing period i and port j.

The estimates of encounter, drop-off, retention, and finclip rates are from data collected by samplers aboard charter vessels. Similar estimates will be completed using anecdotal data from dockside interviews to assess the reliability of dockside data for future estimates of these statistics.

CWT Data

Coded wire tag recoveries from sampled catches will be summed by tag code and catch area. The estimated total number of tags by tag code in the catch for a fishing period i and catch area j is:

$$T_{ij} = \frac{C_{ij}}{c_{hj}}(t_{ij}) \qquad (15)$$

where:

t_{ij} = is the number of tags recovered from among the fish sampled c_{ij} in the total catch C_{ij} for fishing period i and port j.

Gear Profiles

The proportion of sampled anglers by gear and method and the variance of the proportion are:

$$g_{quvxy} = \frac{a_{quvxy}}{\sum_j a_j} \quad and \quad V[g_{quvxy}] = \left(\left.(A_j - a_j)\right/A_j a_j\right)(g_{quvxy}(1 - g_{quvxy})) \qquad (16)$$

where:

a = number of sampled anglers
q = method (e.g. troll or mooch),
u = number of hooks,
v = weight technique,
x = visual attractor, and
y = lure or bait

Hooking Location

The proportion of hook wounds by location in landed catch sampled by onboard observers on charter boats (i.e. $t = charter$) and the variance of the proportion are:

$$w_z = \frac{l_{tz}}{C_t} \quad and \quad V[w_z] = \left(\frac{C_t - l_t}{C_t l_t}\right)(w_z(1 - w_z)) \tag{17}$$

where:

- z = location of the hook wound on the body of the fish.
- t = boat type
- C = total catch of coho in the selective fishery
- l = landed and retained coho sampled

Compliance Rate

The proportion of angler compliance with the finclip retention regulation in the selective fishery is:

$$\hat{p} = \frac{n}{o} \quad and \quad V[\hat{p}] = \left(\frac{(C - o)}{(C)(o)}\right)(\hat{p}(1 - \hat{p})) \tag{18}$$

where:

- n = the number of finclipped landed coho observed by OSP in all weeks and ports of the selective fishery,
- o = the the total number of landed coho observed by OSP in all weeks and ports, and
- C = the total catch of coho in the selective fishery

REPORTING

ODFW will begin processing the data collected as soon as it is available and intends to report preliminary findings in time for review by the Scientific and Statistical Committee (SSC) of the PFMC in their September meeting. A final report is anticipated for the PFMC annual review of ocean salmon management methodology in November.

REFERENCES

Burner, M. 1999. Monitoring Results form the 1998 Ocean and Buoy 10 Recreational Selective Fisheries. Oregon Department of Fish and Wildlife. Fish Division. Portland, Oregon.

NRC. 1998. Final progress report for NEAP at-sea research projects, Volume II. Technical Reports, Effect of gear and method on marine sport salmon hooking mortality rates. Natural Resource Consultants, Seattle, Washington

ODFW 1999a. 1999 Ocean Salmon Sampling Project Procedures Manual. Ocean Salmon Management Program. Newport, Oregon.

ODFW 1999b. 1999 Selective Fishery Observer Logbook Instructions. Ocean Salmon Management Program. Newport, Oregon.

Schindler, E., T. Loynes, and R. Kaiser 1998. Oregon Ocean Salmon Fisheries: Annual Status Report, 1996. Oregon Department of Fish and Wildlife. Ocean Salmon Management Program. Newport, Oregon.

Scroup, J.W. 1999. 1999 Ocean/Buoy 10 Recreational Salmon Fishery Operations. Oregon State Police memorandum, April 19, 1999. Astoria, OR.

Snedecor, G. and W. Cochran. 1980. Statistical Methods, 7th edition. The Iowa State University Press, Ames, Iowa.

Torland, G. Action Plan – 1999 Ocean Sport Coho Salmon Season. Oregon State Police Memorandum, May 10, 1999. Newport, OR.

Wertheimer, A. C. 1988. Hooking mortality of incidentally caught chinook salmon. North American Journal of Fisheries Management 8: 346-355.

Figure 1. Map of Oregon coast showing ports, ODFW catch areas (1-7) used for ocean salmon fishery sampling, and ODFW subareas (A,B,C) used in monitoring selective fisheries. Numbers in parentheses indicate the number of ODFW dockside port samplers at each location. In addition, ODFW will deploy two at-sea observers for each of the catch areas 3-5.

