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THE PACIFIC SALMON COMMISSION

REPORT OF THE JOINT COHO TECHNICAL COMMITTEE

REPORT TCCOHO (87)-1

RESPONSE TO SOUTHERN PANEL QUESTIONS

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Question #1: What was the 1986 contribution by Canadian hatcheries to the WCVI troll fishery and how does this compare with past years?

Estimated B.C. Hatchery Contributions to WCVI Troll Fisheries 1980-86 (Thousand coho)

1980	1981	1982	1983	1984	1985	1986
42.4	43.0	49.5	68.6	98.1	83.2	155.2

These estimates were provided by the Canadian members of the Technical Committee. They were derived using Canada's Mark Recovery Data Base. Coded-Wire-Tag (CWT) recovery data were expanded to reflect sampling catch rates and regional marked to unmarked release ratios. The 1986 data are still preliminary. Contribution estimates based upon fin-clip data for the 1986 season are not yet available.

Question 2a. Describe the current status of information and methodologies required to determine stock composition by fishery.

- Estimates of coho stock composition have not been agreed upon by the Coho Technical Committee. Within the time available to develop the response to this question, it has not been possible for the Committee to fully analyze all available estimates in an attempt to reach agreement. Currently available estimates of coho stock composition in various fisheries are listed in Table 1. Assumptions and limitations inherent with the techniques employed to make those estimates are discussed in the attached appendix.

- For the immediate future, analysis of CWT data holds the greatest promise for estimating stock composition. The following general types of data are required to estimate stock composition:

  - CWT releases that are representative of both hatchery and wild production from each country

  - A means of accurately estimating levels of unmarked hatchery and wild production with their associated CWT groups. For hatchery production, this would require some reliable means of enumerating hatchery production and relating brood stock sources, rearing schedules and release strategies to CWT groups. For wild production, estimates of spawning escapements must be available as well as information concerning differences between the behavior of hatchery and wild stocks.

DISCUSSION: In the past five years, both countries have generated several estimates of stock composition in the southern border fisheries. Interception estimates are not in agreement, and are especially far apart in the Juan de Fuca Strait and North Puget Sound areas.

Coded wire tag data provide relatively uncontroversial estimates of stock distribution. Analysis of hatchery CWT data permits inferences to be made about the likely status of wild stocks without the necessity of making direct estimates

of wild spawning escapements, assuming that hatchery stocks are representative of neighboring wild stocks.

However, the development of stock composition estimates from CWT data requires the expansion of these tag distributions to represent untagged and wild production. Production expansion factors, in simple terms, are the total production of the stock divided by the representative tagged production. These factors must be derived from hatchery rack tag recoveries and escapement estimates, terminal fishery catch and tag recoveries, hatchery release statistics, and estimates of wild production. These sources of statistics all have various degrees of reliability that result in uncertainty.

Coho stock distributions and relative abundances are known to vary from year to year; thus, stock composition estimates derived from one year may not be applicable to another year. Of particular concern is the distribution of Georgia Strait stocks, which in some years have a high incidence of residency, and, in other years, a substantial proportion of the stocks migrate outside Georgia Strait.

The Committee has tentative plans to develop a bilateral coho model derived from CWT recovery data and production factor data sometime this year. The process will be slow, as it will require careful evaluation of a large volume of data and technical determinations as to what data are most appropriate and how that data should be applied. Bilateral stock composition estimates should be a product of this effort. If not, the Committee will have a better understanding of the specific data needed to resolve the issue.

The Committee is in the process of preparing a report reviewing stock composition estimation methodologies, and will soon make recommendations for methodologies to be employed in the future as well as research needs. Although CWT data is likely to remain the primary coho stock identification tool for the near future, several other methods show promise and may be available for general application as soon as 1990.

Question 2b. What stock composition estimates, by country of origin, can be provided in the following areas?

a) North Puget Sound (area 7 and 7A)
b) Strait of Juan de Fuca (Canadian Area 20; US areas 4B, 5, 6 and 6C.
c) Cape Flattery (Washington Troll and Sport)
d) Southwest Vancouver Island
e) Northwest Vancouver Island
f) Georgia Strait

Describe the assumptions and limitations associated with these estimates.

