Development of Troll Fishery Management Models for Southern British Columbia

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The recent Canada/U.S. Pacific Salmon Treaty has significantly influenced the management of British Columbia's commercial and sport fisheries. This report presents some of the information and analytical tools required to manage south coast troll fisheries under the treaty. Distribution and migration timing for chinook and coho stocks was obtained through extensive analysis of coded wire tag recovery data. Other analyses indicated that troll catch per effort data could be used to provide in-season estimates of diversion rates for sockeye and pink stocks vulnerable to Johnstone Strait and West Coast Vancouver Island fisheries. Available catch, effort and catch at age data were analysed and summarized for 1976 through 1985. The results of these analysis were used to update the Georgia Strait chinook and coho model and to develop a simulation model for the West Coast Vancouver Island troll fishery. The latter model includes five species of Pacific salmon and can be used to evaluate a wide variety of management options (e.g., time or area closures by speices, effort restriction, size limits, catch ceilings). Model documentation and data summaries are provided in appendices.

Key Words: Pacific salmon, commercial troll fishery, management model, regulations.

RESUME

Le recent Traité entre le Gouvernement du Canada et le Gouvernement des Etats-Unis d'Amerique concernant le saumon du Pacifique a imposé des constraintes a la gestion des pêches commerciales et sportives en Columbie-Britannique. Le present rapport expose une partie des donneés et des methodes analytiques necessaires a la gèstion de la pèche a la ligne sur la côte Sud dans le cadre de ces nouvelles constraintes. Dan le cas des stocks de saumons quinnat et coho, les donneés sur la repartition et le moment de la remonte ont été obtenues de l'analyse detailée des étiquettes metalliques codées recupérées. D'autres analyses ont révélé que les donneés sur les prises par unité d'effort de pêche aux lignes trainantes peuvent servir aux estimations saisonnieres des taux de déviation des stocks de saumons rouge et rose exposés aux peches effectuées dans le Détroit de Johnstone et les eaux a l'ouest de l'Ile de Vancouver. Les auteurs ont analyse les résumés et les données disponibles sur l'effort, les prises et les prises selon l'age de 1976 a 1985. Les résultats obtenus ont servi a mettre a jour le modèle pour la gestion de la pêche des saumons quinnat et coho du Detroit de Georgie et a elaborer un modèle de simulation de la pêche aux lignes trainantes dans les eaux a l'ouest de l'Ile de Vancouver. Ce dernier modele porte sur cinq especes de saumons du Pacifique et peut servir au calcul d'une grande varieté de choix de gestion (par ex. périodes ou zones de fermeture de la pêche selon l'espèce, restrictions de l'effort, limites de taille, limites de prises). La documentation sur les modeles et des résumés de données sont presentés en annexes.

Mots-clés: saumon du Pacifique, pêche commerciale aux lignes trainantes, modèle de gestion, reglement.

INTRODUCTION

The recent U.S.-Canada Pacific Salmon Treaty has significantly influenced the management of British Columbia's troll fisheries. The Treaty included: commitments to reduce the harvest rate on chinook stocks by introducing chinook catch ceilings on all troll fisheries; coho catch ceilings for the West Coast Vancouver Island troll fishery; and harvest goals for all troll fisheries that target on Fraser River sockeye and pink stocks. This report describes an analytical model developed to assist in the management of the West Coast Vancouver Island troll fishery under these new international constraints.

The major goal of this study was to integrate all recent and reliable information on British Columbia's major troll fishery into an analytical tool that could be used to evaluate management options. The study included: extensive analyses of coded wire tag recovery data for information on the distribution and migration timing of chinook and coho stocks; assessment of whether troll catch per effort data could be used to provide inseason estimates of diversion rates for sockeye and pink stocks vulnerable to Johnstone Strait and West Coast Vancouver Island fisheries; and the organization of reliable catch, effort and fish age data for south coast sport and troll fisheries. The results of these analyses were used to update the Georgia Strait Chinook and Coho Model and develop a simulation model for the West Coast Vancouver Island troll fishery. The latter model includes all five species of pacific salmon and can be used to evaluate a wide variety of management options. This report presents the results of data analyses, and describes the structure and function of the West Coast Vancouver Island Management Model.

WEST COAST VANCOUVER ISLAND TROLL FISHERY

The West Coast Vancouver Island troll fishery (Statistical Areas 21-27) is the largest troll fishery on the Pacific coast. The average annual catch for the five years prior to the imposition of catch ceilings (1979-1983) was: 460,000 chinook, 1,796,000 coho, 525,000 sockeye, 2,303,000 pink in odd years; 119,000 pink in even years; and 27,000 chum. Chinook catches peaked first during the mid-1950's and again in the 1970's (Table 1). A catch ceiling of 360,000 chinook implemented in 1985 has limited catches for the past two years. Coho catch by trollers first exceeded one million pieces in 1961 and since then has fallen below this level only three times, in 1970, 1972 and 1975. The total catch of coho exceeded two million pieces in the two years prior to the implementation of a 1,750,000 catch ceiling in 1985. Since the 1960's, catches of pink and sockeye, principally Fraser River stocks, have been an important feature of the late summer troll fishery on the west coast. Sockeye catches have been consistently largest in the Adams cycle year (e.g., 1978, 1982, 1986). Allocations based on run size have limited troll catches of sockeye and pink salmon since 1985. Troll catches of chum salmon have not been limited like other species, and this may explain the large increase in chum landings observed in 1985 and 1986.

Figures 1 through 4 show the temporal distribution of chinook, coho, sockeye and pink catches and fishing effort for the West Coast Vancouver Island troll fishery for the 1981 through 1984 fishing seasons. Chinook salmon catches are distributed fairly evenly over the entire fishing season, with peak catch occurring in conjunction with peak fishing effort in July and August. Age three chinook account for roughly one half of the catch.

Table 1. Annual catch and effort statistics for the West Coast Vancouver Island troll fishery (Statistical Areas 21, 23-27) for 1951-1986. Statistics obtained from the Salmon Catch Database using the methods outlined in Wong (1983). The history of the west coast Vancouver Island fishery has been described by Argue et al. (1987), and the recent fishery discussed in detail by Shardlow et al. (1986).

Year	Chinook	Coho	Sockeye	Pink	Chum	Effort
1951	270047	1054144	6280	60634	429	0
1952	330817	1076357	1053	2524	97	0
1953	344693	759878	3733	150645	183	0
1954	285393	624225	26375	1527	301	0
1955	290486	633339	5394	100253	211	0
1956	360634	639420	1318	2977	144	0
1957	336349	661702	6903	79821	396	0
1958	252035	823755	23563	7749	293	0
1959	232294	919430	24790	302031	477	0
1960	175795	369590	6110	4616	187	0
1961	151194	1095847	15077	142297	677	0
1962	157325	1069208	20947	99114	1276	0
1963	277342	1079249	8479	584782	1062	53520
1964	343545	1209606	8792	14986	863	59180
1965	404893	1699930	16081	113611	894	66680
1966	522998	1420426	34405	69891	413	69510
1967	395318	1002218	215995	1328705	570	71490
1968	419554	1838960	95019	119734	1805	72610
1969	459866	1040342	151562	479950	2282	69780
1970	353789	779433	277479	236842	9637	64740
1971	615847	2175719	585073	959174	5697	81610
1972	578404	988425	26216	39318	1282	65580
1973	610424	1406301	98253	802575	7415	68920
1974	628310	1644003	749607	115484	5071	66050
1975	547402	781248	54534	606231	8249	61460
1976	656161	1640259	64782	150442	4720	63070
1977	566571	1567879	65306	1701141	9967	74400
1978	555259	1360274	710788	105143	30554	74015
1979	480373	1912878	330956	3064409	18992	85400
1980	488155	1738470	23276	201903	21877	93870
1981	397518	1385323	44433	2753954	9373	80470
1982	543783	1777436	2190455	36680	73426	89010
1983	385367	2167438	36604	1091352	8978	78770
1984	460057	2172166	41797	65971	12930	69050
1985	354052	1389055	1051373	1817907	221852	63060
1986	342063	2156833	1780585	169669	264249	53307

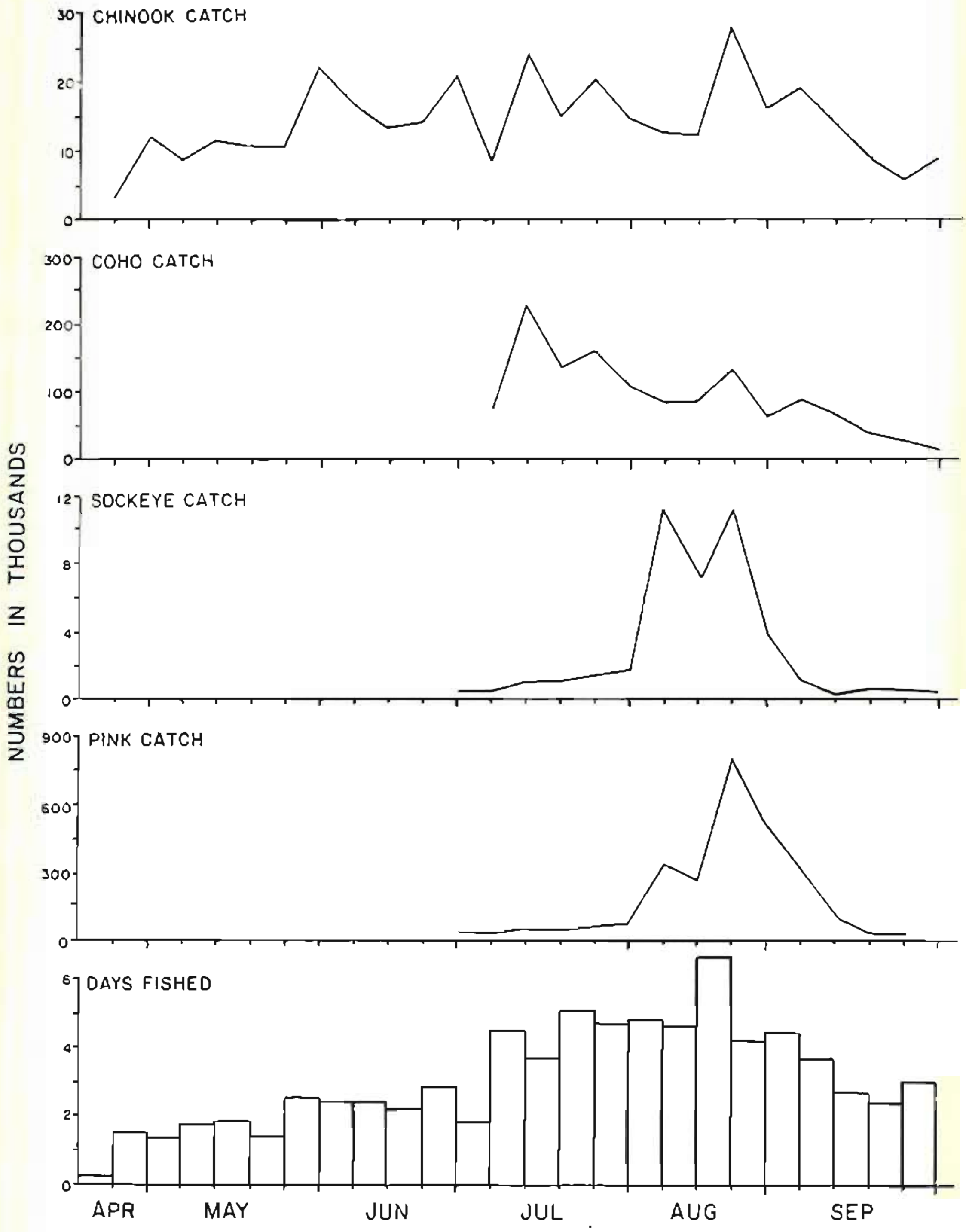


Figure 1. Trends in weekly catch and effort for the West Coast Vancouver Island troll fishery, 1981.

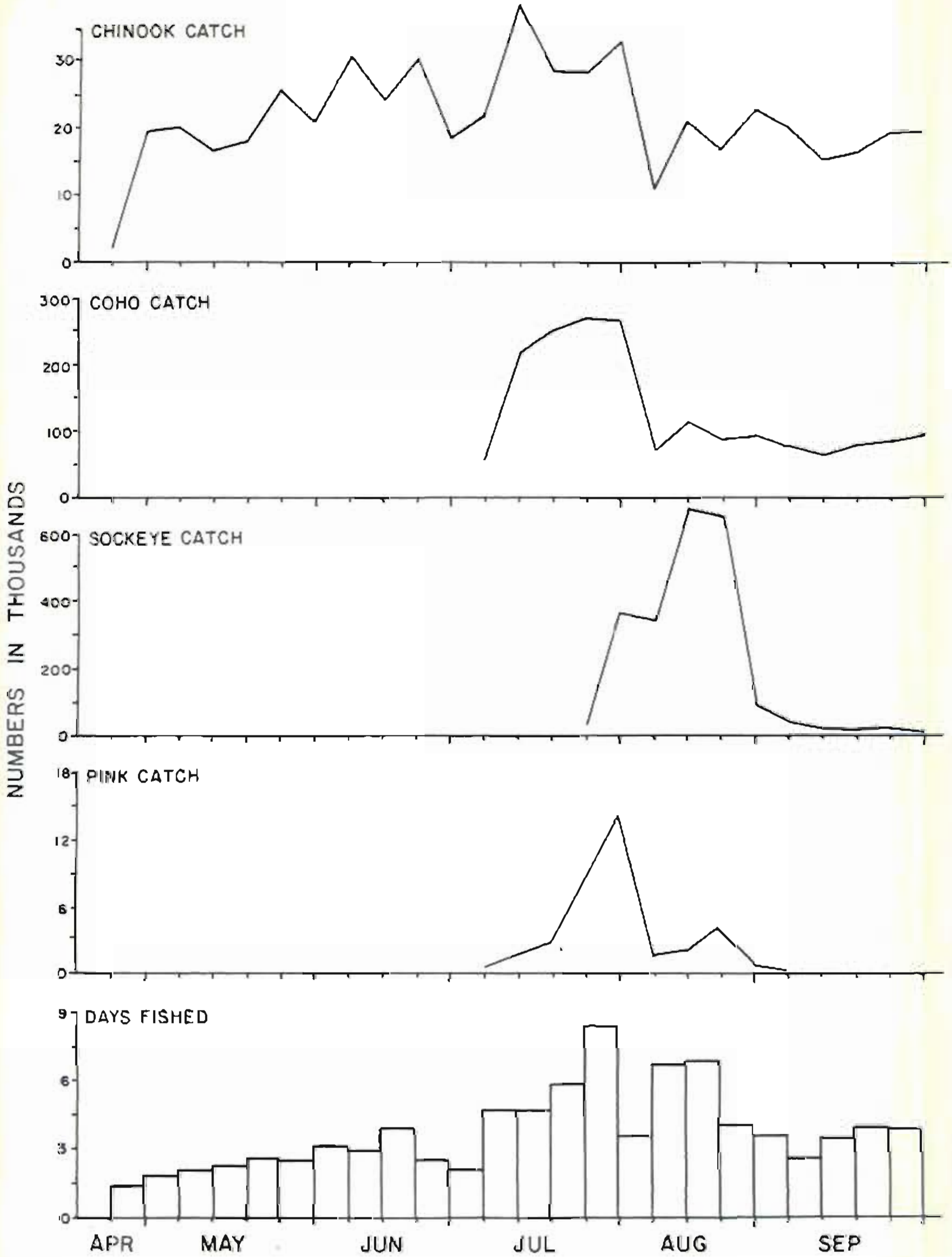


Figure 2. Trends in weekly catch and effort for the West Coast Vancouver Island troll fishery, 1982.

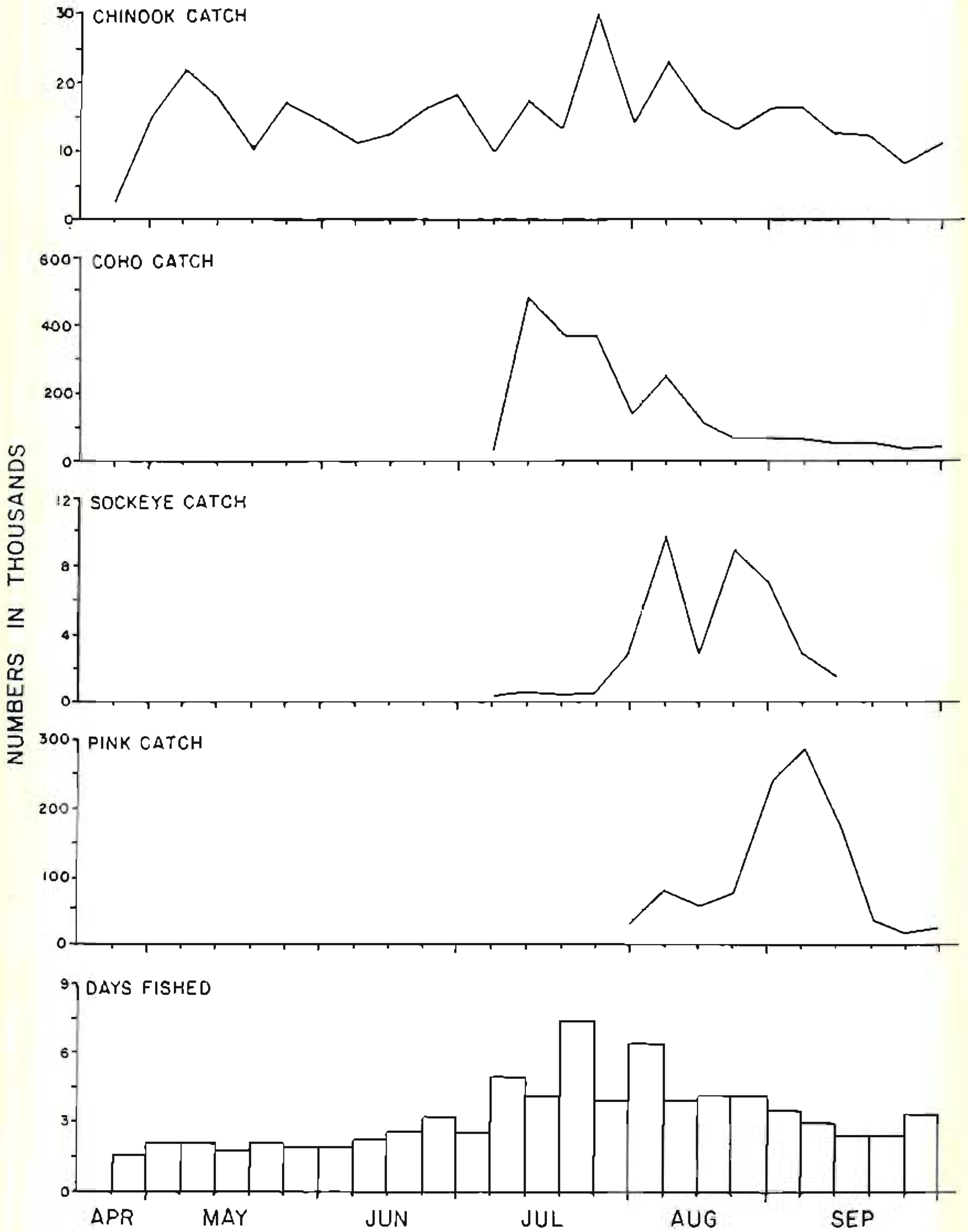


Figure 3. Trends in weekly catch and effort for the West Coast Vancouver Island troll fishery, 1983.

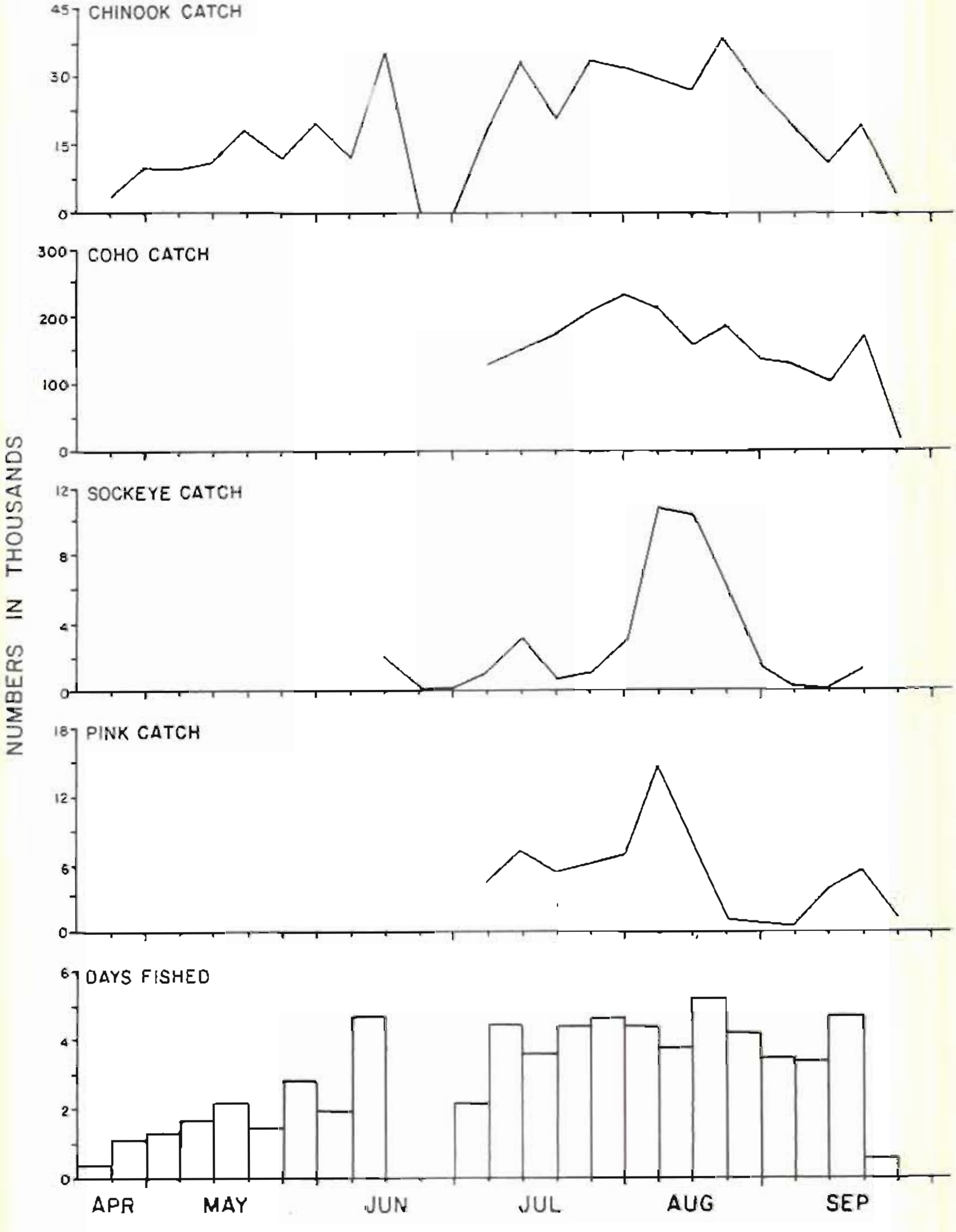


Figure 4. Trends in weekly catch and effort for the West Coast Vancouver Island troll fishery, 1984.

The 1981-83 coho harvests show similar patterns of peak catches in mid-July and a rapid decline through August and September. In 1984, both coho catch and fishing effort remained high through early September. The concentration of fishing effort in this period may have been due to fishermen's response to poor spring fishing and the fishery closure in mid-June.

In each of the years the peak sockeye harvests occurred in mid-August, but the number of sockeye harvested in the Adams cycle year (1982) was more than 50 times the sockeye harvested in other cycle years between 1981 and 1984. However, the 1985 harvest of the Horsefly cycle year was the first time that troll catches exceeded one million sockeye in a non-Adams cycle year.

The pink salmon catch statistics for the West Coast troll fishery are dramatically different for odd and even year stocks. Even year pink harvests are small and peak in late July or early August. Odd year pink catches are large (exceeding 2 million pieces in recent years) and peak in late August or early September. The majority of the pink harvest is taken during 2-3 weeks with weekly catches as high as 750,000 pieces in some years.

United States stocks of chinook salmon from Puget Sound, the Columbia River (fall chinook), and coastal Washington and Oregon are thought to be major contributors to the West Coast troll fishery. Evidence from ocean tagging, analysis of flesh colour of troll catches and escapements, and coded wire tagging suggests that late fall runs of chinook from the Fraser and other B.C. south coast rivers are also important contributors to this fishery. Coho are thought to be mostly from Washington, West Coast Vancouver Island and Georgia Strait stocks. Available coded wire tagging results suggest that hatchery stocks of both species may be a large portion of troll catches; however, this is based on results from limited tagging enhanced stocks. The data on wild stock contributions to West Coast troll catches are far from complete.

Canada has maintained the West Coast troll fishery virtually free from regulations for conservation purposes since its inception in the 1920's. Management actions have been primarily aimed at increasing yield per recruit (e.g., area closures to minimize capture of small coho and chinook during the April - May chinook fishery, and changes to size limits and season).

Over the last decade, Canada has recognized the strategic role that the west coast troll fishery plays in negotiations with the United States. Prior to 1985, there was a reluctance on the part of Canada to curtail west coast troll catches because a high proportion of the catch originated from U.S. stocks.

Domestic and international concern over the status of chinook stocks was responsible for this fishery being placed under a 360,000 catch ceiling for the first two years of the U.S.-Canada Salmon Treaty signed in 1985.

Under the current U.S.-Canada Salmon Treaty, the managers responsible for the West Coast Vancouver Island troll fishery have a number of restrictions to contend with:

1. An annual chinook catch ceiling;
2. an annual coho catch ceiling;

3. an annual sockeye catch limitation based on run size; and
4. an annual pink catch limitation based on run size.

The reasons behind each of these restrictions reveal some of the hidden complexities associated with developing management plans to achieve international objectives.

The chinook catch ceilings were designed to reduce harvest rates on declining wild Canadian chinook stocks, and control the Canadian harvest of U.S. chinook salmon. Since the catch ceilings were based on historical fishing patterns, the effect of any reallocation of fishing effort must be taken into account. For example, area closures or changes to the fishing season may keep the catch under the ceiling yet increase the Canadian harvest of U.S. stocks, with all the benefit going to Canadian chinook stocks. Therefore, the manager must take into account all the available information on the timing, distribution and relative abundance of Canadian wild stocks, Canadian hatchery stocks and U.S. stocks when evaluating alternative hook and line management options for the south coast chinook fisheries.

The reasons behind the West Coast coho catch ceiling are much less refined than those for chinook. The current objective is essentially to control the large catch of coho in the West Coast troll fishery until the status of U.S. and Canadian coho stocks has been determined. The information required for effective management of coho harvests is similar to that for chinook.

The rationale behind the sockeye and pink catch limitations is based on the desire to allocate a set proportion of the total catch of Fraser sockeye and pink stocks to the West Coast Vancouver Island troll fishery. In some years, sockeye and pink catches may help compensate troll fishermen for reductions in their allowable catch of chinook and coho. In years when a large portion of the Fraser stocks do not migrate through Johnstone Strait, a large allocation to the west coast troll fishery may be necessary to achieve the desired Canadian harvest rate for these stocks. Therefore, the west coast troll fishery manager must take into account in-season changes in the estimated run size and diversion rates when opening the West Coast troll fishery for harvests of sockeye and pink salmon.

DATA ANALYSIS

Coded Wire Tagging Data Analysis

Coded wire tag data were examined to extract information on a) the distribution and timing of chinook and coho salmon through the West Coast troll fishery; and b) immigration and emigration to and from Georgia Strait. This information was used to develop a management model for the West Coast Vancouver Island troll fishery and to update models currently used to evaluate management options for the Georgia Strait troll and sport fisheries.

Coded wire tag (CWT) data represents the majority of the available information on the contribution of specific chinook and coho stocks to each salmon fishery. Coded wire tag data are essentially mark-recapture data; the marks are applied where the origin of the fish is known and are recovered in fisheries. The marking involves the removal of the adipose fin and the implantation of a small piece of binary or colour coded wire in the nose of the fish. Most of the fish marked are of hatchery origin; however, some non-hatchery stocks are tagged.

The Mark Recovery Program (MRP) involves the examination of 20% of commercial catches of chinook and coho for missing adipose fins. The heads of the marked fish are removed and sent to a laboratory where the coded wire tags are removed and decoded. In Canada, sport fisheries are not systematically surveyed for CWT's. Therefore, tag recoveries from sport fisheries are from CWT heads voluntarily returned by sport fishermen.

The CWT data used in this project were obtained from the Canadian MRP database. All chinook and coho CWT recoveries for 1976-1982 brood years (1978-1985 catch years) were extracted from the MRP database and organized into files which included the following information:

1. Tag code
2. Hatchery origin
3. Production area
4. Brood year
5. Recovery year
6. Week of recovery

Separate files were created for recoveries for each Canadian commercial catch region with catch-to-sample ratios, and troll recoveries for West Coast Vancouver Island statistical areas and sub-areas without catch-to-sample ratios. Georgia Strait sport fishery recoveries were organized into other files. Table 2 shows the number of observed CWT recoveries for the total Canadian commercial catch for each calendar year. The small number of observed recoveries in 1978 reflects the scarcity of age two chinook and coho in commercial harvests.

The analysis of CWT data involved the following sequence of tasks:

1. determine the appropriate spatial, temporal and stock resolution for analysis;
2. examine stock movements between fisheries; and
3. examine temporal changes in stock composition in major fisheries.

Spatial, Temporal and Stock Resolution

The appropriate spatial scale was determined by examining the number and stock composition of observed recoveries for different levels of stratification, ranging from sub-statistical areas to catch regions. Table 3 shows the percent of total recoveries for chinook and coho that have statistical area and sub-area information. More than 75% of the CWT recoveries from the West Coast Vancouver Island troll fishery between 1981 and 1983 had statistical area information; however, only 36% of these recoveries had sub-area information. The sub-area and statistical area recoveries show similar trends in stock composition for the West Coast troll fishery. Figures 5 and 6 show that the percent of CWT recoveries which were fish of B.C. origin increases from south to north. These trends are probably a product of the B.C. stocks tagged (primarily Georgia Strait and Robertson Creek hatchery stocks) rather than the true distribution of all B.C. chinook and coho stocks. Unfortunately,

Table 2. Observed CWT recoveries for the total Canadian commercial catch.

Calendar Year	Observed Recoveries: Chinook	Coho
1978	34	4
1979	1758	4163
1980	2049	3727
1981	1127	2177
1982	1394	3087
1983	1138	3156
1984	2026	7774
1985	1069	5090
TOTAL	10,595	29,178

Table 3. Percent of total recoveries that have statistical area and sub-area information.

	# of Recoveries			% of Total Recoveries		
Year	Catch Region	Statistical Area	Sub-Area	Catch Region	Statistical Area	Sub-Area
Chinook						
1981	1127	730	446	100	65	40
1982	1394	1115	536	100	80	38
1983	1138	913	320	100	80	28
TOTAL	3659	2758	1302	100	75	36
Coho						
1981	2177	1488	911	100	68	42
1982	3087	2543	903	100	82	29
1983	3156	2763	931	100	88	30
TOTAL	8420	6794	2745	100	81	33

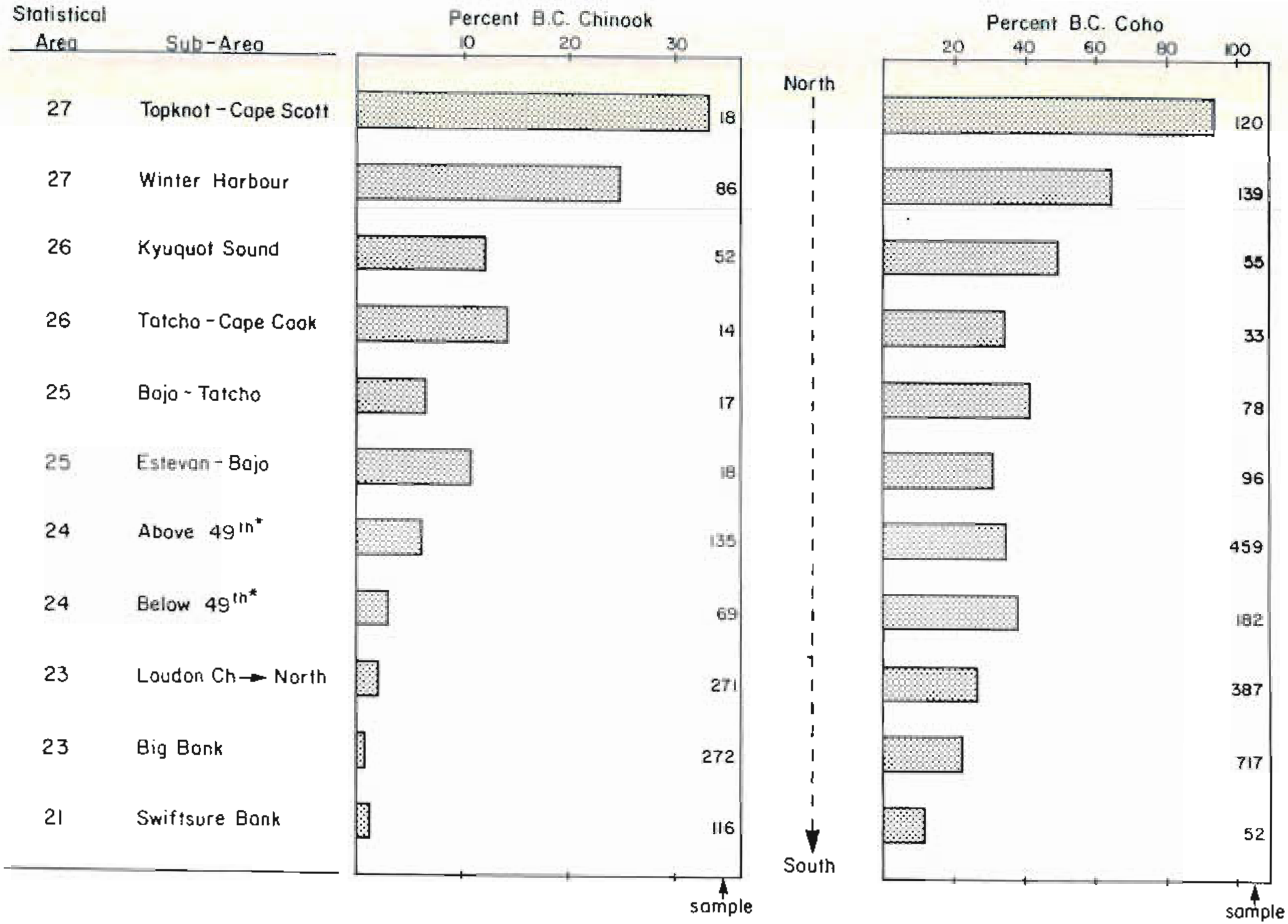


Figure 5. Percent of CWT observed recoveries that were fish of B.C. origin for each major sub-area within the West Coast troll fishery, ordered north to south.

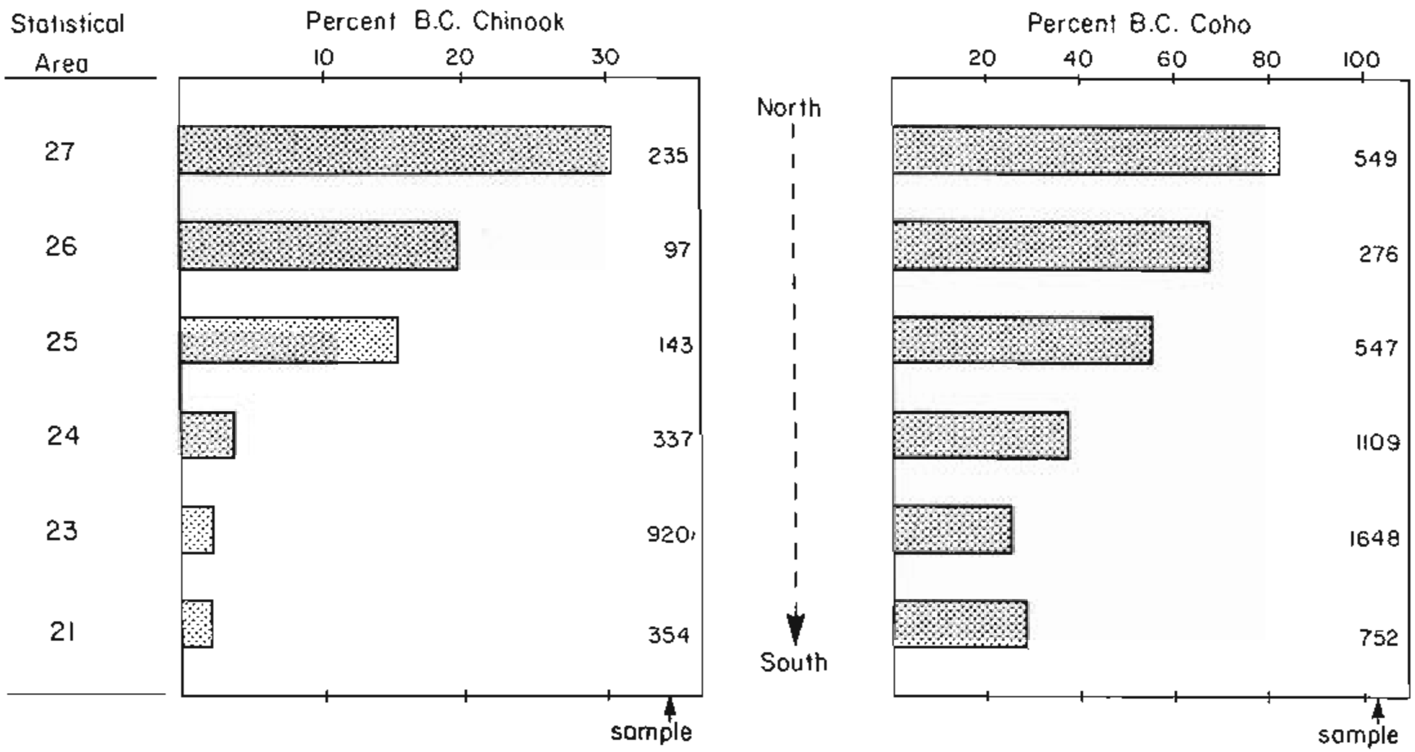


Figure 6. Percent of CWT observed recoveries that were fish of B.C. origin for each statistical area within the West Coast troll fishery, ordered north to south.

statistical area and sub-area recoveries cannot be adjusted for sampling rates, so the bulk of CWT analyses presented in this report are based on on recoveries by catch region (grouped statistical areas) adjusted for sampling rates.