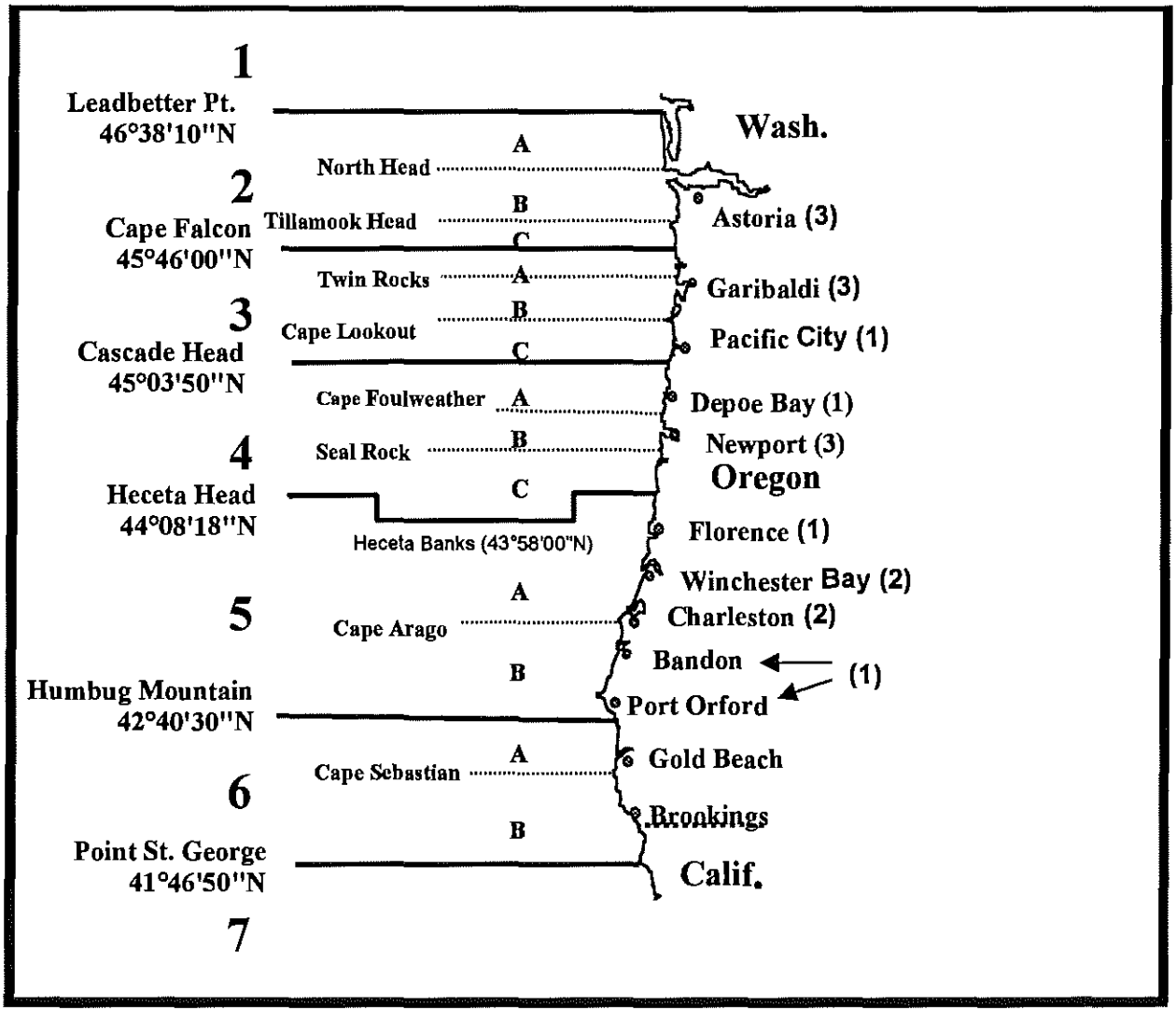

Table 1. Hook wound categories for the 1999 ODFW selective fishery sampling program. [a/]

Location	Definition
Lower Jaw	Excludes tongue.
Tongue	
Roof of Mouth	Includes corner of the mouth. Excluding snout.
Snout	Upper jaw anterior of nares.
Gill	Includes gill arch, rakers, and lamellae.
Eye	Wounds to the eye or the eye orbit.
Gullet	Includes all wounds posterier to the gills.
Maxillary	
Cheek	External head wounds including the operculum.
Isthmus	
Other	Includes external wounds behind head. Describe in comments.
None	No wound apparent.

a/ Derived from hooking mortality studies by NRC (1998) and Wertheimer (1988).