Stock composition estimates are listed in Table 1. The source, key assumptions and limitations of these estimates are addressed in the attached appendix.

Table 1. Estimated Percentages of Coho Catch Comprised of Stocks of U.S. Origin in Washington ocean areas, the Strait of Juan de Fuca, North Puget Sound, the West Coast of Vancouver Island, and in Georgia Strait.

	ESTIMATE NUMBER					
	I	II	III	IV	V	VI
Author	Anon.	Anon.	Swain	Hunter	Ramonda-Powell	English, et al
Year of Est.	1971-81	1971-81	Unpblsh	1985a&b	1986	1986
Nationality	US	Canada	Canada	US	US	Canada
Source of Data	Fin Clips, Adult Tagging		Coded wire tags, Terminal area data and hatchery release statistics.		Coded wire tags, Subtraction methods	
Data base years	1968-70	1968-70	1975-78	1979-81	1979-85	?????
Washington areas						
4B,5,6 Net	70%	65%		91%		
7 Net	18%	20%		68%		
7A Net	18%	10%		49%		
4 Sport & Troll	60%	65%		94%		
3 Sport and Troll	76%	70%		96%		
2 Sport and Troll	93%	93%		98%		
1 Sport and Troll	93%	93%		100%		
BC areas						
13-19 (GS spt&trl)	16%	10%	8%	19%		
Area 20 Net	70%	65%	45%	89%	88%	
SWVI Troll	60%	55%	43%	* 64%		55%
NWVI Troll	60%	50%	25%	** 26%		55%

* 19% of the coho in these areas were of unidentified origin.

** 42% of the coho in these areas were of unidentified origin. It is likely that the bulk of these are of Canadian origin.

Question #3: Recognizing that formal forecasts have yet to be prepared, what are the preliminary expectations for 1987 for coho stocks of concern in the Southern Panel area?

For Washington and Oregon stocks, 1987 preliminary forecasts are currently available for only the Puget Sound region. Forecasts for all other stocks will be available about February 20. In general, the Puget Sound wild run is forecast to be below average based on low summer stream flows experienced in 1985. The hatchery run is expected to be about average. The most depressed stock is that returning to the Skagit River. The Skagit wild run size is forecast to be about 27,000 returning to U.S. waters, which is below the optimum escapement goal of 30,000. Preliminary indications are that Washington north coastal coho stocks will be improved over recent years.

Forecasts for the 1987 return of Canadian southern coho stocks are available only for the Fraser River and Howe Sound/Burrard Inlet stocks. These forecasts are based on brood year escapements and recent trends in the terminal area and are highly subjective in nature.

Wild coho salmon returns to Howe Sound/Burrard Inlet are dominated by the Squamish River system. Wild returns are expected to be near recent averages (1981-85 ave. escapement of 12,800), well below the interim wild escapement target of 100,000. In addition, hatchery surpluses of 11,000 and 18,000 are expected to the Tenderfoot (Squamish) and Capilano hatcheries.

Wild coho salmon returns to the Fraser River system are expected to improve over recent levels (1981-85 average escapement of 58,300) on the basis of a brood year escapement of 91,000 and a recent trend toward improved returns. However, the wild escapement goal of 175,000 is unlikely to be met. In addition, a hatchery surplus of 115,000 coho is expected in the terminal area, primarily returning to the lower Fraser River area.

Question 4: What is the status of our current understanding of coho productivity of southern BC, Washington and Oregon stocks?

SUMMARY: For management purposes, the productivity of salmon stocks can be defined as the proportion of the adult production that can be harvested at spawning escapements associated with maximum sustained harvest. Thus, a stock which is capable of producing three recruits per spawner at MSH escapement has a productivity of 67% because 2 of the three are harvestable surplus (2/3=67%).

Coho productivity appears to lie in the 60%-70% range for Oregon coastal, Washington coastal and Southern British Columbia stocks. Productivity levels for some Puget Sound stocks may lie at or above the high end of this range. Because of specific environmental or biological factors, the productivity of some stocks may lie outside this range.