The maximum temporal resolution of one week was selected because weekly tag recoveries could be adjusted for sampling rates, and weekly time series may reveal movement patterns between fisheries and temporal changes in stock composition within a fishery.

Tag recoveries were amalgamated into seven chinook and six coho stocks on the basis of the distribution of recoveries and the stock's national origin. The stock groupings are defined in Table 4. Further sub-division of Georgia Strait chinook stocks could be justified if these stocks were not such a minor component of the west coast troll fishery. For stocks outside Georgia Strait the variability between hatchery stocks within a production area was small. The stock groupings defined in Table 4 include hatchery stocks with similar distributions among the major fisheries, while each stock group has a distinct distribution from the other stock groups with the same national origin. (For example: GSTR coho are distributed differently from all other coho stocks while WCVI coho are distinctly different from other B.C. stocks but very similar to LOCO coho).

Stock Movements Between Fisheries

The change in stock distribution over time was used as an indicator of stock movements. Observed CWT recoveries for a specific stock were adjusted for sampling rate and accumulated for major catch regions each week. The tables resulting from these analyses revealed the temporal changes in the catch of a stock within each catch region and information on the timing of movements between catch regions. Figure 7 shows an example of the distribution and timing of CWT recoveries for Georgia Strait chinook stocks. These figures do not show any clear indication of the timing of juvenile migrations out of Georgia Strait, possibly because the majority of out migrants are unavailable to fisheries (i.e., out migration occurs during periods when the fisheries are closed or most out migrant chinook are too small to be caught or legally landed). These fisheries do provide some indication of the timing of migration into Georgia Strait of spawning age fish and the existence of a resident population in Georgia Strait. The peaks in late summer recoveries of age three to five chinook in Johnstone Strait, probably represent mature fish migrating through these fisheries on the way to their natal streams. The consistent presence of Georgia Strait stocks in the Georgia Strait troll fishery supports the hypothesis that some portion of Georgia Strait chinook stocks reside in Georgia Strait throughout the year. The large decrease in chinook recoveries per effort from May to June, and coho recoveries per effort from July to August suggests that the Georgia Strait fisheries may be harvesting from a closed population (i.e., very little immigration or emigration) over this period of time (Figure 8). Similar rationale and data were used to describe the resident and migratory components of the major stocks caught in the Georgia Strait and West Coast Vancouver Island troll fisheries (Table 5). All of the stocks presented in Table 5, except WCVI chinook, appear to have a component that was resident in one or both of the south coast troll fisheries. The West Coast Vancouver Island chinook (mainly Robertson Creek hatchery fish) are primarily caught in northern B.C. and

Table 4. Definition of chinook and coho stock groups using the distribution of CWT recoveries among major B.C. and Alaskan fisheries.

Origin	Code Name	Production Area	% Distribution of Recoveries: Juan de Fuca Strait (net)	Georgia Strait (sport & troll)	Johnstone Strait (net)	West Coast Vancouver Is. (troll)	Northern B.C. and Alaska (troll)
<u>Chinook</u>							
B.C.	GSTR	GSML,GSVI	1	53	12	2	32
B.C.	LWFR	LWFR	9	47	2	33	9
B.C.	WCVI	SWVI,NWVI	1	1	1	12	85
U.S.	WA13	WA01,WA02,WA03	5	48	3	36	8
U.S.	WA46	WA04,WA05,WA06	5	12	1	75	7
U.S.	UPCO	*LOCO,UPWA,LWWA,UPOR HEAD,BRGT,WILL DESC	2	1	2	65	30
U.S.	LOCO	*LOCO,LWDR,CALI,SACR	3	0	1	95	1
<u>Coho</u>							
B.C.	GSTR	GSML,GSVI	6	50	20	21	3
B.C.	LWFR	LWFR	2	62	4	30	2
B.C.	WCVI	SWVI,NWVI	1	1	0	96	2
U.S.	WA01	WA01	12	39	5	42	2
U.S.	PGSD	WA02-06	14	3	1	82	0
U.S.	LOCO	LOCO,WILL,LWOR UPOR,UPWA,LWWA	1	1	0	96	2

GSTR - Georgia Strait
LWFR - Lower Fraser
WCVI - West Coast Vancouver Island

WA13 - Washington Area 1-3
WA46 - Washington Area 4-6
WA01 - Washington Area 1

PGSD - Puget Sound
UPCO - Upper Columbia
LOCO - Lower Columbia

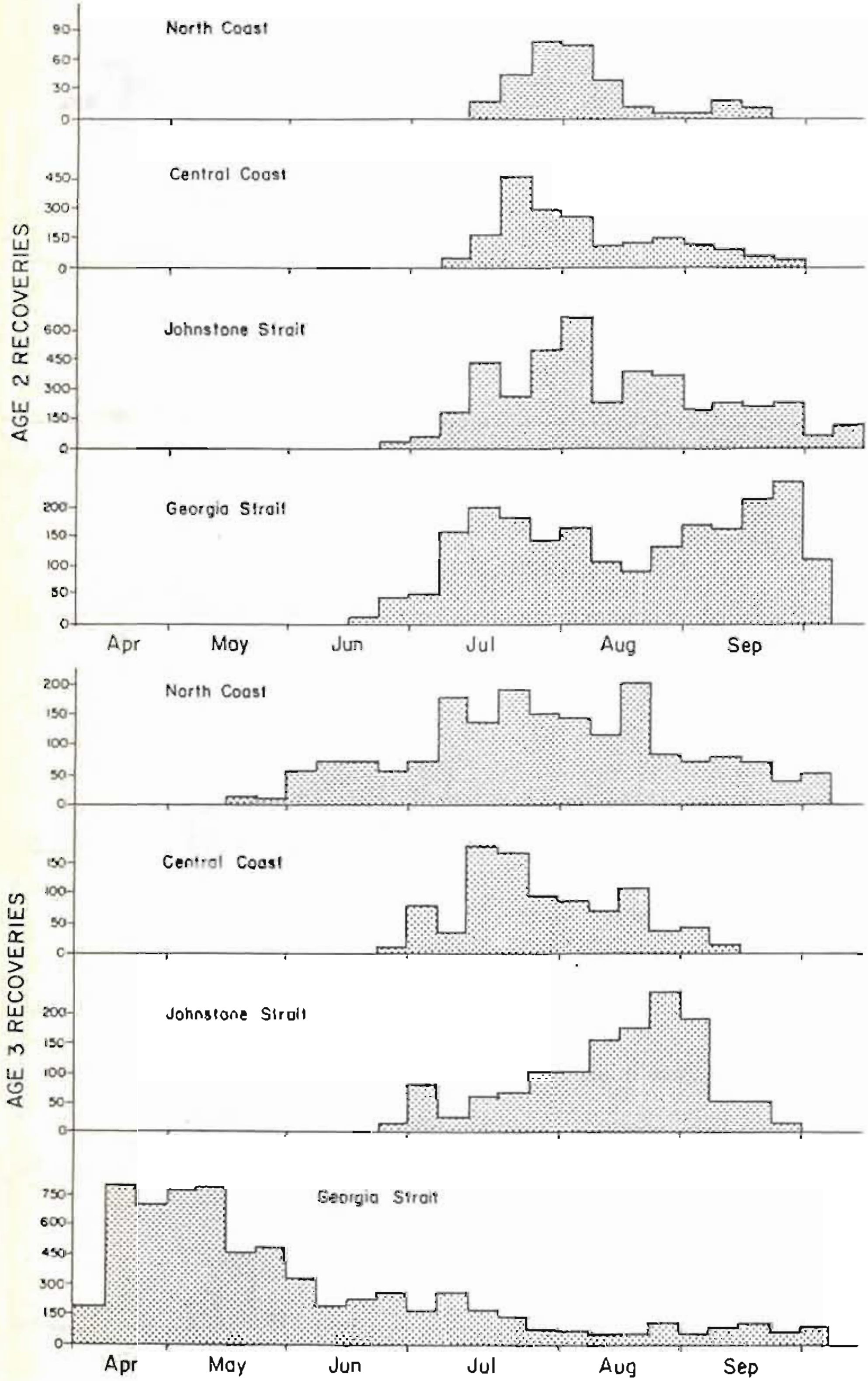


Figure 7. Timing and distribution of estimated CWT recoveries for Georgia Strait chinook stocks, 1976-1980 brood years.

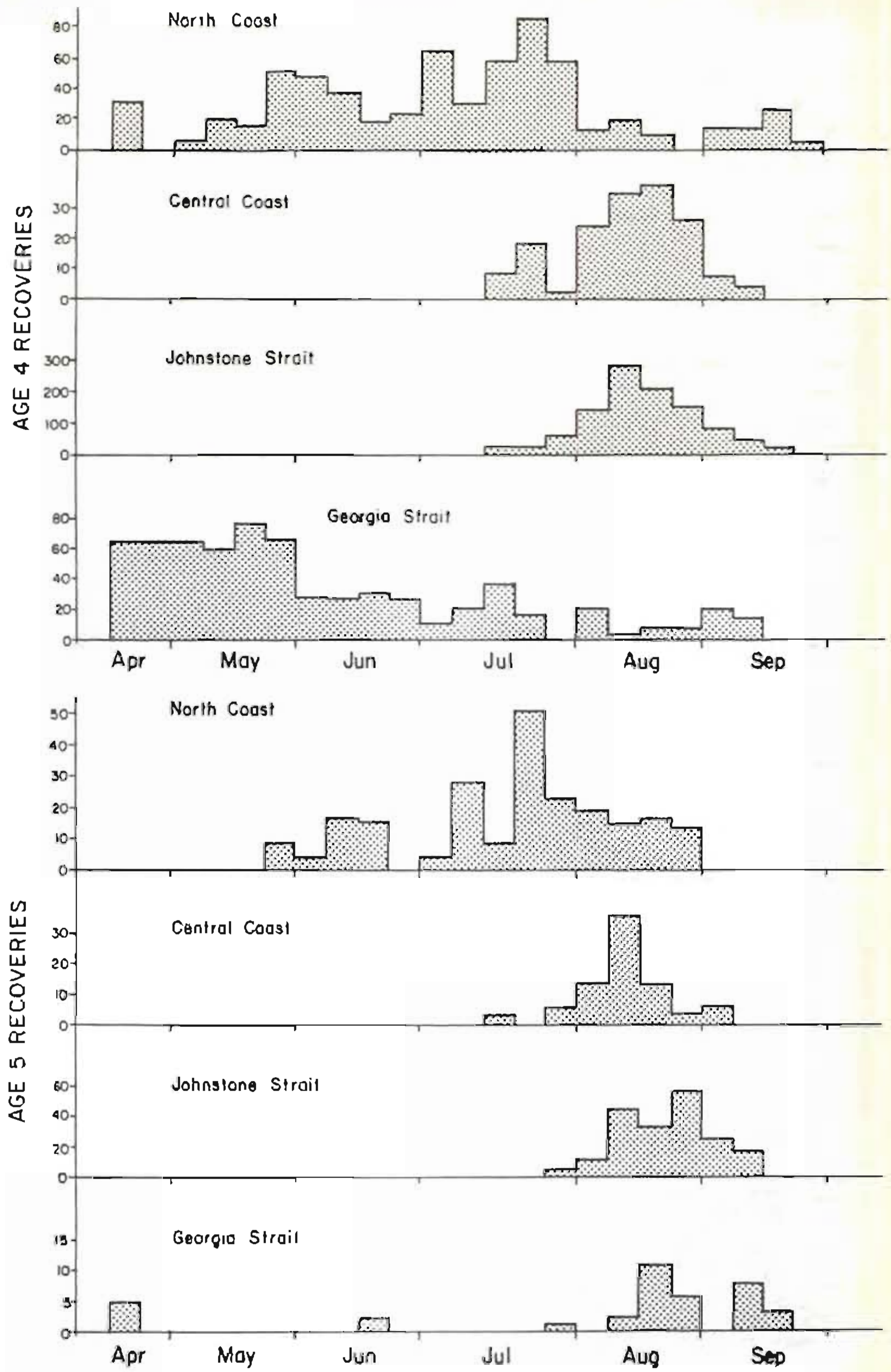


Figure 7 (continued)

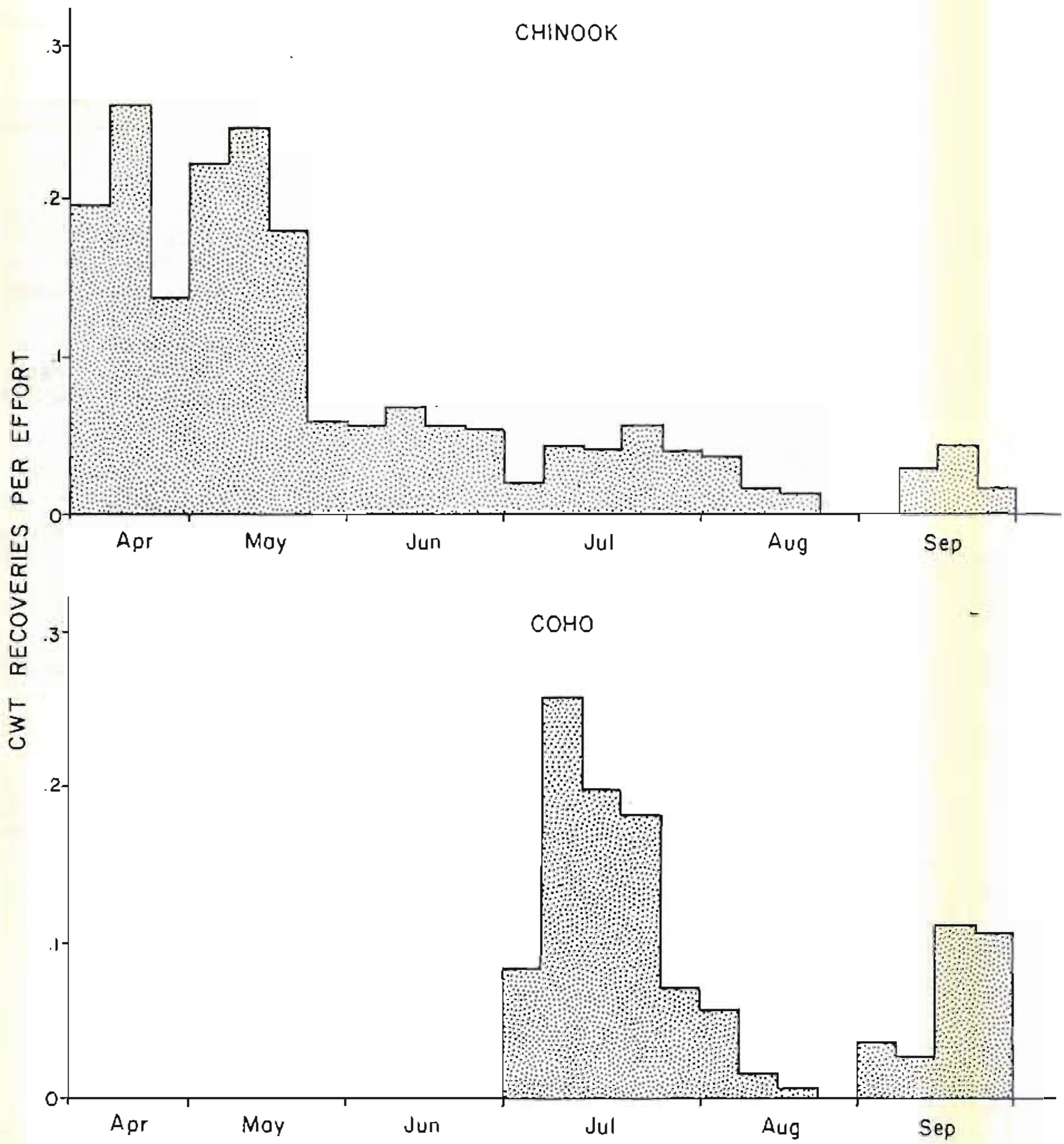


Figure 8. Seasonal changes in CWT recoveries per effort for age 3 Georgia Strait chinook and coho stocks (GSTR) in the Georgia Strait troll fishery, 1982.

Table 5. Summary of residence and migratory information derived from CWT data for major stocks caught in the Georgia Strait and West Coast troll fisheries.

Stock	Residence	Adult Migratory Group	
		Prop. of Stock	Timing
Georgia Strait Troll			
Chinook GSTR	Yes	Medium	early Aug. - mid Sep.
Chinook LWFR	Yes	Medium	mid Aug. - late Sep.
Chinook WA13	Yes	Small	early Aug. - late Sep.
Coho GSTR	Yes	Medium	late Aug. - late Sep.
Coho LWFR	Yes	Medium	mid Sep. - early Oct.
Coho WA01	Yes	Medium	mid Aug. - mid Sep.
West Coast Vancouver Island			
Chinook LWFR	Yes	Medium	late July - late Aug.
Chinook WCVI	No	Large	late July - mid Sep.
Chinook WA46	Yes	Small	mid Aug. - mid Sep.
Chinook UPCO	Yes	Medium	Unknown
Chinook LOCO	Yes	Small	Unknown
Coho GSTR	Yes	Small	mid Aug. - mid Sep.
Coho LWFR	Yes	Small	late Aug. - late Sep.
Coho WCVI	Yes	Small	mid Aug. - mid Sep.
Coho PGSO	Yes	None	mid Aug. - late Sep.
Coho LOCO	Yes	Small	Unknown

Alaskan fisheries. Most of the catch of the West Coast Vancouver Island chinook in the West Coast troll fishery occurs during a period that coincides with the return migration of mature fish. These fish probably represent an adult migratory group that is vulnerable to the West Coast troll fishery for only 3 or 4 weeks in late summer. The CWT data provide some information on the relative proportion of each stock represented by the adult migratory group, and the timing of the adult migration through each fishery. Migration timing through Georgia Strait troll fisheries was determined using CWT recoveries for the Georgia Strait troll fishery and Johnstone Strait and Fraser River net fisheries. For example, the September peak in Figure 8 indicates the adult migration timing for Lower Fraser and Georgia Strait coho stocks. Migration timing through the West Coast troll fishery was determined using similar CWT statistics for West Coast troll and Juan de Fuca net fisheries. These CWT statistics did not reveal any clear timing trends for Columbia River stocks.

Seasonal trends in chinook and coho catch per effort for the Georgia Strait and West Coast Vancouver Island troll fisheries provide additional support for the hypothesis that the bulk of the chinook and coho harvested in these fisheries are from resident populations. Figure 9 and 10 show the decreasing trends in chinook and coho catch per effort that would be expected for a closed or "pool" fishery. The catch per effort data for the 1980 fishing season was selected because this was the only year since 1976 that catch per effort statistics would not have been affected by large sockeye or pink runs, or management regulations. While seasonal trends in chinook catch per effort are similar for most years prior to the season changes imposed in 1984, seasonal trend in coho catch per effort are affected by the relative size and timing of the annual sockeye and pink salmon migration through the fisheries. The trends shown in Figure 9 for all chinook and coho stocks combined are consistent with trends presented in Figure 8 for just Georgia Strait stocks.

The above analyses suggest that a pool fishery model with an adult migratory component could adequately simulate the movement of chinook and coho stocks harvested in the Georgia Strait and West Coast Vancouver Island troll fisheries.

Relative Size of the Adult Migratory Component

The addition of an adult migratory component to "pool" fishery models requires some estimate of the contribution of the migratory fish to the escapement from the pool fishery. The size of the adult migratory component relative to the "resident" population will determine the degree to which management actions in the pool fishery effect escapement from the pool fishery. Tables 6 and 7 present the numbers and methods used to estimate the relative size of the adult migration component for chinook and coho, respectively. The major assumptions associated with the estimation procedure are:

1. the majority of the chinook and coho caught in the Georgia Strait and West Coast Vancouver Island fisheries are resident fish (i.e., fish that stay within the fishery boundaries until they mature);

2. the distribution of CWT recoveries is a reasonable approximation for the distribution of each stock (i.e., the harvest rates in the pool fishery are similar to those in other fisheries); and

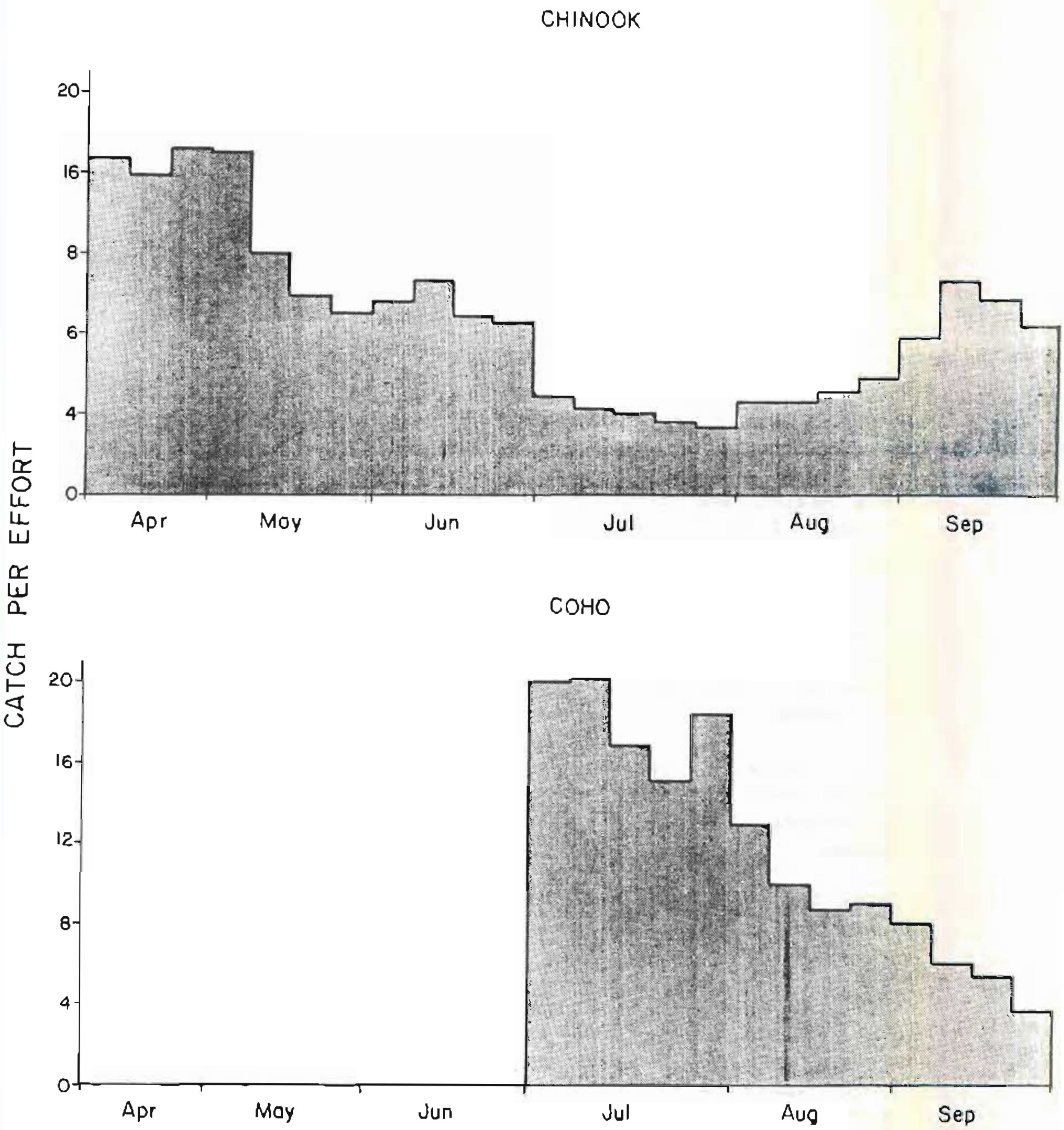


Figure 9. Seasonal changes in chinook and coho catch per effort in the Georgia Strait troll fishery, 1980.

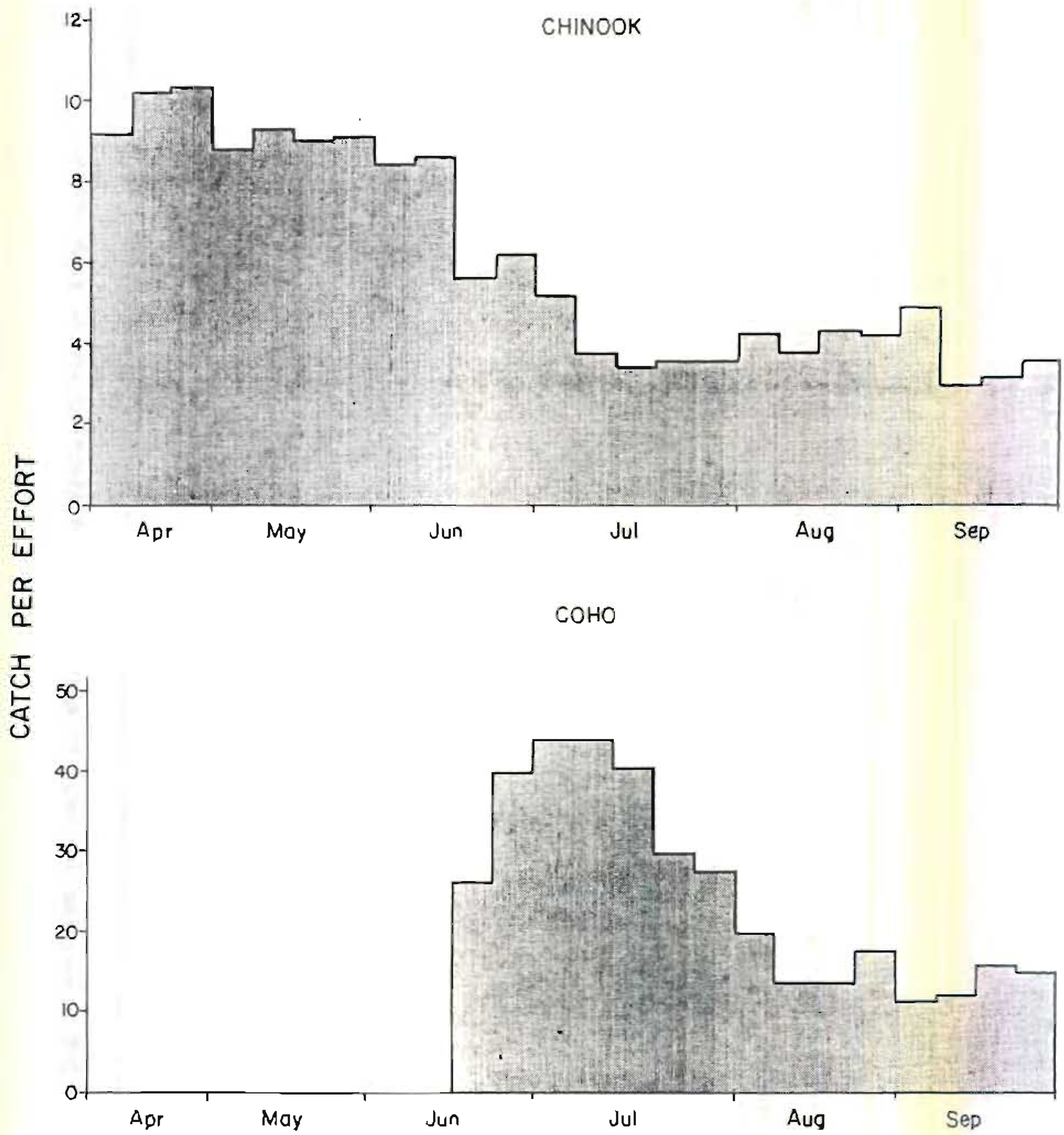


Figure 10. Seasonal changes in chinook and coho catch per effort in the West Coast Vancouver Island troll fishery, 1980.

Table 6. Numbers used to estimate the contribution of adult migratory chinook to the escapement from each pool fishery.

Fishery/Stock	% Distribution of Stock* Pool Fishery (A)	% Distribution of Stock* Other Fisheries (B)	% of B that returns through the pool fishery (C)	Migration Component B x C (D)	Relative Stock Size (E)	% Migratory Component of escapement from pool D/(A+D)
Georgia Strait						
GSTR	53	47	85	40	30	43
LWFR	47	53	80	42	40	47
WA13	48	52	40	21	15	30
WA46	12	88	20	18	15	59
					Weighted Mean =	45
West Coast Vancouver Island						
LWFR	33	67	10	7	20	17
WCVI	12	88	95	84	15	87
WA13	36	64	10	6	10	15
WA46	75	25	25	6	15	8
UPCO	65	35	85	30	15	31
LOCO	95	5	20	1	25	1
					Weighted Mean =	24

*the distribution of CWT recoveries was used to approximate the distribution of each stock.

Table 7. Numbers used to estimate the contribution of adult migratory coho to the escapement from each pool fishery.

Fishery/Stock	% Distribution of Stock* Pool Fishery (A)	Other Fisheries (B)	% of B that returns through the pool fishery (C)	Migration Component B x C (D)	Relative Stock Size (E)	% Migratory Component of escapement from pool D/(A+D)
Georgia Strait						
GSTR	50	50	70	35	30	41
LWFR	62	38	80	30	40	33
WA01	39	61	40	24	30	38
					Weighted Mean =	37
West Coast Vancouver Island						
GSTR	21	79	3	2	15	10
LWFR	30	70	3	2	20	6
WCVI	96	4	90	4	10	4
WA01	42	58	2	1	15	3
PGSD	82	18	0	0	25	0
LOCO	96	4	50	2	15	2
					Weighted Mean =	4

*the distribution of CWT recoveries was used to approximate the distribution of each stock.

3. only a portion of the fish outside the pool fishery migrate through the pool fishery on their return to their natal stream.

Analysis presented in the previous section provides some limited support for the first assumption. While the second assumption is most certainly violated, it has been used in the absence of reliable estimates of the harvest rates for each fishery. If harvest rates for stocks caught in Georgia Strait sport and troll fisheries and in the West Coast Vancouver Island troll fishery were higher than the harvest rates for the same stocks caught in other fisheries (as is probably the case), then the calculation appearing in Tables 6 and 7 would underestimate the contribution of the adult migratory component to the escapement from these two fisheries. The third assumption, and column C in Tables 6 and 7, are necessary to account for the differnce between the migration routes used by each stock. For example; the portion of the lower Fraser River stock (LWFR) that resides in Georgia Strait would probably not migrate through the West Coast Vancouver Island troll fishery on their return to the Fraser River. The numbers appearing in column C are approximations based on the location of stock production areas relative to each pool fishery and the distribution of CWT recoveries among the other fisheries. In summary, this approach probably provides a minimum estimate of the relative contribution and importance of the adult migratory component to the escapement from these two major fisheries.

Stock Composition within Fisheries

One of the major purposes of the CWT Programs currently conducted in the U.S. and Canada, is to estimate the contribution of tagged stocks to the various West Coast salmon fisheries. Under ideal circumstances, contribution estimates for all tagged stocks could be combined to estimate the stock composition within each fishery. However, the following factors combine to make the estimation of stock composition using CWT tags a complex, if not impossible task.

1. Not all stocks are represented by CWT tags.

2. Each CWT group may represent anywhere from 1,000 to 1,000,000 unmarked fish.

3. Each agency and research group uses different procedures to select fish for tagging and has different objectives for their CWT studies.

4. The procedures, objectives and stocks marked change every year, yet some stocks remain in the fisheries for as many as six years.

An example of the amount of work and assumptions required to derive annual contribution estimates for coastal salmon fisheries can be found in English (1985). Given the amount of work and untested assumptions required to make annual contribution estimates, we did not attempt to repeat the analysis described in English (1985), to estimate the weekly stock composition required to assess the effect of management actions on specific stocks. Instead, we examined how the estimated CWT recoveries per stock varied with respect to the total estimated CWT recoveries for each week of the fishing season (Figures 11 and 12). Recoveries for the 1981 chinook brood year were selected because this was the first year lower Fraser (LWFR) chinook stocks were adequately

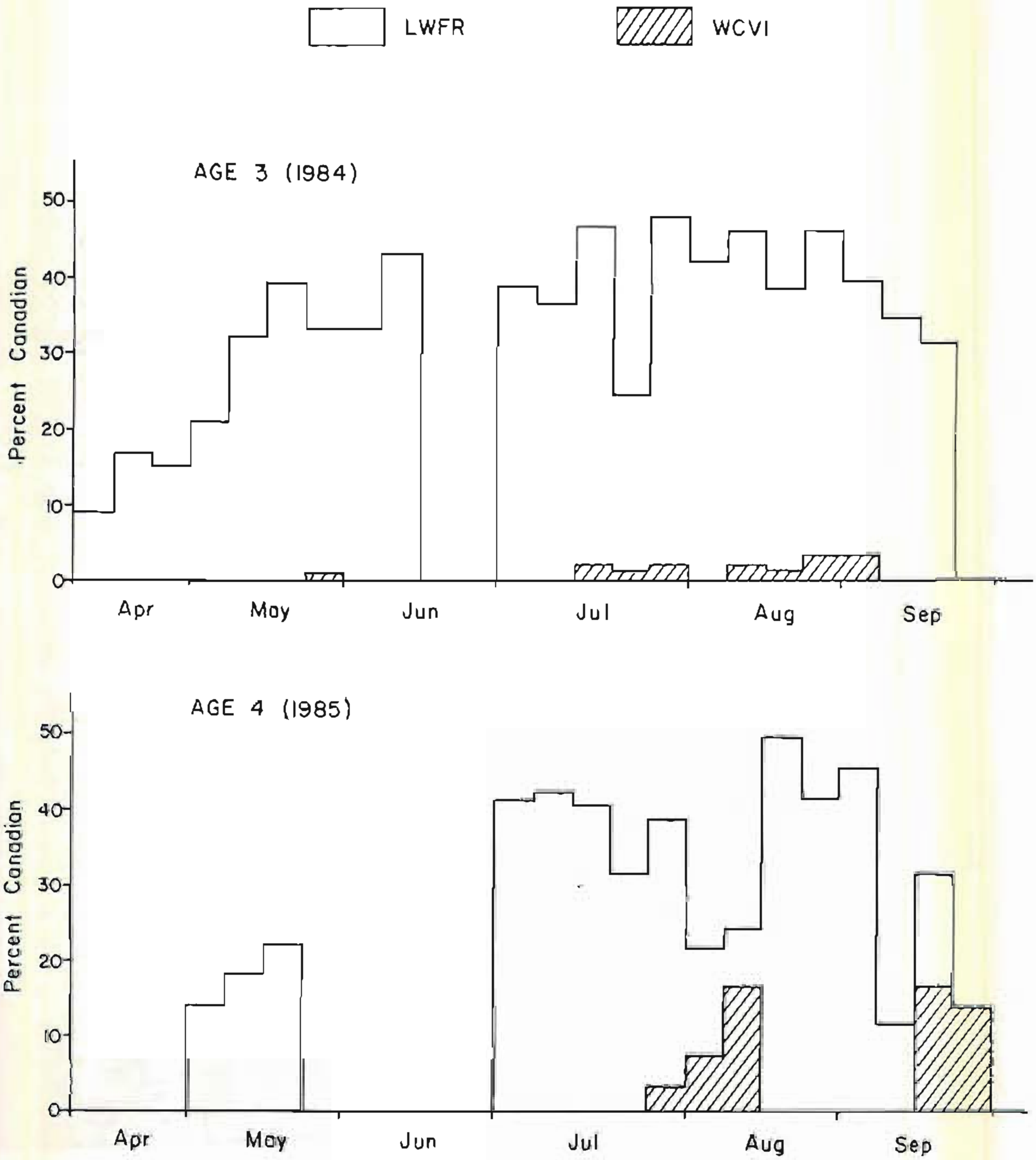


Figure 11. Seasonal changes in the stock composition of chinook CWT recoveries in the West Coast troll fishery, age 3 and 4 of 1981 brood year.