Appendix 9. Monitoring Results from the 1998 Ocean and Buoy 10 Recreational Selective Fisheries.

by Mike Burner

The Pacific Fishery Management Council (Council) adopted the first selective ocean fishery for the 1998 recreational fishery off the mouth of the Columbia River. Selective regulations were also adopted for the popular Buoy 10 fishery in the Columbia River estuary. Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) started mass marking hatchery coho in 1995 and the management tool of selective harvest was tested on the first adult returns of mass marked fish in 1998.

ODFW and WDFW wanted to seize this unique opportunity to collect valuable data on this inaugural selective ocean coho fishery. When the Council set the 1998 selective fisheries they made assumptions about coho and chinook abundance, distribution of stocks, coho mark rates, compliance with the new regulations, and incidental mortality. A monitoring plan was developed to test some of these assumptions through dockside catch and effort sampling along with direct on board and at sea observations of the fishery in progress.

Fishery Descriptions

The ocean recreational fishery from Leadbetter Point, Washington to Cape Falcon, Oregon opened on August 3rd and was scheduled to run through September 24th or until a coho quota of 8,000 was reached. There was also a harvest guideline of 1,050 chinook. The bag limit was two salmon per day and no more than one chinook and four salmon per calendar week with minimum size limits of 24" and 16" for chinook and coho respectively. Selective fishery regulations required all retained coho to have a healed adipose fin clip. Due to selective regulations, 1,000 of the 8,000 coho quota were set aside for incidental mortality. Incidental mortality was estimated preseason using the coho Fishery Regulation and Assessment Model (FRAM) and included hooking and drop off mortality. Additionally, mark recognition error to account for fin marked coho mistakenly released as unmarked coho and mortality from unmarked coho illegally retained were modeled into the fishery simulation.

The estuary fishery (Buoy 10) in the Columbia River from the mouth upriver to the Astoria-Megler Bridge opened August 8th and closed August 23rd. The bag limit was two salmon per day with minimum size limits of 24" and 16" for chinook and coho respectively. The Buoy 10 fishery was not quota managed but selective fishery regulations required all retained coho to have a healed adipose fin clip. Incidental mortalities due to the selective regulations were modeled preseason following the same methods as those used for the ocean fishery.

Trolling whole bait with a tandem hook arrangement was the predominant fishing method in the ocean and Buoy 10 fisheries. Barbless hooks were required in the ocean.

Methods

ODFW utilized existing staff and concentrated their efforts on the charter fleet operating in the selective recreational ocean fishery off the mouth of the Columbia River. Three full-time observers were hired by the WDFW to observe catches on the water in the ocean and Buoy 10 salmon fisheries. Charter operators from the ports of Ilwaco, Astoria, Warrenton, Hammond, and Garibaldi volunteered space on their vessels to accommodate the ODFW and WDFW observers. Additionally, WDFW observers rode aboard a private vessel contracted to observe private fishing boats.

The observers on charter boats collected information about that specific boat's encounters for the day. Data recorded included species hooked, presence or absence of the adipose fin, size (legal or sublegal), and result of the hookup (fish retained, released, or dropped off) for each hookup that occurred on that vessel.

Observers aboard the contracted private vessel observed hookups by the private boat fleet. The observer vessel positioned itself each day near a concentration of private fishing boats. When a hookup was observed, the contracted vessel moved as close as feasible, and observers recorded as much of the above information as possible for the hookup.

Dockside port samplers collected catch information through interviews and catch inspections as fishing boats returned to the docks. Data collected per boat included catch by species, presence or absence of adipose fins on all retained salmon, number of anglers, total number of salmon released by species, and number of adipose-clipped coho released. Landed salmon were sampled for species, fork length, scale collection, fin mark, and coded-wire tag. Due to the mass marking of hatchery coho, electronic detection equipment was used to indicate the presence or absence of coded-wire tags in all coho.

Total effort data was collected through either exit or entrance counts of vessels passing through the entrance of the ports. Dockside sampling data was then expanded according to the observed effort profile to estimate total retained and released catch.