DISCUSSION: Most theoretical models of salmon management are based upon a relationship between productivity and spawning escapement levels. Except at extremely low escapement levels, production per unit spawner would be higher at lower escapement levels than at higher escapement levels (It is important to recognize, however, that the maximum sustainable harvest is not obtained by maximizing the sustainable exploitation rate). As a result, comparisons of productivity among stocks requires measurements at the same relative level of abundance, i.e. at MSH escapement.

Direct estimates of coho productivity require a series of reliable adult production data across a broad range of spawning escapements. Such data series are rare. Problems exist in the accurate estimation of both spawning escapements and adult production and the collection of a long time series of consistent data. Because coho typically spawn in many small tributaries and streams during times of year when visibility and access to survey crews are poor, escapement estimation is often difficult. Most coho stocks are exploited in a range of fisheries, often commingled with other coho stocks, making estimation of total adult production from a single stock very difficult.

However, inferences on productivity ranges can still be drawn from groups of stocks for which suitable data are available. Coho productivity relationships have been estimated for regional composites of coho stocks. Estimates of the exploitation rate at MSH escapement levels can be derived from those analyses. One such composite analysis is used as part of the management strategy for Oregon coastal natural stocks (Beidler, et al., 1980). The estimated MSY exploitation rate for the composite Oregon coastal natural stocks is slightly less than 70%. A similar composite MSH exploitation rate, 72%, was derived from an analysis of British Columbia natural coho stocks (Wong, 1982). This estimate may be optimistic because spawner data was derived from fishery officer estimates which are felt to be minimums for most coho stocks. Attempts to derive stock specific production relationships are underway for some Puget Sound and Washington coastal stocks.

Indirect estimates of productivity can be derived from juvenile:spawner production information in combination with data on smolt to adult survival rates. Neither of these components is constant from year to year, and regional differences exist.

Coho productivity is likely to vary between stocks as a result of differences in physical and biological characteristics of the stocks and their specific environments. For example, relative differences in marine survival can affect productivity. The productivity of Puget Sound stocks is estimated to range from 60% to 85% a/, depending upon marine survival rates and smolt production per spawner at MSH escapements. Relative survival rates for hatchery stocks originating along the Strait of Juan De Fuca and Washington coast indicate significantly lower productivities. It is also important to recognize that productivity not only can vary in response to random variation in survival, but also change over time with trends in survival.

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a/ assuming the average smolt produced per female at MSH escapement levels is in the range 50 - 100, a 1:1 male to female adult ratio in the spawning population, and a range of survival to recruitment is 10% -15%.

Expressing coho productivity in terms of theoretical exploitation rates at MSH escapement is particularly useful for fisheries management purposes. Analysis of hatchery CWT data permits inferences to be made about the likely status of wild stocks without the necessity of making direct estimates of wild spawning escapements, assuming that hatchery stocks are representative of neighboring wild stocks. For stock management purposes, fisheries can be regulated to achieve target total exploitation rates (established recognizing expected variations in year-to-year survival and stock-to-stock differences) as an alternative to management for MSH fixed-point escapement goals. If the productivities of the stocks are properly estimated, spawning escapements should stabilize at MSH levels. These features are particularly useful where measurement of coho escapements is difficult, where MSH escapement levels are unknown, or where the structure of the fisheries makes it impractical to manage directly for MSH fixed-point escapement goals (e.g. West Coast Vancouver Island coho stocks are predominantly harvested by mixed-stock troll fisheries and there are few West Coast fisheries that operate on individual stocks).

QUESTION #5: What is the current rate of exploitation of Southern B.C. and Washington origin stocks?

Exploitation rates for Southern British Columbia hatchery stocks with reliable escapement data are presented in Table 1. It should be noted that exploitation rate data for Canadian hatchery stocks differ from those presented in the 1986 Report of the Committee. These differences are due to updates in the Canadian Mark Recovery Data Base. Particular changes in the Canadian data base are due to different procedures for distributing CWT's recovered from the troll fishery and for estimating expansion factors for sport catch, and for changes in escapement estimates made in the last few months.