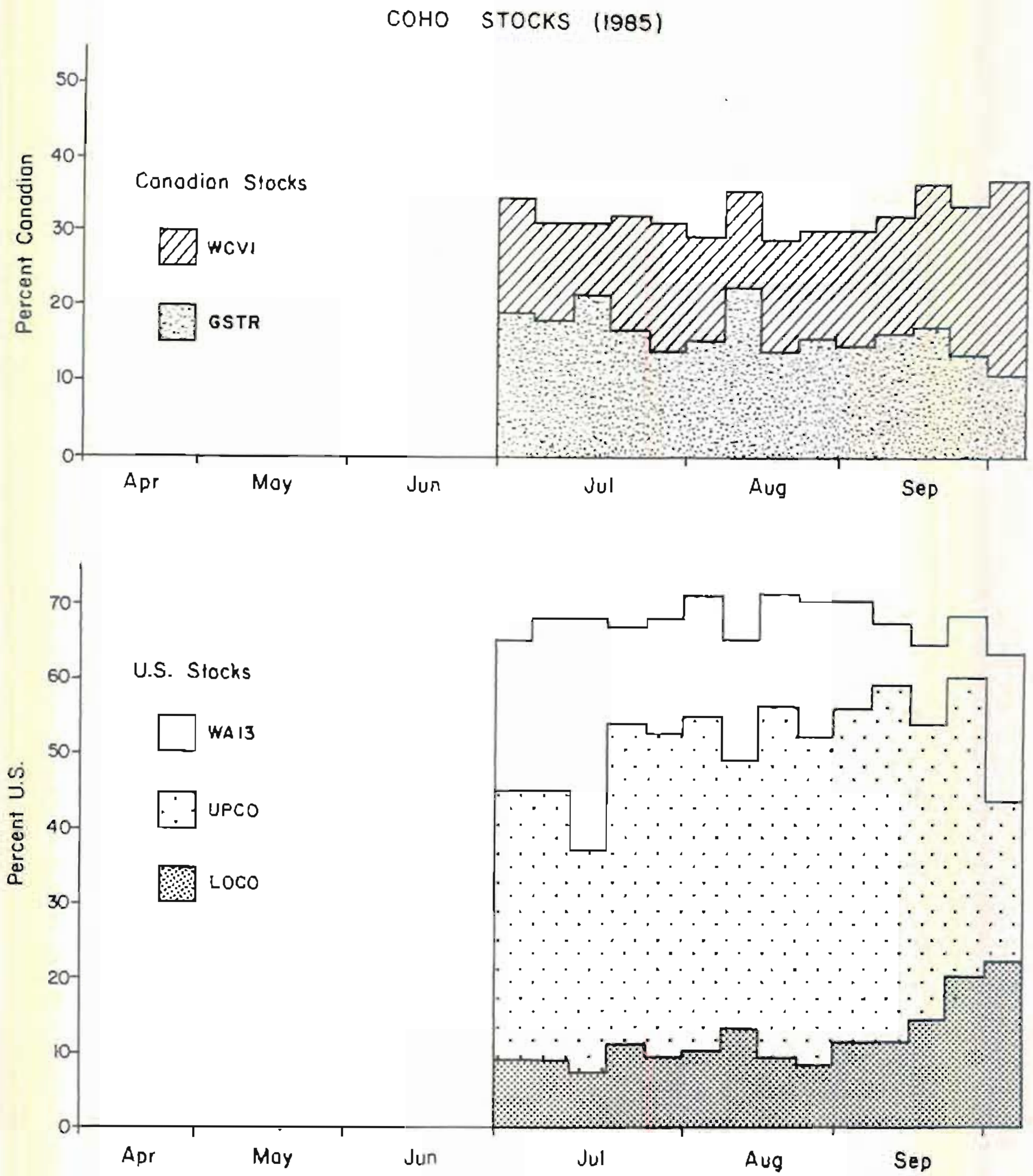


Figure 12. Seasonal changes in the stock composition of coho CWT recoveries in the West Coast troll fishery, 1985.

tagged. In other years, the only CWT recoveries of Canadian stocks in the West Coast troll fisheries were those from West Coast Vancouver Island (WCVI) hatcheries. The 1985 coho CWT recoveries were selected because all stocks were well represented in the West Coast troll fishery and the seasonal changes in stock composition were similar to those for recent years. These figures indicate whether the stock composition in the fishery changed during the fishing season. The actual stock composition in any week is still unknown. The weekly information in Figures 11 and 12 was combined with the annual contribution estimate from English (1985) to provide an initial "best guess" of the temporal changes in stock composition in the West Coast troll fishery (Table 8). These estimates reflect the observed changes in chinook stock composition (U.S. vs. Canadian) and the apparent static nature of coho stock composition. The West Coast troll model uses these estimates to simulate the catch of U.S. and Canadian fish; however, we recommend that similar analysis be conducted using the most recent data, if management decisions are going to be heavily influenced by stock specific catch estimates.

Emigration Rates

Juvenile emigration rates should reflect both the timing and proportion of the stocks emigrating from the Georgia Strait and West Coast troll fisheries as immature fish. Indicators of an emigration of immature fish from Georgia Strait are the recoveries of Georgia Strait stocks outside Georgia Strait. The recovery of U.S. and West Coast Vancouver Island stocks in the northern B.C. and Alaskan troll fisheries indicates that some portion of these stocks probably emigrated from the West Coast troll fishery (see Table 4).

Several attempts were made to estimate the timing of juvenile emigration, however, none of the analyses indicated that juvenile emigration occurred during the fishing season. These findings are consistent with the belief that the bulk of juvenile emigration from these fisheries occurs either in the fall after the fishing season or the fish emigrating are too small to be caught or landed.

Diversion Rate Analysis

Pink and sockeye salmon (primarily Fraser River stocks) enter into South Coast areas either through Johnstone Strait (termed north entry) or through the Strait of Juan de Fuca (termed south entry). The proportion of pink or sockeye salmon using the north entry route is called the "diversion rate". The sockeye and pink allocations to the West Coast troll fishery are largely determined by the diversion rate; indeed, deployment of the entire South Coast commercial fleet is highly dependent upon the diversion rate.

Unfortunately, information gained from the in-season operation of net fisheries can contribute little to the in-season management of the West Coast since the troll fisheries are positioned ahead of the nets in the fisheries gauntlet and, historically, troll openings have preceded net openings. Further, statistics derived from troll fisheries have not been examined for any information which they could bestow upon diversion rates, basically because there was no need for information (management of the West Coast troll has been minimal until recent years) and researchers have long recognized many fundamental reporting problems with the catch and effort data. Nevertheless, all of the above dictates that any contribution to an in-season estimate of diversion rate, even the early detection of an extreme diversion rate year, would be a significant contribution to salmon management.

Table 8. Estimated stock composition for West Coast troll fishery. Boxed numbers are the sum of 1977-79 contribution estimates from English (1985), in thousands.

Chinook Stock	West Coast Troll Catch Estimate	West Coast Troll Catch Prop.	Stock Composition Estimate Canadian	Stock Composition Estimate U.S.	Stock Composition Proportion Canadian	Stock Composition Proportion U.S.
Hatchery	914	.58	20	894	.02	.98
Wild	689	.42	?	?	.8	.2
TOTAL	1603	1.00			.35	.65

Coho Stock	West Coast Troll Catch Estimate	West Coast Troll Catch Prop.	Stock Composition Estimate Canadian	Stock Composition Estimate U.S.	Stock Composition Proportion Canadian	Stock Composition Proportion U.S.
Hatchery	1384	.29	115	1269	.08	.92
Wild	3457	.71	?	?	.6	.4
TOTAL	4841	1.00			.45	.55

'BEST GUESS'

Month	Proportion Canadian Fish in Fishery: Chinook	Proportion Canadian Fish in Fishery: Coho
Apr.	.15	
May	.25	
Jun.	.35	
Jul.	.40	.45
Aug.	.40	.45
Sep.	.35	.45

Therefore, the objective of this task was a preliminary examination of sockeye and pink catch and effort data to evaluate techniques for in-season estimation of diversion rate. The potential usefulness of a relationship between troll data and diversion rate, coupled with the relatively small expenditure in analytical effort to answer the question, gave this task a very high priority.

General Approach and Methods

Emphasis was placed upon keeping the analysis simple because, if the abundance of fish available to troll gear can be used to predict diversion rates, then the relationship should be readily apparent through an examination of historical catch and effort statistics. Further, the requirement to obtain in-season information on the diversion rate demanded that the historical datashould be processed or viewed in the same order which they would have become (or had the potential to become) available through the fishing season.

Analyses were conducted on three databases containing catch and effort statistics: 1) sales slip data, 2) in-season catch monitoring program, and 3) the log book program. Analyses were further restricted to the years 1980 to 1985 because of the following factors:

1. The data are recent. Long-term climatic and fishing pattern trends combined with variable stock vulnerability to fishing may effect the computed diversion rate (Groot et al. 1984, Mysak 1986); thus, any relationship between troll catch per effort and diversion rate may change through time.

2. Post season diversion rate estimates over these years may be more reliable. Diversion rate estimates have received more scrutiny in recent years because of the interest in the role of climatic events (e.g., el Nino) upon the inter-annual variability of fisheries in the Northeast Pacific Ocean and because of the increased concern by fishery managers as to the role that diversion rates play in the allocation of catch between fisheries (J. Woody, IPSFC, pers. comm.).

3. Diversion rates over these years have good contrast. A wide range of diversion rates have been observed (22-80%) over recent years. Therefore, if a relationship cannot be established, the use of alternative or additional years of data is unlikely to improve the ability to detect within season the occurrence of an extreme year.

Before presenting the analytical approach to the problem, some basic assumptions and definitions must be articulated.

By definition, the diversion rate (P) is the fraction of fish using the north entry (Johnstone Strait) migration route, i.e.,

$$P = \frac{N_n}{N_s + N_n} \tag{1}$$

where N_s and N_n are the abundance of fish using the south and north entries, respectively. Abundance is routinely related to catch and effort data by the following relationship:

$$N = C/qE \tag{2}$$

where C represents catch, E effort and q the catchability coefficient. Substitution of equation (2) and (1) yields:

$$P = \frac{1}{1 + R} \tag{3}$$

where,

$$R = \frac{q_n C_s E_n}{q_s C_n E_s}$$

which is the ratio of north to south abundance. Since only catch and effort by troll gear data were used, q_s and q_n should be approximately equal. Certainly, this is a reasonable assumption for an exploratory analysis.

The analysis proceeded by partitioning catch and effort statistics into convenient geographic areas which north or south migrating fish were thought to uniquely traverse. Next, the diversion rate was calculated (equation 3) under the assumption that the catchability coefficients were equivalent and the resultant estimate was compared to diversion rate estimates prepared post-season with all catch and escapement data by IPSFC. If reasonable agreement was obtained between the two estimates then the cumulative diversion rate estimate was calculated:

$$R_i = (\Sigma C_{si} \Sigma E_{ni})/(\Sigma C_{ni} \Sigma E_{si})$$

where R_i is the ratio of abundance up to the i'th week. The advantages of using this cumulative scheme (termed a cumulative sum control) are simplicity and their ability to detect large changes quickly. The main disadvantage is that they are slow in signalling small or moderate changes. Johnson and Leone (1976) present a full discussion of the properties of this class of estimator.

While the methods described above are not exhaustive, many combinations and permutations of catch and effort statistics were processed. Certainly, a more sophisticated analysis may produce useful relationships which are masked by the simplicity of our approach. In any case, for brevity, the results presented in the sections to follow have been restricted to the best candidate; namely, sockeye salmon sales slip data for Statistical Areas 11 and 27. The exclusion of the alternative databases (in-season catch monitoring and the log book programs) does not mean they were devoid of information; however, the exploratory analyses did not indicate they were useful for the immediate task because of either sparse sample size or overly gross temporal and geographical resolution.

Catch and Effort Data

The area 11 inside troll fishery is thought to catch mostly sockeye salmon destined to migrate through Johnstone Strait, while the Area 27 fishery (off the north-west coast of Vancouver Island) is thought to target upon sockeye migrating towards Juan de Fuca Strait (the southern route). In order to use catch per unit of effort data (CPUE) from the sales slip database as a measure of abundance some caveats must first be acknowledged.

The most serious issue is that sales slip data are censused at the time of sale and not during the fishery. Therefore, any computed weekly CPUE value is confounded by catches which could have been taken two or more weeks prior to sale. In order to minimize the problem freezer troll data were not included in the analysis. Less serious problems include unreported catch, multiple fishing areas, and errors in the reported area of operation. On the other hand, CPUE data derived from sales slip data offer some advantages in the context of this analysis. First, we can be confident that the reported effort applies to the quantity of fish taken, whereas catch and effort obtained from independent sources may not match perfectly over time. Second, Areas 11 and 27 are usually the first fisheries to catch Fraser stocks, therefore, catch and effort data are often available sooner within the season than for south coast fisheries. Finally, if data gathering and processing delays are consistent, the historical time series of CPUE data are in exactly the same order as would have become available during the operation of the fishery.

Weekly catch per unit of effort data (1980-85) from 1980-85 sales slip data are plotted in Figures 13-15. Since only the relative abundances between areas and within a year are needed to calculate diversion rates, a common scale for CPUE was not used. Note the similarity of the plots for 1980 and 1981 (Figure 13) while 1982 and 1983 (Figure 14) demonstrate completely different behaviour.

Annual Diversion Rate Estimates

Table 9 presents the diversion rate estimates for sockeye and odd year pink salmon calculated from the troll data (equation 3), assuming equal catchability coefficients in Areas 11 and 27. While agreement with IPSFC estimates for sockeye is good, the odd year pink estimate only capture the rank order dynamics. We believe that the diversion estimates for pink salmon may be confounded by the catch of early run stocks destined for Central Coast streams. In any case, there is not sufficient difference in the pink estimates to enable an in-season predictor to be developed.

Figure 16 plots the estimates for sockeye listed in Table 9. The arrows on the figure indicate that the 1981 IPSFC estimate is likely an overestimate (J. Cave, IPSFC, pers. comm.) and the 1984 estimate may be revised upward. The open circle point for 1984 indicates the value used by Mysak (1986). Further, if the catchability in Area 27 is greater than in Area 11 then the troll diversion rate estimates would consistently be less than the IPSFC estimates (given that the commission estimates are unbiased) and vice versa. Therefore, there does not appear to be large differences between the catchability coefficients.

In summary, indices of abundance available to troll gear in Statistical Areas 11 and 27 largely capture the inter-annual variation of routes taken by migrating sockeye salmon. Therefore, there may be some utility in applying the troll data as in-season tools for the detection of extreme diversion events for sockeye salmon.

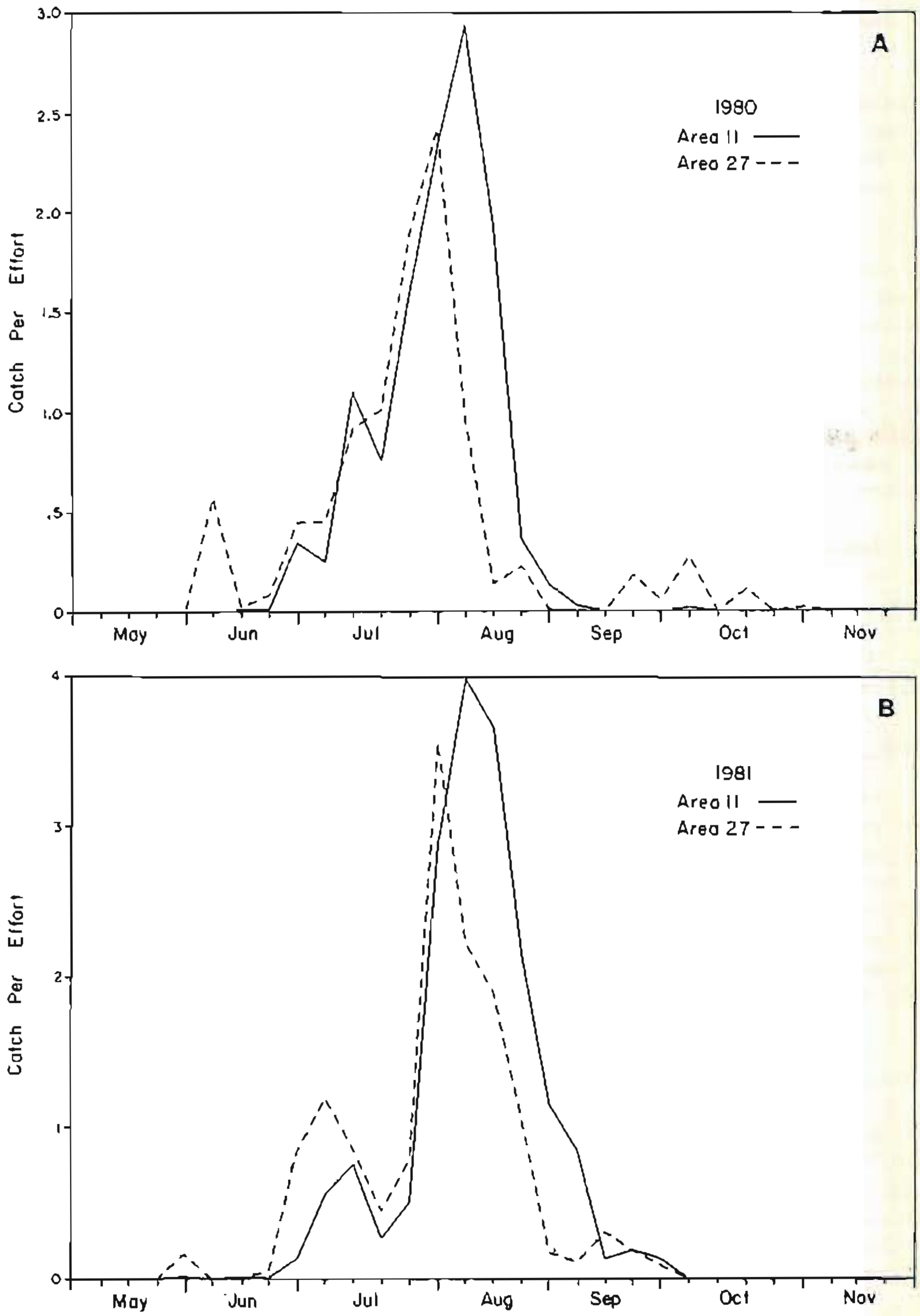


Figure 13. Catch per unit of effort (CPUE) during 1980 (panel A) and 1981 (panel B) for Statistical Area 11 (solid line) and 27 (broken line).

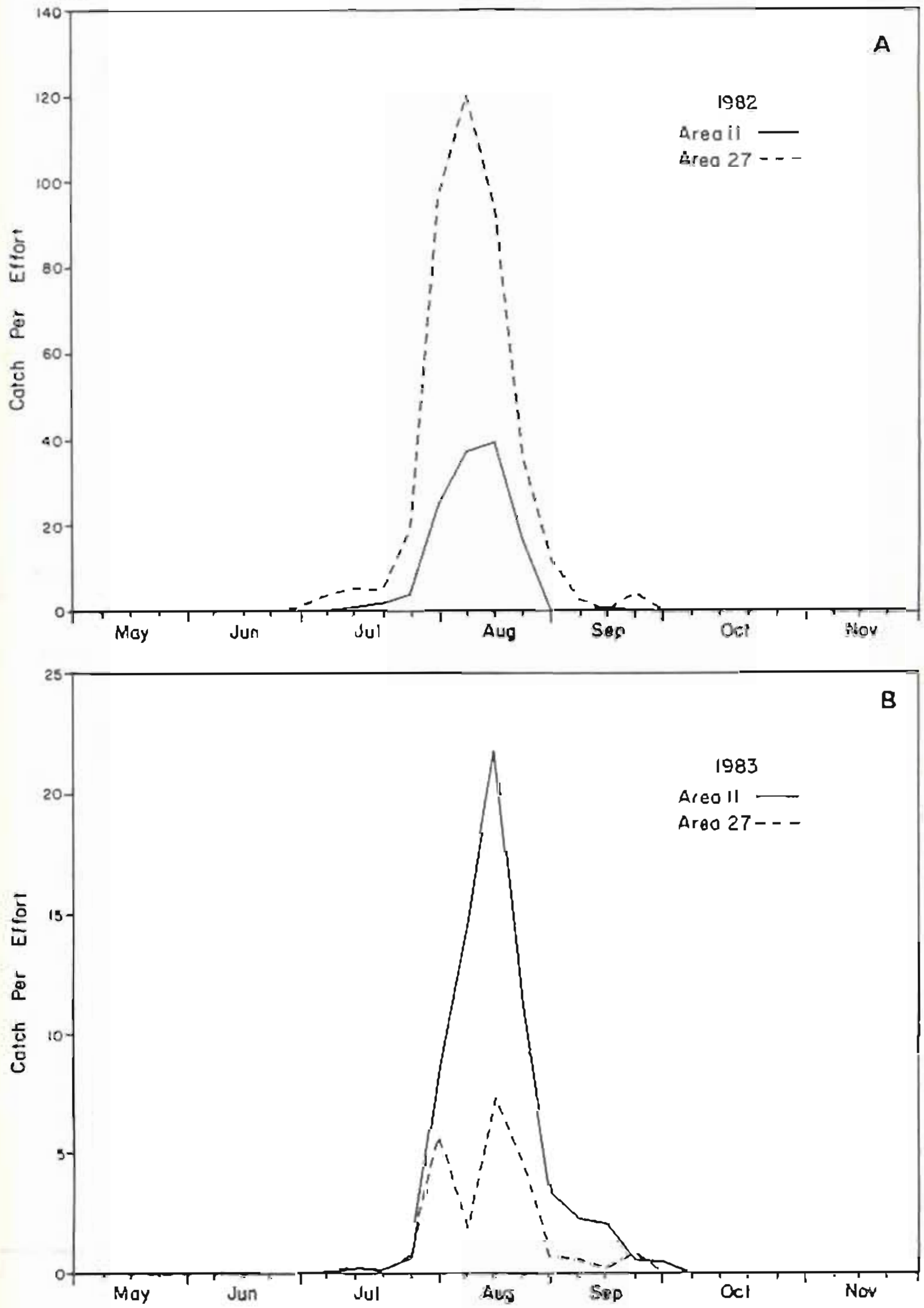


Figure 14. Catch per unit of effort (CPUE) during 1982 (panel A) and 1983 (panel B) for Statistical Area 11 (solid line) and 27 (broken line).

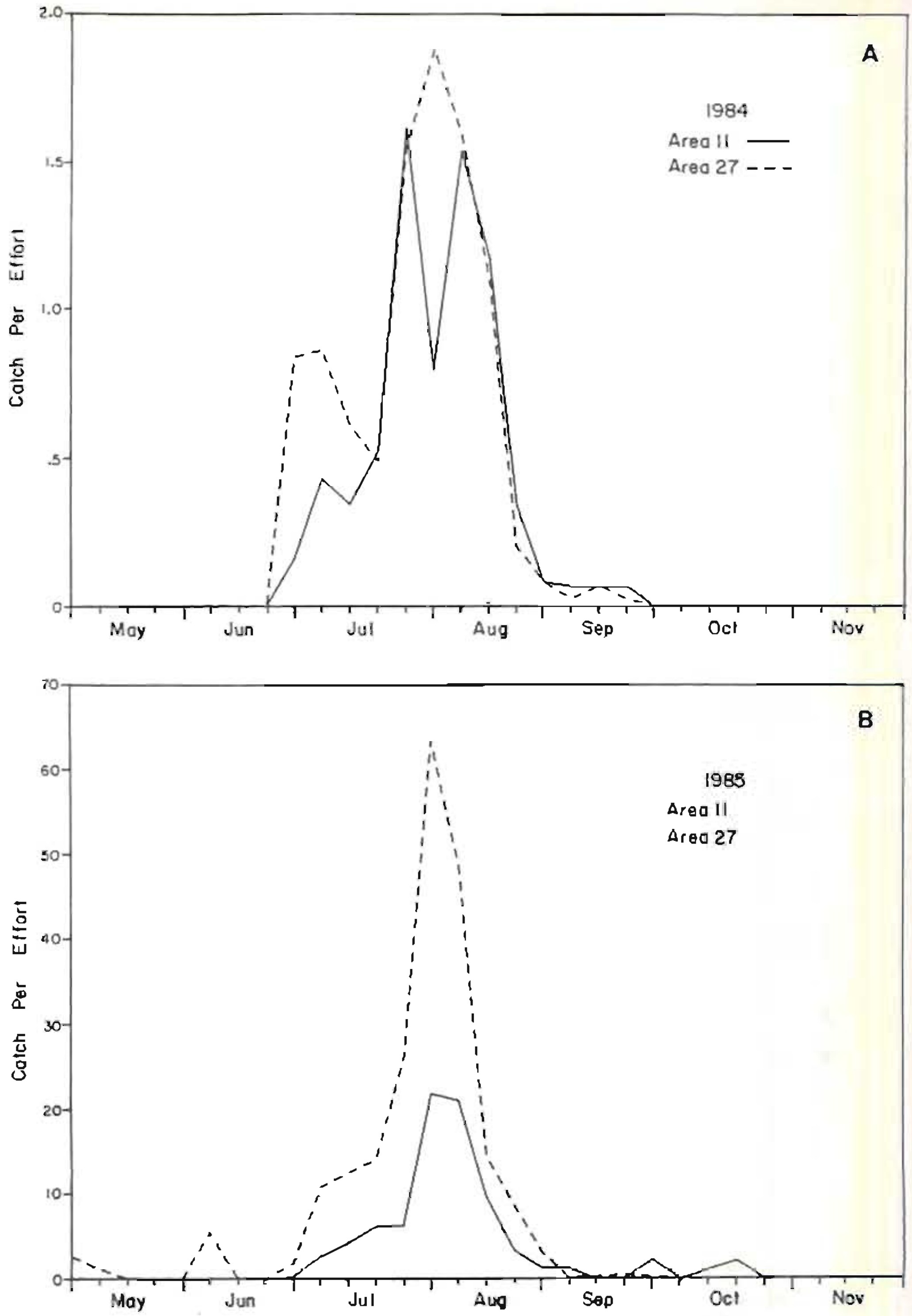


Figure 15. Catch per unit of effort (CPUE) during 1984 (panel A) and 1985 (panel B) for Statistical Area 11 (solid line) and 27 (broken line).

Table 9. Estimates of annual diversion rate from the sales slip troll data base (troll) and those made by the International Pacific Salmon Fisheries Commission (IPSFC).

	Sockeye		Pink	
Year	IPSFC	Troll	IPSPC	Troll
1980	70	54		
1981	67	58	33	55
1982	22	12		
1983	80	82	63	66
1984	31*	46		
1985	31	27	38	63

* to be revised

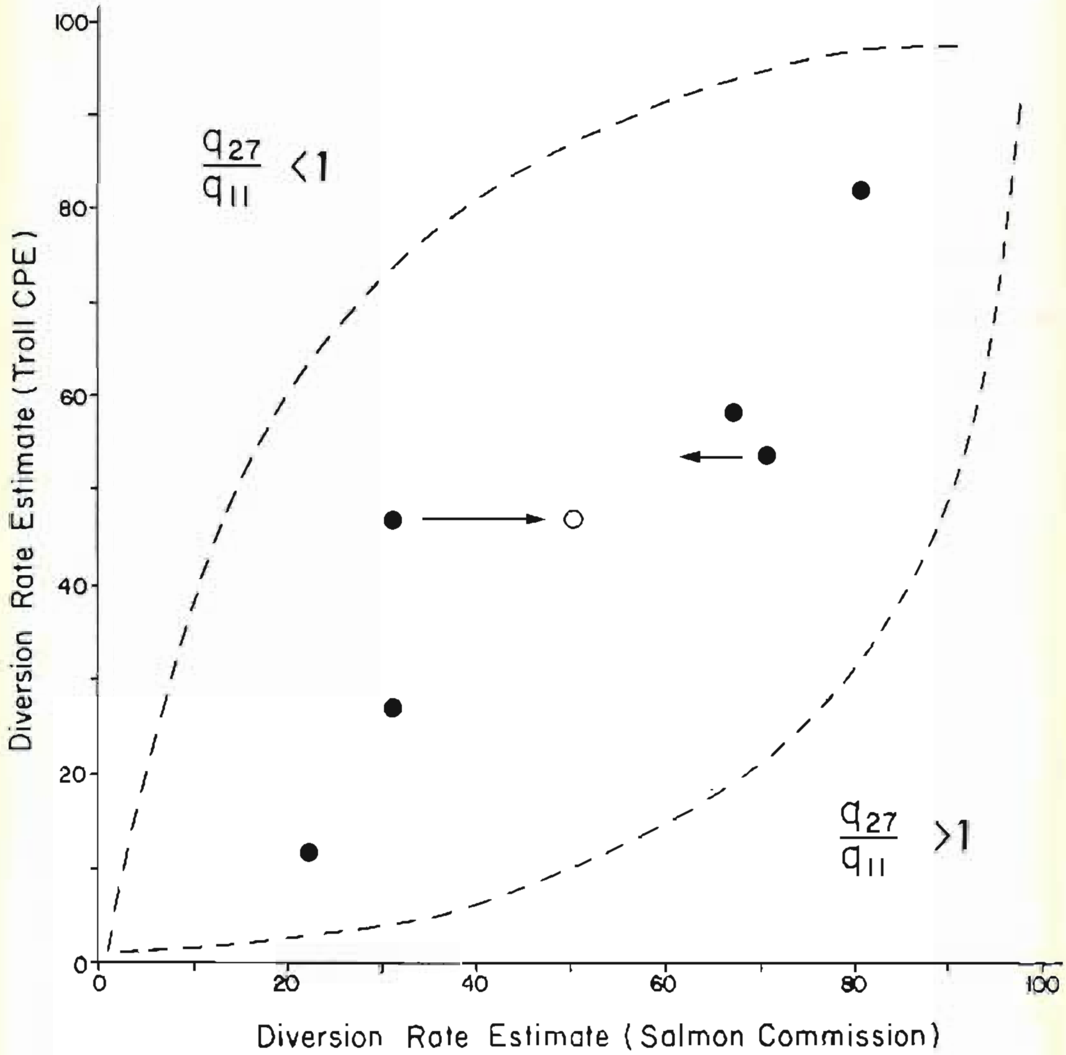


Figure 16. Diversion rate estimates from troll data and IPSFC. Lines of perfect agreement with equal (solid line) and unequal (broken line) catchability coefficients are plotted. Arrows indicate direction of possible revisions.

In-Season Cumulative Diversion Rate Estimates

Figure 17 plots the in-season cumulative sockeye diversion rate estimates for the years 1980-1985 (equation 4). Two general trends are apparent from an examination of the graph. First, diversion increases as the season progresses and second, within season variability increases with annual mean diversion rate. From an examination of the raw data, the variability during high diversion years is more attributable to changes in fishing effort than to changes in catch.

In conclusion, the cumulative index can readily detect low diversion rate years early in the fishing season. High diversion rate years cannot be detected until approximately mid-season when the characteristic magnitude and variability of the index can be identified.

Effort Analysis

All fisheries management actions affect the quantity or distribution of fishing effort. Therefore, the ability to predict fishing effort is central to the development of an analytical model that will assist managers in their evaluation of regulatory options. In this study we considered effort at three levels of resolution: 1) total annual fishing effort, 2) weekly total fishing effort, and 3) weekly fishing effort directed at each species.

The effort statistics used in this section were obtained from the Department of Fisheries and Oceans Catch Database, currently accessible through the VAX-11 computer at the Pacific Biological Station. All statistics were extracted from the "Catch Summary Data System" by means of several VAX-supported subroutines available for this purpose (for documentation see Wong, 1983). Actual effort values consisted of the number of days fished per week by troll vessels (ice boats and freezer boats). For the West Coast Vancouver Island (WCVI) fishing fleet, weekly effort levels were estimated by combining the total number of 'boat days' in Statistical Areas 21, 23, 24, 25, 26, and 27. The number of licensed troll vessels in B.C. each year was obtained from DFO Planning and Economic Branch. In the initial analyses, effort values for the 1970-1985 period were used, but subsequent analyses focused mostly on effort patterns observed during the 1975-1985 period.

Forecasting Total Effort

In this study, several factors which traditionally play a major role in influencing fishing were examined. These consisted of the following:

1. WCVI troll catch by species
2. combinations of WCVI troll catches
3. total WCVI troll catch (all species)
4. fuel prices
5. fish prices
6. fleet sizes by vessel type

A strong relationship was found to exist between the annual troll effort, and a combination of salmon catches and fleet size. A multiple regression analysis produced the following relationship:

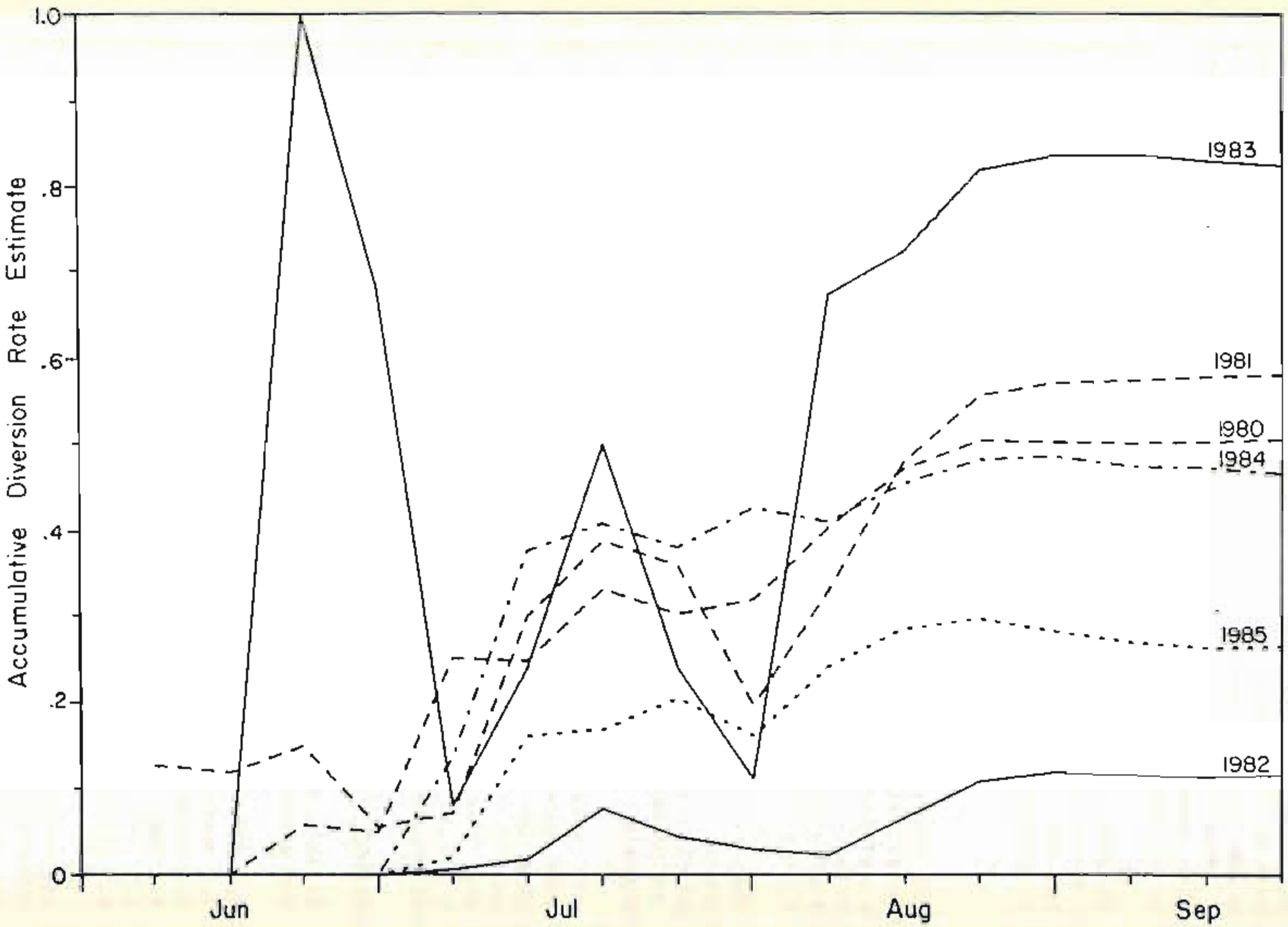


Figure 17. In-season cumulative diversion rate estimates for sockeye salmon (1980-85).

$$TE = 4200 + 0.00786\ C + 0.01405\ P + 15.246\ F\ (n=16;\ r=0.925)$$

where:

- TE = total number of troll boat days per year
- C = annual WCVI troll catch of chinook + coho
- P = mean WCVI troll pink catch (for two consecutive years)
- F = vessels licensed to fish with commerical troll gear in British Columbia

The above relationship accounts for 86% of the total variation in fishing effort observed between 1970 and 1985 (Figure 18). The data used in the above regression are presented in Table 10. The number of vessels licensed to fish with troll gear (F) is the most important variable in the above regression. Because of the relatively good fit of the estimated figures to the actual data, this relationship could be used to predict annual troll effort in future years. In order to use this relationship as a predictive model, actual catch figures for chinook, coho and pink salmon should be replaced with the expected catch or catch ceilings for the current fishing season.

Forecasting Weekly Effort

The prediction of weekly fishing effort was simplified by assuming that the proportion of the annual fishing effort occurring in each week is similar each year. Figures 19 and 20 show the weekly distribution of fishing effort for even and odd years, respectively. These figures show the similarity in the pattern of effort distribution for each year along with the degree of variability associated with each week. Clearly these effort patterns will be affected by management actions especially those that eliminate the opportunity to fish in certain weeks. The following equation was used to predict the percent of the total effort to be allocated to each week (P_i').

$$P_i' = \frac{P_i}{\sum_i P_i}$$

where P_i is the proportion of the base year fishing effort that occurred in week i and i only includes those weeks that will be open for fishing in the current fishing season. The above equation was used to predict the distribution of the 1984 fishing effort using the average distribution of fishing effort for even years, 1976-82. Figure 21 shows the predicted versus the actual fishing effort for the 1984 fishing season. The peaks in effort at the end of each open season are probably the result of vessels being forced to land their catch. A large portion of this effort may be attributable to freezer trollers which land less frequently than the other troll vessels. In subsequent analyses we distributed the catch and effort for freezer trollers according to the catch and effort distribution for those troll vessels which landed more frequently.