Catch and Effort

Catch in the ocean fishery was strong (Table 1) with the first 5 open days of the fishery (August 3-6 and August 9) producing retained catches of 6,046 coho and 366 chinook for 6,101 angler trips. Catch rates for coho were good and angler interest in the fishery only relaxed during poor weather conditions. The Council postponed a sixth day of opportunity until catch rates and effort were projected to decrease. The fishery was opened for one day on September 3rd to access the remaining 891 fish of the 7,000 retained coho quota. Catch rates and effort levels decreased moderately and the final day

of the fishery produced retained catches of 498 coho and 53 chinook for 704 angler trips. Overall the fishery performed within expectations and the final retained coho catch was estimated at 6,544 for 6,805 angler trips, 456 coho below the retained coho quota.

Catch rates and effort levels were strong in the Buoy 10 fishery as well. The fishery was open as scheduled and produced retained catches of 3,175 coho and 5,784 chinook for 29,998 angler trips (Table 2).

Selective Fishery Observation

WDFW and ODFW staff observed anglers on board charter and private boats for each of the 6 days the ocean selective fishery was open. Data collected includes observations of more than 250 angler trips on board chartered fishing vessels and more than 140 individual hook-ups from private fishing vessels. This resulted in observations of 292 or 4.5% of the 6,544 coho retained in the ocean fishery (Table 3). Ten percent of the coho brought to the boat were of sublegal size, and of the legal-sized coho, 49% were adipose fin clipped. Approximately 35% of the chinook brought to the boat were of sublegal size and 29% of all the salmon observed to be hooked in the ocean fishery dropped off prior to being landed.

The Buoy 10 selective fishery was observed on 12 out of 16 days with sampling effort spread evenly over the entire period. Data collected in the Buoy 10 selective fishery include observations of more than 100 angler trips on board chartered fishing trips and more than 600 individual hook-ups from private fishing vessels. This resulted in observations of 213 or 6.7% of the 3,175 coho retained in the Buoy 10 fishery (Table 4). Three percent of the coho brought to the boat were of sublegal size, and 68% of the legal-sized coho were adipose fin clipped. Eight percent of the chinook brought to the boat were of sublegal size and 21% of all the salmon observed to be hooked in the Buoy 10 fishery dropped off prior to being landed.

Comparison of Preseason vs. Postseason Estimates of Coho Mark Rates

Preseason projections of 1998 coho mark rates were estimated using the coho FRAM and showed declining coho mark rates in catch areas north of the Columbia River (Table 5). Inseason information on coho mark rates (percent of legal-sized coho adipose fin clipped) was obtained from the Buoy 10 selective fishery as well as recreational coho fisheries from three ocean catch areas. Ocean recreational fisheries out of the ports of Westport and La Push, Washington were open to the retention of all coho. Data gathered through dockside sampling in these two fisheries combined with the observation data from the Columbia River catch area provide estimates of coho mark rates in ocean areas from Cape Falcon, Oregon to Cape Alava, Washington.

Observation data and dockside sampling of coho mark rates showed reasonable agreement between the preseason projections and postseason estimates. The observed coho mark rate in the ocean selective fishery off the mouth of the Columbia River was identical to the preseason forecasts of 49%. The observed coho mark rate in the Buoy 10

selective fishery was 68%, 13% higher than the preseason prediction of 60%. The ocean fishery out of the port of Westport was open to the retention of all coho during the same time period as the selective fishery in the Columbia River ocean area. Dockside sampling of the non-selective fishery out of the port of Westport showed a 28% coho mark rate in August, 33% higher than the preseason estimate of 21% and a 35% coho mark rate in September, 41% lower than the preseason expectation of 59%. Coho mark rates from dockside sampling of the La Push non-selective fishery were identical to the preseason estimate of 15%.

Overall, postseason estimates of coho mark rates were similar to those estimated preseason. Preseason estimates made by the coho FRAM are done on a monthly basis and use preseason estimates of abundance. The short 1998 ocean recreational fishery seasons did not adequately sample coho populations in these areas throughout the month. Particularly, postseason estimates for September are suspect because they are based on a single day of fishing. For this reason and because the preseason coho mark rates predicted for the Columbia River area ocean fishery were nearly identical for August and September, sampling data from this fishery were pooled. Based on data collected in the short 1998 coho recreational seasons it appears that the current methodology for preseason estimation of coho mark rates is adequate.