No comparable time series estimates of exploitation rates for individual hatchery stocks are available for most Washington stocks, due to the incomplete nature of recoveries (particularly escapement) in the existing data base. However, estimates of the 1979-81 average distributions for Washington and Columbia River stock composite groups are presented in Table 3. These data were developed by Hunter (1985a) for purposes of modeling impacts of regulatory alternatives for the Pacific Fishery Management Council. Estimates were based upon CWT recoveries, almost entirely of hatchery stocks, and simulations where suitable data were not available. The totals represented in the last column are <u>not</u> direct estimates of exploitation rates comparable to the data presented in Table 1. In most instances, tag distributions for these stock composites are not directly applicable to natural stock components due to differential harvest patterns by Washington net fisheries.

More recent estimates of CWT recovery distributions for a north Puget Sound, South Puget Sound, Washington Coastal and Columbia River hatchery stock for the 1982 and 1983 recovery years are presented in the middle section of Table 3. These data do not represent exploitation rates. As indicated earlier, available data are incomplete (for example, escapement data for the Lummi/Nooksack stock are not considered, leading to the high proportion of the total recoveries being accounted for by fisheries).

The third section of Table 3 presents CWT recovery data for wild coho tagging experiments on the Queets River of the north Washington coast. Because several small release groups were involved each year, (typically <5,000 fish were tagged per CWT group), recoveries for all groups within a brood year were pooled for analysis. Escapements were derived from mark rates rather than enumeration. Estimates were provided by the Quinault Fisheries Department.

TABLE 2. EXPLOITATION RATES FOR CANADIAN HATCHERY COHO STOCKS
(1984 and 1985 ESTIMATES ARE MINIMUMS DUE TO UNAVAILABILITY OF WASHINGTON CWT DATA)

	BIG QUALICUM PRIMARY RECOVERY YEAR						CAPILANO PRIMARY RECOVERY YEAR					
FISHERY	1980	1981	1982	1983	1984	1985	1980	1981	1982	1983	1984	1985
NORTH/CENTRAL TROLL	4.5%	9.8%	4.2%	14.3%	7.3%	1.6%	0.2%	0.9%	0.4%	2.0%	0.5%	0.0%
NW VANCOUVER TR	3.9%	4.6%	2.9%	6.4%	8.8%	3.3%	1.0%	1.5%	0.7%	2.4%	1.5%	0.4%
SW VANCOUVER TR	5.5%	7.8%	9.3%	4.7%	8.0%	6.1%	4.9%	7.5%	6.9%	6.9%	13.0%	3.1%
GEORGIA/JOHNSTONE TROLL	8.6%	4.8%	8.0%	0.5%	3.2%	6.9%	3.1%	3.6%	2.9%	0.9%	3.5%	4.7%
NORTH CENTRAL NET	0.4%	0.3%	0.2%	0.5%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
WEST VANCOUVER NET	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.2%	0.2%	0.1%	0.0%	0.0%	0.3%
JOHNSTONE NET	8.5%	12.0%	12.2%	12.9%	7.3%	7.0%	0.3%	2.7%	2.1%	4.5%	3.2%	0.2%
SOUTHERN BC NET	1.0%	2.5%	2.3%	4.6%	3.9%	11.6%	3.5%	8.4%	3.3%	2.7%	5.7%	4.1%
BC SPORT	35.7%	24.1%	28.6%	32.8%	21.7%	39.0%	41.4%	40.8%	33.1%	38.1%	37.2%	46.4%
WASHINGTON	5.7%	2.2%	4.0%	1.3%	0.0%	0.0%	8.5%	16.4%	9.7%	6.2%	0.0%	0.0%
ALASKA	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL	73.9%	68.2%	71.8%	78.0%	60.4%	75.8%	63.2%	82.2%	59.2%	63.8%	64.5%	59.2%