Forecasting Directed Effort

The ability of troll fishermen to direct their fishing effort at a specific species of salmon is possibly the most important and least studied aspect of the West Coast Vancouver Island troll fishery. The effect of

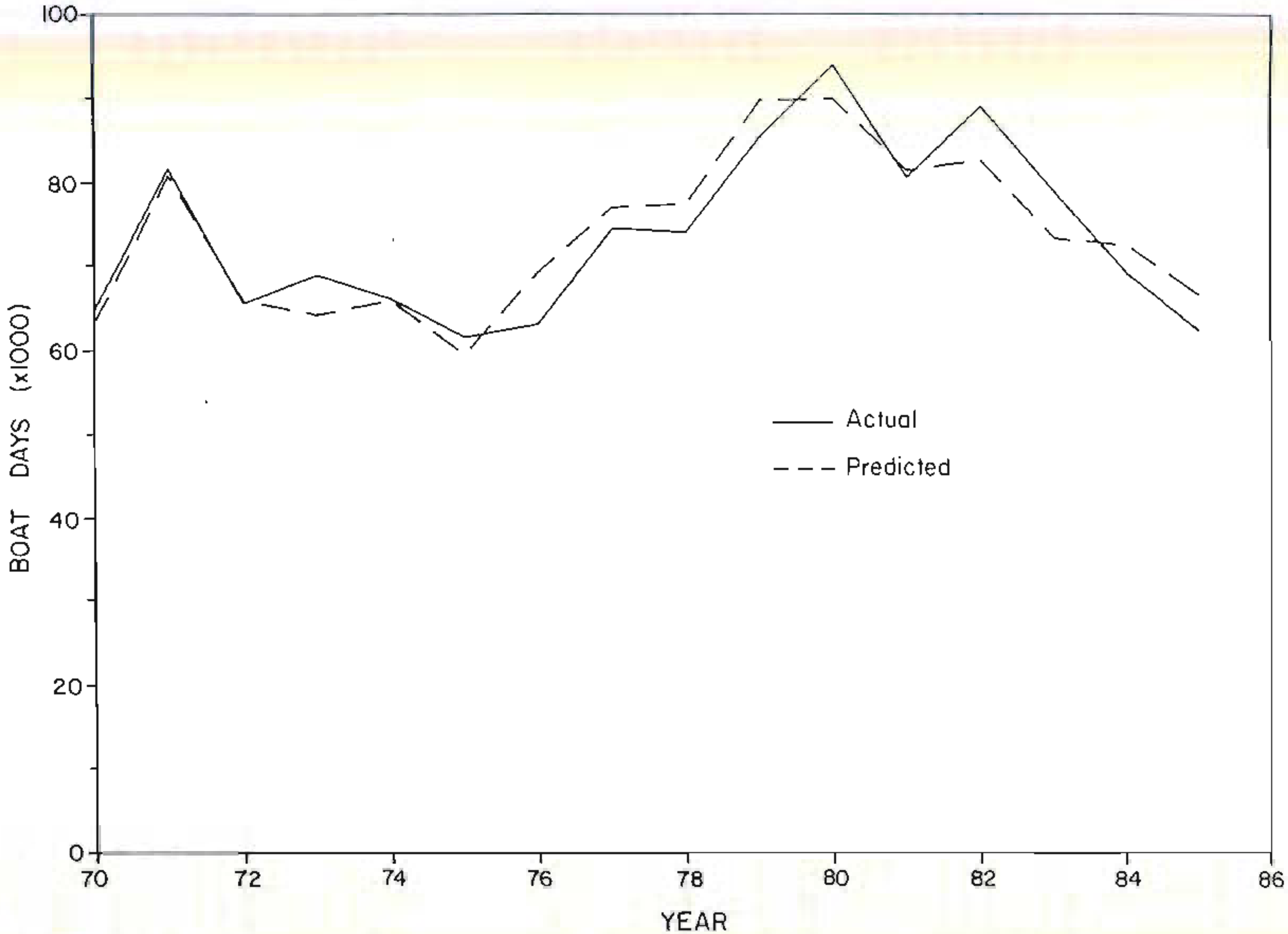


Figure 18. Actual fishing effort versus fishing effort predicted using linear regression model.

Table 10. Statistics used to predict total annual fishing effort.

Year	Dependent Effort (E)	Independent Variables Used				Not Used	
		Fleet Size (F)	Chinook (C)	- Coho	Ave. Pink (P)	Sockeye	Pink
70	64740	3177	353789	779433	118421	277479	236842
71	81610	3033	615847	2175719	598008	585073	959174
72	65580	2779	578404	988425	499246	26216	39318
73	68920	2507	610424	1406301	420946	98253	802575
74	66050	2453	628310	1644003	459029	749607	115484
75	61460	2603	547402	781248	360857	54534	606231
76	63070	2737	656161	1640259	378336	64782	150442
77	74400	2818	566571	1567879	925791	65306	1701141
78	73960	2978	555259	1360274	903142	710788	105143
79	85400	2917	480373	1912878	1584776	330956	3064409
80	93870	2971	488155	1738470	1633156	23276	201903
81	80470	2778	397518	1385323	1477928	44433	2753954
82	89010	2658	543783	1777436	1395317	2190455	36680
83	78760	2692	385355	2167149	563853	36601	1091027
84	69050	2584	460317	2172171	578499	41797	65971
85	62300	2345	347795	1340686	948186	1029980	1830402

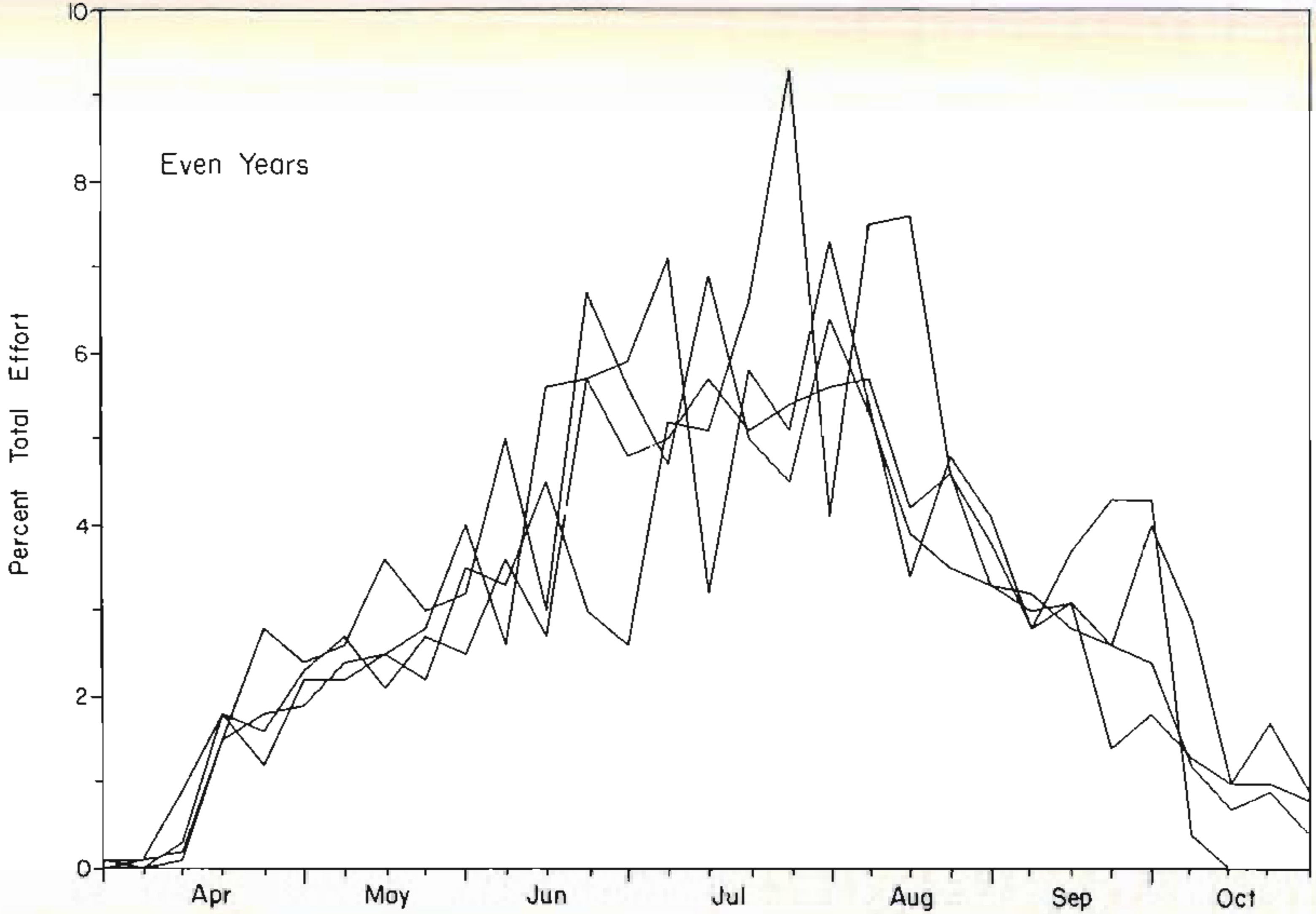


Figure 19. Weekly effort distribution for even years, 1976-82.

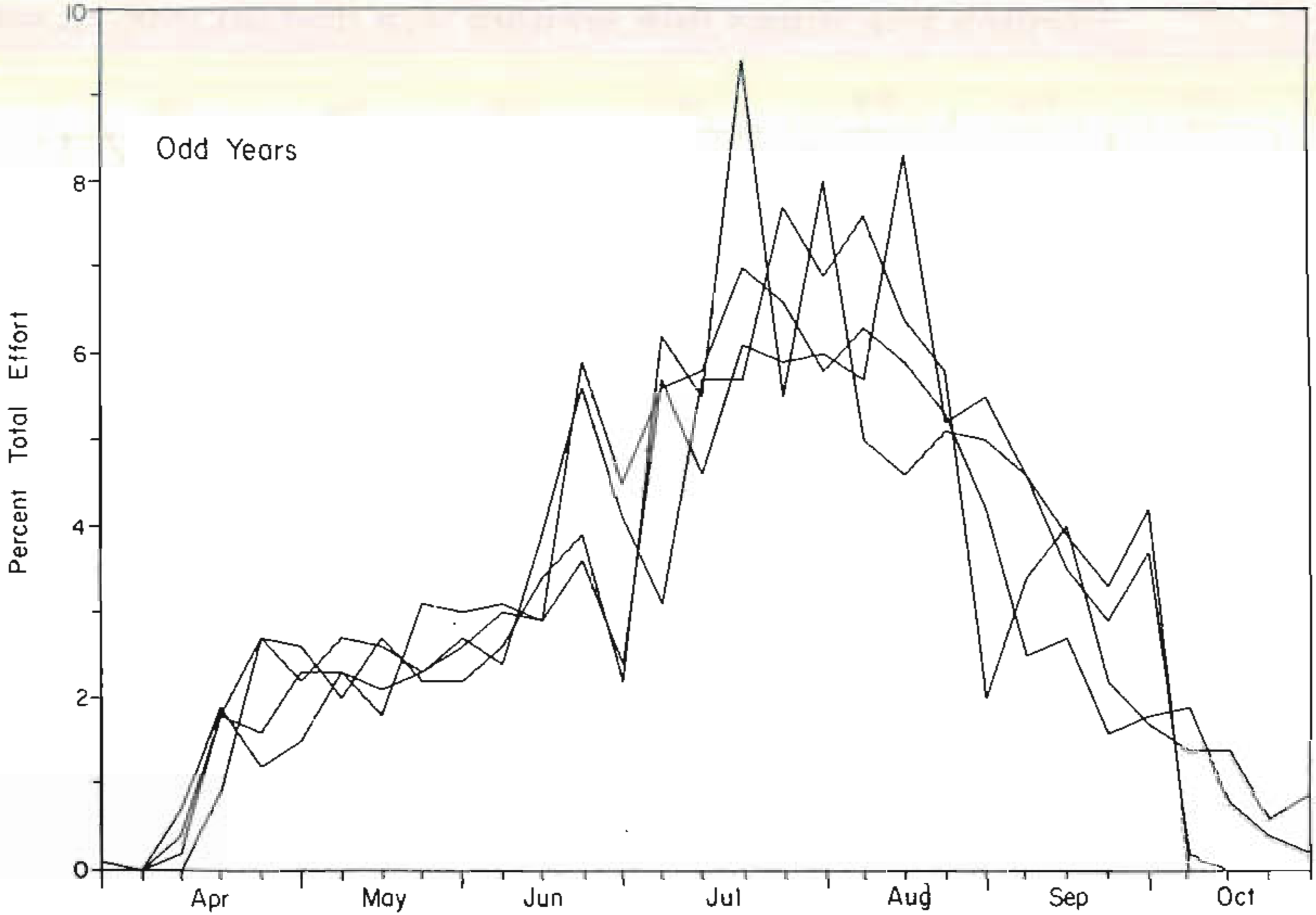


Figure 20. Weekly effort distribution for odd years, 1977-83.

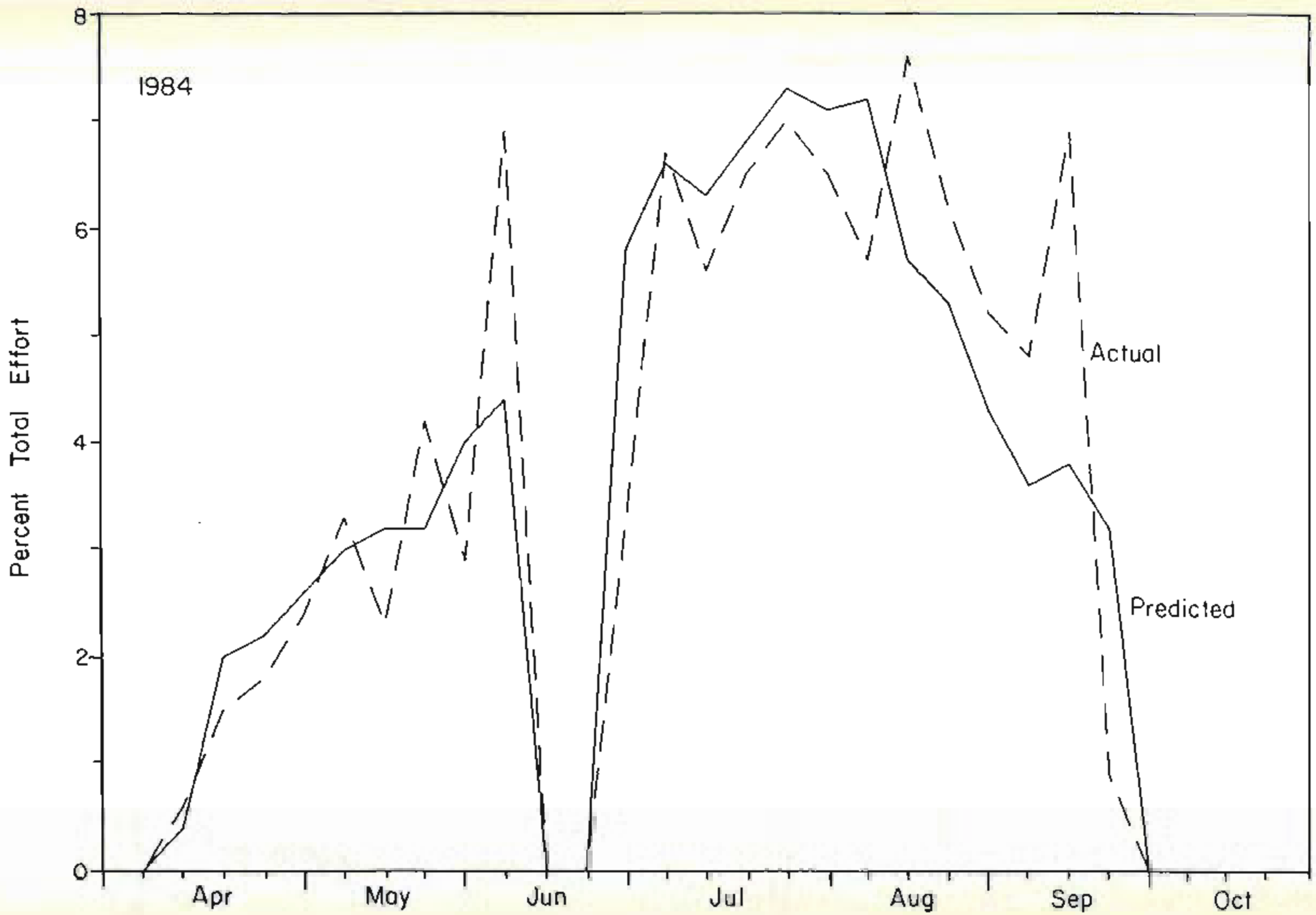


Figure 21. Actual 1984 weekly effort distribution versus predicted effort distribution.

management actions which limit the catch of specific species without closing the entire fishery cannot be assessed without a method of predicting directed effort. The prediction of directed effort was made possible by assuming that the amount of effort directed at a species (DE_i) is related to the relative value of the catch of each species (V_i).

$$DE_i = \frac{V_i}{\sum_i V_i}$$

where $V_i = P_i \cdot C_i$ and P_i is the relative price per fish for species i and C_i is the estimated catch of species i. The price per fish relative to coho are presented in Table 11. Appendix A includes estimates of the proportion of total fishing effort directed at each species from 1976 to 1985. Unfortunately, there are no data that can be used to verify these estimates because individual fishermen may direct effort at more than one species at a time. However, we did examine each troll fisherman's catch per trip in 1983 and accumulated the fishing effort associated with different catch compositions. Figure 22 shows the percent of the total effort in each week that appears to have been directed at a single species (over 80% of the catch was one species). Prior to July 1, virtually all the effort was directed at chinook because coho could not be legally landed and other species were not abundant. The first statistical week in July actually included 5 June days and only 2 July days, so coho fishing was only legal for 2 days in this week. Most of the fishing effort appears to be directed at coho in the next three weeks because coho are much more abundant than chinook, and sockeye and pink runs do not enter the fishery until August. In the last two months of the fishery, most of the fishermen caught all four commercial species of salmon. The dominant species were coho and pink because pink runs are large in odd years and most of the sockeye returning to southern B.C. streams avoided the West Coast Vancouver Island troll fishery by going through Johnstone Strait in 1983 (see Diversion Rate section). Since the same gear and fishing techniques will not catch each species equally well, Figure 22 indicates that fishermen do direct their effort at different species at different times of the year. Also, the proportion of the effort that results in a mixed catch is largest during periods when different species are equally abundant (early August and late September in 1983).

Other Analyses

Troll Log Book Data

The 1981-83 troll log book data were examined for information on diversion rates, directed effort, shakers and catch per effort for the West Coast troll fishery. The number of fishermen participating in the log book program was too small to provide any useful data on diversion rates or directed effort. The number of each species hooked and released per boat day (shaking rate) was estimated for chinook, coho, pink and sockeye for each week (Table 12). The seasonal pattern of shaking rates was fairly consistent with the size limit, growth and fishing seasons for each species. However, the maximum shaking rates of 20 fish per day for chinook and coho appear to be fairly conservative. The coho shaking rates were arbitrarily increased two fold for use in the coho cohort analysis component of the West Coast Troll Model. Catch per effort estimates generated from log book data were similar

Table 11. Relative value of salmon caught in the West Coast Vancouver Island troll fishery 1975-85. Values are relative to coho, and incorporate differences in the average size of each species/age category.

Year	Chinook				Coho	Sockeye	Pink	Chum
	Age 2	Age 3	Age 4	Age 5				
1975	0.52	1.54	3.75	5.49	1.00	0.99	0.52	0.74
1976	0.68	1.82	4.43	6.50	1.00	0.82	0.44	0.64
1977	0.57	1.81	5.11	7.50	1.00	0.82	0.41	0.69
1978	0.62	1.82	4.69	6.88	1.00	1.24	0.37	0.80
1979	0.55	1.53	3.78	5.55	1.00	0.94	0.31	0.62
1980	0.65	1.92	5.91	8.67	1.00	0.91	0.51	0.94
1981	0.65	1.91	5.53	8.12	1.00	1.08	0.41	0.99
1982	0.64	1.90	5.78	8.48	1.00	0.97	0.33	0.89
1983	0.66	2.06	5.79	8.50	1.00	1.08	0.34	1.17
1984	0.70	2.46	6.61	9.70	1.00	1.30	0.34	1.20
1985	0.73	2.27	5.64	8.27	1.00	1.48	0.37	1.02

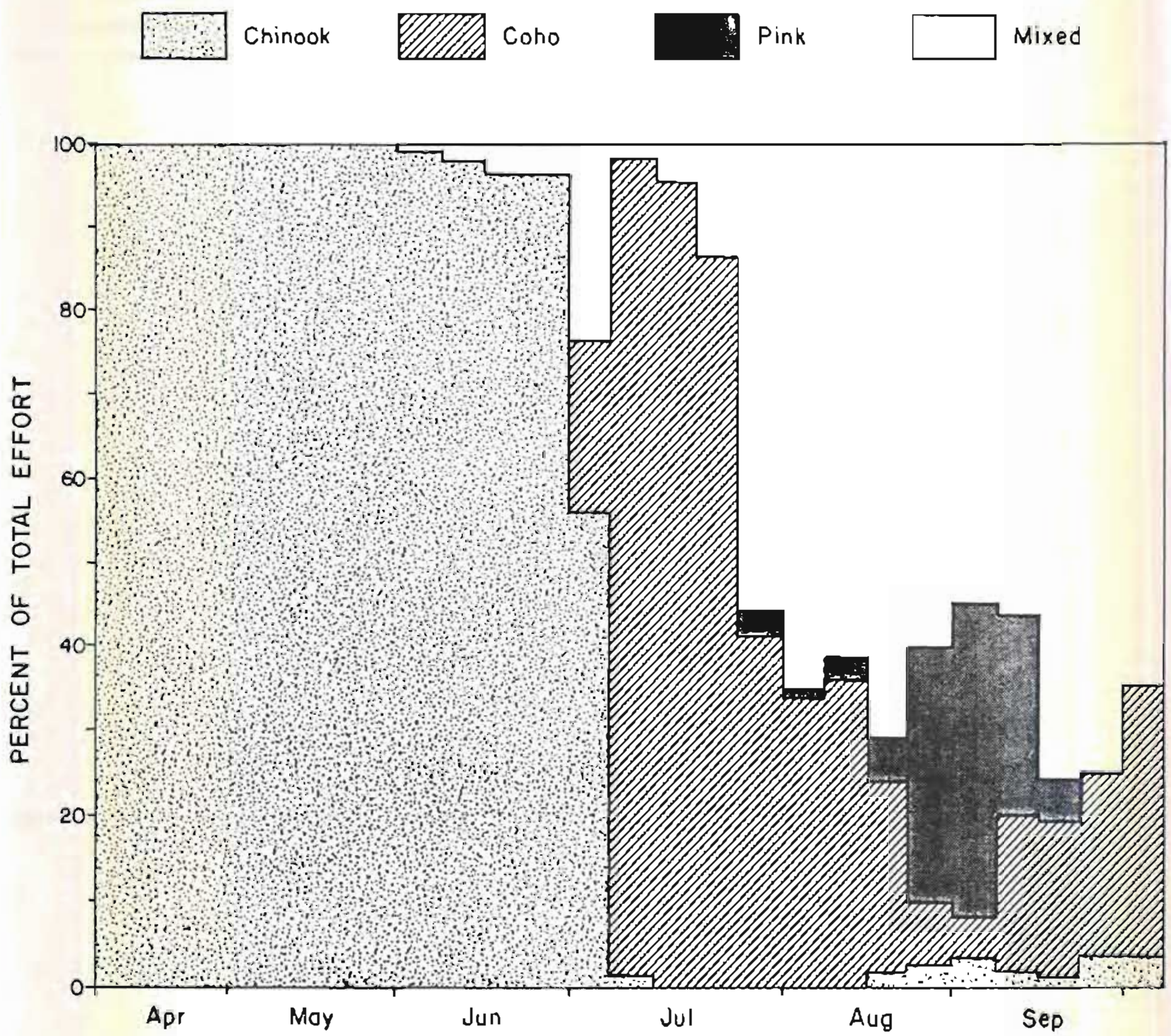


Figure 22. Proportion of fishing effort directed at a specific salmon species for each week during the 1983 fishing season.

Table 12. Mean number of fish hooked and released per boat day (shakers per effort), for log book trollers fishing in Statistical Areas 21-27 from 1981-83.

Week	Shakers per Effort			
	Chinook	Coho	Pink	Sockeye
4-3	12.9	9.1		
4-4	11.9	11.1		
4-5	12.6	13.7		
5-1	8.0	13.5		
5-2	11.4	11.2		
5-3	17.7	12.4		
5-4	14.1	11.0		
6-1	7.4	6.1		
6-2	6.2	10.4		
6-3	6.7	12.2		
6-4	6.8	20.8		
7-1	3.4	3.5	4.7	
7-2	4.3	0.8	10.6	
7-3	5.8	0.4	6.5	0.2
7-4	3.0	0.3	7.1	0.4
7-5	4.3	0.5	3.6	0.2
8-1	4.9	0.2	0.5	
8-2	3.5	0.5	0.8	
8-3	3.1	0.2	0.9	
8-4	4.4	1.1	0.4	
9-1	12.4	8.5		
9-2	16.0	8.3		
9-3	14.7	4.7		
9-4	20.1	11.5		
10-1	5.2	4.8		

to those estimated from Sales Slip data. These consistencies suggest that the troll effort data provided on sales slips may not be as inaccurate as previously believed.

Troll Biosampling Data

Troll biosampling data were used to estimate the weekly age composition for chinook caught in the West Coast troll fishery. Table 13 lists the sample size and age composition for each week estimated by combining 1981 through 1983 biosampling data. Estimates generated for each year separately were similar so the data were combined to increase the sample size in each week. The results suggest that the age structure was fairly stable from April through June, after which the proportion of age 3 fish in the catch increased as the age 4 proportion decreased. Three anomalous high age 5 proportions were adjusted so the estimates in Table 13 could be used in the chinook cohort analysis component of the West Coast Troll Model.

WEST COAST VANCOUVER ISLAND TROLL MODEL

Spatial, Temporal and Stock Resolution

The first steps in the construction of the model was the definition of the spatial, temporal and stock resolution. The spatial scale defines the West Coast Vancouver Island troll fishery as a single fishery (Statistical Areas 21, 23-27). The temporal scale includes 40 periods; 39 one-week periods and one 13-week period identical to those used in the MRP and Salmon Catch Statistics databases (see Table 14). The model includes all five species of Pacific salmon sub-divided into 13 distinct stocks defined in Table 15.

The level of resolution selected for the model reflects the basic objective of the project to develop the simplest model that would be useful in evaluating a wide range of management options. The temporal resolution of one week represents the maximum resolution of most of the data collected for the fishery.

The stock resolution includes the stocks, for which data are available, that are of primary interest to south coast fisheries managers. The coarse spatial resolution was selected because:

1. reliable information on the movement of chinook and coho stocks within the West Coast troll fishery was not available;

2. modeling stock movements on a fine spatial scale would add substantial complexity to the model; and

3. a mechanism was developed for evaluating small area closures within a single fishery model, thereby removing the need for finer spatial resolution.

Model Structure

The model was designed so that the user can reconstruct the weekly West Coast Vancouver Island troll catch for any base year. The decision to use this approach places the following constraints on the model:

Table 13. Mean weekly age composition for chinook caught in West Coast troll fisheries, 1981-83.

Week	Sample Size	Catch Composition (%) Age 2	Age 3	Age 4	Age 5
4-3	596	0.0	58.2	40.4	1.3
4-4	984	0.0	58.6	39.6	1.7
4-5	834	0.0	55.1	42.6	2.3
5-1	812	0.0	53.9	42.9	3.2
5-2	1546	0.0	58.7	39.6	1.7
5-3	1474	0.0	64.1	34.1	1.8
5-4	1080	0.0	59.2	38.5	2.3
6-1	1065	0.0	63.2	34.6	2.3
6-2	887	0.0	57.9	39.1	2.9
6-3	999	0.0	64.8	33.2	2.0
6-4	427	0.0	55.3	40.5	4.2
7-1	564	0.0	53.6	43.6	2.8
7-2	534	0.0	59.7	37.8	2.4
7-3	490	0.0	51.6	45.1	3.3*
7-4	731	0.0	55.7	41.5	2.9
7-5	428	0.0	62.4	35.0	2.6
8-1	537	0.0	62.5	34.5	3.0*
8-2	437	0.0	68.6	29.5	1.8
8-3	239	0.4	69.9	27.2	2.5**
8-4	481	0.6	75.9	21.8	1.7
9-1	380	0.3	79.7	17.6	2.4
9-2	227	0.4	88.5	10.1	0.9
9-3	249	1.6	86.7	11.2	0.4

* Age 5 component reduced by 2%, Age 3 component increased by 2%.
** Age 5 component reduced by 5%, Age 3 component increased by 5%.

Table 14. Definition of time periods.

Week Number	Statistical Week	Week Number	Statistical Week
1	3-1	21	7-4
2	3-2	22	7-5
3	3-3	23	8-1
4	3-4	24	8-2
5	4-1	25	8-3
6	4-2	26	8-4
7	4-3	27	9-1
8	4-4	28	9-2
9	4-5	29	9-3
10	5-1	30	9-4
11	5-2	31	10-1
12	5-3	32	10-2
13	5-4	33	10-3
14	6-1	34	10-4
15	6-2	35	10-5
16	6-3	36	11-1
17	6-4	37	11-2
18	7-1	38	11-3
19	7-2	39	11-4
20	7-3	40	12.1 through 2.4

Table 15. Definition of stocks.

Species	Stocks	Description
Chinook	Canadian	Originating from Canadian streams or hatcheries.
	U.S.	Originating from U.S. streams or hatcheries.
Coho	Canadian	Originating from Canadian streams or hatcheries.
	U.S.	Originating from U.S. streams or hatcheries.
Sockeye	E. Fraser	Early run Fraser River stocks: Stuart, Horsefly, Chilko, Stellako, Birkenhead, Pitt, Nadina, Seymour, Raft, Bouron, Gates.
	L. Fraser	Late run Fraser River stocks: Adams, Lower Shuswap, Weaver, Portage, Harrison, Cultus.
	U.S.	U.S. stocks: Lake Washington.
Pink (odd)	Georgia Strait	Originating from streams on middle eastern Vancouver Island, and streams flowing into Phillips Arm, Toba Inlet, Howe Sound, Jervis Inlet and Burrard Inlet.
	Fraser	Originating from the Fraser River.
	U.S.	U.S. Stocks: Nooksack River, Skagit River, Puget Sound.
Pink (even)	Upper Van. Is. and Mainland	Originating from streams on Upper Vancouver Island and streams flowing into inlets between Kingcome and Wakemen Inlet.
	Johnstone Strait and Area	Originating from streams in the following areas: Johnstone Strait, Bard to Knight Inlet, Loughborough to Bute Inlet, Phillips Arm and the Bear River.
	Mid. Van. Is.	Originating from streams on middle eastern Vancouver Island.
Chums	Summer	Summer runs possibly originating from B.C. central coast.
	Canadian	Fall runs originating from Canadian streams: Lower and southern Vancouver Island, Howe Sound, Fraser River.
	U.S.	Fall runs originating from U.S. streams: Nooksack, Skagit, Stillwater-Snohomish, Puget Sound and Hood Canal.

1. extensive data requirements for sockeye, pink and chum run reconstruction;

2. the use of the South Coast Stock Planning Model for sockeye, pink and chum run reconstruction;

3. extensive parameter requirements for chinook and coho cohort analyses;

4. development of chinook and coho cohort analysis models for the West Coast troll fishery; and

5. the execution of the run reconstruction and cohort analysis models prior to the execution of the West Coast Troll Model for any base year.

Figure 23 shows the sequence of tasks required to prepare a base year for the West Coast Troll Management Model. The tasks required to prepare a single base year appear formidable at first glance; however, most of these tasks can be completed very quickly. The organization of data for the South Coast Stock Planning Model requires a considerable amount of work. Half weekly sockeye, pink and chum escapement estimates have to be accumulated for the various stocks running in each year and marked with daily catch estimates for Fraser and Juan de Fuca net fisheries. Fortunately this task has been completed for 1979-85 sockeye, pink and chum runs. Further details on the various models are included in the following sections.

Data Organization for West Coast Troll Fishery

The two major data sources for the West Coast troll management model were the sales slip catch and effort database and the run size entering the Strait of Juan de Fuca derived from the South Coast management model (Gazey et al. 1986). Figure 24 displays the overall data flow used as input to the West Coast Model. The calculations used to construct the corrected catch and effort summaries (Appendix A) are presented first because these summaries were central to all other analyses. The analyses that access the corrected catch and effort data (stock reconstruction and cohort analysis) are described in subsequent sections.

The catch and directed effort summaries were formed by first approximating the week that fish were caught from the week of sale given by the sales slip database. The resultant total effort in any week was then partitioned into the effort directed at each of the five salmon species based on the relative value, catchability and abundance for each species (see below). These two steps, the temporal adjustment of catch statistics and the calculation of directed effort are described below.

Catch and effort statistics in the sales slip summary database are given by week for freezer trollers and non-freezer trollers (e.g., day boats). Since freezer trollers can operate for extended periods (i.e., 5-8 weeks) without landing their catch, this inclusion can distort the true catch record. Therefore, the proportion of annual catch taken and effort expended in any given week was assumed to be the proportion of catch and effort

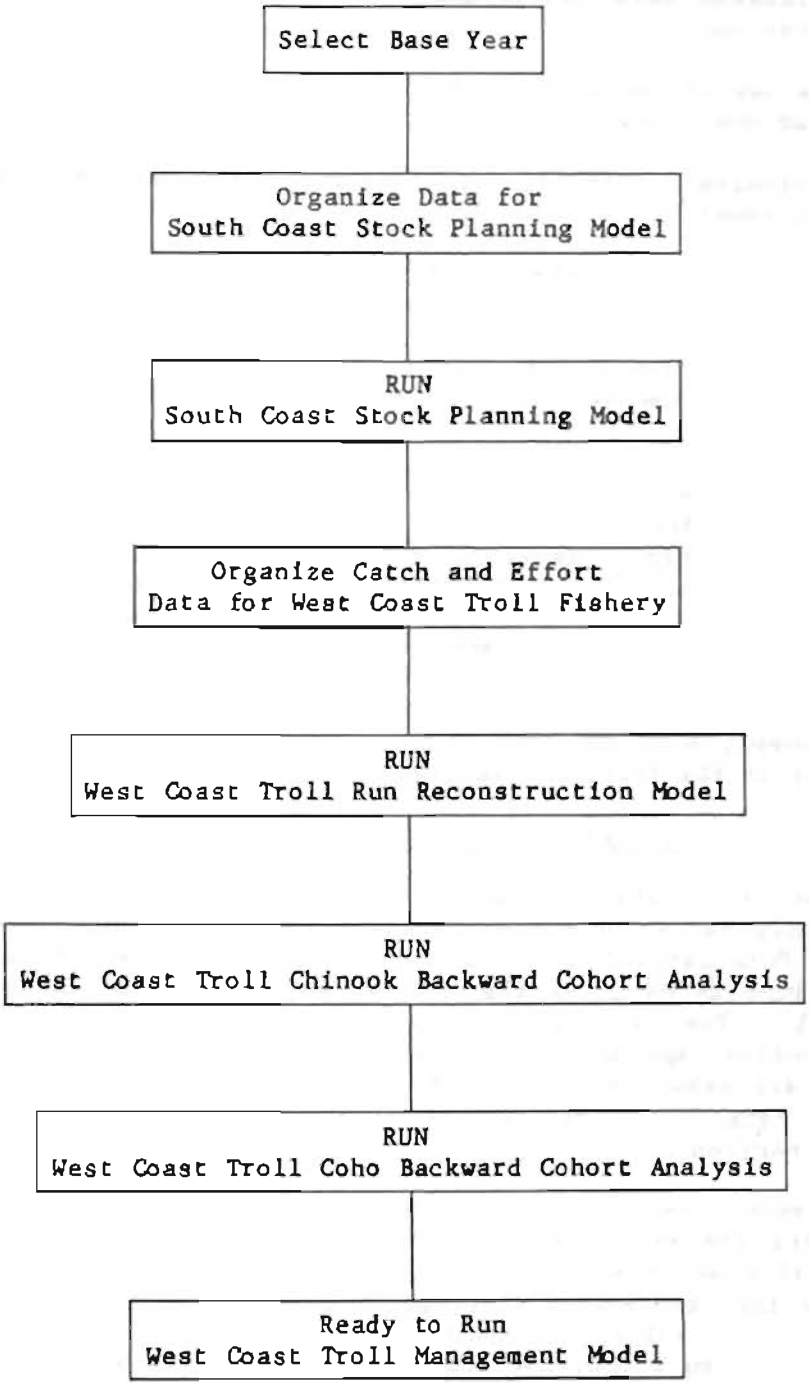


Figure 23. Sequence of tasks required to prepare a base year for the West Coast Troll Management Model.