Comparison of Dockside and Observer Data in Selective Fisheries

Observation data on 1998 selective coho fisheries were collected in part to investigate potential bias in estimates of coho mark rates based on angler recognition of released coho. Relative to estimates of released salmon from fishery observation data, information collected at the dock shows a consistent bias toward higher numbers of salmon released (Tables 6 and 7).

The dockside sampling of the ocean area selective fishery showed a coho mark rate of 42%, 14% lower than the 49% estimated from observation data. This discrepancy suggests that in general, angler recollection of released fish is biased high. A similar bias was evident in the dockside sampling for released chinook in the ocean selective fishery. Dockside data suggests 45% of all chinook caught were released, approximately 29% higher than the 35% chinook release rate calculated from observation data.

Overestimation of released salmon based on angler recollection at the dock was evident in the Buoy 10 selective fishery as well. The dockside sampling of the Buoy 10 selective fishery showed a coho mark rate of 59%, 13% lower than the 68% estimated from observation data. Dockside sampling of the Buoy 10 fishery showed that 14% of the chinook caught were released, 75% higher than the 8% chinook release rate from observation data.

Based on 1998 results in both the ocean and Buoy 10 selective fisheries, dockside sampling for released salmon is biased towards higher release rates. Use of observation data is favorable when investigating mark rates in selective fisheries.

Compliance

There were preseason concerns about compliance with selective regulations because 1998 was the first year of selective ocean fisheries. Using combined information from dockside sampling and boat patrols conducted by Oregon State Police (OSP) estimates of compliance with selective regulations were assessed as a percentage of the retained coho catch with a healed adipose fin clip (Tables 6 and 7).

Compliance with the selective fishery regulation in the ocean area fishery was very high for both private and charter vessels. Nearly half of the total retained coho in the ocean selective fishery was sampled at the dock and an estimated 1% did not have an adipose clip. This compliance rate of 99% was confirmed by random boat patrols conducted by OSP which found only six violations for intact adipose fin retention for 541 contacts (personal communication, Senior Trooper Mike Schacher, OSP).

Compliance with the selective fishery regulation in the Buoy 10 fishery was also high. Approximately one-third of the total retained coho in the Buoy 10 selective fishery were sampled at the dock and an estimated 5% did not have an adipose fin clip.

Excellent compliance with selective regulations in the 1998 Ocean and Buoy 10 fisheries was in part due to extensive efforts to inform the public of the new regulations, adequate fishery sampling, and an effective enforcement presence. Additionally, anglers in the region were accustomed to selective fishery regulations based on the adipose fin clip which have been in place for steelhead in the Columbia River since the mid-1980's.

Estimated Mortality

Estimates of total coho mortality in the Buoy 10 and ocean selective fisheries are shown in Table 8. This analysis uses estimates of coho mark rates from ODFW and WDFW sampling to estimate total coho retention and release. Estimates of incidental mortality are calculated using rates adopted by the Council for recreational fisheries (5% drop off mortality and 8% hooking mortality).

Incidental coho mortality in the ocean selective fishery is estimated at 1,195 which, when combined with a total coho retention of 6,544, puts the estimate of total coho mortality in the ocean selective fishery at 7,739. Based on these preliminary results, the ocean selective fishery was successfully managed within its coho quota both in terms of a coho retention quota of 7,000 and a total coho quota of 8,000.

Incidental mortality in the Buoy 10 selective fishery is estimated at 320 coho which, when combined with the total coho retention of 3,175, puts the estimate of total coho mortality in the Buoy 10 selective fishery at 3,495.

Drop Off Rates

Observers from ODFW and WDFW recorded information on fish which were hooked but lost before being brought to the boat, commonly referred to as drop offs. Current Council methodology for estimating mortality due to drop off uses a rate of five percent of the total number of fish handled (retention plus release). Estimates of drop off mortality rates from observation data collected during the ocean and Buoy 10 selective fisheries are displayed in Table 9. Rates for both chinook and coho were never estimated to be greater than four percent. Based on this analysis, the methodology for assessing drop off mortality adopted by the Council is conservatively high.