	PUNTLEDGE PRIMARY RECOVERY YEAR						QUINSAM PRIMARY RECOVERY YEAR					
FISHERY	1980	1981	1982	1983	1984	1985	1980	1981	1982	1983	1984	1985
NORTH/CENTRAL TROLL	6.5%	12.2%	5.0%	20.3%	8.4%	2.9%	12.6%	12.9%	6.8%	18.7%	12.7%	5.1%
NW VANCOUVER TR	4.1%	8.3%	2.6%	4.7%	7.0%	4.5%	5.7%	3.4%	5.6%	8.9%	6.7%	3.2%
SW VANCOUVER TR	5.2%	5.7%	5.8%	1.6%	6.2%	6.5%	4.2%	2.8%	3.0%	1.9%	6.1%	2.4%
GEORGIA/JOHNSTONE TROLL	9.7%	1.7%	6.4%	1.1%	5.6%	7.7%	5.9%	2.1%	3.0%	2.3%	2.7%	3.0%
NORTH CENTRAL NET	0.4%	0.8%	0.3%	0.8%	0.1%	0.3%	1.4%	0.1%	1.0%	0.5%	0.3%	0.5%
WEST VANCOUVER NET	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
JOHNSTONE NET	11.6%	17.7%	18.2%	28.4%	11.7%	11.6%	17.8%	24.3%	16.9%	22.0%	12.8%	16.6%
SOUTHERN BC NET	0.8%	1.7%	2.0%	2.2%	2.2%	6.4%	0.8%	1.6%	0.8%	0.3%	0.5%	1.1%
BC SPORT	24.4%	11.5%	25.6%	13.9%	21.6%	40.5%	24.8%	20.5%	18.0%	20.7%	23.9%	40.8%
WASHINGTON	3.3%	2.6%	2.6%	0.8%	0.0%	0.0%	1.0%	1.6%	0.7%	0.5%	0.0%	0.0%
ALASKA	0.0%	0.5%	0.1%	0.3%	0.1%	0.0%	0.7%	0.0%	0.1%	0.1%	0.0%	0.0%
TOTAL	66.0%	62.6%	68.6%	74.1%	62.9%	80.4%	75.2%	69.3%	57.8%	75.9%	65.7%	72.7%

	ROBERTSON CREEK PRIMARY RECOVERY YEAR						CHILLIWACK PRIMARY RECOVERY YEAR	
FISHERY	1980	1981	1982	1983	1984	1985	1983	1984
NORTH/CENTRAL TROLL	6.3%	2.9%	3.3%	5.9%	5.8%	3.8%	6.9%	3.5%
NW VANCOUVER TR	26.2%	33.0%	21.4%	21.2%	26.4%	31.9%	4.6%	8.9%
SW VANCOUVER TR	31.7%	32.3%	33.7%	25.9%	30.0%	22.8%	12.6%	24.7%
GEORGIA/JOHNSTONE TROLL	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.8%	7.4%
NORTH CENTRAL NET	0.9%	0.0%	1.3%	0.5%	0.2%	0.0%	0.2%	0.1%
WEST VANCOUVER NET	4.3%	1.8%	0.0%	1.0%	2.6%	0.0%	0.0%	0.1%
JOHNSTONE NET	0.2%	0.0%	0.5%	1.2%	0.0%	0.0%	6.8%	3.1%
SOUTHERN BC NET	0.1%	1.6%	0.0%	0.0%	0.4%	0.9%	1.5%	2.3%
BC SPORT	0.7%	2.6%	1.1%	2.1%	1.0%	1.2%	37.3%	27.0%
WASHINGTON	1.8%	1.5%	1.0%	0.4%	0.0%	0.0%	4.4%	0.0%
ALASKA	0.2%	0.3%	0.0%	0.5%	0.7%	0.1%	0.1%	0.1%
TOTAL	72.5%	76.1%	62.2%	58.6%	67.1%	60.8%	78.1%	77.1%