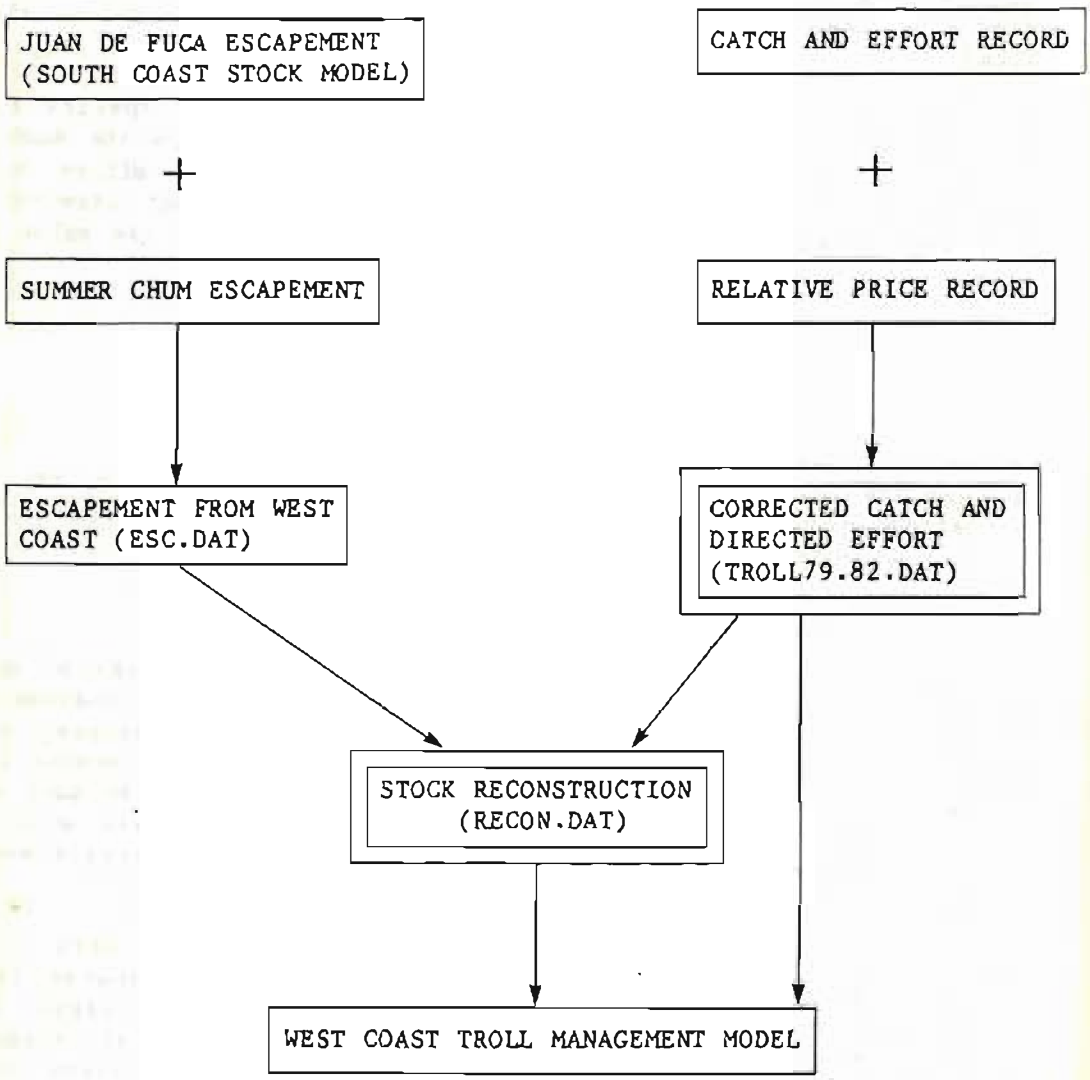


Figure 24. Data flow used in the West Coast troll management model. Double margins indicate the major data summaries read directly by the model.

reported by non-freezer trollers over a two week period: half during the week of sale and half during the previous week. All catch and effort reported for the first week of the season or the first week of fishing following a closure was assumed to occur the same week. The catch and effort for any week was then calculated as the simple product of the proportion and the annual catch or effort obtained from all sources (i.e., freezer and non-freezer statistics).

The proportion of the effort directed at a particular species for any given week was then calculated, assuming the fishery will operate such that, on average, the value of the catch taken by a unit of effort will be equivalent for all species. Therefore, the measure of effort directed at a particular species during any given week is in proportion to the value of the catch, i.e.,

$$E_{ij} = E_i \frac{P_j C_{ij}}{\sum_j P_j C_{ij}}$$

where E_{ij} is the effort directed at species j during week i, E_i the weekly corrected effort described above, C_{ij} the weekly catch for species j, and P_j the relative value index for species j (see Table 11).

West Coast Troll Run Reconstruction Model

Gazey et al. (1986) produced half-weekly run size estimates of sockeye, pink and chum stocks entering the Strait of Juan de Fuca and Johnstone Strait by stock reconstruction methods, for the purpose of obtaining harvest rates to be applied in the South Coast management model. The multiple stocks used by Gazey et al. were amalgamated into three stocks (1979-1982) for each species (see Table 15) with a one-week time resolution (two half-weeks were summed together). These weekly run size estimates for Juan de Fuca Strait were then taken to be escapement from the West Coast troll fishery.

Next, a very simple run reconstruction was conducted with a single fishery (i.e., West Coast troll) using the "escapement" estimates from the South Coast model and the catch calculated from the catch and effort summary file described above. Travel time through the West Coast troll fishery was assumed to be 1 week for sockeye, 2 weeks for pink and 2 weeks for chum salmon. Weekly harvest rates were calculated and divided by the directed effort (described above) to obtain the catchability coefficient.

The run reconstructions explained greater than 99% of the catch (see Appendix B) for sockeye and pink salmon; however, only the late-season catch could be explained for chum salmon. We believe summer chum stocks destined for the central coast and the Queen Charlotte Islands, which were not represented in the South Coast model, are available to the West Coast troll fishery. Since the interception rate for these stocks in the West Coast fishery is unknown and escapement estimates for these stocks are unavailable, the summer chum run escaping the West Coast fishery was approximated by the following method.

First, a visual examination of the summer catch data revealed two peaks for all years which indicated the presence of at least two summer chum stocks. Next, the period over which the two "stocks" were subject to exploitation was determined by inspection under the assumption that the run size over time could be explained by a simple binomial (symmetrical) distribution. Finally, the total escapement for each of the two "stocks" was set such that the resultant harvest rate upon the stock was equivalent to the fall harvest rate calculated using the South Coast model data. The resultant approximations are presented in Table 16.

The run reconstruction data and results can be found in Appendix C.

West Coast Troll Backward Cohort Analysis Model

A backward cohort analysis was used to reconstruct weekly chinook and coho populations in the West Coast troll fishery, from estimated escapement, actual catch data and a finite set of parameters. The weekly population estimates were combined with weekly catch and effort data to estimate weekly catchability coefficients. These catchability coefficients provide the basis for predicting catch in a forward cohort analysis where population size and fishing effort can be altered.

Both chinook and coho backward cohort analysis models have the same structure, parameter requirements, interactive inputs, formulas and outputs (see Figure 25). The only noteworthy differences are that the chinook model includes four age groups (age 2 through 5) while the coho model only includes two age groups (age 2 and 3), and all parameter values are different. The parameter values used in the cohort analysis are listed in Table 17. Most of the parameters are self explanatory or have the same definition as those used in the Georgia Strait Model (Argue et al. 1983). However, unlike the initial Georgia Strait Model the west coast troll cohort analyses include a migratory component (the category "Adult Others" in Table 17). This migratory component represents maturing fish that reared outside the West Coast troll fishery pool but their migration back to their natal stream takes them through the West Coast troll fishery. The current model includes a residence time of four weeks for this migratory component, therefore, the West Coast troll fishery has a very low harvest rate on this group of fish. The chinook stocks represented by these fish are those with distributions similar to Robertson Creek or the Upper Columbia River stocks. These stocks are primarily caught in the Alaska troll, Northern B.C. troll and West Coast troll fisheries (see Table 4).

Backward cohort analyses were run for the 1979 through 1982 calendar years to coincide with the sockeye, pink and chum run reconstructions. Catch by age and directed effort were obtained from the data files organized for all species. The values used for total escapement from the West Coast troll fishery and the proportion of the total escapement that came from outside the pool (migratory component) are listed in Table 18. Estimates for total escapement from the West Coast troll fishery were not based on any escapement data, rather the values selected insure that resultant harvest rates are similar and "reasonable" for each year. The migratory component for chinook (25%) was assumed to be a larger proportion of the total escapement than that for coho (5%). These proportions are based on analyses presented in an earlier section and are consistent with the emigration parameters which suggest that the

Table 16. Summer chum salmon escapement approximation from the West Coast troll fishery.

Year	Stock	Starting* Week	Ending* Week	Total Escapement
1979	1	15	22	600,000
	2	21	27	1,040,000
1980	1	10	16	75,000
	2	17	27	1,750,000
1981	1	16	22	90,000
	2	21	27	700,000
1982	1	10	17	40,000
	2	17	27	2,040,000

* week 1 = 1st week in March.

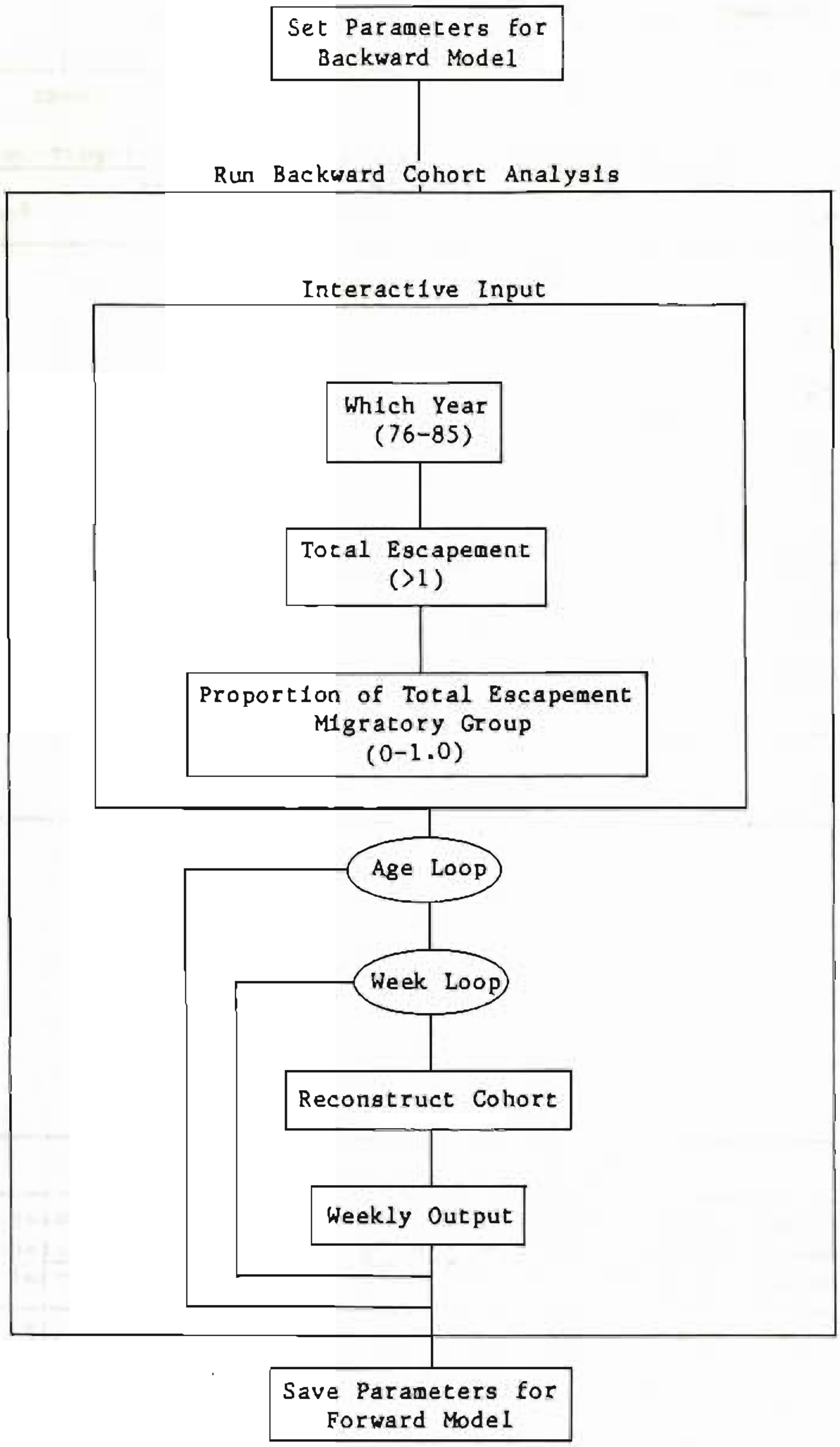


Figure 25. Structure of the West Coast Troll backward cohort analysis model.

Table 17. Parameter values used in the cohort analysis.

		Chinook			Coho		
		Monthly Proportion Emigrating			Monthly Proportion Emigrating		
		Juveniles	Adults		Juveniles	Adults	
Month	Weeks		Pool	Others		Pool	Others
Mar.	1-4						
Apr.	5-9						
May	10-13						
June	14-17		.15				
July	18-22		.05	.05			
Aug.	23-26		.20	.20	.4		
Sep.	27-30		.32	.36	.4	.4	.4
Oct.	31-35	.4	.20	.30	.2	.4	.4
Nov.	36-39	.4	.08	.09		.2	.2
Dec-Feb.	40	.2					

	Chinook					Coho				
Total Age	Shaker Mortal. Rates	Instantaneous Mortal. Rates Weekly	Annual	Proportion Emigrating Juv.	Adult	Shaker Mortal. Rates	Instantaneous Mortal. Rates Weekly	Annual	Proportion Emigrating Juv.	Adult
2	.3	.007	.302	.25	.20	.3	.018	.617	.1	0
3	.3	.0035	.165	.15	.35	.3	.009	.381	0	1.0
4	.3	.0035	.165	.10	.44					
5	.3	.0035	.165	0	.01					

Table 18. Values used for base year cohort analysis.

Calendar Year	Total Catch	Escapement from Fishery Total	Escapement from Fishery Prop. Migratory	Harvest Rate*
Chinook				
1979	478,000	400,000	.25	.614
1980	481,000	400,000	.25	.611
1981	391,000	320,000	.25	.616
1982	544,000	400,000	.25	.639
Coho				
1979	1,912,000	1,500,000	.05	.594
1980	1,738,000	1,500,000	.05	.582
1981	1,382,000	1,100,000	.05	.599
1982	1,777,000	1,500,000	.05	.574

* Total harvest rate (catch and shaker deaths/escapement) estimated using the backward cohort analysis.

proportion of immature fish emigrating from the West Coast troll fishery is larger for chinook than for coho (see parameter Table 17).

West Coast Troll Management Model

Now that the run reconstruction and backward cohort analysis models have been run for the necessary base years, fisheries managers can run the West Coast Troll Management Model to reproduce catch patterns for any base year.

The Management Model was developed as a series of discrete sub-models. A brief description of each sub-model name function and the execution sequence is shown in Figure 26. The model dynamics are focused on the prediction of directed effort (i.e., the fishing effort directed at catching a specific species of salmon). Most management actions affect the catch of a specific species by increasing or decreasing the fishing effort directed at that species. The following section describes the key components of each sub-model and the algorithms used to predict directed effort.

Effort Sub-model

The effort sub-model has two distinct functions: 1) reading the file containing all management actions and major parameters and 2) predicting total and weekly fishing effort for any fishing season.

Management Actions and Parameters

Table 19 shows the structure of a typical input file containing all management actions and major parameters for a specific simulation year. The base year selected should be as similar as possible to the simulation year. Therefore, the base year to use to simulate (predict) the 1986 fishing season would be 1982 because both 1982 and 1986 are the dominant cycle years for Adams River sockeye salmon. The price per fish relative to coho should reflect the predicted prices for the simulation year or the fishermen's relative preference for catching each species. The run size relative to the base year is self explanatory (i.e., if the predicted run size for sockeye is twice that of the base year the factor under SOCK should be 2.0)

The next set of inputs are used to predict total fishing effort. For the 1986 fishing season, the numbers under "LAST" and "NEXT" reflect the actual 1985 pink catch and the predicted 1986 pink catch, respectively; the number under "CHINOOK" and "COHO" are the predicted 1986 catches for these species; and the number under "#LIC. (TR. + GN/TR)" is the predicted number of vessels licensed to fish with troll gear. The equation that uses these numbers to predict total fishing effort for the West Coast troll fishery was described in the section on Effort Analysis.

The next set of numbers in the input file indicates which of the weeks during the year will be open for fishing. A zero indicates the whole fishery is closed for all species that week. Specific area and species closures can be implemented using the next sequence of inputs. The time component indicates the starting and ending week of the partial closure, and the species components identify what the manager believes will be the effect of the closure on each species. The effect on each species is specified through two parameters: a diffusion rate (DR) and the proportion of the fishing area

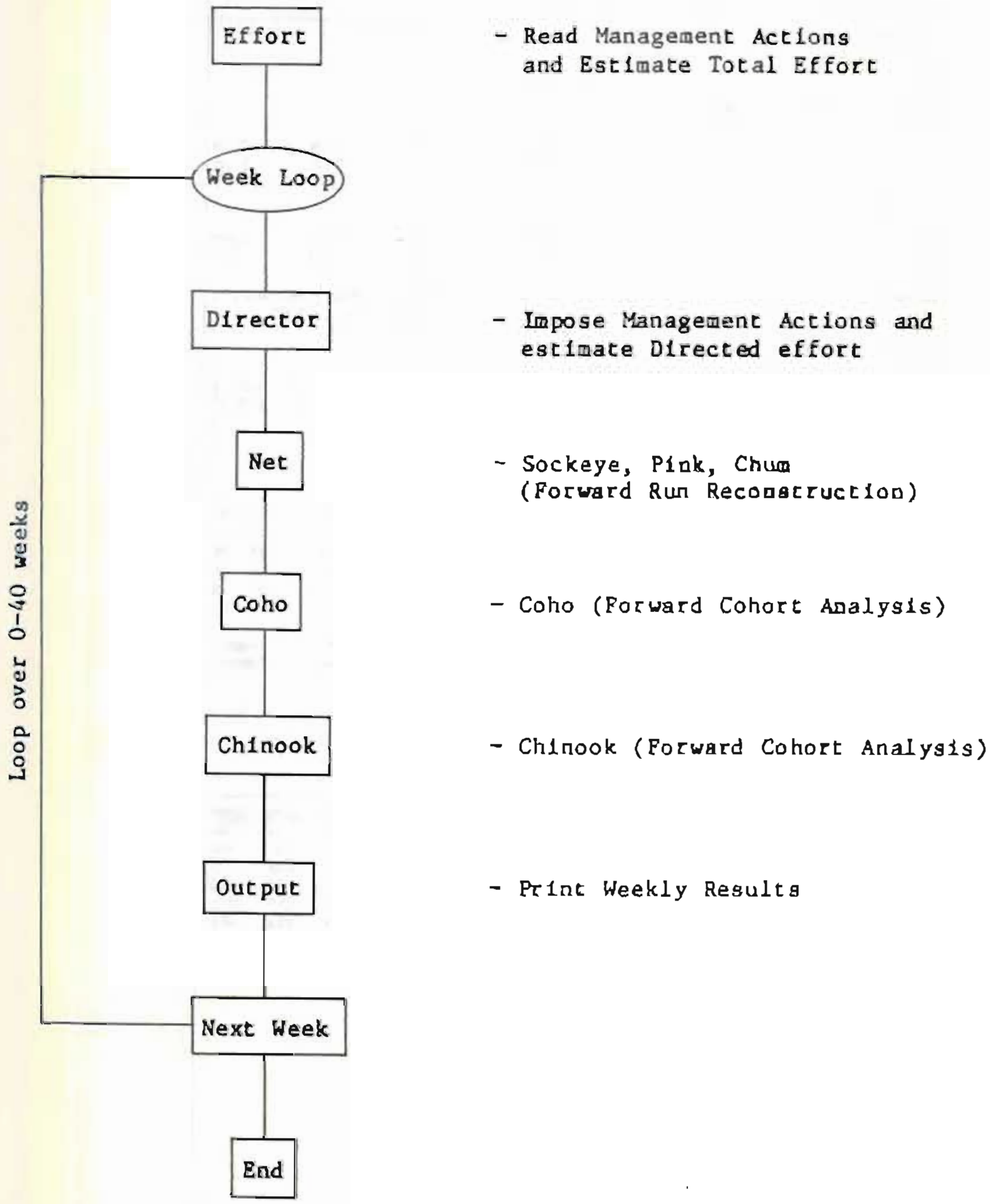


Figure 26. Structure of the West Coast Troll Management Model.

Table 19. Structure of a typical input data file.

INITIALIZATION FOR WCVI TROLL MODEL

BASE YEAR FOR SIMULATION (1979-1982)

1982

PRICE/PIECE REL. TO COHO (=1.00)

CN.2	CN.3	CN.4	CN.5	COHO	SOCK	PINK	CHUM
0.73	2.27	4.51	6.62	1.00	1.42	0.37	1.02

RUN SIZE REL. TO BASE YEAR

CN.2	CN.3	CN.4	CN.5	COHO	SOCK	PINK	CHUM
0.9	0.9	0.9	0.9	1.0	0.8	1.2	1.5

CATCHES: PINK	LAST	NEXT	CHINOOK	COHO	#LIC.(TR.+GN/TR)
	1830402	45000	360000	1750000	2300

CLOSURES: 0=CLOSED 1=OPEN

MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 1 1	1 1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1 1	0 0 0 0

NUMBER OF AREA-SPECIES CLOSURES - 3

CLOSURES: TYPES 0=AREA CLOSURES 1=4 CURDIE 2=RED GEAR

	TIME		CHINOOK		COHO		SOCKEYE		PINK		CHUM	
TYPE	START	END	DR	PA	DR	PA	DR	PA	DR	PA	DR	PA
0	1	1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
0	15	22	.0	.0	.0	.0	.0	.0	.0	1.	.0	.0
0	31	35	.0	.0	.0	1.	.0	1.	.0	1.	.0	1.

CATCH CEILINGS:	CHIN	COHO	SOCK	PINK	CHUM
	360000	1750000	1428800	1350000	200000

NUMBER OF EXTENSIONS - 6

EXTEND THE CHINOOK,COHO AND CHUM SEASON

TIME		EFFORT			CATCHABILITY (X1000)					
START	END	CHIN	COHO	CHUM	CH.2	CH.3	CH.4	CH.5	COHO	CHUM
16	16	1500.	2000.	0.	.000	.034	.031	.050	.024	.000
31	31	800.	250.	80.	.009	.031	.022	.041	.027	.100
32	32	700.	200.	70.	.007	.028	.021	.046	.026	.050
33	33	600.	160.	60.	.003	.016	.014	.045	.182	.030
34	34	500.	150.	50.	.001	.007	.007	.032	.009	.010
35	35	500.	150.	50.	.001	.008	.009	.016	.014	.005

CHINOOK SIZE LIMIT (MM) - 630

LICENCE CONTROL (MUST BE SAME # USED AS EFFORT PREDICTOR ABOVE)

NUMBER GEAR REGULATION TYPES - 2

READ PARAMETERS FOR TYPES OF GEAR REGULATIONS

TYPE	CHIN	COHO	SOCK	PINK	CHUM
1	0.0	0.2	0.4	0.4	0.1
2	0.0	0.0	0.7	0.7	0.0

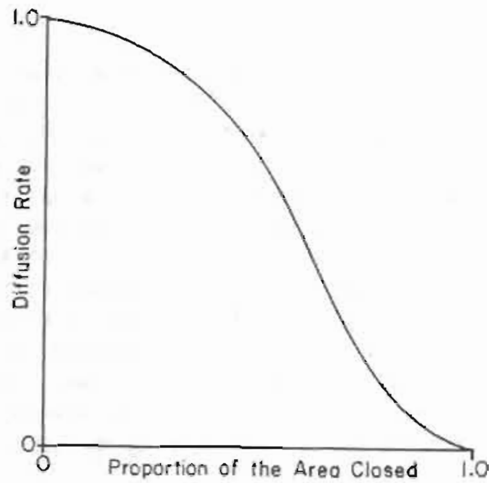
READ PARAMETERS FOR NON-RETENTION BY SPECIES

NON-RETENTION SPECIES	BI-CATCH WEIGHT CN 1	CO 2	SX 3	PK 4	CM 5	MAX %
1	0	2	1	1	2	40
2	3	0	2	3	1	40
3	1	1	0	1	1	40
4	1	3	1	0	1	40
5	1	1	1	1	0	40

READ SHAKER MORTALITY RATES

CN.2	CN.3	CN.4	CN.5	COHO	SOCK	PINK	CHUM
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

closed (PA). Diffusion rates are used to represent fish movement in and out of the closed area. For example, if all of the fish in the closed area can move out of the area in a single week the diffusion rate is 1.0; conversely, if none of the fish in the closed area move out of the area in a single week the diffusion rate is zero. Therefore, the diffusion rate is probably related to the size of the closure in the following manner:



These inputs allow managers to evaluate the effect of any size closure for any species given different assumptions about the rate of fish movement.

Catch ceilings allow managers to specify a total allowable catch for any species. Once the cumulative catch has exceeded the catch ceiling, the fishery is effectively closed for that species (i.e., fishing may continue but the closed species must not be landed).

The next sequence of inputs permits managers to evaluate the impact of fishing during weeks when the fishery was not open in the base year. The only species options are chinook, coho and chum because the West Coast troll fishing was open throughout the sockeye and pink seasons in every base year. To extend the fishing season the manager must specify the period, approximate the effort directed at each species, and allocate appropriate catchabilities for each species.

The chinook size limit indicates the minimum size of legally landed chinook salmon. The 1986 minimum size limit for the West Coast troll fishing was 66 cm total length, which translates to the effective size limit used in this model of 63 cm. Any larger number would result in an unreasonable number of age 2 shaker deaths. This problem may be the result of incorrect aging of chinook catches, landing of sub-legal age 2 chinook or incorrect estimates of size at age.

The licence control line in the input file indicates that licence control management actions can be implemented by reducing the number of licensed vessels used in the equation to predict total effort. Therefore, licence control can produce a direct reduction in total effort.

The next set of inputs are parameters which define the effect of two types of gear restrictions on each species. The two types of gear restrictions are: 1) a reduction in the maximum number of gurdies from six to four, and 2) a ban on the use of red gear (gear used primarily to catch sockeye and pink salmon). The values used reflect the estimated reduction in directed effort (i.e., no red gear would reduce the directed effort on sockeye and pink by 70%).

The parameters for non-retention by species indicated the relative by-catch for a non-retention species for effort directed at other species on a three point scale. Therefore, if the troll fishery was closed for chinook (i.e., non-retention), each unit of effort directed at coho and chum would have twice the by-catch rate of chinook than each unit of effort directed at sockeye and pink salmon. The species maximum percent parameter indicates the maximum percent of the new effort directed at another species (caused by non-retention) that results in catch of the non-retention species. Therefore, if a coho non-retention results in a 100 boat-day increase in chinook directed effort then 20 boat days of the new effort directed at chinook will result in coho by-catch, because chinook directed effort has the maximum by-catch rate for coho (3). The equations that use these parameters to estimate by-catch during non-retention are presented in the section which described the Director sub- model.

The last parameters read from the input file are shaker mortality rates (mortality rates for hooked and released fish). Many consider these parameters controversial but the managers currently use 0.3 for all species and for this model. The same values must be used in the backward and forward cohort analyses.

Effort Prediction

Effort estimation includes three steps: 1) prediction of total effort for a specific year, 2) the distribution of total effort over the fishing season by week and 3) the separation of weekly effort into directed weekly effort by species. The first two steps are completed in the Effort sub-model, the third step is completed in the Director sub-model. The equation used to predict total effort (TE) was described in an earlier section.

An adjustment to the predicted fishing effort was made if the number of weeks open for fishing was less than 22 (to a minimum of 5 weeks):

$$TE' = TE \cdot \frac{N+18}{40}$$

where N is the number of weeks the fishery was open.

The rationale for this adjustment was that the length of the fishing season should affect our ability to predict total effort based on a time series of data from a fishing season of 22 weeks or longer. In fact, the predictive equation overestimates the 1985 fishing effort by 17%. Since the 1985 fishing season was only open for 16 weeks, the above equation would estimate an appropriate reduction in total effort to 85% of the predicted value for 1985.

The distribution of the total effort (TE') over the fishing season was determined by the weeks open for fishing and the distribution of effort for the base year:

$$E_i = TE' \frac{BE_i}{\sum_i BE_i}$$

where E_i is the effort in week i, BE_i is the base year effort in week i and i includes only those weeks when the fishery is open.

Director Sub-model

The Director sub-model estimates the amount of fishing effort to be directed at each species on the basis of comparative value, population size, catchability and management actions.

The first values that must be estimated are the directed efforts (DE'_{ij}) for each species prior to imposing the management actions that apply to that week:

$$DE'_{ij} = E_i \frac{DE_{ij}\ P_j\ Q_{ij}\ N_{ij}}{\sum_j DE_{ij}\ P_j\ Q_{ij}\ N_{ij}}$$

where E_i is the predicted total effort for week i, DE_{ij} are the initial directed efforts, P_j is the relative value of each species, Q_{ij} is the catchability coefficient and N_{ij} is the population size for species j in week i. It should be noted that the above equation was used to estimate the directed efforts (DE_{ij}) for the backward cohort analyses and run reconstruction models, which estimate the catchability coefficient (Q_{ij}).

Therefore, $DE'_{ij} = DE_{ij}$

if no management actions are imposed and relative prices and population size are the same as in the base year. The following sequence of equations was used to simulate the effect of management actions on directed effort.

$$FR_j = (1-DR_j)\ PA_j\ GF_j$$

$$DE''_{ij} = DE'_{ij}\ (1-FR_j)$$

where FR_j is the fraction of the effort directed toward a species that is affected by the management action, DR_j is the diffusion rate, PA_j is the proportion of the fishing area affected and GF_j is a gear restriction factor.

These three factors (DR_j, PA_j, and GF_j) have been defined in more detail in the previous section.

Management actions that result in non-retention of a species have three effects on the fishing that must be simulated: 1) a reduction in total fishing effort, 2) a reallocation of fishing effort from the non-retention species to the species that can be retained, and 3) a by-catch (the catch and release of the non-retention species). The reduction in total fishing effort is that portion of the direct effort affected by the equation (DEA_j) that was not reallocated to other species. The following sequence of equations was used to estimate the reallocated effort (RA_j)

$$DEA_j = DE''_{ij} - DE'_{ij}$$

$$RA_j = DEA_j \left(1 - \frac{\sum_j DEA_j}{E_i}\right)$$

where all variables are as previously defined. The latter relationship suggests that most of the directed effort affected by regulation (DEA_j) will be reallocated to other species if DEA_j is a small portion of the total week's effort (E_i). Figure 27 shows the shape of two alternative relationships between the portion of the affected effort reallocated (RA_j/DEA_j) and the proportion of the total effort affected by the regulations (DEA_j/E_i). The directed effort estimate for each species not affected by the management action can now be adjusted for effort reallocated from the affected species.

$$DE'''_{ij} = DE''_{ij} + RA \frac{V_j(1-FR_j)}{\sum_j (V_j(1-FR_j))}$$

where $V_j = DE_{ij} \quad P_j \quad Q_{ij} \quad N_{ij}$

and all other variables are as previously defined. Therefore, the effort is reallocated according to the relative value (V_j) of each species available to the fishermen.

The last component that the Director sub-model estimates is the amount of effort that results in by-catch (catch and release) of the regulated species (BE_k).

$$BE_k = RA_k \ MAX_k \ \frac{\sum_j WT_{jk} \ DE'''_{ij}}{3.0 \sum_j DE'''_{ij}}$$

where RA_k is the amount of effort reallocated from the regulated species (k) to the unregulated species (j), MAX_k is the maximum portion of the reallocated effort that would result in by-catch of the regulated species (initially defined as 40%, see previous section). WT_{jk} is the relative by-catch weights for the regulated species (k) for effort directed at other species (j) on a 3 point scale and DE'''_{ij} represents the effort directed at the unregulated species in week i.

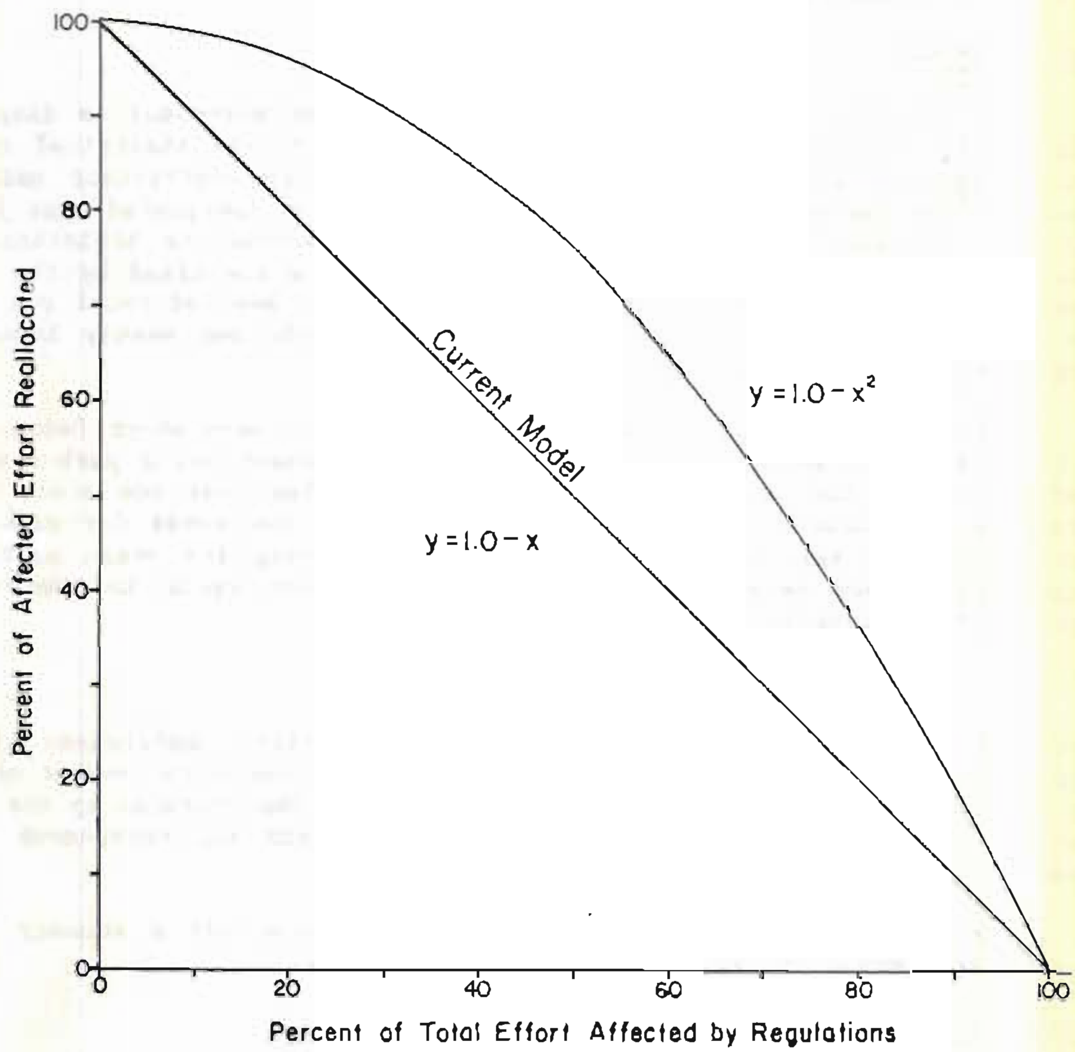


Figure 27. Alternative relationships for estimating effort reallocation.

Table 20 shows the changes in directed effort resulting from two different management actions. The first example shows that a small area closure for chinook results in a small reduction of chinook directed effort (59 boat days), small increase in the effort directed at other species (57 boat days), a total loss of only 2 boat days and an estimated 12 boat days of chinook by-catch effort. The second example shows the much more significant effects of complete closures on two species.

Net Sub-Model

The sequence of calculations used for the Net sub-model is displayed in Figure 28. During the initialization week (week 0) the historical run size, stock proportions, directed effort and catchability coefficient columns are read in from the file RECON.DAT (Appendix C) for the designated base year. If the user chooses to extend the fishing season beyond the historical record then catchability coefficients and directed efforts specified by the user are appended to the appropriate columns. Further, the desired total run size for each species is portioned into the three sub-stocks and weekly intervals in the same proportions as the historical data.

For model weeks after the initialization week, each stock (nine in total - three for each species) is moved through the fishery via a push-down stack. The length of the stack is determined by the time that the stock takes to traverse the fishery (i.e., one week for sockeye, two weeks for pink and two weeks for chum salmon). The number of fish leaving the stack each week is accumulated into escapement. The catch for each stock in the stack is calculated next using the simple relationship:

$$C = qEN$$

where C is the catch, q the historical catchability coefficient, E is the directed effort calculated by the Effort sub-model and N the number of fish in each stock. The number of fish in each stock is then reduced by the computed catch. Finally, the stock proportions of the catch and escapement for each species is calculated.

During the final week of the simulation (week 40) a summary table of catch, escapement and stock proportions is printed.

Coho Sub-model

The Coho sub-model is essentially equivalent to running the previously described cohort analysis forward. This sub-model estimates catch, shaker death and escapement, and keeps track of the size of cohort in the pool fishery every week. The cohort size is passed to the Director sub-model where it is used to estimate directed effort and catch; shaker deaths and escapement are passed to the Output sub-model for summary output. The Coho sub-model also produces summary output which includes catch, shaker deaths and escapement estimates for two coho stocks (Canada and U.S.) and one age class (age 3). The coho stock composition used for initial runs was assumed to be identical for each week of the fishing season. The basis for these values can be found in the section on CWT analyses.