Conclusion

Monitoring of the ocean and Buoy 10 selective fisheries on boat patrols, from at sea observations, and from dockside sampling indicates the 1998 selective coho fisheries performed according to preseason expectations. Catch estimates made in season from dockside sampling and effort profiling were timely and accurate preventing the fisheries from exceeding their quotas. Preseason mark rates were reasonably accurate and compliance with the selective fishery regulations was high. The 1998 selective fisheries in the ocean and Buoy 10 were firsts for ocean salmon management and based on monitoring by ODFW, WDFW, and OSP the fisheries were a success.

Acknowledgments

This report was completed through a joint effort of ODFW, WDFW, and OSP including the following staff members: Wendy Beeghley (WDFW), Eric Schindler (ODFW), Jimmy Watts (ODFW), Matt Hunter (ODFW), Curt Melcher (ODFW), and Doug Milward (WDFW), Senior Trooper Mike Schacher (OSP) and all of the samplers and observers whose data collection made these analyses possible. Additionally, ODFW and WDFW would like to thank the charter operators who voluntarily provided space on their boats for observers.

Table 1. Salmon catch and effort in the 1998 Ocean area selective fishery.

		Charter			Private			Bank			Total		
	Date	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook
Oregon	8/3-8/9	368	465	21	1,456	1,556	73	0	0	0	1,824	2,021	94
	9/3	47	39	0	237	111	11	0	0	0	284	150	11
	Total	415	504	21	1,693	1,667	84	0	0	0	2,108	2,171	105
Washington	8/3-8/9	941	1,221	87	2,371	2,784	185	965	20	0	4,277	4,025	272
	9/3	141	163	25	279	185	17	0	0	0	420	348	42
	Total	1,082	1,384	112	2,650	2,969	202	965	20	0	4,697	4,373	314
Subtotals	8/3-8/9	1,309	1,686	108	3,827	4,340	258	965	20	0	6,101	6,046	366
	9/3	188	202	25	516	296	28	0	0	0	704	498	53
Grand Total		1,497	1,888	133	4,343	4,636	286	965	20	0	6,805	6,544	419

Table 2. Salmon catch and effort in the 1998 Buoy 10 area selective fishery.

		Charter			Private			Bank			Total		
	Date	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook	Angler Trips	Coho	Chinook
Oregon	8/8-8/9	39	6	6	936	14	90	158	0	0	1,133	20	96
	8/10-8/16	248	4	66	3,109	134	742	114	0	0	3,471	138	808
	8/17-8/23	301	49	73	5,904	1,021	1,359	359	31	0	6,564	1,101	1,432
	Total	588	59	145	9,949	1,169	2,191	631	31	0	11,168	1,259	2,336
Washington	8/8-8/9	8	0	4	1,732	51	135	0	0	0	1,740	51	139
	8/10-8/16	474	62	131	5,538	427	969	410	0	0	6,422	489	1,100
	8/17-8/23	598	126	198	9,118	1,106	1,971	952	144	40	10,668	1,376	2,209
	Total	1,080	188	333	16,388	1,584	3,075	1,362	144	40	18,830	1,916	3,448
Subtotals	8/8-8/9	47	6	10	2,668	65	225	158	0	0	2,873	71	235
	8/10-8/16	722	66	197	8,647	561	1,711	524	0	0	9,893	627	1,908
	8/17-8/23	899	175	271	15,022	2,127	3,330	1,311	175	40	17,232	2,477	3,641
Grand Total		1,668	247	478	26,337	2,753	5,266	1,993	175	40	29,998	3,175	5,784

Table 3. Observation data from the Ocean area selective fishery.

	Coho				Chinook		
	Released Unmarked	Released Sublegal	Kept AD-clipped	% of Legal Sized Catch AD-clipped	Released Sublegal	Kept	Salmon Drop Offs
Washington							
Private	42	5	47	53%	0	4	32
Charter	118	37	87	42%	10	16	120
Oregon							
Charter	143	20	158	52%	8	14	140
Subtotals							
Private	42	5	47	53%	0	4	32
Charter	261	57	245	48%	18	30	260
Total	303	62	292	49%	18	34	292

Table 4. Observation data from the Buoy 10 area selective fishery.

	Coho				Chinook		
	Released Unmarked	Released Sublegal	Kept AD-clipped	% of Legal Sized Catch AD-clipped	Released Sublegal	Kept	Salmon Drop Offs
Washington							
Private	96	9	200	68%	6	146	116
Charter	2	1	11	85%	9	23	17
Oregon							
Charter	1	0	2	67%	0	2	2
Subtotals							
Private	96	9	200	68%	6	146	116
Charter	3	1	13	81%	9	25	19
Total	99	10	213	68%	15	171	135

Table 5. Projected and observed coho mark rates in Ocean and Buoy 10 area fisheries.