TABLE 3. 1979-81 AVERAGE ESTIMATED DISTRIBUTIONS FOR WASHINGTON AND COLUMBIA RIVER COHO STOCK GROUPS a/

STOCK	YEAR	AK	N/C TR	N/C NET	NWVI TR	SWVI TR	WCVI NET	GA/JN TROLL	GA/JN NET	B.C. SPORT	P.S. SPT/NT	U.S. WA CST OCN	U.S. WA CST COL	U.S. WA CST RIV	TOTAL
NOOKSACK/SAMISH	79-81	0.0%	0.8%	0.0%	1.8%	17.2%	0.0%	7.9%	6.7%	14.4%	32.2%	8.1%	0.0%		89.1%
SKAGIT	79-81	0.0%	0.4%	0.0%	3.5%	17.2%	0.1%	1.5%	11.9%	3.1%	18.1%	22.4%	0.0%		78.2%
STILLAGUAMISH/SNOH.	79-81	0.0%	0.1%	0.1%	3.7%	26.7%	0.1%	0.6%	9.1%	1.2%	25.9%	13.6%	0.0%		81.1%
SOUTH SOUND NORMAL	79-81	0.0%	0.1%	0.0%	2.7%	23.3%	0.1%	0.1%	6.0%	0.4%	34.5%	12.7%	0.0%		79.9%
SOUTH SOUND DELAYED	79-81	0.0%	0.1%	0.0%	1.1%	17.9%	0.0%	0.1%	6.0%	0.4%	53.2%	11.0%	0.0%		89.8%
HOOD CANAL	79-81	0.0%	0.1%	0.1%	2.5%	26.7%	0.1%	0.1%	6.1%	0.9%	25.5%	15.1%	0.0%		77.2%
JUAN DE FUCA STRAIT	79-81	0.0%	0.9%	0.2%	5.7%	35.5%	0.1%	0.2%	6.0%	0.7%	17.3%	15.3%	0.0%		81.9%
QUILLAYUTE SUMMER	79-81	0.0%	0.2%	0.1%	3.6%	22.6%	1.3%	0.0%	0.0%	0.0%	0.0%	26.5%	25.3%		79.6%
QUILLAYUTE/HOH	79-81	0.0%	0.4%	0.0%	1.9%	31.1%	0.0%	0.0%	0.3%	0.0%	0.0%	32.6%	11.0%		77.3%
QUEETS/QUINAULT	79-81	0.0%	1.0%	0.2%	8.0%	26.4%	0.1%	0.0%	0.6%	0.3%	0.3%	29.4%	16.8%		83.1%
GRAYS HARBOR	79-81	0.2%	3.7%	0.0%	10.0%	28.6%	0.1%	0.0%	0.2%	0.0%	0.1%	21.8%	19.8%		84.5%
WILLAPA BAY	79-81	0.0%	0.7%	0.0%	0.6%	5.4%	0.0%	0.0%	0.0%	0.0%	0.0%	62.2%	17.0%		85.9%
COLUMBIA RIVER LATE	79-81	0.0%	0.1%	0.0%	0.4%	4.8%	0.0%	0.0%	0.5%	0.1%	0.6%	59.7%	22.6%		88.8%
COLUMBIA RIVER EARLY	79-81	0.0%	0.0%	0.0%	0.3%	2.3%	0.0%	0.0%	0.1%	0.0%	0.2%	70.8%	13.5%		87.2%

RECENT DISTRIBUTION OF CWT RECOVERIES FOR SELECTED HATCHERY STOCKS b/

STOCK	RECOVERY YEAR	BC OUT TR	WCVI NET	BC IN TR	BC IN NET	B.C. SPORT	P.S. SPORT	P.S. NET	U.S. WA CST OCN	U.S. WA CST COL R	TOTAL
LUMMI/NOOKSACK	1982	22.2%	0.1%	3.2%	6.4%	9.5%	2.8%	48.6%	7.1%	0.0%	99.9% c/
" "	1983	35.5%	0.8%	0.0%	5.8%	18.2%	1.3%	30.4%	0.7%	0.0%	92.7% c/
SOUTH SOUND DELAYED	1982	26.4%	0.0%	0.0%	3.1%	0.2%	4.3%	48.5%	8.9%	0.0%	91.4%
" "	1983	27.1%	0.0%	0.0%	1.0%	0.7%	9.6%	44.4%	2.3%	0.0%	85.1%
QUINAULT HATCHERY	1982	38.4%	0.0%	0.0%	1.7%	0.0%	0.0%	1.2%	23.6%	1.4%	66.3%
" "	1983	69.3%	0.4%	0.0%	1.1%	0.0%	0.0%	0.2%	16.6%	0.0%	87.6%
COLUMBIA RIVER LATE	1982	3.3%	0.0%	0.0%	0.1%	0.0%	0.1%	0.2%	48.6%	29.0%	81.3%
" "	1983	17.4%	0.2%	0.0%	0.2%	0.2%	0.9%	0.1%	62.0%	0.9%	81.9%