Table 20. Two examples of how the Director Model estimates the effect of management actions on one weeks directed effort.
Note: By-catch effort (BE) was estimated using the parameters in Table 19.

Example 1: E_i = 3000, with a small area closure for chinook.
(DR = .6 and PA = .3)

	V	DE'	FR	DE''	DEA	RA	DE'''	BE
Chinook	100	600	.12	528	72	70	541	12
Coho	200	1200	.0	1200	0	0	1229	0
Sockeye	40	240	.0	240	0	0	246	0
Pink	150	900	.0	900	0	0	921	0
Chum	10	60	.0	60	0	0	61	0
	500	3000		2928	72	70	2998	12

Example 2: E_i = 3000, with a complete closure for chinook and pink.

	V	DE'	FR	DE''	DEA	RA	DE'''	BE
Chinook	100	600	1.0	0	600	300	0	73
Coho	200	1200	0	1200	0	0	1800	0
Sockeye	40	240	0	240	0	0	360	0
Pink	150	900	1.0	0	900	450	0	156
Chum	10	60	0	60	0	0	90	0
	500	3000		1500	1500	750	2250	229

where E_i = initial total effort for week i
DR = diffusion rate
PA = proportion of the fishery closed
V = initial relative value-abundance-catchability
DE = directed effort
FR = DR times PA
DEA = directed effort affected by the regulation
RA = total effort reallocated among all species
BE = effort resulting in by-catch of the regulated species

$$CO = \frac{300 \times .4 \times 2 \times 1800}{3 \times 2250}$$

$$Sx = \frac{300 \times 0.4 \times 1 \times 360}{3 \times 2250}$$

$$CM = \frac{300 \times 0.4 \times 2 \times 90}{3 \times 2250}$$

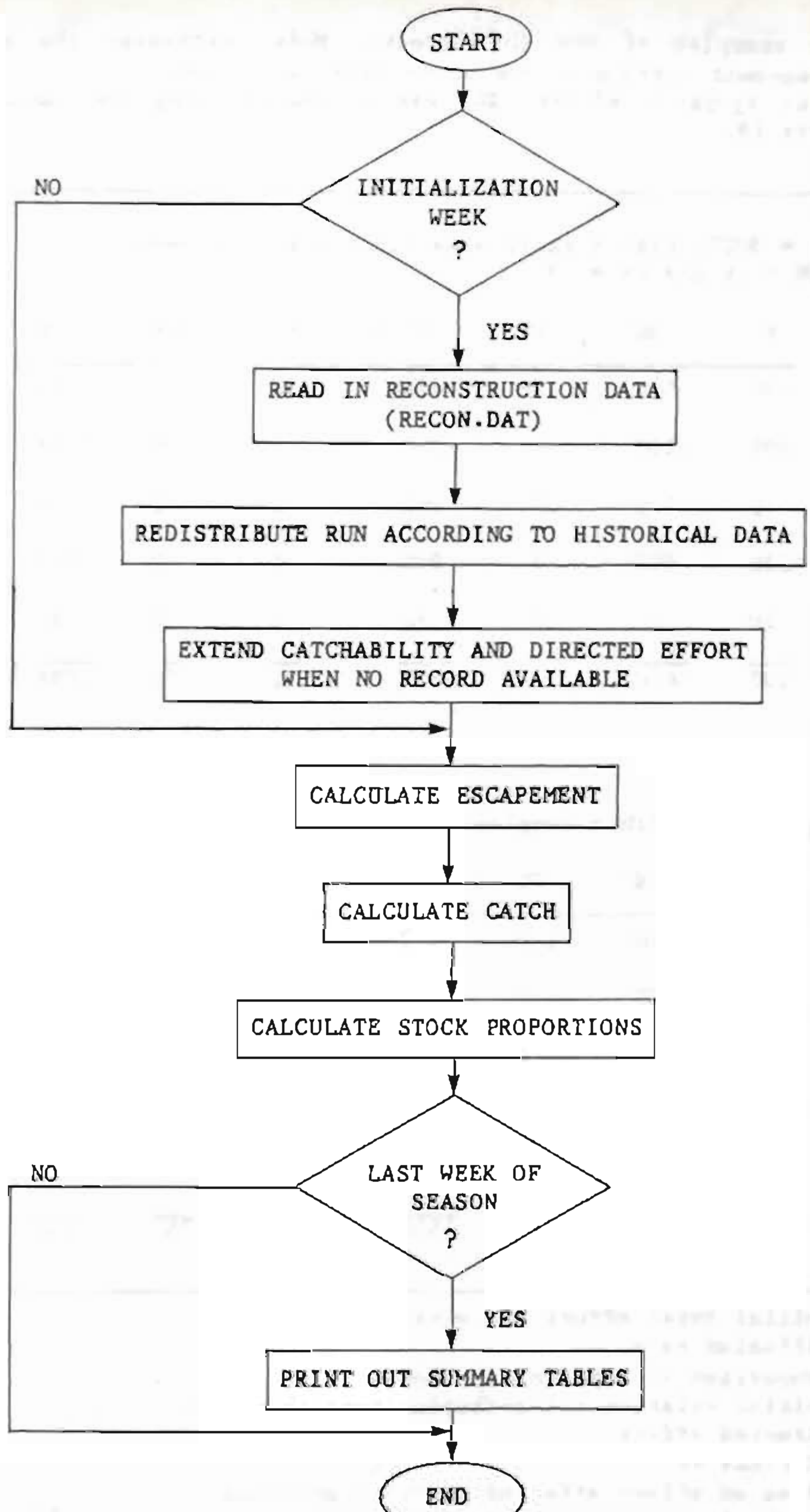


Figure 28. Sequence of calculations for the net sub-model.

Chinook Sub-model

The Chinook sub-model has the same structure and function as the Coho sub-model; however, there are two noteworthy differences. First, the Chinook sub-model keeps track of four age classes (age 2-5) and second, the Chinook sub-model includes a mechanism for assessing different minimum size limits. The necessity to keep track of four age classes of chinook means that the Chinook sub-model must operate as four separate cohort analyses, one for each age class. Therefore, model results show the effect management actions have on a specific age class, not the cumulative affects on all age classes (the cohort) as in the Georgia Strait Model.

Model outputs include catch, shaker deaths and escapement estimates for two chinook stocks (Canada and U.S.) and four age classes. The chinook stocks were separated using the proportions listed in Table 8.

Output Sub-model

The Output sub-model accumulates catch, escapement and shaker deaths, prints weekly cummulative catch and annual totals and provides an estimate of adult equivalent escapement for changes in the age 2 through 4 harvest rates. The summary output from this sub-model (Table 21) is self-explanatory, except there are two types of shaker deaths: 1) shaker deaths attributable to the minimum size limit "SL SHAKER DEATHS", and 2) shaker deaths attributable to non-retention regulations "NR SHAKER DEATHS". Therefore, if the minimum size limit was increased, the number of "SL SHAKER DEATHS" would increase, while a non-zero number for "NR SHAKER DEATHS" indicates that at some point during the year that species could not be retained in some portion of the fishing area.

Total directed effort printed in the summary table indicates the relative amount of effort directed at catching each species. However, these values may not accurately reflect the actual fishing effort directed at each species because of the inseparable relationship between directed effort and catch-ability. Therefore, the models predictive power should be judged on the basis of catch estimates not estimates of directed effort.

Estimates for chinook adult equivalent escapement are necessary to identify the effect of management actions on the different age classes of chinook. The effect of management actions on the abundance of each age class is revealed by comparing the value used as the initial population size (START POP) for an age class with the final population size (END POP) for the previous age class. If no management actions were imposed these values would be equal. The adult equivalent escapement (Adult EQ) reflects the maximum additional escapement that would result from the management action if the harvest of these age groups in subsequent years was zero.

DISCUSSION

The model described above was developed for the sole purpose of assisting fisheries managers in their evaluation of regulatory options for the West Coast Vancouver Island troll fishery. One of the current goals for management of this fishery is to obtain the total allowable catch of each salmon species without having to resort to single species fisheries during periods when several salmon species are abundant. For example: single species fisheries

Table 21. Example of summary output from West Coast Troll Management Model.

MONTH	WEEK	CHINOOK	COHO	SOCKEYE	PINK	CHUM
3	1	0.	0.	0.	0.	0.
3	2	0.	0.	0.	0.	0.
3	3	0.	0.	0.	0.	0.
3	4	0.	0.	0.	0.	0.
4	5	0.	0.	0.	0.	0.
4	6	0.	0.	0.	0.	0.
4	7	0.	0.	0.	0.	0.
4	8	0.	0.	0.	0.	0.
4	9	0.	0.	0.	0.	0.
5	10	0.	0.	0.	0.	0.
5	11	0.	0.	0.	0.	0.
5	12	0.	0.	0.	0.	0.
5	13	0.	0.	0.	0.	0.
6	14	0.	0.	0.	0.	0.
6	15	0.	0.	0.	0.	0.
6	16	44164.	67918.	67.	0.	0.
6	17	60167.	103222.	505.	0.	767.
7	18	92566.	271623.	3517.	0.	3563.
7	19	130956.	536744.	11429.	0.	8482.
7	20	157275.	801342.	29604.	0.	31493.
7	21	185850.	1040425.	207480.	0.	78867.
7	22	207766.	1184288.	515226.	0.	112405.
8	23	225171.	1265987.	924495.	1974.	123175.
8	24	242705.	1345124.	1404992.	4200.	129892.
8	25	261841.	1421963.	1640262.	5544.	132907.
8	26	291079.	1522070.	1640262.	5974.	133559.
9	27	313108.	1596060.	1640262.	6136.	133853.
9	28	332333.	1664862.	1640262.	6136.	134195.
9	29	348448.	1718924.	1640262.	6136.	138146.
9	30	360221.	1748517.	1640262.	6136.	146994.
10	31	360221.	1748517.	1640262.	6136.	146994.
10	32	360221.	1748517.	1640262.	6136.	146994.
10	33	360221.	1748517.	1640262.	6136.	146994.
10	34	360221.	1748517.	1640262.	6136.	146994.
10	35	360221.	1748517.	1640262.	6136.	146994.
11	36	360221.	1748517.	1640262.	6136.	146994.
11	37	360221.	1748517.	1640262.	6136.	146994.
11	38	360221.	1748517.	1640262.	6136.	146994.
11	39	360221.	1748517.	1640262.	6136.	146994.
12	40	360221.	1748517.	1640262.	6136.	146994.

TOTALS

CATCH	360221.	1748517.	1640262.	6136.	146994.
ESCAPEMENT	431839.	1649434.	8989666.	962245.	4430838.
SL SHAKER DEATHS	84557.	69550.	884.	3355.	0.
NR SHAKER DEATHS	0.	0.	0.	0.	0.
DIRECTED EFFORT	16411.	25183.	18718.	18.	1149.

CHINOOK ADULT EQUIVALENT ESCAPEMENT

AGE	END POP	START POP	DIFFERENCE	ADULT EQ
3	996750.	995635.	1115.	970.
4	409108.	326430.	82678.	81416.
5	20651.	14408.	6242.	6242.

TRUE CHINOOK ESCAPEMENT = 520468.

are reasonable in April and May when the bulk of the legal size salmon are chinook, but single species fisheries in August "when several species of salmon are abundant" should be avoided. Therefore, one of the major uses of the West Coast Troll Model would be to assist in the development of fishing plans such that trollers achieve their chinook and coho catch ceilings after their allocation of sockeye and pink salmon have been caught.

The utility of the model for evaluating fishing plans was assessed by comparing simulated with actual catches for a fishing season, given a set of management actions and estimates of relative run size and landed value for each speices. The 1985 fishing season was used as a test case. Given the effect of Fraser sockeye and pink cycles on the West Coast troll fishery, 1981 was selected as the base year for the 1985 simulation. Table 22 shows the relative value and run size for each of the salmon species harvested by trollers. The landed values are relative to coho and show only minor changes from 1981 to 1985. The size of the chinook and coho populations off the west coast of Vancouver Island in 1985 were left unchanged from those in 1981 while the size of sockeye, pink and chum runs was adjusted to reflect the difference between run reconstruction estimates for the 1981 and 1985 returns. All management regulations imposed in 1985 were incorporated into the model. These included a large reduction in the fishing season and several area and time closures used to hold chinook and coho catches below their respective catch ceilings and ensure that trollers did not exceed their sockeye and pink allocations. Table 23 summarizes the management actions and troll catch statistics for the base year, the simulation of the 1985 fishing season and the actual 1985 fishery. While there were large differences between the 1981 and 1985 fishing season, there was close agreement between the official catch statistics for each species and those simulated for 1985. One of the most interesting aspects of these results was that model reproduced the 25 fold increase in sockeye catch observed between 1981 and 1985, with only a 4.5 fold increase in sockeye run size and a 37% increase in relative value. The mechanism responsible for generating such a large increase in sockeye catch was the algorithm use to combine information on the abundance relative value and catchability of each species into estimates of the amount of fishing effort directed at each species.

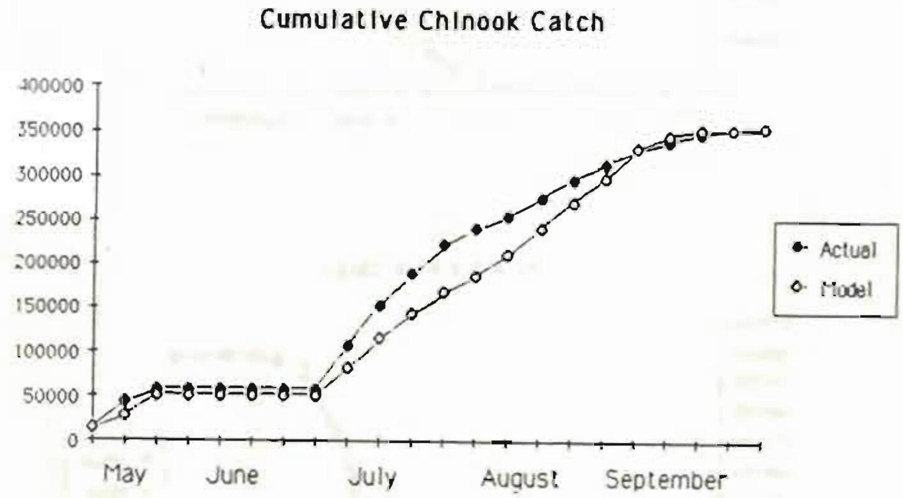
Figure 29 presents comparisons of the actual and simulated accumulation of the 1985 troll catch for each species. The initial shape of each curve was largely determined by the short three week opening in May and the five week closure in June. The model tracks the actual cumulative catch fairly well for all species except chum. Discrepancies between actual and simulated catches of chinook and coho in early July are probably the result of overestimating the amount of effort directed at coho during this period, while minor discrepancies for sockeye and pink were largely the result of a one week difference in run timing between the base year (1981) and simulation year (1985). The large discrepancies for chum were clearly the result of a large change in the seasonal distribution and size of the chum catch between the base and simulation year. In 1981, over 50% of the troll catch of chum salmon was taken in the first three weeks of August and the total catch was less than 9,400 fish. In 1985, over 75% of the chum catch was taken in July and the total catch was approximately 222,000 fish (23.6 times the 1981 catch). The large increase in chum catches in recent years (1985 and 1986, see Table 1) are probably the result of imposition of catch limitations for the other salmon species. More accurate simulations of future troll catches of chum

Table 22. Relative value and run size for each of the salmon species harvested by trollers.

Species/Age	Relative Value 1981	Relative Value 1985	Run Size Relative to Base Year
Chinook - Age 2	.65	.73	1.0
Chinook - Age 3	1.91	2.27	1.0
Chinook - Age 4	5.53	5.64	1.0
Chinook - Age 5	8.12	8.27	1.0
Coho	1.00	1.00	1.0
Sockeye	1.08	1.48	4.5
Pink	.41	.37	0.9
Chum	.99	1.02	5.0

Table 23. Comparison of management regulations and troll catches for the base year (1981) with the actual and simulated values for the 1985 fishing season.

	Base Year (1981)	1985 Fishing Season	
		Actual	Model
Management Regulations			
Length of Season (weeks)	31	17	17
Chinook Catch Ceiling	none	360,000	none
Coho Catch Ceiling	none	1,750,000	none
Chinook Area Closures	none	4	4
Coho Area Closures	none	1	1
Sockeye Season Limits	none	Yes	Yes
Pink Season Limits	none	Yes	Yes
Troll Catch			
Chinook	397,518	354,052	353,700
Coho	1,385,323	1,389,055	1,468,400
Sockeye	44,433	1,051,373	1,106,500
Pink	2,753,954	1,817,907	1,797,500
Chum	9,373	221,852	221,900



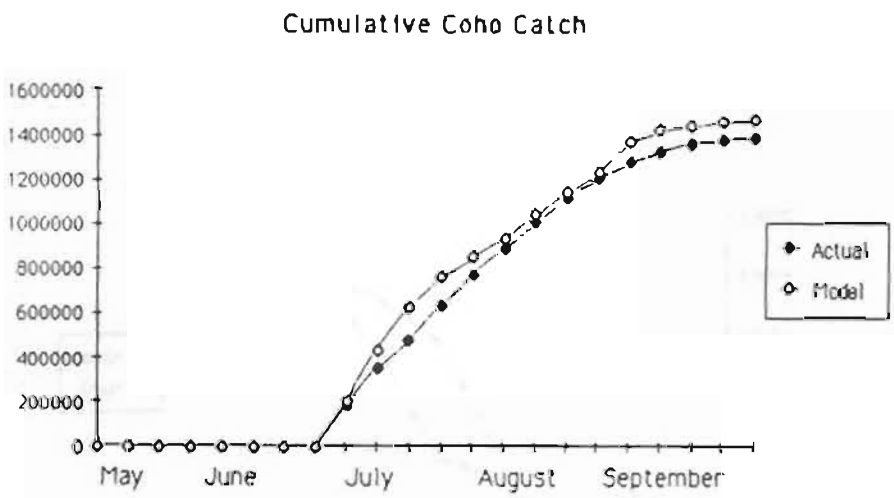


Figure 29. Comparison of the actual and simulated accumulation of the 1985 troll catch of each salmon species.

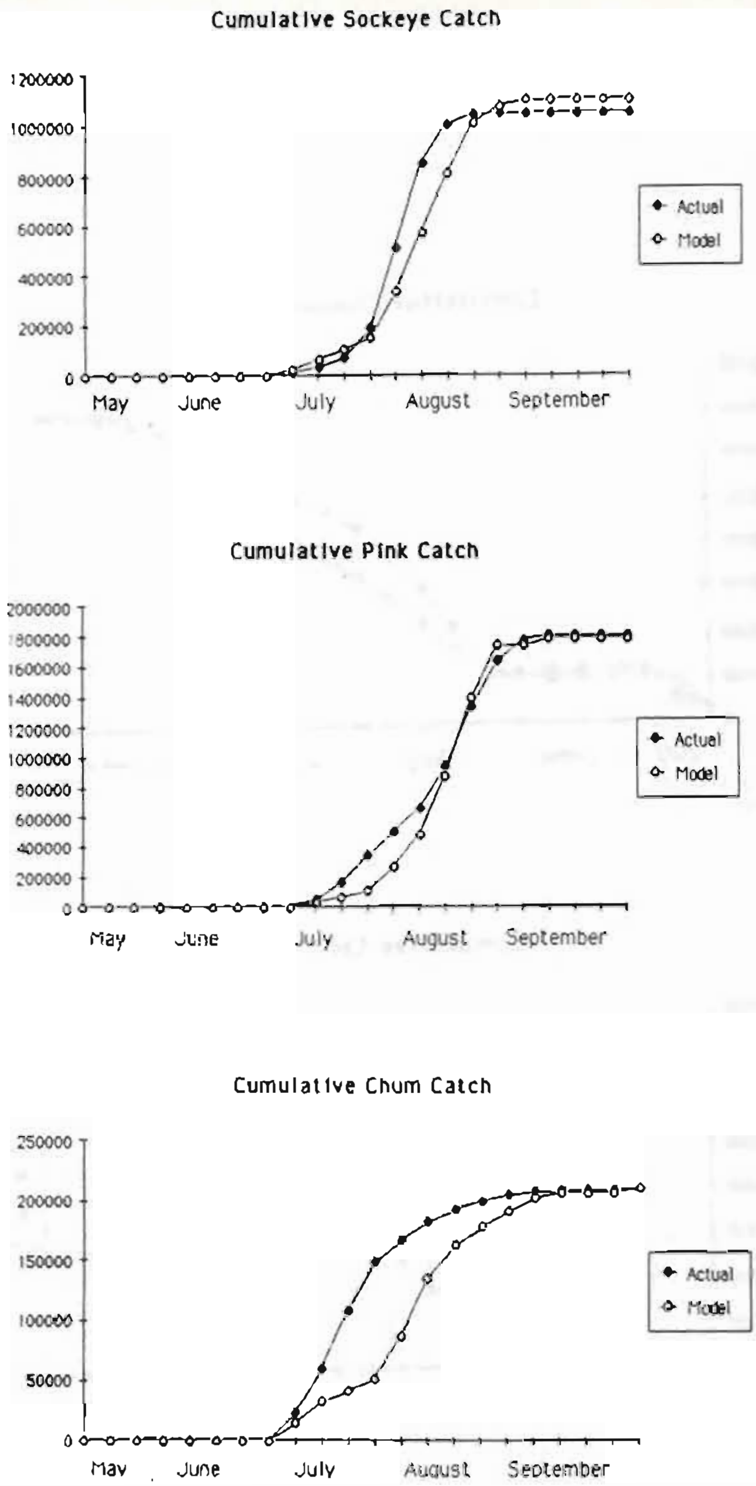


Figure 29. continued

salmon will not be possible without better chum run reconstruction and the use of post 1984 catch statistics to estimated base year catchability coefficients.

In summary, the simulation of the 1985 fishing season has provided some evidence that the West Coast Troll Model has captured the major stock and fishery dynamics associated with the troll fishery off the west coast of Vancouver Island, but the true utility of the model will be revealed through its contributions to pre-season and post-season analyses of future troll fishery management plans.

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APPENDIX A

This appendix includes catch, effort and the proportion of the total effort directed at each species for the years 1976 through 1985. Week codes are identical to the period code used in the MRP database and Salmon Commercial Catch data system. The Week codes associated with each month are:

Week 1 - 4 = March
5 - 9 = April
10-13 = May
14-17 = June
18-22 = July
23-26 = August
27-30 = September
31-35 = October
36-39 = November
40 = December - February

Catch statistics are in pieces and effort statistics are in vessel days. Percentages indicate the portion of the weekly effort directed at each species based on the relative value and catch statistics for that year. The method used to produce the following summary statistics are described in the section "Data Organization for West Coast Troll Fishery."

YEAR = 1976

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	654	454	15	0	0	0	0	107	100.00	0.00	0.00	0.00	0.00
2	0	343	238	8	0	0	0	0	59	100.00	0.00	0.00	0.00	0.00
3	0	298	207	7	0	0	0	0	59	100.00	0.00	0.00	0.00	0.00
4	0	225	156	5	0	0	0	0	62	100.00	0.00	0.00	0.00	0.00
5	0	446	309	10	0	0	0	0	87	100.00	0.00	0.00	0.00	0.00
6	0	782	543	17	0	0	0	0	141	100.00	0.00	0.00	0.00	0.00
7	0	4804	3334	107	0	0	0	0	594	100.00	0.00	0.00	0.00	0.00
8	0	12777	8634	371	0	0	2	1	1476	100.00	0.00	0.00	0.00	0.00
9	0	14970	11574	625	0	0	7	4	1790	99.99	0.00	0.00	0.00	0.00
10	0	12743	10142	757	0	4	9	17	1723	99.98	0.00	0.00	0.01	0.01
11	0	15452	10424	448	0	18	30	33	2148	99.94	0.00	0.02	0.02	0.03
12	0	18996	10106	533	0	41	37	35	2259	99.91	0.00	0.04	0.02	0.03
13	0	14796	9623	575	0	241	22	17	2069	99.70	0.00	0.27	0.01	0.01
14	0	20232	11076	736	3	282	29	7	2761	99.72	0.00	0.25	0.01	0.00
15	0	18276	12342	915	50490	169	433	14	2738	64.90	34.87	0.10	0.13	0.01
16	0	21318	10922	658	232243	948	4465	48	3256	28.04	71.11	0.24	0.60	0.01
17	0	24064	17624	1828	266683	2108	17896	95	4043	32.63	65.01	0.42	1.93	0.01
18	0	19228	15641	1004	158022	2881	28391	111	3289	39.07	55.66	0.83	4.41	0.03
19	0	22691	14367	912	205708	6221	27787	148	3602	33.21	61.56	1.52	3.67	0.03
20	0	21995	19224	1407	191912	9615	19462	156	3697	39.21	55.96	2.29	2.50	0.03
21	0	18973	14136	988	92086	11121	12675	124	3062	49.24	43.74	4.32	2.66	0.04
22	0	24623	13811	1026	75426	12564	13908	226	3575	55.08	36.84	5.02	3.00	0.07
23	0	25381	14011	1218	75146	11628	14573	262	3779	56.03	36.20	4.58	3.10	0.08
24	0	17802	7655	467	53976	5754	8607	136	2958	52.60	40.89	3.57	2.88	0.07
25	72	12562	4888	449	40662	852	1760	67	2438	52.99	45.32	0.78	0.87	0.05
26	91	11481	3298	257	38985	281	296	86	2198	48.62	50.84	0.30	0.17	0.07
27	39	10422	2301	314	44869	15	37	92	1990	41.02	58.86	0.02	0.02	0.08
28	44	9700	1107	99	40918	7	16	136	1802	36.19	63.65	0.01	0.01	0.14
29	130	7068	913	33	25172	5	4	225	1352	40.50	59.15	0.01	0.00	0.34
30	123	6664	861	31	22957	1	4	232	1225	41.29	58.33	0.00	0.00	0.38
31	99	5381	695	25	16475	19	2	907	979	43.45	54.56	0.05	0.00	1.93
32	52	2840	367	13	4474	19	0	839	494	57.93	37.42	0.13	0.00	4.52
33	67	3632	469	17	2611	0	0	370	490	75.66	22.30	0.00	0.00	2.03
34	48	2618	338	12	1206	0	0	337	386	81.76	15.45	0.00	0.00	2.78
35	11	615	79	3	232	0	0	9	128	86.32	13.35	0.00	0.00	0.33
36	2	130	17	1	13	0	0	1	28	95.94	3.84	0.00	0.00	0.22

YEAR = 1977

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	738	513	16	0	0	0	0	105	100.00	0.00	0.00	0.00	0.00
2	0	776	539	17	0	0	0	0	78	100.00	0.00	0.00	0.00	0.00
3	0	697	484	16	0	0	0	0	74	100.00	0.00	0.00	0.00	0.00
4	0	346	240	8	0	0	0	0	62	100.00	0.00	0.00	0.00	0.00
5	0	385	267	9	0	0	0	0	83	100.00	0.00	0.00	0.00	0.00
6	0	254	177	6	0	0	0	0	76	100.00	0.00	0.00	0.00	0.00
7	0	3344	2321	75	0	0	0	1	417	100.00	0.00	0.00	0.00	0.00
8	0	14337	9689	416	0	0	1	6	1520	99.99	0.00	0.00	0.00	0.01
9	0	16523	12775	690	0	0	2	19	2048	99.99	0.00	0.00	0.00	0.01
10	0	13927	11084	827	0	0	14	48	2034	99.96	0.00	0.00	0.01	0.04
11	0	15769	10638	457	0	2	106	111	2198	99.86	0.00	0.00	0.05	0.09
12	0	13529	7197	380	0	6	512	129	2017	99.53	0.00	0.01	0.33	0.14
13	0	11156	7255	433	190	116	672	73	2022	99.00	0.31	0.16	0.45	0.08
14	0	12861	7041	468	810	245	454	26	2198	98.10	1.26	0.31	0.29	0.03
15	0	11898	8035	596	47846	516	2842	24	2346	57.59	41.04	0.36	1.00	0.01
16	0	20445	10475	631	152779	1178	16015	196	3663	37.28	59.72	0.38	2.56	0.05
17	0	17867	13085	1357	162680	2219	32640	395	4089	38.07	56.56	0.63	4.65	0.09
18	0	13806	11230	721	138378	5190	87288	689	3848	32.95	51.88	1.59	13.41	0.18
19	0	16292	10315	655	142540	7452	149400	1720	4300	29.24	47.79	2.04	20.52	0.40
20	0	13499	11799	863	137590	8631	139384	1614	4709	31.04	46.77	2.40	19.41	0.38
21	0	16265	12119	847	144958	11189	103099	639	5008	33.20	49.20	3.11	14.34	0.15
22	0	15128	8485	630	119127	11273	134824	845	4441	29.09	45.87	3.55	21.27	0.22
23	0	13009	7181	624	99659	9234	259271	927	4514	23.29	35.71	2.71	38.06	0.23
24	0	18411	7917	483	96798	5628	327560	724	4733	24.71	30.87	1.47	42.79	0.16
25	116	20288	7895	726	88292	1726	261100	435	4260	29.56	31.57	0.51	38.25	0.11
26	130	16493	4737	369	82305	388	136550	96	3647	29.13	42.08	0.16	28.60	0.03
27	34	9017	1991	272	65586	144	40146	41	2676	25.81	59.21	0.11	14.85	0.03
28	34	7500	856	76	42398	92	7383	26	2022	28.98	66.16	0.12	4.72	0.03
29	115	6208	802	29	24742	53	1288	138	1453	38.10	60.28	0.11	1.29	0.23
30	98	5288	683	24	10144	20	584	132	968	55.95	42.60	0.07	1.00	0.38
31	124	6740	871	31	6830	0	9	75	989	71.15	28.62	0.00	0.02	0.22
32	91	4951	640	23	3438	1	6	218	714	77.64	21.40	0.01	0.01	0.93
33	38	2069	267	10	531	1	1	355	341	87.03	8.86	0.02	0.01	4.09
34	138	7473	965	34	129	4	0	239	153	98.45	0.67	0.02	0.00	0.86
35	130	7035	909	32	59	4	0	37	111	99.51	0.33	0.02	0.00	0.14
36	5	272	35	1	16	0	0	3	97	97.45	2.21	0.00	0.00	0.34

YEAR = 1978

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	1759	1221	39	0	0	0	0	277	100.00	0.00	0.00	0.00	0.00
2	0	1165	809	26	0	0	0	0	191	100.00	0.00	0.00	0.00	0.00
3	0	769	534	17	0	0	0	0	159	100.00	0.00	0.00	0.00	0.00
4	0	540	375	12	0	0	0	0	133	100.00	0.00	0.00	0.00	0.00
5	0	490	340	11	0	0	0	1	117	99.96	0.00	0.00	0.00	0.04
6	0	3742	2597	84	0	0	1	1	462	99.99	0.00	0.00	0.00	0.01
7	0	10671	7408	238	0	0	4	4	1198	99.99	0.00	0.00	0.00	0.01
8	0	10949	7399	318	0	0	4	6	1299	99.99	0.00	0.00	0.00	0.01
9	0	10227	7907	427	0	0	1	13	1421	99.98	0.00	0.00	0.00	0.02
10	0	11774	9371	699	0	1	8	19	1888	99.97	0.00	0.00	0.00	0.02
11	0	12537	8458	363	0	1	9	32	2026	99.95	0.00	0.00	0.01	0.04
12	0	14682	7811	412	17	3	5	45	2235	99.91	0.03	0.00	0.00	0.05
13	0	17738	11536	689	68	36	6	88	2802	99.80	0.07	0.05	0.00	0.08
14	0	17047	9333	620	30248	86	43	140	2756	72.16	27.62	0.10	0.01	0.10
15	0	13757	9290	689	149313	596	974	485	3563	32.71	66.62	0.33	0.16	0.17
16	0	22083	11314	682	227094	814	2188	772	4776	29.90	69.36	0.31	0.25	0.19
17	0	20033	14671	1521	200527	880	3232	578	4717	36.27	62.87	0.34	0.37	0.15
18	0	22469	18277	1174	168996	1426	7147	676	5013	43.63	54.77	0.57	0.85	0.18
19	0	18837	11927	757	93836	1569	9624	783	3573	48.83	48.04	1.00	1.82	0.32
20	0	15012	13121	960	47465	9907	19303	1507	3155	58.36	29.03	7.52	4.35	0.74
21	0	19828	14773	1032	54270	61990	26065	3336	4401	43.93	21.20	30.07	3.75	1.04
22	0	15282	8572	637	38205	225458	20745	8244	4845	17.88	9.44	69.16	1.89	1.63
23	0	10683	5897	513	21660	246274	12283	8348	4325	13.00	5.57	78.55	1.16	1.72
24	0	9423	4052	247	13687	97708	2951	2666	2978	21.49	7.78	68.91	0.62	1.21
25	53	9292	3616	332	36958	42284	300	674	3002	28.64	29.27	41.57	0.09	0.43
26	79	10055	2888	225	99922	19670	131	422	3334	21.13	63.19	15.44	0.03	0.21
27	30	7940	1753	239	94209	1632	43	186	2599	20.14	78.04	1.68	0.01	0.12
28	24	5301	605	54	44016	317	37	188	1867	22.38	76.64	0.69	0.02	0.26
29	87	4729	611	22	23841	130	21	426	1352	32.38	66.20	0.45	0.02	0.95
30	82	4427	572	20	8461	11	1	472	921	55.22	42.80	0.07	0.00	1.91
31	69	3720	481	17	4439	8	1	244	735	66.39	32.12	0.07	0.00	1.42
32	73	3959	511	18	1845	0	14	88	533	83.56	15.79	0.00	0.04	0.61
33	63	3402	440	16	898	0	14	58	377	89.83	9.62	0.00	0.05	0.50
34	39	2101	271	10	185	0	0	35	242	96.05	3.42	0.00	0.00	0.52
35	26	1430	185	7	124	0	0	25	168	96.08	3.39	0.00	0.00	0.54
36	1	77	10	0	0	0	0	0	23	100.00	0.00	0.00	0.00	0.00

YEAR = 1979

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	747	519	17	0	0	0	0	165	100.00	0.00	0.00	0.00	0.00
2	0	580	403	13	0	0	0	0	131	100.00	0.00	0.00	0.00	0.00
3	0	676	469	15	0	0	0	0	150	100.00	0.00	0.00	0.00	0.00
4	0	523	363	12	0	0	0	0	135	100.00	0.00	0.00	0.00	0.00
5	0	392	272	9	0	0	0	0	97	100.00	0.00	0.00	0.00	0.00
6	0	3023	2098	68	0	0	0	0	410	100.00	0.00	0.00	0.00	0.00
7	0	11561	8025	258	0	0	0	1	1380	100.00	0.00	0.00	0.00	0.00
8	0	13275	8971	385	0	0	0	2	1672	100.00	0.00	0.00	0.00	0.00
9	0	8795	6800	367	10	4	0	4	1433	99.96	0.02	0.01	0.00	0.01
10	0	11911	9480	707	10	5	0	8	1893	99.97	0.02	0.01	0.00	0.01
11	0	15676	10575	454	0	2	0	14	2211	99.98	0.00	0.00	0.00	0.01
12	0	14920	7937	419	3	1	19	13	2155	99.97	0.00	0.00	0.01	0.01
13	0	14963	9731	581	432	5	1154	42	2342	98.72	0.68	0.01	0.56	0.04
14	0	15772	8635	574	6705	37	1190	87	2468	89.33	9.99	0.05	0.55	0.08
15	0	13176	8898	660	65024	197	5529	114	3210	46.17	52.26	0.15	1.37	0.06
16	0	15674	8030	484	155051	464	59038	863	4588	24.65	67.07	0.19	7.86	0.23
17	0	9652	7076	734	132332	777	104744	2776	4249	21.44	62.24	0.34	15.16	0.81
18	0	5562	4524	291	102369	2041	60807	2307	3206	17.95	67.50	1.27	12.34	0.95
19	0	7734	4897	311	201403	6931	44581	695	4140	12.61	79.24	2.57	5.40	0.17
20	0	9023	7886	577	203389	12474	56629	454	4795	16.74	72.72	4.21	6.23	0.10
21	0	9651	7198	503	149194	111113	246208	1525	5517	11.92	39.73	27.92	20.17	0.25
22	0	10082	5655	420	144109	135344	604524	3014	6280	7.84	28.89	25.60	37.29	0.38
23	0	14583	8050	700	174146	42389	745632	2980	6440	11.27	34.69	7.97	45.70	0.37
24	0	16578	7129	435	187877	14034	617097	2121	6198	12.24	42.03	2.96	42.48	0.30
25	79	13805	5372	494	151659	3842	363955	1017	5287	14.16	48.59	1.16	35.88	0.20
26	84	10605	3046	238	93233	950	126649	347	3508	17.91	57.41	0.55	24.00	0.13
27	26	6927	1530	209	42966	169	18071	68	2387	26.46	64.84	0.24	8.39	0.06
28	63	14039	1602	143	48714	82	4843	82	3116	36.01	61.93	0.10	1.89	0.07
29	261	14146	1827	65	34598	25	1259	104	2406	45.27	53.98	0.04	0.60	0.10
30	133	7197	930	33	11745	20	783	45	999	55.09	43.83	0.07	0.90	0.11
31	119	6467	835	30	3641	26	998	11	725	76.92	21.12	0.14	1.78	0.04
32	121	6559	847	30	3093	31	618	14	818	80.20	18.44	0.17	1.13	0.05
33	37	1981	256	9	1005	5	62	118	438	78.66	19.45	0.09	0.37	1.43
34	4	230	30	1	127	0	0	110	131	70.76	18.96	0.00	0.00	10.28
35	2	133	17	1	15	0	0	0	50	94.76	5.24	0.00	0.00	0.00
36	1	73	9	0	3	0	0	0	19	98.35	1.65	0.00	0.00	0.00