Ocean Catch Area / Type of Data		Total Legal Sized Coho Retained/Handled	AD-clipped Coho Retained	Observed % AD-clipped	FRAM Projected % AD-clipped
Columbia River (Selective)					
Observation Data		595	292	49%	49%
Buoy 10 (Selective)					
Observation Data		312	213	68%	60%
Westport (Non-Selective)					
Dockside Sampling	August	6,628	1,838	28%	21%
	September	1,066	375	35%	60%
	Total	7,694	2,213	29%	
La Push (Non-Selective)					
Dockside Sampling		577	87	15%	15%

Table 6. Dockside sampling data from the Ocean area

	Coho						Chinook	
	Released Unmarked	Released Sublegal a/	Kept AD-clipped	Kept Unmarked	% of Legal Sized Catch AD-clipped	% of Retained Catch AD-clipped b/	Released	Kept
Washington								
Charter	1,495	306	1,042	1	41%	100%	65	77
Private	1,247	256	940	24	43%	98%	61	66
Oregon								
Charter	256	53	208	0	45%	100%	4	7
Private	906	186	696	7	43%	99%	20	34
Subtotals								
Charter	1,751	359	1,250	1	42%	100%	69	84
Private	2,153	442	1,636	31	43%	98%	81	100
Total	3,904	801	2,886	32	42%	99%	150	184

Table 7. Dockside sampling data from the Buoy 10 area

	Coho						Chinook	
	Released Unmarked	Released Sublegal a/	Kept AD-clipped	Kept Unmarked	% of Legal Sized Catch AD-clipped	% of Retained Catch AD-clipped b/	Released	Kept
Washington								
Charter	125	12	138	7	51%	95%	50	249
Private	311	31	363	26	52%	93%	189	800
Oregon								
Charter	12	0	23	0	66%	100%	8	50
Private	222	10	518	17	68%	97%	108	1,059
Subtotals								
Charter	137	12	161	7	53%	96%	58	299
Private	533	41	881	43	60%	95%	297	1,859
Total	670	53	1,042	50	59%	95%	355	2,158

a/ ODFW and WDFW did not distinguish between released legal sized and sublegal sized fish during dockside sampling. Esti released coho were calculated using the proportion of legal to sublegal coho released during on board observations.

b/ Compliance with the selective fishery regulations for the Oregon portion of the ocean catch was estimated from monitoring by Oregon State Police. All other compliance estimates are from dockside sampling by WDFW and

Table 8. Estimated coho mortality in the Ocean and Buoy 10 area selective fisheries.

	Total Retention	Marked Retention	Unmarked Retention a/	Unmarked Releases	Total Handle b/	Observed Mark Rate	Drop Off Mortality c/	Release Mortality d/	Incidental Mortality e/	Total Mortality
Ocean	6,544	6,479	65	6,678	13,222	49.0%	661	534	1,195	7,739
Buoy 10	3,175	3,016	159	1,241	4,416	68.3%	221	99	320	3,495

a/ Based on compliance rates of 99% in the ocean and 95% at Buoy 10.
b/ Marked Retention/Observed
c/ 5% of total
d/ 8% of unmarked
e/ Drop off + release
f/ Total retention + incidental

Table 9. Estimated drop off mortality rates in the Ocean and Buoy 10 area selective fisheries. a/

	Coho a/				Chinook a/			
	Observed Drop Offs	Estimated Mortality b/	Total Handle	Drop Off Rate c/	Observed Drop Offs	Estimated Mortality b/	Total Handle	Drop Off Rate c/
Ocean	271	22	595	3.6%	21	2	52	3.3%
Buoy 10	86	7	312	2.2%	49	4	186	2.1%

a/ Observed drop offs of chinook and coho estimated from the ratio of chinook to coho in
b/ Assumes fish which drop off wil die at the same rate (8%) as fish brought to the
c/ Estimated Mortality/Total Handle, 5% used

Appendix 10. Regional Coordination of Reporting Mass Marking and Selective Fishery Data. Modified PSC Data Exchange formats.