DISTRIBUTION OF CWT RECOVERIES FOR WILD COHO TAGGING STUDIES ON THE QUEETS RIVER SYSTEM d/

	RECOVERY YEAR	BC OUTSIDE TROLL	US OCEAN	TERMINAL NET	TOTAL
	1981	10.3%	33.1%	9.0%	52.4%
	1982	26.0%	23.7%	7.7%	57.4%
	1983	47.2%	22.3%	2.6%	72.1%
	1984	38.0%	5.8%	7.0%	50.8%
	1985	24.2%	11.4%	18.6%	54.2%
Preliminary	1986	33.8%	7.4%	11.0%	52.2%

a/ Based on hatchery stock CWT recoveries and modeling. Exploitation rates for wild stocks in near terminal fisheries may differ substantially due to differences in run timing and management actions.

b/ Estimates provided by Washington Department of Fisheries.

c/ CWT recoveries in escapements are not available.

d/ Estimates provided by the Quinault Fisheries Department, Taholah, Washington.

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APPENDIX: ASSUMPTIONS AND LIMITATIONS OF PROCEDURES EMPLOYED TO MAKE STOCK COMPOSITION ESTIMATES LISTED IN TABLE 1

ESTIMATES I & II. Technical committee on salmon interceptions: (Anon 1981a, Anon 1981b)

A report entitled "US-Canada Consultations of Salmon Problems of Mutual Concern" led to the documentation of salmon interception estimates in bilateral, confidential agency reports. These reports eventually led to a series of Canada-US interception reports which were prepared annually from 1971 through 1978 by the Technical Committee on Salmon Interceptions.

These reports estimated the Canadian and US interception of all salmon species in fisheries of each country. The reports applied fixed percentages to all years. There was never a consensus on the interception percentages; thus, the reports typically listed two set of figures for interception percentages and numbers.

The estimates of stock composition by nation of origin were made from an amalgam of data available at that time, including adult tagging programs (Wright 1968, Argue and Heizer 1971, Bourque and Pitre 1972) and fin clip data (Godfrey 1968, Senn and Satterwaite 1971, Senn 1971). Percentage data have not been updated since 1971 (Anon. 1971), thus they do not incorporate coded wire tag data.

Assumptions:

1. The distribution and abundance of individual stocks do not change from year to year.

2. Reliable estimates of spawning escapements are available for all relevant stocks.

3. Subsequent fisheries and escapements are adequately sampled for the tagged stocks.

4. Fin regeneration, natural marks, mortality loss, and tagging mortality loss can be accurately estimated.

Limitations:

1. These estimates are based on limited data that do not allow assessment against assumptions.

2. These estimates have not been adjusted for changes in hatchery and wild production.

3. There are several potentially serious sources of biases in the procedures employed to derive stock composition estimates from fin-clip data.

ESTIMATE III. Swain's CWT stock composition analysis.

This analysis of stock composition is based on CWT data and hatchery production. All tag codes are used and all unmarked hatchery production is associated with tagged production adjusted for relative survival rates. Untagged releases are associated with tagged releases based on:

1. Area of release.
2. Time of release.
3. Size of release.
4. Stock similarity.

Recoveries are expanded by the catch/sample ratio and then corrected for marked/unmarked ratio at release. This produces estimates of hatchery production in every time and area strata. Wild US production is calculated by run reconstruction which uses marked to unmarked ratios at the hatcheries and in the terminal fisheries to calculate terminal run sizes. The Canadian wild component is the residual after subtraction of all US production and Canadian hatchery production.

Assumptions:

1. The marine distributions of all tag codes are representative of their associated untagged hatchery and wild production.

2. Canadian wild production is the remainder after subtracting US and Canadian hatchery production and estimates of US wild production.

3. Run timing and exploitation rates in terminal fisheries are the same for hatchery and wild stocks.

Limitations:

1. Run reconstruction assumes that migration patterns and timing are known for all stocks.

2. Not all tag codes are representative of production. Stocks of non-local genetic origin and some delayed release production often have different survival rates and marine distributions.