YEAR = 1980

Week Code	Chinook Age 2	Chinook Age 3	Chinook Age 4	Chinook Age 5	Coho	Sockeye	Pink	Chum	Effort	Distribution of Effort (%) Chinook	Coho	Sockeye	Pink	Chum
1	0	1600	1111	36	0	0	0	0	323	100.00	0.00	0.00	0.00	0.00
2	0	681	472	15	0	0	0	0	179	100.00	0.00	0.00	0.00	0.00
3	0	471	327	11	0	0	0	0	166	100.00	0.00	0.00	0.00	0.00
4	0	672	466	15	0	0	0	0	192	100.00	0.00	0.00	0.00	0.00
5	0	490	340	11	0	0	0	0	119	100.00	0.00	0.00	0.00	0.00
6	0	993	689	22	0	0	0	0	208	100.00	0.00	0.00	0.00	0.00
7	0	7249	5032	162	0	4	5	2	1277	99.98	0.00	0.01	0.01	0.00
8	0	12126	8195	352	0	4	5	12	2077	99.98	0.00	0.01	0.00	0.02
9	0	11272	8715	471	0	2	1	32	2234	99.96	0.00	0.00	0.00	0.04
10	0	12795	10184	760	19	9	4	61	2711	99.91	0.02	0.01	0.00	0.06
11	0	13249	8938	384	81	13	2	120	2571	99.75	0.10	0.01	0.00	0.14
12	0	14454	7689	406	149	7	0	173	2604	99.59	0.19	0.01	0.00	0.21
13	0	12827	8342	498	90	2	1	125	2575	99.73	0.11	0.00	0.00	0.15
14	0	14709	8052	535	4	113	15	61	2928	99.79	0.00	0.13	0.01	0.07
15	0	13661	9225	684	44148	450	613	422	3459	65.70	33.45	0.31	0.24	0.30
16	0	17954	9199	554	177934	842	5728	745	4801	33.94	64.47	0.28	1.05	0.25
17	0	16633	12182	1263	255896	1779	12059	530	5763	30.31	67.51	0.43	1.62	0.13
18	0	11115	9041	581	237157	2478	17490	990	5213	24.26	72.07	0.69	2.70	0.28
19	0	11468	7261	461	237494	2301	33911	2059	5654	21.04	72.47	0.64	5.26	0.59
20	0	10041	8776	642	198100	2486	37477	2066	5617	25.74	66.46	0.76	6.39	0.65
21	0	10043	7482	523	125644	2768	39861	2620	4926	31.08	57.39	1.16	9.25	1.12
22	0	12519	7022	522	98090	3617	37071	3184	5132	36.25	50.74	1.71	9.75	1.55
23	0	13794	7614	662	78304	3550	13541	1573	5583	46.21	46.85	1.94	4.12	0.88
24	0	13869	5964	364	59355	1704	2544	258	5069	51.02	46.55	1.22	1.01	0.19
25	75	13064	5084	467	55452	496	418	90	4382	51.32	48.03	0.39	0.18	0.07
26	98	12425	3569	278	41126	188	99	47	3648	53.40	46.30	0.19	0.06	0.05
27	36	9591	2118	289	33725	87	49	29	3182	49.71	50.09	0.12	0.04	0.04
28	34	7602	868	77	40968	137	37	44	3137	33.17	66.53	0.20	0.03	0.07
29	111	6026	778	28	33207	140	9	72	2482	33.05	66.55	0.26	0.01	0.14
30	74	4027	520	19	14027	34	478	370	1595	42.94	54.64	0.12	0.95	1.35
31	51	2749	355	13	4000	31	476	450	981	61.58	32.74	0.23	1.98	3.46
32	59	3187	412	15	1692	3	0	2849	721	66.62	12.93	0.02	0.00	20.43
33	59	3188	412	15	926	11	10	2811	707	70.90	7.52	0.08	0.04	21.45
34	50	2687	347	12	491	21	10	79	564	92.58	6.18	0.24	0.06	0.93
35	35	1888	244	9	157	10	0	4	281	96.81	2.94	0.17	0.00	0.08
36	8	408	53	2	14	0	0	1	73	98.68	1.23	0.00	0.00	0.09

YEAR = 1981

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	1652	1147	37	0	0	0	0	318	100.00	0.00	0.00	0.00	0.00
2	0	1331	924	30	0	0	0	0	238	100.00	0.00	0.00	0.00	0.00
3	0	1124	780	25	0	0	0	0	213	100.00	0.00	0.00	0.00	0.00
4	0	599	416	13	0	0	0	0	140	100.00	0.00	0.00	0.00	0.00
5	0	208	145	5	0	0	0	0	75	100.00	0.00	0.00	0.00	0.00
6	0	1405	975	31	0	0	0	0	253	100.00	0.00	0.00	0.00	0.00
7	0	5778	4011	129	0	0	2	0	1139	100.00	0.00	0.00	0.00	0.00
8	0	7508	5073	218	0	0	2	0	1667	100.00	0.00	0.00	0.00	0.00
9	0	6694	5176	279	0	0	1	1	1856	100.00	0.00	0.00	0.00	0.00
10	0	7141	5684	424	0	0	1	1	2142	100.00	0.00	0.00	0.00	0.00
11	0	7757	5233	225	0	0	1	0	1936	100.00	0.00	0.00	0.00	0.00
12	0	13032	6933	366	0	5	9	5	2398	99.98	0.00	0.01	0.01	0.01
13	0	13240	8610	514	1401	54	1291	7	2822	97.48	1.77	0.07	0.67	0.01
14	0	10261	5618	373	1417	65	2078	4	2655	95.82	2.53	0.13	1.53	0.01
15	0	8392	5667	420	179	22	4259	14	2506	96.27	0.34	0.04	3.32	0.03
16	0	10762	5514	332	165	357	13867	18	2533	89.54	0.27	0.64	9.51	0.03
17	0	8183	5993	621	49798	695	17138	23	2546	48.31	44.66	0.68	6.33	0.02
18	0	10691	8696	558	190604	1104	32771	673	3965	26.20	68.30	0.43	4.84	0.24
19	0	13961	8840	561	225411	1565	49067	770	4993	24.43	68.67	0.52	6.16	0.23
20	0	10127	8851	648	176617	1633	51935	386	4848	26.89	64.51	0.65	7.81	0.14
21	0	10104	7528	526	132823	1799	63941	427	4469	28.77	58.57	0.86	11.61	0.19
22	0	10721	6013	447	84680	7485	226240	1560	4476	23.44	34.57	3.31	38.05	0.63
23	0	11493	6344	552	81350	10204	347098	2204	4871	20.58	27.19	3.70	47.80	0.73
24	0	14753	6344	387	98582	9019	552701	1181	5202	16.47	24.42	2.42	56.40	0.29
25	80	14022	5456	502	85773	7187	663659	647	5017	14.26	20.01	1.82	63.77	0.15
26	104	13102	3763	293	74348	2355	445729	495	4448	15.63	24.03	0.83	59.36	0.16
27	53	14039	3100	423	87344	590	223426	365	4379	20.84	38.33	0.28	40.39	0.16
28	44	9667	1103	98	53051	165	50005	166	3158	25.57	53.36	0.18	20.72	0.16
29	85	4630	598	21	23173	102	6484	63	2029	32.27	60.33	0.29	6.95	0.16
30	53	2857	369	13	13191	34	1585	203	1564	35.20	60.71	0.17	3.01	0.92
31	24	1279	165	6	5405	2	559	174	736	37.08	58.54	0.03	2.49	1.86
32	0	1	0	0	0	0	4	0	10	64.24	0.00	0.00	35.76	0.00
33	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
34	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
35	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
36	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00

YEAR = 1982

Week Code	Chinook Age 2	Chinook Age 3	Chinook Age 4	Chinook Age 5	Coho	Sockeye	Pink	Chum	Effort	Distribution of Effort (%) Chinook	Coho	Sockeye	Pink	Chum
1	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
2	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
3	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
4	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
5	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
6	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
7	0	8681	6026	194	302	1864	1	62	1061	96.06	0.55	3.29	0.00	0.10
8	0	13993	9456	406	0	0	17	0	1862	99.99	0.00	0.00	0.01	0.00
9	0	11994	9273	501	91	4	17	13	1992	99.86	0.11	0.00	0.01	0.01
10	0	10841	8629	644	94	4	1	36	2221	99.83	0.12	0.00	0.00	0.04
11	0	15545	10487	450	13	0	17	59	2588	99.92	0.01	0.00	0.01	0.06
12	0	18043	9598	507	13	3	17	136	2515	99.85	0.01	0.00	0.01	0.13
13	0	16248	10567	631	38	10	3	301	2832	99.68	0.04	0.01	0.00	0.27
14	0	18632	10200	678	38	196	3	622	3353	99.23	0.04	0.19	0.00	0.55
15	0	15959	10777	799	8	309	3	743	3556	99.03	0.01	0.30	0.00	0.66
16	0	13805	7073	426	21	339	5	442	3089	98.96	0.03	0.46	0.00	0.55
17	0	8428	6173	640	37480	510	316	328	2635	59.81	39.26	0.52	0.11	0.30
18	0	16570	13479	866	177892	3571	1361	1231	4239	38.95	59.38	1.16	0.15	0.36
19	0	21659	13713	871	280895	9444	2847	2090	5154	30.37	66.78	2.18	0.23	0.44
20	0	13154	11497	841	278826	21994	6688	10014	5069	24.04	68.03	5.22	0.54	2.17
21	0	15903	11849	828	259291	228706	12467	21793	6716	17.30	42.44	36.42	0.68	3.16
22	0	13751	7713	573	156779	402870	8273	16090	6077	11.78	24.45	61.12	0.43	2.22
23	0	11062	6106	531	88871	536163	1440	5221	5488	8.99	13.14	77.12	0.07	0.68
24	0	11986	5154	314	85131	635627	1680	3236	6545	7.24	11.17	81.14	0.07	0.38
25	74	12937	5034	463	80239	315280	1087	1452	5170	12.91	17.98	68.74	0.08	0.29
26	141	17878	5135	400	88453	27760	236	272	3875	36.68	48.37	14.77	0.04	0.13
27	59	15715	3470	473	73725	3536	122	115	3316	41.09	56.18	2.62	0.03	0.08
28	68	15000	1712	153	70115	1642	37	180	3126	35.57	62.85	1.43	0.01	0.14
29	235	12723	1644	59	55852	139	3	1908	3008	37.27	60.74	0.15	0.00	1.84
30	177	9587	1238	44	31203	116	25	4428	2445	42.29	51.09	0.18	0.01	6.43
31	73	3936	509	18	12058	17	22	2663	1085	42.34	48.14	0.07	0.03	9.43
32	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
33	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
34	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
35	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
36	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00

YEAR = 1983

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
2	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
3	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
4	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
5	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
6	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
7	0	7580	5262	169	0	0	0	0	1147	100.00	0.00	0.00	0.00	0.00
8	0	13186	8911	383	0	0	24	0	2219	99.99	0.00	0.00	0.01	0.00
9	0	13481	10423	563	0	0	24	2	2613	99.99	0.00	0.00	0.01	0.00
10	0	9463	7531	562	0	0	3	3	2250	99.99	0.00	0.00	0.00	0.01
11	0	9797	6609	284	0	0	3	3	2242	99.99	0.00	0.00	0.00	0.01
12	0	11925	6344	335	0	0	2	8	2297	99.98	0.00	0.00	0.00	0.01
13	0	8661	5632	336	9	0	2	16	2041	99.95	0.02	0.00	0.00	0.03
14	0	8169	4473	297	343	30	44	27	2166	99.08	0.75	0.07	0.03	0.07
15	0	7362	4972	369	404	70	243	51	2328	98.70	0.85	0.16	0.18	0.13
16	0	8213	4208	253	128	77	270	102	2498	99.03	0.29	0.19	0.21	0.27
17	0	6615	4844	502	12897	276	219	196	2347	77.30	21.68	0.50	0.13	0.39
18	0	8570	6971	448	322642	607	628	1067	4056	16.00	83.45	0.17	0.06	0.32
19	0	10024	6347	403	516422	476	1004	1352	5212	10.50	89.08	0.09	0.06	0.27
20	0	11280	9859	721	372366	187	828	741	5633	18.80	80.91	0.04	0.06	0.19
21	0	12196	9087	635	219679	1523	24832	658	5325	26.51	69.99	0.52	2.73	0.25
22	0	11224	6295	468	162835	7890	83842	1126	4946	23.98	61.41	3.21	10.90	0.50
23	0	12802	7067	615	169028	7751	92625	1067	5170	25.63	59.70	2.96	11.27	0.44
24	0	10956	4712	287	97805	5291	76756	469	3963	28.62	53.48	3.12	14.47	0.30
25	58	10157	3952	363	65544	6872	179458	428	3703	25.77	35.95	4.07	33.93	0.28
26	92	11617	3337	260	51318	3945	298911	476	3717	22.26	25.07	2.08	50.32	0.27
27	39	10302	2275	310	46173	1237	222482	471	3302	22.92	28.53	0.83	47.38	0.34
28	44	9735	1111	99	50444	226	79439	297	3084	25.88	47.68	0.23	25.88	0.33
29	175	9463	1222	44	42263	80	23172	186	2945	34.89	54.43	0.11	10.29	0.28
30	134	7283	941	34	25698	52	4771	177	2434	43.02	53.04	0.11	3.39	0.43
31	57	3087	399	14	11158	20	1456	65	1141	42.91	54.18	0.10	2.44	0.37
32	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
33	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
34	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
35	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
36	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00

YEAR = 1984

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
2	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
3	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
4	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
5	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
6	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
7	0	6172	4285	138	0	0	0	1	1111	100.00	0.00	0.00	0.00	0.00
8	0	7238	4891	210	0	0	0	10	1372	99.98	0.00	0.00	0.00	0.02
9	0	7643	5909	319	1	0	0	15	1780	99.97	0.00	0.00	0.00	0.03
10	0	9981	7944	593	1	0	0	22	2389	99.97	0.00	0.00	0.00	0.03
11	0	10990	7414	318	0	0	21	21	2336	99.96	0.00	0.00	0.01	0.03
12	0	12697	6755	357	22	1	21	32	2670	99.91	0.03	0.00	0.01	0.05
13	0	10814	7033	420	614	90	12	85	2746	98.93	0.79	0.15	0.01	0.13
14	0	11698	6405	426	603	1218	23	500	3079	96.41	0.77	2.03	0.01	0.77
15	0	7099	4794	356	12	1129	14	441	2038	96.30	0.02	2.70	0.01	0.97
16	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
17	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
18	0	23105	18794	1207	360142	2854	18941	4035	5428	33.95	63.40	0.66	1.14	0.86
19	0	18927	11984	761	282444	2225	13257	3741	4878	31.15	66.05	0.68	1.06	1.05
20	0	15045	13150	962	204075	978	9986	628	4420	38.89	59.53	0.37	1.00	0.22
21	0	18717	13945	975	203480	2229	9006	856	4455	41.24	56.80	0.81	0.86	0.29
22	0	19549	10965	815	198540	7733	7328	1037	4365	37.70	58.24	2.96	0.73	0.37
23	0	19156	10574	919	180951	11644	4052	692	4237	38.85	55.79	4.68	0.43	0.26
24	0	24031	10334	631	174991	7911	1659	317	4627	41.77	54.71	3.23	0.18	0.12
25	126	21958	8545	785	150492	2967	919	202	4552	43.29	55.09	1.42	0.11	0.09
26	130	16450	4725	368	132429	702	438	142	3960	36.07	63.34	0.44	0.07	0.08
27	44	11605	2563	349	123389	74	279	56	3556	28.36	71.49	0.06	0.06	0.04
28	40	8833	1008	90	103759	30	16	42	3288	22.01	77.92	0.03	0.00	0.04
29	82	4421	571	20	55930	19	5	43	1733	21.03	78.86	0.03	0.00	0.07
30	2	91	12	0	304	1	0	19	41	48.23	47.85	0.23	0.00	3.69
31	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
32	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
33	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
34	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
35	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
36	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00

YEAR = 1985

Week	Chinook									Distribution of Effort (%)				
Code	Age 2	Age 3	Age 4	Age 5	Coho	Sockeye	Pink	Chum	Effort	Chinook	Coho	Sockeye	Pink	Chum
1	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
2	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
3	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
4	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
5	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
6	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
7	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
8	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
9	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
10	0	8844	7039	525	419	555	1171	381	2312	96.88	0.63	1.24	0.66	0.59
11	0	15097	10185	437	83	347	1152	516	3913	98.40	0.09	0.53	0.44	0.54
12	0	12194	6487	342	798	664	86	809	3065	96.22	1.14	1.41	0.05	1.18
13	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
14	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
15	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
16	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
17	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
18	0	21983	17882	1148	157023	11535	9177	20246	4234	44.71	43.81	4.77	0.96	5.75
19	0	26578	16828	1068	168093	21408	40101	37162	5278	39.37	40.33	7.62	3.59	9.08
20	0	17524	15317	1121	119237	33913	115292	48171	4538	34.11	30.03	12.67	10.84	12.35
21	0	18053	13450	940	151727	118230	174665	38955	5154	22.39	27.26	31.51	11.72	7.13
22	0	11286	6330	470	135357	313549	172970	19927	5395	8.69	18.03	61.97	8.60	2.70
23	0	9683	5345	465	115451	332685	167352	15266	5305	7.53	15.54	66.43	8.41	2.09
24	0	13150	5655	345	112809	148976	285735	10073	4785	12.54	21.89	42.89	20.70	1.99
25	82	14380	5596	514	105020	39825	390602	7842	4453	17.73	27.18	15.29	37.73	2.07
26	104	13184	3787	295	83467	5790	301837	5159	3944	20.40	31.64	3.26	42.71	1.99
27	43	11470	2533	345	69601	994	138116	2803	3324	25.62	41.25	0.87	30.56	1.69
28	37	8180	934	83	46448	116	28997	1210	2457	29.51	55.80	0.21	13.00	1.48
29	117	6358	821	29	34689	51	2707	200	1901	35.04	62.63	0.14	1.82	0.37
30	80	4338	560	20	17760	124	51	658	1206	41.54	55.72	0.58	0.06	2.10
31	23	1265	163	6	4638	122	15	617	355	41.46	49.80	1.94	0.06	6.74
32	0	6	1	0	3	0	0	0	7	87.97	12.03	0.00	0.00	0.00
33	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
34	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
35	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
36	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00

APPENDIX B

This appendix presents the run reconstruction and stock composition for sockeye, pink and chum returns from 1979 through 1985. The week codes are the same as those defined in Appendix A. The following table provides a brief definition of the stocks for each species:

Species	Stock 1	Stock 2	Stock 3
Sockeye	Early Fraser	Late Fraser	U.S.
Pink (odd)	Georgia Str.	Fraser	U.S.
Pink (even)	Upper Van Is. and Mainland	Johnstone Str. and Area	Mid Van. Is.
Chum	Summer	Canadian	U.S.

More detailed definitions are provided in Table 15 of the report. Escapement represents the number of fish leaving the west coast troll fishery each week, catch is the troll landings and pieces derived from the summary tables presented in Appendix A, and run is the number of fish of a specific species in the fishery at the end of each week. Therefore, harvest rates reflect the percent of the fish present that were harvested each week. Effort represents the amount of fishing effort directed at a specific species each week and represents the catchability coefficient for each week derived from the catch, population size and directed effort estimates. The code -99 was used for harvest rates and catchability coefficients for weeks when catch and escapement data were inconsistent (i.e., catch but no escapement). The percent of the total catch and effort included in the run reconstruction is presented at the bottom of each table.

SOCKEYE YEAR = 1979

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	5.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	1.	7957.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	5.	27950.	0.06	0.	3.799
14	7952.	100.00	0.00	0.00	37.	30858.	0.13	1.	1.031
15	27913.	100.00	0.00	0.00	197.	42879.	0.64	5.	1.334
16	30661.	98.63	0.00	1.37	464.	124671.	1.08	9.	1.246
17	42415.	72.55	0.00	27.45	777.	170410.	0.62	15.	0.425
18	123894.	48.91	0.00	51.09	2041.	348844.	1.20	41.	0.294
19	168369.	40.96	0.00	59.04	6931.	607339.	1.99	107.	0.186
20	341913.	85.96	0.00	14.04	12474.	1678909.	2.05	202.	0.102
21	594865.	98.96	0.00	1.04	111113.	985362.	6.62	1541.	0.043
22	1567796.	94.96	5.03	0.01	135344.	502840.	13.74	1608.	0.085
23	850018.	88.45	11.55	0.00	42389.	256101.	8.43	513.	0.164
24	460451.	60.36	39.64	0.00	14034.	95780.	5.48	184.	0.298
25	242067.	35.75	64.25	0.00	3842.	50232.	4.01	61.	0.653
26	91938.	4.97	95.03	0.00	950.	13057.	1.89	19.	0.977
27	49282.	0.00	100.00	0.00	169.	0.	1.29	6.	2.250
28	12888.	0.00	100.00	0.00	82.	0.	-99.00	3.	-99.000
29	0.	0.00	0.00	0.00	25.	0.	-99.00	1.	-99.000
30	0.	0.00	0.00	0.00	20.	0.	-99.00	1.	-99.000
31	0.	0.00	0.00	0.00	26.	0.	-99.00	1.	-99.000
32	0.	0.00	0.00	0.00	31.	0.	-99.00	1.	-99.000
33	0.	0.00	0.00	0.00	5.	0.	-99.00	0.	-99.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	4612421.				330968.	4943188.		4318.	

Catch Explained = 330767. Percent = 99.94
Mean Harvest Rate = 6.69
Effort Explained = 4310. Percent = 99.82
Total Qxle3 = 0.016

SOCKEYE YEAR = 1980

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	9.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	13.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	7.	50.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	2.	2342.	4.03	0.	601.854
14	48.	0.00	0.00	100.00	113.	32967.	4.82	4.	12.881
15	2229.	0.00	0.00	100.00	450.	141382.	1.36	11.	1.266
16	32517.	1.48	0.00	98.52	842.	207884.	0.60	13.	0.445
17	140540.	2.90	0.00	97.10	1779.	115165.	0.86	25.	0.346
18	206105.	1.78	0.00	98.22	2478.	55484.	2.15	36.	0.600
19	112687.	4.15	0.00	95.85	2301.	72161.	4.15	36.	1.144
20	53183.	64.99	0.00	35.01	2486.	161173.	3.45	43.	0.805
21	69675.	99.01	0.00	0.99	2768.	301922.	1.72	57.	0.302
22	158405.	99.63	0.37	0.00	3617.	242198.	1.20	88.	0.137
23	298305.	98.29	1.71	0.00	3550.	51660.	1.47	108.	0.135
24	238648.	94.28	5.72	0.00	1704.	16443.	3.30	62.	0.533
25	49956.	90.58	9.42	0.00	496.	9986.	3.02	17.	1.753
26	15947.	59.20	40.80	0.00	188.	14661.	1.88	7.	2.673
27	9798.	26.32	73.68	0.00	87.	10659.	0.59	4.	1.577
28	14574.	2.08	97.92	0.00	137.	3547.	1.29	6.	2.010
29	10522.	0.23	99.77	0.00	140.	4147.	3.95	6.	6.220
30	3407.	0.00	100.00	0.00	34.	0.	0.82	2.	4.310
31	4113.	0.00	100.00	0.00	31.	0.	-99.00	2.	-99.000
32	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
33	0.	0.00	0.00	0.00	11.	0.	-99.00	1.	-99.000
34	0.	0.00	0.00	0.00	21.	0.	-99.00	1.	-99.000
35	0.	0.00	0.00	0.00	10.	0.	-99.00	0.	-99.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	1420660.				23287.	1443832.		531.	

Catch Explained = 23172. Percent = 99.51
Mean Harvest Rate = 1.60
Effort Explained = 525. Percent = 98.86
Total Qx1e3 = 0.031

SOCKEYE YEAR = 1981

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
11	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	5.	77.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	54.	1172.	69.71	2.	334.524
14	23.	0.00	0.00	100.00	65.	15874.	5.55	3.	16.703
15	1107.	54.90	0.00	45.10	22.	75166.	0.14	1.	1.250
16	15852.	53.60	0.00	46.40	357.	225609.	0.47	16.	0.291
17	74809.	57.53	0.00	42.47	695.	153675.	0.31	17.	0.179
18	224914.	78.72	0.00	21.28	1104.	122777.	0.72	17.	0.423
19	152571.	83.02	0.00	16.98	1565.	365620.	1.27	26.	0.494
20	121212.	96.47	0.00	3.53	1633.	356763.	0.45	31.	0.143
21	363987.	99.95	0.00	0.05	1799.	583872.	0.50	38.	0.131
22	354964.	99.34	0.66	0.00	7485.	404661.	1.28	148.	0.086
23	576387.	98.86	1.14	0.00	10204.	171354.	2.52	180.	0.140
24	394457.	98.01	1.99	0.00	9019.	110512.	5.26	126.	0.418
25	162335.	88.90	11.10	0.00	7187.	28882.	6.50	91.	0.714
26	103325.	63.89	36.11	0.00	2355.	10120.	8.15	37.	2.222
27	26527.	25.20	74.80	0.00	590.	1372.	5.83	12.	4.747
28	9530.	0.00	100.00	0.00	165.	0.	12.03	6.	21.129
29	1207.	0.00	100.00	0.00	102.	0.	-99.00	6.	-99.000
30	0.	0.00	0.00	0.00	34.	0.	-99.00	3.	-99.000
31	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	2583207.				44442.	2627506.		761.	

Catch Explained = 44299. Percent = 99.68
Mean Harvest Rate = 1.69
Effort Explained = 753. Percent = 98.84
Total Qx1e3 = 0.022

SOCKEYE YEAR = 1982

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	1864.	0.	-99.00	35.	-99.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	3.	256.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	10.	5331.	3.91	0.	133.358
14	246.	44.80	0.00	55.20	196.	24603.	3.68	6.	5.791
15	5135.	13.51	0.00	86.49	309.	75619.	1.26	11.	1.179
16	24294.	10.92	0.00	89.08	339.	133314.	0.45	14.	0.314
17	75280.	17.42	0.00	82.58	510.	133347.	0.38	14.	0.279
18	132804.	15.67	0.00	84.33	3571.	114619.	2.68	49.	0.545
19	129776.	23.33	0.00	76.67	9444.	374144.	8.24	113.	0.732
20	105175.	34.47	0.00	65.53	21994.	1090648.	5.88	265.	0.222
21	352150.	92.19	0.00	7.81	228706.	1510080.	20.97	2446.	0.086
22	861942.	100.00	0.00	0.00	402870.	2628870.	26.68	3714.	0.072
23	1107210.	78.92	21.08	0.00	536163.	3250962.	20.40	4232.	0.048
24	2092707.	38.52	61.48	0.00	635627.	2895947.	19.55	5310.	0.037
25	2615335.	14.00	86.00	0.00	315280.	902751.	10.89	3554.	0.031
26	2580667.	3.56	96.44	0.00	27760.	243633.	3.08	572.	0.054
27	874991.	0.84	99.16	0.00	3536.	15727.	1.45	87.	0.167
28	240097.	0.02	99.98	0.00	1642.	0.	10.44	45.	2.334
29	14085.	0.00	100.00	0.00	139.	0.	-99.00	4.	-99.000
30	0.	0.00	0.00	0.00	116.	0.	-99.00	5.	-99.000
31	0.	0.00	0.00	0.00	17.	0.	-99.00	1.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	11211896.				2190104.	13399852.		20477.	

Catch Explained = 2187957. Percent = 99.90
Mean Harvest Rate = 16.33
Effort Explained = 20433. Percent = 99.78
Total Qx1e3 = 0.008

SOCKEYE YEAR = 1983

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
11	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	0.	1883.	0.00	0.	0.000
13	0.	0.00	0.00	0.00	0.	17325.	0.00	0.	0.000
14	1883.	33.46	0.00	66.54	30.	61355.	0.17	2.	1.114
15	17295.	21.81	0.00	78.19	70.	99384.	0.11	4.	0.311
16	61285.	11.06	0.00	88.94	77.	106861.	0.08	5.	0.163
17	99307.	30.11	0.00	69.89	276.	109878.	0.26	12.	0.219
18	106585.	22.19	0.00	77.81	607.	89803.	0.55	7.	0.803
19	109271.	33.37	0.00	66.63	476.	157993.	0.53	5.	1.146
20	89327.	29.60	0.00	70.40	188.	172892.	0.12	2.	0.478
21	157805.	79.22	0.00	20.78	1526.	133274.	0.88	28.	0.316
22	171366.	71.61	26.78	1.61	7890.	87215.	5.92	159.	0.372
23	125384.	73.81	26.19	0.00	7750.	93449.	8.89	153.	0.581
24	79465.	66.57	33.43	0.00	5291.	48569.	5.66	124.	0.457
25	88158.	9.87	90.13	0.00	6872.	12982.	14.15	151.	0.938
26	41697.	4.31	95.69	0.00	3945.	5377.	30.39	77.	3.928
27	9037.	12.51	87.49	0.00	1237.	5694.	23.00	27.	8.441
28	4140.	0.00	100.00	0.00	226.	0.	3.97	7.	5.578
29	5468.	0.00	100.00	0.00	80.	0.	-99.00	3.	-99.000
30	0.	0.00	0.00	0.00	52.	0.	-99.00	3.	-99.000
31	0.	0.00	0.00	0.00	20.	0.	-99.00	1.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	1167474.				36613.	1203935.		769.	

Catch Explained = 36461. Percent = 99.58
Mean Harvest Rate = 3.03
Effort Explained = 762. Percent = 99.05
Total Qx1e3 = 0.040

SOCKEYE YEAR = 1984

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
11	0.	0.00	0.00	0.00	0.	2069.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	1.	26265.	0.05	0.	10.071
13	2068.	0.00	0.00	100.00	90.	61099.	0.34	4.	0.831
14	26175.	0.00	0.00	100.00	1218.	101333.	1.99	63.	0.318
15	59881.	1.07	0.00	98.93	1129.	148513.	1.11	55.	0.203
16	100204.	8.80	0.00	91.20	0.	117638.	0.00	0.	0.000
17	148513.	16.10	0.00	83.90	0.	162619.	0.00	0.	0.000
18	117638.	31.48	0.00	68.52	2854.	309599.	1.76	36.	0.494
19	159765.	73.50	0.00	26.50	2225.	556989.	0.72	33.	0.217
20	307374.	94.70	0.00	5.30	978.	960868.	0.18	16.	0.107
21	556011.	99.13	0.00	0.87	2229.	1095620.	0.23	36.	0.064
22	958639.	100.00	0.00	0.00	7733.	360298.	0.71	129.	0.055
23	1087887.	100.00	0.00	0.00	11644.	299090.	3.23	198.	0.163
24	348654.	98.54	1.46	0.00	7911.	32901.	2.65	149.	0.177
25	291179.	93.79	6.21	0.00	2967.	13663.	9.02	64.	1.398
26	29934.	82.16	17.84	0.00	702.	5335.	5.14	17.	2.963
27	12961.	37.92	62.08	0.00	74.	569.	1.39	2.	6.931
28	5261.	8.66	91.34	0.00	30.	0.	5.27	1.	55.358
29	539.	0.00	100.00	0.00	19.	0.	-99.00	1.	-99.000
30	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
31	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	4212683.				41805.	4254468.		805.	

Catch Explained = 41785. Percent = 99.95
Mean Harvest Rate = 0.98
Effort Explained = 805. Percent = 99.91
Total Qx1e3 = 0.012

SOCKEYE YEAR = 1985

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	566.	0.	-99.00	30.	-99.000
11	0.	0.00	0.00	0.00	354.	192.	-99.00	22.	-99.000
12	0.	0.00	0.00	0.00	0.	4356.	0.00	0.	0.000
13	192.	0.00	0.00	100.00	0.	25362.	0.00	0.	0.000
14	4356.	0.00	0.00	100.00	0.	105950.	0.00	0.	0.000
15	25362.	25.89	0.00	74.11	0.	128413.	0.00	0.	0.000
16	105950.	56.63	0.00	43.37	0.	136491.	0.00	0.	0.000
17	128413.	56.37	0.00	43.63	0.	162674.	0.00	0.	0.000
18	136491.	66.67	0.00	33.33	12847.	234689.	7.90	229.	0.346
19	149827.	65.40	0.00	34.60	22578.	882728.	9.62	418.	0.230
20	212111.	72.85	0.00	27.15	35605.	2344297.	4.03	602.	0.067
21	847123.	95.45	0.00	4.55	121378.	3218603.	5.18	1654.	0.031
22	2222919.	98.80	0.00	1.20	322362.	2119209.	10.02	3367.	0.030
23	2896241.	99.93	0.00	0.07	338933.	847560.	15.99	3551.	0.045
24	1780276.	99.66	0.34	0.00	149403.	216470.	17.63	2064.	0.085
25	698157.	97.87	2.13	0.00	40798.	60869.	18.85	696.	0.271
26	175672.	89.80	10.20	0.00	5429.	13874.	8.92	120.	0.745
27	55440.	54.17	45.83	0.00	695.	2018.	5.01	20.	2.483
28	13179.	43.27	56.73	0.00	129.	155.	6.39	6.	11.432
29	1889.	8.61	91.39	0.00	50.	0.	32.23	2.	128.910
30	105.	100.00	0.00	0.00	127.	0.	-99.00	7.	-99.000
31	0.	0.00	0.00	0.00	124.	0.	-99.00	7.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	9453702.				1051378.	10503909.		12793.	

Catch Explained = 1050207. Percent = 99.89
Mean Harvest Rate = 10.00
Effort Explained = 12728. Percent = 99.49
Total Qx1e3 = 0.008

PINK YEAR = 1979

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
11	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	19.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	1154.	0.	-99.00	13.	-99.000
14	0.	0.00	0.00	0.00	1190.	0.	-99.00	13.	-99.000
15	0.	0.00	0.00	0.00	5529.	0.	-99.00	44.	-99.000
16	0.	0.00	0.00	0.00	59038.	0.	-99.00	361.	-99.000
17	0.	0.00	0.00	0.00	104744.	94523.	-99.00	644.	-99.000
18	0.	0.00	0.00	0.00	60807.	106971.	64.33	396.	1.626
19	0.	0.00	0.00	0.00	44581.	251531.	31.69	223.	1.418
20	23032.	0.00	53.54	46.46	56629.	806217.	17.45	299.	0.584
21	60326.	0.12	17.61	82.27	246208.	2645045.	24.28	1113.	0.218
22	157225.	0.88	16.95	82.17	604524.	5495397.	18.57	2342.	0.079
23	497081.	1.68	68.13	30.18	745632.	2485205.	9.75	2943.	0.033
24	1943921.	0.93	83.37	15.70	617097.	558143.	8.29	2633.	0.031
25	4548617.	0.34	85.41	14.26	363955.	247844.	12.83	1897.	0.068
26	1986850.	0.31	83.30	16.38	126649.	24772.	17.25	842.	0.205
27	402641.	0.06	80.72	19.22	18071.	2973.	7.86	200.	0.392
28	188979.	0.10	83.64	16.26	4843.	0.	18.77	59.	3.181
29	18540.	0.04	76.86	23.10	1259.	0.	52.13	15.	35.851
30	1156.	0.00	17.28	82.72	783.	0.	-99.00	9.	-99.000
31	0.	0.00	0.00	0.00	998.	0.	-99.00	13.	-99.000
32	0.	0.00	0.00	0.00	618.	0.	-99.00	9.	-99.000
33	0.	0.00	0.00	0.00	62.	0.	-99.00	2.	-99.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	9828367.				3064390.	12718621.		14069.	

Catch Explained = 2890255. Percent = 94.32
Mean Harvest Rate = 22.72
Effort Explained = 12961. Percent = 92.12
Total Qx1e3 = 0.018

PINK YEAR = 1980

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	5.	0.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	5.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	0.	20.	0.00	0.	0.000
13	0.	0.00	0.00	0.00	1.	1971.	4.95	0.	2422.576
14	0.	0.00	0.00	0.00	15.	41129.	0.75	0.	27.750
15	19.	100.00	0.00	0.00	613.	211566.	1.42	8.	1.743
16	1928.	55.02	44.98	0.00	5728.	537382.	2.27	51.	0.449
17	39623.	23.72	76.28	0.00	12059.	699832.	1.62	93.	0.174
18	203408.	20.15	79.41	0.45	17490.	526674.	1.42	141.	0.101
19	521147.	16.28	82.97	0.75	33911.	412070.	2.79	297.	0.094
20	670639.	13.68	85.12	1.20	37477.	216158.	4.06	359.	0.113
21	491228.	8.43	86.44	5.13	39861.	100106.	6.52	456.	0.143
22	369587.	2.39	84.49	13.12	37071.	74400.	12.27	500.	0.245
23	177278.	0.42	61.15	38.43	13541.	46994.	8.35	230.	0.363
24	80494.	0.00	87.75	12.24	2544.	18353.	2.21	51.	0.430
25	66684.	0.00	99.39	0.61	418.	5387.	0.65	8.	0.806
26	45657.	0.00	99.98	0.02	99.	938.	0.42	2.	2.022
27	18158.	0.00	100.00	0.00	49.	300.	0.78	1.	6.599
28	5323.	0.00	100.00	0.00	37.	0.	3.01	1.	31.586
29	902.	0.00	100.00	0.00	9.	0.	3.10	0.	142.678
30	282.	0.00	100.00	0.00	478.	0.	-99.00	15.	-99.000
31	0.	0.00	0.00	0.00	476.	0.	-99.00	19.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	10.	0.	-99.00	0.	-99.000
34	0.	0.00	0.00	0.00	10.	0.	-99.00	0.	-99.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	2692356.				201914.	2893279.		2235.	