The use of the adipose clip on hatchery coho as a mass mark for the purpose of selective fisheries has necessitated a number of changes for sampling the fisheries. Electronic detection equipment (hand wands and tube detectors) will be required to separate CWT marked fish from untagged fish in the catch. In addition, samplers will also need to estimate the marked and unmarked catch (i.e. numbers of adipose clipped fish and unmarked fish). For example, CWT marked fish may or may not be adipose clipped, depending on the intent of the marking objectives such as double index tagging studies.

The PSC Data Standards Working Group recently revised the PSC data exchange formats (Version 3.2) to capture the necessary release, recovery, and catch/sample information associated with mass marking, double index tagging, and selective fisheries. These new data elements are summarized below.

Release Data:

Two new fields were added to the Release data format to capture the type of external mark placed on tagged fish (field 31: 'CWT Mark Id') and untagged fish (field 32: 'Non-CWT Mark Id'). In addition, two new fields were added to indicate if other related groups were tagged. Field 33 ('Related Group Type') identifies if the study was part of a double index tag group or other related groups. Field 34 ('Related Group Id') carries a unique code that specifies linkage among the double index tag groups or other related groups.

The Data Standards Working Group also developed a numeric coding scheme to capture the mark information (fields 31 and 32) on both fish release groups and on fish sampled in the harvest. The primary objective was to provide a means of reporting the key external mass marks that are used for fishery management purposes. These key marks include the adipose clip (whether single or in combination with other fin clips) plus the right and left ventral fin clips.

The coding scheme uses a four character numeric code for the various marks. Fish groups released without a mark are coded '0000', while the left and right ventral marks are coded '0001' and '0002', respectively. The adipose only mark is coded '5000', while all other marks in combination with the adipose clip (e.g. Ad+LV) are assigned a code within the 5000 series. This will allow easy data retrieval for any adipose marked release groups.

Recovery Data:

The Recovery data format has four new fields. Field 36 ('Catch/Sample Id') links the recovery record to the correct sampling information in the Catch and Sample data file.

Field 37 ('Recorded Mark') captures the external mark found on the fish when sampled since not all marks are expected to match that reported for the respective release group. Field 38 ('Sample Mark Class') records the external mark used for differential sampling treatment. It will be used only in situations where the sampling treatment of returning fish is different based upon the external mark of the fish. As an example, in 1995, WDFW had Ad+LV marked hatchery fish and Ad+CWT marked wild fish returning to a trap above the hatchery. The Ad+LV+CWT marked hatchery fish were all sacrificed to recover the CWT, while the majority of the wild fish (Ad+CWT) were allowed to continue on upstream to spawn. Hence different expansions were required for the two groups of sampled fish.

Lastly, field 39 ('CWT Detection Method'), captures whether the sampling was done by visual check for the missing adipose fin or by electronic detection. Any coho recoveries prior to 1998 would be listed as 'Visual Detection'. However, subsequent recoveries in 1998 or later could be either visual or electronic detection.

Catch/Sample Data:

Six new fields were added to the Catch/Sample data format to facilitate new data requirements for mass marking, double index tagging, and selective fisheries.

The first of these (Field 33: 'Catch/Sample Id') is a unique id number that is assigned to each catch/sample record by the reporting agency. It is also carried on the respective recovery records to provide the necessary linkage between recoveries and the catch/sample data. Prior to this, data users had a very difficult time matching recoveries to the correct sampling stratum that was used to generate the respective expansion factor.

Field 34 ('Sample Mark Class') represents the external mark used for differential sampling treatment. It is also reported on the recovery record (recovery field 38: see above for an expanded discussion.)

Field 35 ('CWT Detection Method') is likewise shared on the recovery record (field 39) and captures whether the sampling was done by visual check for the missing adipose fin or by electronic detection.

The last three new fields (#36-38) were specifically added in order to evaluate mass marking and selective fisheries where the adipose clip is the mass mark. These fields capture the 'Number Adipose Clipped' (field 36), 'Number not Tagged, Sampled for Adipose Clip' (field 37), and 'Number not Tagged, Adipose Clipped' (field 38). Sampling crews and supervisors need to be aware that data fields 37 and 38 have to do with counting the number of fish that are not tagged (i.e. don't 'beep' in the field when electronically sampled). These latter fish must then be separated into separate totals for adipose marked and unmarked fish in order to determine the correct expansion factors.