3. Several stocks incorporated into the model had no representative releases of CWT codes during the base years used to derive the estimate, and their contributions to various fisheries were estimated by other means.

4. Run timing of the hatchery and wild components of the same stock sometimes differ.

5. Inaccuracies exist in some escapement and hatchery production estimates. Stock composition estimates would be highly sensitive to errors in these data.

ESTIMATE IV. Hunter's (1985) CWT stock composition estimates.

Although developed independently, estimation techniques by Swain and Hunter are very similar.

All available tag codes released during the base period were utilized except those with non-local genetic origins or marine distributions different from other codes of the same stock. Association analysis assigned all unmarked hatchery production to the most representative CWT code of the same stock. Once this step was done, all CWT recoveries were expanded to derive estimates of hatchery stock catches by time and area strata. Then, using independent estimates of wild production and terminal area sampling, hatchery catch estimates were expanded to represent total stock production. Production of Georgia Strait wild stocks was estimated as the portion of the total Georgia Strait sport and troll catch that remained after subtracting the catch accounted for by other stocks. The distribution of Georgia Strait hatchery fish was then assumed to be representative of Georgia Strait wild stocks.

Assumptions:

See the assumptions listed under Swain's CWT estimate.

Limitations:

1. See limitations of Swain's estimates above.

2. Some of the CWT data and escapement estimates incorporated were preliminary.

3. Several stocks incorporated into the model had no representative releases of CWT codes during the 1976-8 brood base years of the model, and were estimated by other means. The Skagit River stock marine distribution was estimated by extrapolation of adjacent Puget Sound stocks. For the Quillayute-Hoh, Grays Harbor and Willapa Bay stocks, CWT recovery data from an earlier time period was manipulated to reflect the catch patterns in the 1979-81 catch base period.

ESTIMATE V. Ramonda-Powell's (1986) stock composition estimates indirectly derived from CWT data

This analysis was undertaken to provide a rough estimate of stock composition for the Area 20 net fishery. Tables made available from the Canadian Department of Fisheries and Oceans (DFO) provided estimates of all Canadian hatchery catches in the Georgia Strait troll and sport fishery and the Area 20 net fishery. After subtracting out estimated catches of Canadian hatchery fish and US fish from the total Georgia Strait catches, the remaining catch was assumed to be Georgia Strait wild stocks. The estimated proportion of Georgia Strait wild fish in the Georgia Strait fisheries was then applied to the catch estimate of Canadian hatchery stocks in Area 20 to derive a catch estimate of total Canadian stock contributions in Area 20. The remaining catch was assumed to be fish of US origin.

Assumptions:

1. 19% of the Georgia Strait sport and troll catch were of US (i.e., Puget Sound) origin, based upon an analysis independent of this effort.

2. Georgia Strait wild stocks and Georgia Strait hatchery stocks, collectively, have identical marine distributions.

Limitations:

1. The ratio of Georgia Strait wild to hatchery coho in Georgia Strait fisheries is not likely to be identical to that in Area 20 fisheries.

2. Fraser stocks were not directly represented by tagged hatchery production during the period examined.

ESTIMATE VI. WCVI Troll Model (English et al 1986)

The WCVI troll management model was developed by Canadian managers prior to the 1986 fishing season to analyze the fishery and resource impacts of alternative management strategies. Interception percentages were estimated for areas 21 through 27 as a unit by using the results of an analysis conducted by LGL Environmental Associates, Ltd for DFO to estimate hatchery composition. Wild stock contributions are estimated by simple subtraction. The total hatchery contribution is estimated as 29 percent of the total catch. In addition, US hatchery stocks are estimated to contribute 92 percent of the hatchery total. After wild stocks are included in this method, 55% of the WCVI troll catch is estimated to consist of US stocks.

Assumptions:

1. Accurate estimates of hatchery contribution rates are provided by the LGL analysis.

2. 71% of the catch is of wild stocks.

3. 60% of the wild stocks are of Canadian origin.

Limitations:

1. Wild stock compositions are informed guesses. Available data are incomplete.

2. The method assumes that the stock composition is constant during the season, between areas and between seasons.