Catch Explained = 200923. Percent = 99.51
Mean Harvest Rate = 6.94
Effort Explained = 2199. Percent = 98.42
Total Qxle3 = 0.032

PINK YEAR = 1981

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	9.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	1291.	0.	-99.00	19.	-99.000
14	0.	0.00	0.00	0.00	2078.	0.	-99.00	41.	-99.000
15	0.	0.00	0.00	0.00	4259.	0.	-99.00	83.	-99.000
16	0.	0.00	0.00	0.00	13867.	122906.	-99.00	241.	-99.000
17	0.	0.00	0.00	0.00	17138.	100838.	13.94	161.	0.865
18	0.	0.00	0.00	0.00	32771.	149968.	15.86	192.	0.827
19	88992.	61.62	38.38	0.00	49067.	365128.	20.90	307.	0.680
20	67114.	21.07	78.93	0.00	51935.	1096475.	10.74	379.	0.283
21	105894.	14.70	85.26	0.04	63941.	2404011.	4.50	519.	0.087
22	311277.	4.81	94.86	0.33	226240.	3844778.	6.56	1703.	0.038
23	978538.	2.28	96.32	1.40	347098.	4472919.	5.70	2328.	0.024
24	2118409.	1.17	95.34	3.48	552701.	2547613.	6.82	2934.	0.023
25	3378249.	0.48	94.28	5.24	663659.	1498822.	9.88	3199.	0.031
26	3755776.	0.28	91.42	8.30	445729.	145021.	11.75	2640.	0.044
27	2026163.	0.11	89.23	10.66	223426.	21410.	15.22	1769.	0.086
28	1121416.	0.02	92.87	7.11	50005.	5543.	34.64	654.	0.529
29	80357.	0.00	95.76	4.24	6484.	0.	33.19	141.	2.353
30	9349.	0.00	92.87	7.13	1585.	0.	42.80	47.	9.108
31	2118.	0.00	0.00	100.00	559.	0.	-99.00	18.	-99.000
32	0.	0.00	0.00	0.00	4.	0.	-99.00	4.	-99.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	14043652.				2753853.	16775431.		17380.	

Catch Explained = 2731779. Percent = 99.20
Mean Harvest Rate = 16.28
Effort Explained = 16974. Percent = 97.67
Total Qx1e3 = 0.010

PINK YEAR = 1982

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	17.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	17.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	17.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	17.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
14	0.	0.00	0.00	0.00	3.	362.	-99.00	0.	-99.000
15	0.	0.00	0.00	0.00	3.	2214.	0.83	0.	265.359
16	0.	0.00	0.00	0.00	5.	12660.	0.19	0.	25.510
17	359.	100.00	0.00	0.00	316.	69875.	2.13	3.	7.318
18	2163.	82.88	17.12	0.00	1361.	172078.	1.65	6.	2.579
19	12186.	69.42	30.58	0.00	2847.	204460.	1.18	12.	1.017
20	67906.	38.88	61.12	0.00	6688.	144815.	1.79	28.	0.648
21	167007.	35.30	64.70	0.00	12467.	51374.	3.61	46.	0.790
22	193566.	17.84	80.75	1.42	8273.	40286.	4.33	26.	1.658
23	133544.	9.01	88.28	2.72	1440.	47755.	1.61	4.	4.136
24	48357.	3.37	92.92	3.71	1680.	29344.	1.92	5.	3.998
25	38876.	0.09	98.73	1.18	1087.	6854.	1.43	4.	3.399
26	46168.	0.00	99.94	0.06	236.	1881.	0.66	2.	3.950
27	28735.	0.00	100.00	0.00	122.	411.	1.40	1.	13.718
28	6713.	0.00	100.00	0.00	37.	0.	1.63	0.	47.294
29	1825.	0.00	100.00	0.00	3.	0.	0.74	0.	257.805
30	401.	0.00	100.00	0.00	25.	0.	-99.00	0.	-99.000
31	0.	0.00	0.00	0.00	22.	0.	-99.00	0.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	747805.				36688.	784370.		138.	

Catch Explained = 36565. Percent = 99.66
Mean Harvest Rate = 4.66
Effort Explained = 136. Percent = 99.05
Total Qx1e3 = 0.342

PINK YEAR = 1983

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	24.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	24.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
14	0.	0.00	0.00	0.00	44.	0.	-99.00	1.	-99.000
15	0.	0.00	0.00	0.00	243.	0.	-99.00	4.	-99.000
16	0.	0.00	0.00	0.00	270.	0.	-99.00	5.	-99.000
17	0.	0.00	0.00	0.00	219.	2630.	-99.00	3.	-99.000
18	0.	0.00	0.00	0.00	627.	14437.	23.84	2.	105.095
19	0.	0.00	0.00	0.00	1058.	87450.	6.44	3.	19.640
20	1874.	100.00	0.00	0.00	1101.	278555.	1.09	5.	2.347
21	13361.	46.08	9.12	44.80	25046.	530537.	6.86	146.	0.469
22	80562.	13.40	43.84	42.76	83825.	1177440.	10.61	539.	0.197
23	231913.	5.01	60.06	34.93	92606.	1894360.	5.61	583.	0.096
24	447652.	2.04	69.56	28.40	76741.	1240854.	2.55	573.	0.045
25	1083048.	0.44	84.07	15.49	179422.	1819884.	5.81	1256.	0.046
26	1738697.	0.09	88.04	11.87	298850.	498427.	10.00	1870.	0.053
27	1051861.	0.03	79.15	20.82	222437.	64934.	10.41	1564.	0.067
28	1467362.	0.01	91.29	8.70	79423.	24006.	15.53	798.	0.195
29	377191.	0.00	80.58	19.42	23167.	0.	29.38	303.	0.970
30	38737.	0.00	0.00	100.00	4770.	0.	28.14	83.	3.408
31	12183.	0.00	0.00	100.00	1456.	0.	-99.00	28.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	6544441.				1091363.	7633515.		7767.	

Catch Explained = 1089073. Percent = 99.79
Mean Harvest Rate = 14.27
Effort Explained = 7726. Percent = 99.47
Total Qx1e3 = 0.018

PINK YEAR = 1984

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	0.	5969.	0.00	0.	0.000
11	0.	0.00	0.00	0.00	21.	17277.	0.35	0.	16.444
12	0.	0.00	0.00	0.00	21.	36896.	0.09	0.	3.733
13	5943.	3.31	96.69	0.00	12.	58836.	0.02	0.	1.572
14	17258.	4.45	95.55	0.00	23.	71328.	0.02	0.	0.760
15	36879.	4.87	95.13	0.00	14.	72926.	0.01	0.	0.600
16	58815.	5.52	94.48	0.00	0.	82646.	0.00	0.	0.000
17	71321.	7.68	92.32	0.00	0.	96199.	0.00	0.	0.000
18	72926.	12.73	87.27	0.00	18941.	94335.	10.59	62.	1.712
19	73893.	22.09	75.01	2.90	13257.	81038.	7.35	52.	1.422
20	79688.	27.74	56.12	16.14	9986.	74041.	5.93	44.	1.347
21	82219.	33.69	33.89	32.43	9006.	32998.	5.99	38.	1.565
22	71665.	25.19	10.08	64.74	7328.	9983.	7.14	32.	2.227
23	64633.	12.12	21.36	66.53	4052.	5998.	9.97	18.	5.514
24	27585.	9.53	39.89	50.58	1659.	5113.	11.07	8.	13.500
25	7992.	0.00	68.01	31.99	919.	1963.	8.80	5.	16.815
26	4865.	0.00	85.77	14.23	438.	641.	6.61	3.	23.301
27	4355.	0.00	94.87	5.13	279.	71.	11.28	2.	57.434
28	1626.	0.00	100.00	0.00	16.	0.	2.50	0.	180.823
29	554.	0.00	100.00	0.00	5.	0.	7.22	0.	1845.619
30	64.	0.00	100.00	0.00	0.	0.	0.00	0.	0.000
31	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	682281.				65977.	748258.		265.	

Catch Explained = 65977. Percent = 100.00
Mean Harvest Rate = 8.82
Effort Explained = 265. Percent = 100.00
Total Qx1e3 = 0.332

PINK YEAR = 1985

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	1207.	0.	-99.00	16.	-99.000
11	0.	0.00	0.00	0.00	1189.	0.	-99.00	18.	-99.000
12	0.	0.00	0.00	0.00	6.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
14	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
15	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
16	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
17	0.	0.00	0.00	0.00	0.	74253.	0.00	0.	0.000
18	0.	0.00	0.00	0.00	9892.	201373.	13.32	44.	3.009
19	0.	0.00	0.00	0.00	41365.	439516.	15.57	193.	0.807
20	54342.	100.00	0.00	0.00	117724.	508154.	19.31	501.	0.386
21	137188.	36.14	1.44	62.42	171960.	1246250.	19.93	590.	0.338
22	283949.	2.66	42.43	54.91	164995.	1932759.	9.98	434.	0.230
23	366265.	1.91	36.88	61.21	154356.	3852652.	5.05	407.	0.124
24	1065174.	0.48	73.28	26.24	281345.	3027494.	4.95	978.	0.051
25	1744320.	0.16	79.28	20.56	395126.	1527219.	5.91	1695.	0.035
26	3445776.	0.04	84.93	15.03	304158.	466944.	6.95	1689.	0.041
27	2650668.	0.01	84.72	15.26	142615.	52867.	7.55	1041.	0.073
28	1313723.	0.01	76.85	23.14	30109.	12141.	6.21	328.	0.190
29	404849.	0.00	72.73	27.27	1801.	0.	2.92	22.	1.299
30	48135.	0.00	2.64	97.36	52.	0.	0.44	1.	6.001
31	11734.	0.00	0.00	100.00	15.	0.	-99.00	0.	-99.000
32	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
33	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
34	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
35	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
36	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
TOTAL	11526124.				1817915.	13341621.		7957.	

Catch Explained = 1815498. Percent = 99.87
Mean Harvest Rate = 13.61
Effort Explained = 7922. Percent = 99.57
Total Qx1e3 = 0.017

CHUM YEAR = 1979

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
9	0.	0.00	0.00	0.00	4.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	8.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	14.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	13.	4740.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	42.	32917.	0.89	1.	9.234
14	0.	0.00	0.00	0.00	87.	98845.	0.23	2.	1.154
15	4688.	100.00	0.00	0.00	114.	165986.	0.09	2.	0.474
16	32813.	100.00	0.00	0.00	863.	166896.	0.33	11.	0.305
17	98438.	100.00	0.00	0.00	2776.	99769.	0.84	35.	0.241
18	164063.	100.00	0.00	0.00	2307.	49441.	0.87	30.	0.286
19	164063.	100.00	0.00	0.00	695.	102943.	0.47	7.	0.664
20	98438.	100.00	0.00	0.00	454.	246109.	0.30	5.	0.614
21	49063.	100.00	0.00	0.00	1525.	330806.	0.44	14.	0.313
22	102188.	100.00	0.00	0.00	3014.	250159.	0.52	24.	0.221
23	243750.	100.00	0.00	0.00	2980.	102733.	0.51	24.	0.216
24	327381.	99.27	0.73	0.00	2121.	22655.	0.60	18.	0.329
25	247371.	98.54	1.46	0.00	1017.	8444.	0.82	11.	0.758
26	101281.	96.27	2.90	0.83	347.	9790.	1.12	5.	2.403
27	22218.	73.14	18.85	8.01	68.	14012.	0.37	2.	2.448
28	8318.	0.00	68.38	31.62	82.	10963.	0.35	2.	1.693
29	9720.	0.00	61.50	38.50	104.	17446.	0.42	2.	1.714
30	13906.	0.00	32.34	67.66	45.	11724.	0.16	1.	1.503
31	10899.	0.00	41.30	58.70	11.	21102.	0.04	0.	1.339
32	17411.	0.00	19.12	80.88	14.	21461.	0.04	0.	0.978
33	11715.	0.00	31.91	68.09	118.	14765.	0.28	6.	0.443
34	21034.	0.00	24.57	75.43	110.	5668.	0.30	13.	0.226
35	21336.	0.00	13.19	86.81	0.	3843.	0.00	0.	0.000
36	14720.	0.00	20.41	79.59	0.	0.	0.00	0.	0.000
TOTAL	1784811.				18936.	1813215.		216.	

Catch Explained = 18894. Percent = 99.78
Mean Harvest Rate = 1.04
Effort Explained = 215. Percent = 99.57
Total Qxle3 = 0.048

CHUM YEAR = 1980

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	2.	1188.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	12.	7076.	1.01	0.	31.707
9	0.	0.00	0.00	0.00	32.	17673.	0.39	1.	4.434
10	1172.	100.00	0.00	0.00	61.	23605.	0.25	2.	1.451
11	7031.	100.00	0.00	0.00	120.	17742.	0.29	4.	0.822
12	17578.	100.00	0.00	0.00	173.	7118.	0.42	5.	0.762
13	23438.	100.00	0.00	0.00	125.	1349.	0.50	4.	1.304
14	17578.	100.00	0.00	0.00	61.	2031.	0.72	2.	3.472
15	7031.	100.00	0.00	0.00	422.	17864.	12.52	10.	12.056
16	1172.	100.00	0.00	0.00	745.	77608.	3.79	12.	3.115
17	1709.	100.00	0.00	0.00	530.	206546.	0.56	8.	0.739
18	17090.	100.00	0.00	0.00	990.	361136.	0.35	15.	0.237
19	76904.	100.00	0.00	0.00	2059.	433218.	0.36	33.	0.109
20	205078.	100.00	0.00	0.00	2066.	362099.	0.26	37.	0.071
21	358887.	100.00	0.00	0.00	2620.	208715.	0.33	55.	0.060
22	430664.	100.00	0.00	0.00	3184.	79161.	0.56	79.	0.070
23	358887.	100.00	0.00	0.00	1573.	26524.	0.55	49.	0.111
24	206409.	99.36	0.64	0.00	258.	24887.	0.25	10.	0.255
25	78534.	97.92	2.08	0.00	90.	22591.	0.18	3.	0.547
26	26413.	64.70	8.23	27.06	47.	31317.	0.10	2.	0.551
27	24819.	6.89	21.10	72.02	29.	62416.	0.05	1.	0.420
28	22557.	0.00	28.96	71.04	44.	77309.	0.05	2.	0.221
29	31285.	0.00	39.63	60.37	72.	187014.	0.05	3.	0.153
30	62354.	0.00	29.35	70.65	370.	105804.	0.14	22.	0.065
31	77161.	0.00	26.74	73.26	450.	134338.	0.15	34.	0.045
32	186465.	0.00	12.14	87.86	2849.	112991.	1.19	147.	0.081
33	104387.	0.00	21.88	78.12	2811.	53211.	1.14	152.	0.075
34	131225.	0.00	12.67	87.33	79.	25229.	0.05	5.	0.091
35	111645.	0.00	8.03	91.97	4.	14126.	0.01	0.	0.232
36	53183.	0.00	3.76	96.24	1.	0.	0.00	0.	0.378
TOTAL	2640655.				21879.	2701884.		698.	

Catch Explained = 21877. Percent = 99.99
Mean Harvest Rate = 0.81
Effort Explained = 698. Percent = 99.99
Total Qx1e3 = 0.012

CHUM YEAR = 1981

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	1.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
12	0.	0.00	0.00	0.00	5.	0.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	7.	1412.	-99.00	0.	-99.000
14	0.	0.00	0.00	0.00	4.	8455.	0.28	0.	14.877
15	0.	0.00	0.00	0.00	14.	21116.	0.14	1.	2.233
16	1406.	100.00	0.00	0.00	18.	28520.	0.06	1.	0.829
17	8438.	100.00	0.00	0.00	23.	21786.	0.05	1.	0.891
18	21094.	100.00	0.00	0.00	673.	19831.	1.34	9.	1.420
19	28125.	100.00	0.00	0.00	770.	67454.	1.86	12.	1.615
20	21094.	100.00	0.00	0.00	386.	165029.	0.44	7.	0.659
21	19375.	100.00	0.00	0.00	427.	222834.	0.18	8.	0.222
22	67031.	100.00	0.00	0.00	1560.	168981.	0.40	28.	0.143
23	164063.	100.00	0.00	0.00	2204.	74059.	0.56	35.	0.159
24	220685.	99.12	0.88	0.00	1181.	27601.	0.49	15.	0.325
25	167209.	98.12	1.88	0.00	647.	21164.	0.64	7.	0.856
26	73227.	89.62	4.63	5.76	495.	27920.	1.02	7.	1.452
27	27145.	40.29	22.07	37.64	365.	49695.	0.75	7.	1.082
28	20792.	0.00	41.10	58.90	166.	37657.	0.21	5.	0.413
29	27652.	0.00	43.19	56.81	63.	81710.	0.07	3.	0.222
30	49552.	0.00	34.54	65.46	203.	42454.	0.17	14.	0.118
31	37566.	0.00	25.09	74.91	174.	60608.	0.14	14.	0.103
32	81457.	0.00	10.46	89.54	0.	63305.	0.00	0.	0.000
33	42394.	0.00	21.07	78.93	0.	38733.	0.00	0.	0.000
34	60608.	0.00	10.91	89.09	0.	17088.	0.00	0.	0.000
35	63305.	0.00	5.42	94.58	0.	12132.	0.00	0.	0.000
36	38733.	0.00	5.65	94.35	0.	0.	0.00	0.	0.000
TOTAL	1240951.				9387.	1279544.		175.	

Catch Explained = 9373. Percent = 99.85
Mean Harvest Rate = 0.73
Effort Explained = 174. Percent = 99.69
Total Qx1e3 = 0.042

CHUM YEAR = 1982

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	62.	314.	-99.00	1.	-99.000
8	0.	0.00	0.00	0.00	0.	2208.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	13.	6612.	0.52	0.	18.270
10	313.	100.00	0.00	0.00	36.	11042.	0.41	1.	4.343
11	2188.	100.00	0.00	0.00	59.	11189.	0.33	1.	2.340
12	6563.	100.00	0.00	0.00	136.	7128.	0.61	3.	1.903
13	10938.	100.00	0.00	0.00	301.	2720.	1.65	8.	2.128
14	10938.	100.00	0.00	0.00	622.	2735.	6.39	18.	3.482
15	6563.	100.00	0.00	0.00	743.	20378.	14.07	23.	6.027
16	2188.	100.00	0.00	0.00	442.	90252.	1.94	17.	1.148
17	2305.	100.00	0.00	0.00	328.	240713.	0.30	8.	0.370
18	19922.	100.00	0.00	0.00	1231.	424189.	0.37	15.	0.241
19	89648.	100.00	0.00	0.00	2090.	519309.	0.31	23.	0.139
20	239063.	100.00	0.00	0.00	10014.	438519.	1.06	110.	0.097
21	418359.	100.00	0.00	0.00	21793.	252507.	2.29	212.	0.108
22	502031.	100.00	0.00	0.00	16090.	98547.	2.36	135.	0.175
23	418359.	100.00	0.00	0.00	5221.	31098.	1.51	38.	0.403
24	242811.	98.46	1.54	0.00	3236.	21520.	2.53	25.	1.025
25	94605.	94.76	5.24	0.00	1452.	21801.	2.80	15.	1.878
26	29463.	67.62	8.19	24.19	272.	35243.	0.64	5.	1.246
27	20784.	9.59	13.58	76.84	115.	69776.	0.20	3.	0.785
28	21618.	0.00	23.47	76.53	180.	74374.	0.17	4.	0.383
29	35112.	0.00	28.39	71.61	1908.	170367.	1.32	55.	0.239
30	68733.	0.00	15.71	84.29	4428.	94852.	1.82	157.	0.116
31	72056.	0.00	13.25	86.75	2663.	174815.	1.02	102.	0.099
32	165573.	0.00	6.83	93.17	0.	153507.	0.00	0.	0.000
33	93888.	0.00	11.86	88.14	0.	99755.	0.00	0.	0.000
34	174815.	0.00	7.87	92.13	0.	42487.	0.00	0.	0.000
35	153507.	0.00	3.49	96.51	0.	26291.	0.00	0.	0.000
36	99755.	0.00	7.46	92.54	0.	0.	0.00	0.	0.000
TOTAL	3002096.				73435.	3144247.		981.	

Catch Explained = 73373. Percent = 99.92
Mean Harvest Rate = 2.33
Effort Explained = 980. Percent = 99.89
Total Qx1e3 = 0.024

CHUM YEAR = 1983

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	2.	0.	-99.00	0.	-99.000
10	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
11	0.	0.00	0.00	0.00	3.	0.	-99.00	0.	-99.000
12	0.	0.00	0.00	0.00	8.	254.	-99.00	0.	-99.000
13	0.	0.00	0.00	0.00	16.	1677.	6.31	1.	88.362
14	0.	0.00	0.00	0.00	27.	4998.	1.41	2.	9.369
15	234.	100.00	0.00	0.00	51.	8361.	0.77	3.	2.633
16	1641.	100.00	0.00	0.00	102.	8949.	0.77	7.	1.126
17	4922.	100.00	0.00	0.00	196.	5804.	1.14	9.	1.254
18	8203.	100.00	0.00	0.00	1067.	10471.	7.28	13.	5.540
19	8203.	100.00	0.00	0.00	1353.	47917.	8.54	14.	5.974
20	4922.	100.00	0.00	0.00	743.	118136.	1.29	11.	1.211
21	9453.	100.00	0.00	0.00	660.	159885.	0.40	13.	0.303
22	47109.	100.00	0.00	0.00	1126.	121600.	0.41	25.	0.164
23	117188.	100.00	0.00	0.00	1067.	51130.	0.38	23.	0.166
24	158631.	98.50	1.50	0.00	469.	14167.	0.27	12.	0.228
25	120808.	97.00	3.00	0.00	428.	8715.	0.66	10.	0.644
26	50656.	92.54	5.80	1.67	475.	10097.	2.08	10.	2.056
27	13781.	56.69	30.40	12.91	471.	14185.	2.53	11.	2.241
28	8318.	0.00	68.38	31.62	297.	11050.	1.24	10.	1.214
29	9720.	0.00	61.50	38.50	186.	17559.	0.74	8.	0.896
30	13906.	0.00	32.34	67.66	177.	11741.	0.62	10.	0.596
31	10899.	0.00	41.30	58.70	65.	21034.	0.22	4.	0.525
32	17411.	0.00	19.12	80.88	0.	21336.	0.00	0.	0.000
33	11715.	0.00	31.91	68.09	0.	14720.	0.00	0.	0.000
34	21034.	0.00	24.57	75.43	0.	5668.	0.00	0.	0.000
35	21336.	0.00	13.19	86.81	0.	3843.	0.00	0.	0.000
36	14720.	0.00	20.41	79.59	0.	0.	0.00	0.	0.000
TOTAL	674811.				8992.	693297.		197.	

Catch Explained = 8976. Percent = 99.82
Mean Harvest Rate = 1.29
Effort Explained = 196. Percent = 99.67
Total Qx1e3 = 0.066

CHUM YEAR = 1984

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	1.	402.	-99.00	0.	-99.000
8	0.	0.00	0.00	0.00	10.	2753.	2.48	0.	80.554
9	0.	0.00	0.00	0.00	15.	8227.	0.48	1.	8.877
10	391.	100.00	0.00	0.00	22.	13701.	0.20	1.	2.582
11	2734.	100.00	0.00	0.00	21.	13740.	0.10	1.	1.286
12	8203.	100.00	0.00	0.00	32.	8603.	0.12	1.	0.902
13	13672.	100.00	0.00	0.00	85.	3105.	0.38	4.	1.060
14	13672.	100.00	0.00	0.00	500.	2547.	4.28	24.	1.801
15	8203.	100.00	0.00	0.00	441.	19531.	7.99	20.	4.040
16	2734.	100.00	0.00	0.00	0.	88986.	0.00	0.	0.000
17	2344.	100.00	0.00	0.00	0.	238674.	0.00	0.	0.000
18	19531.	100.00	0.00	0.00	4035.	412823.	1.23	46.	0.265
19	87891.	100.00	0.00	0.00	3741.	492997.	0.58	51.	0.112
20	234375.	100.00	0.00	0.00	628.	411201.	0.07	10.	0.071
21	410156.	100.00	0.00	0.00	856.	239002.	0.09	13.	0.074
22	492188.	100.00	0.00	0.00	1037.	93283.	0.16	16.	0.100
23	410156.	100.00	0.00	0.00	692.	29266.	0.21	11.	0.191
24	238123.	98.43	1.57	0.00	317.	20898.	0.26	6.	0.469
25	92847.	94.66	5.34	0.00	202.	21712.	0.40	4.	0.997
26	29073.	67.18	8.30	24.52	142.	35161.	0.33	3.	1.033
27	20745.	9.42	13.60	76.98	56.	68782.	0.10	1.	0.715
28	21618.	0.00	23.47	76.53	42.	72083.	0.04	1.	0.326
29	35112.	0.00	28.39	71.61	43.	165586.	0.03	1.	0.241
30	68733.	0.00	15.71	84.29	19.	93888.	0.01	2.	0.053
31	72056.	0.00	13.25	86.75	0.	174815.	0.00	0.	0.000
32	165573.	0.00	6.83	93.17	0.	153507.	0.00	0.	0.000
33	93888.	0.00	11.86	88.14	0.	99755.	0.00	0.	0.000
34	174815.	0.00	7.87	92.13	0.	42487.	0.00	0.	0.000
35	153507.	0.00	3.49	96.51	0.	26291.	0.00	0.	0.000
36	99755.	0.00	7.46	92.54	0.	0.	0.00	0.	0.000
TOTAL	2972096.				12937.	3053810.		216.	

Catch Explained = 12936. Percent = 99.99
Mean Harvest Rate = 0.42
Effort Explained = 216. Percent = 99.98
Total Qx1e3 = 0.020

CHUM YEAR = 1985

WEEK CODE	ESCAPE -MENT	STOCK 1	STOCK 2	STOCK 3	CATCH	RUN	HARVEST RATE	EFFORT	Q (X1000)
5	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
6	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
7	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
8	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
9	0.	0.00	0.00	0.00	0.	0.	0.00	0.	0.000
10	0.	0.00	0.00	0.00	380.	0.	-99.00	14.	-99.000
11	0.	0.00	0.00	0.00	673.	0.	-99.00	28.	-99.000
12	0.	0.00	0.00	0.00	626.	4688.	-99.00	30.	-99.000
13	0.	0.00	0.00	0.00	0.	32813.	0.00	0.	0.000
14	0.	0.00	0.00	0.00	0.	98438.	0.00	0.	0.000
15	4688.	100.00	0.00	0.00	0.	164063.	0.00	0.	0.000
16	32813.	100.00	0.00	0.00	0.	177081.	0.00	0.	0.000
17	98438.	100.00	0.00	0.00	0.	130117.	0.00	0.	0.000
18	164063.	100.00	0.00	0.00	22584.	77458.	7.35	276.	0.267
19	164063.	100.00	0.00	0.00	36322.	143603.	18.34	462.	0.397
20	98438.	100.00	0.00	0.00	48441.	270983.	23.42	562.	0.417
21	48438.	100.00	0.00	0.00	39962.	334108.	10.49	374.	0.281
22	98438.	100.00	0.00	0.00	19452.	251066.	3.37	139.	0.242
23	234375.	100.00	0.00	0.00	14937.	110044.	2.60	107.	0.242
24	314435.	99.38	0.62	0.00	10165.	36689.	2.87	96.	0.297
25	237521.	98.68	1.32	0.00	7438.	24048.	5.18	87.	0.595
26	101352.	92.50	3.34	4.16	4999.	29718.	8.50	76.	1.123
27	31832.	49.09	18.82	32.09	2849.	50439.	5.51	57.	0.971
28	20792.	0.00	41.10	58.90	1198.	37878.	1.53	36.	0.429
29	27652.	0.00	43.19	56.81	207.	82377.	0.24	7.	0.335
30	49552.	0.00	34.54	65.46	707.	42621.	0.59	27.	0.217
31	37566.	0.00	25.09	74.91	662.	63053.	0.53	25.	0.214
32	81457.	0.00	10.46	89.54	0.	69167.	0.00	0.	0.000
33	42394.	0.00	21.07	78.93	5126.	40679.	3.88	1.	38.844
34	60608.	0.00	10.91	89.09	5126.	17088.	4.78	1.	47.926
35	63305.	0.00	5.42	94.58	0.	12132.	0.00	0.	0.000
36	38733.	0.00	5.65	94.35	0.	0.	0.00	0.	0.000
TOTAL	2050951.				221854.	2300346.		2404.	

Catch Explained = 220175. Percent = 99.24
Mean Harvest Rate = 9.57
Effort Explained = 2332. Percent = 97.02
Total Qx1e3 = 0.041

APPENDIX C

This appendix describes the function, input and output files for each of the FORTRAN programs and subroutines required to run the West Coast Vancouver Island Troll Model. Documentation is provided for two sets of programs: 1) the components of the troll model (TROLL PROGRAMS); and 2) those used to produce the input files required to run the troll model (SETUP PROGRAMS). The setup programs are described in the order in which they are run.

SETUP PROGRAM

Program: TROLL7685.FOR

Function: Compile the troll catch and effort statistics that form the basis for the west coast Vancouver Island troll model.

Subroutines: NONE

Input Files:

- CATCH7685.DAT - weekly catch and effort data for freezer and non-freezer troll vessel fishing in Statistical Areas 21-27 for 1976 through 1985; derived from the Salmon Commercial Catch Data System.

- TWCAGE.FIX - adjusted weekly chinook catch at age composition information; derived from biological samples of chinook caught in Statistical Areas 21-27 in the 1981 through 1983 fishing seasons.

- PRICE7685.DAT - contains prices relative to coho for salmon landed in Statistical Area 24 for each year from 1976 through 1985.

Output Files:

- TROLL7685.DAT - a formatted file containing information presented in Appendix A.

- TROLL7685.STT - an unformatted file containing information presented in Appendix A.

SETUP PROGRAM

Program: RECON.FOR

Function: Reconstruct sockeye, pink and chum salmon runs through the west coast Vancouver Island troll fishery for the years 1979 through 1985.

Subroutines: BIN(N,BON) - returns an array (BON) containing the bionomial distribution for the escapement given the length of the run in weeks (N).

Input Files: TROLL7685.STT - unformatted file containing the troll catch and effort data presented in Appendix A.

CMFUD.DAT - parameters used to simulate the run timing for summer chum stocks.

ssssxx.STT - unformatted files containing the weekly escapement from the west coast troll fishery and estimates for the stock composition for species ssss in year xx. The current version of RECON.FOR requires 21 of these files, representing run reconstruction for three species (SOCK, PINK, CHUM) and seven years (79-85). These files were generated by the run reconstruction component of the South Coast Stock Planning Model.

Output Files: RECON.DAT - weekly output containing information presented in Appendix B.

SETUP PROGRAM

Program: BACKCH.FOR

Function: Chinook backward cohort analysis that combines troll catch and effort data with mortality, emigration and immigration rates to produce the weekly catchability coefficients needed for the west coast troll model.

Program prompts user to specify the following:

1) the base year (1976-85);
2) total annual escapement from the fishery; and
3) the proportion migratory (see Table 18).

Subroutines: LEGAL(PLEGAL,CV,SIZELIMIT) - returns an array (PLEGAL) containing the portion of the stock that is above the minimum size limit (SIZELIMIT) given a coefficient of variation (CV) for the mean size in each week.

Input Files: TROLL7685.STT - unformatted file containing the troll catch and effort data presented in Appendix A.

Ouput Files: BACKCHxx.OUT - weekly output from cohort analysis where XX is the base year.

BACKCHxx.STT - unformatted file of parameters and catchability coefficients for the forward cohort analysis component of the west coast troll model.

SETUP PROGRAM

Program: BACKCO.FOR

Function: Coho backward cohort analysis that combines troll catch and effort data with mortality, emigration and immigration rates to produce the weekly catchability coefficients needed for the west coast troll model.

Program prompts user to specify the following:

1) the base year (1976-85);
2) total annual escapement from the fishery; and
3) the proportion migratory (see Table 18).

Subroutines: NONE

Input Files: TROLL7685.STT - unformatted file containing the troll catch and effort data presented in Appendix A.

Output Files: BACKCOxx.OUT - weekly output from cohort analysis where xx is the base year.

BACKCOxx.STT - unformatted file of parameters and catchability coefficients for the forward cohort analysis component of the west coast troll model.

TROLL (Main)

Program: TROLL.FOR

Function: Main routine for West Coast Vancouver Island Troll Management (WCVITM) Model. Calls each subroutine in sequence for each period.

Subroutine:

- EFFORT.FOR - reads management actions and estimates total effort.
- DIRECTOR.FOR - impose management actions and calculate directed effort.
- NET.FOR - Forward Run Reconstruction for sockeye, pink and chum.
- COHO.FOR - Forward Cohort Analysis for coho.
- CHINOOK.FOR - Forward Cohort Analysis for chinook
- OUTPUT.FOR - Print weekly results and summary table.

Link Statement: LINK TROLL,EFFORT,DIRECTOR,NET,COHO,CHINOOK,LEGAL, OUTPUT

Input Files: NONE

Output Files: NONE

Common Block: COMMON.FOR

TROLL (Sub)

Program: EFFORT.FOR

Function: Read management actions and estimate total annual and weekly effort. Prompts for interactive answer to the following question:

'USE BASE OR PREDICTIVE EFFORT (B/P)'

- if the answer is 'B' the model uses the base years weekly effort as compiled in the file TROLL7685.DAT.
- if the answer is 'P' the model uses an equation to estimate total effort and distributes the effort over the fishing season proportional to the base year.
- the effort allocated to each week is displayed on the users terminal.

Input Files: TROLL7685.DAT - weekly troll catch statistics for chinook by age (2-5), coho, sockeye, pink and chum; total effort; percent of total effort directed at each species.

INPUT.DAT - management options and parameters.

Output Files: NONE

Common Block: COMMON.FOR

TROLL (Sub)

Program: DIRECTOR.FOR

Function: Impose management actions and calculate directed effort and shaker effort for each species. Shaker effort is the fishing effort that results in fish being hooked and released.

Input File: NONE

Output File: DIRECT.OUT - displays the initial directed effort, new directed effort after management actions have been imposed and the estimated amount of shaker effort; for each species each week.

Common Block: COMMON.FOR

TROLL (Sub)

Program: CHINOOK.FOR

Function: Forward cohort analysis for chinook. Chinook directed effort from the DIRECTOR subroutine as combined with initial stock size, catchability coefficients and other parameters from the backward cohort analysis, to predict weekly catch by age class.

Subroutines: LEGAL (PLEGAL,CV,SIZELIMIT) - returns an array (PLEGAL) containing the portion of the stock that is above the minimum size limit (SIZELIMIT) given a coefficient of variation (CV) for the mean size in each week.

Input Files: BACKCH<u>82</u>.STT - unformatted file containing all parameter values from the backward cohort analysis for the 1982 chinook base year.

Output Files: CHIN<u>82</u>.OUT - formatted output containing weekly estimates of cohort size, catch, shakers, emigration, immigration and escapement for age 3 chinook.
- also includes a summary of catch, shakers and escapement for each age class; along with total effort and harvest rate.

Common Block: COMMON.FOR

Troll (Sub)

Program: LEGAL.FOR

Function: returns an array (PLEGAL) containing the portion of the chinook stock that is above the minimum size limit (SIZELIMIT) given a coefficient of variation (CV) for the mean size in each week. Note: the size limit must be in millimetres.

Subroutines: XSIZE(A) - interpolates the mean size for each chinook age class each week from monthly mean size at age data.

Input Files: NONE

Output Files: NONE

TROLL (Sub)

Program:	COHO.FOR	
Function:	Forward cohort analysis for coho. Coho directed effort from the DIRECTOR subroutine is combined with initial stock size, catchability coefficients and other parameters from the backward cohort analysis, to predict weekly catch for age 3 coho.	
Subroutines:	NONE	
Input Files:	BACKCO82.STT	- unformatted file containing all parameter values from the backward cohort analysis for the 1982 coho base year.
Output Files:	COHO82.OUT	- formatted output containing weekly estimates of cohort size, catch, shakers, emigration, immigration and escapement for age 3 coho. - also includes a summary of catch, shakers and escapement, along with total effort and harvest rate.
Common Block:	COMMON.FOR	

TROLL (Sub)

Program: NET.FOR

Function: Forward run reconstruction for sockeye, pink and chum stocks. Directed effort from DIRECTOR subroutine is combined with initial run size, stock proportions and catchability coefficients from the backward run reconstruction to predict weekly catch for sockeye, pink and chum (all ages).

Input Files: RECON.DAT - formatted file containing all results from the backward run reconstruction for each species, for the years 1976-85.

Output Files: NET82.OUT

TROLL (Sub)

Program: OUTPUT.FOR

Function: Print weekly catch predictions for each species and seasonal total for catch, escapement, shaker deaths (due to size limit or other non-retention regulations) and total directed effort. Adult equivalent escapement is calculated and printed for chinook.

The program prompts for a response to the following question:

'WRITE OUTPUT FILE FOR SHORT TERM MODEL (Y/N)'

If the answer is 'Y' (yes) the program prompts for a file name (WCCAT82.DAT) to store the weekly catch estimates for sockeye, pink and chum.

Input Files: NONE

Output Files: OUTPUT82.OUT - summary output.

WCCAT82L.DAT - the user specifies the file name, however, the short term model will attempt to open a file with this name for the 1982 cycle - low diversion rate year.

Common Block: COMMON.FOR