

Incidental Salmon Catch Monitoring in Juan de Fuca Strait and Johnstone Strait Net Fisheries, 1997

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NET FISHERIES, 1997**

by

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ABSTRACT

Kelly, J. G. and L. Hop Wo. 1998. Incidental salmon catch monitoring in Juan de Fuca Strait and Johnstone Strait net fisheries, 1997. *Can. Manuscr. Rep. Fish. Aquat. Sci.* 2460: vii + 28 p.

In 1997, the Department of Fisheries and Oceans and the Commercial Fishing Industry agreed to implement an on-grounds monitoring program. The program would estimate incidental catch and associated mortality of non-target species in Juan de Fuca Strait and Johnstone Strait. Fishery managers used this information to minimize by-catch, while allowing a harvest on target species. Estimated incidental catch was compiled in-season and tracked using a yellow line - red line catch ceiling strategy. Additional actions to reduce incidental catch for the 1997 season included mandatory non-retention for the seine fleet, and a proposed sequence of zone closures.

Monitoring data were collected by examining the catch from commercial seine and gillnet vessels. Data included observed number of fish (by species), date and time, and location by individual set. The numbers of commercial (seine plus gillnet) sets monitored in Juan de Fuca Strait and Johnstone Strait were 360 and 748, respectively. The total incidental species encountered during the monitoring program were as follows: for Juan de Fuca Strait (seines and gillnets) -- 1,801 coho, 549 chinook, 54 chinook jacks and 16 steelhead; for Johnstone Strait (seines) -- 453 coho, 185 chinook, 108 chinook jacks and 12 steelhead.

Species encounters were expanded to obtain in-season total estimates of the incidental catch by fishery and area. Post-season analysis of these data included comparison between in-season and post-season catch estimates, and comparison of coho catch among different zones for each fishery. For Juan de Fuca Strait, the difference between in-season and post-season coho catch estimates was 2,572 for seines and 58 for gillnets. For Johnstone Strait, this difference was 11,722 for seines and 1,154 for gillnets. For both areas, the in-season coho catch estimates were higher than the post-season estimates (derived from sales slips).

Review of the monitoring program suggests potential issues in observer coverage, species identification and Industry participation. Recommendations for future programs focus on education of the fishing crews, and a change in their perception regarding conservation of non-target species.

Key words: by-catch, coho salmon, monitoring, Juan de Fuca Strait, Johnstone Strait, commercial fishery.

RÉSUMÉ

Kelly, J. G. and L. Hop Wo. 1998. Incidental salmon catch monitoring in Juan de Fuca Strait and Johnstone Strait net fisheries, 1997. Can. Manuscr. Rep. Fish. Aquat. Sci. 2460: vii + 28 p.

En 1997, le ministère des Pêches et des Océans et l'industrie de la pêche commerciale ont convenu de mettre en oeuvre un programme de surveillance sur les lieux de pêche. Le programme visait à estimer les prises accessoires et la mortalité des espèces non visées dans le détroit de Juan de Fuca et le détroit de Johnstone. Les gestionnaires des pêches se sont servis de l'information recueillie pour réduire au minimum les prises accessoires tout en fixant un volume de capture pour les espèces cibles. Les estimations des prises accessoires ont été compilées au cours de la saison et suivies grâce à une stratégie de double plafond des captures (ligne jaune - ligne rouge). Des mesures complémentaires ont été prises pour réduire les prises accessoires au cours de la saison 1997 : obligation de remise à l'eau pour la flottille de senneurs et série proposée de fermetures de zones.

Pour recueillir les données de surveillance, on a examiné les captures des senneurs et fileyeurs commerciaux. Les données recueillies concernaient le nombre observé de poissons (par espèce), la date, l'heure et le lieu de chaque trait. Dans le détroit de Juan de Fuca et le détroit de Johnstone, les traits commerciaux observés se chiffraient respectivement à 360 et 748. Les nombres totaux de poissons observés dans les prises accessoires pendant le programme de surveillance étaient, par espèce : dans le détroit de Juan de Fuca (sennes et filets maillants) - 1 801 cohos, 549 quinnats, 54 jeunes mâles précoces de quinnat et 16 saumons arc-en-ciel; dans le détroit de Johnstone (sennes) - 453 cohos, 185 quinnats, 108 jeunes mâles précoces de quinnat et 12 saumons arc-en-ciel

À partir des espèces observées, on a calculé le total des prises accessoires par type de pêche et par secteur. Après la saison, on a analysé ces données en comparant les estimations des prises pendant et après la saison, et en comparant les prises de coho dans les diverses zones pour chaque type de pêche. Dans le détroit de Juan de Fuca, la différence entre les estimations des prises de coho pendant et après la saison était de 2 572 pour les sennes et de 58 pour les filets maillants. Dans le détroit de Johnstone, cette différence était de 11 722 pour les sennes et de 1 154 pour les filets maillants. Dans les deux secteurs, les estimations des prises de coho pendant la saison étaient supérieures aux estimations faites après la saison (d'après les bordereaux de vente).

L'examen du programme de surveillance fait ressortir la possibilité de problèmes liés à la couverture par les observateurs, à l'identification des espèces et à la participation de l'industrie. Pour la suite du programme, il est recommandé de veiller à mieux former les équipages et à les sensibiliser à la conservation des espèces non visées.

Mots clés : prises accessoires, coho, surveillance, détroit de Juan de Fuca, détroit de Johnstone, pêche commerciale.

1.0 INTRODUCTION

Commercial salmon fisheries are not completely effective in selecting between different species as salmon may exhibit similar characteristics, such as migration routes and timing. Consequently, fishing vessels which target on a particular species, also capture non-target salmon species, such as coho, chinook and steelhead. A significant Total Allowable Catch (TAC) of sockeye was anticipated for seines and gillnets for the 1997 season based on a pre-season run-size forecast of 18.2 million Fraser sockeye. This high TAC was expected to result in significant incidental catches of non-target species. Since low returns of southern B.C. coho stocks were again expected for 1997, the conservation of wild coho stocks was a management priority of the Department of Fisheries and Oceans (DFO) for the 1997 commercial fishing season.

In 1997, DFO adopted a policy of reducing the overall exploitation rate of coho in South Coast waters to between 20% and 25%. This represents a substantial reduction from the 55% to 70% exploitation rate applied in 1995 and 1996. The revised rate was projected to result in a reduction from approximately 1.0 million total coho catch in 1996 to approximately 300,000 total coho mortality for all South Coast fisheries in 1997. To meet this reduced exploitation rate, the commercial net fisheries were managed not to exceed a ceiling of 87,000 to 108,000 coho mortalities. For the Johnstone Strait gillnet and seine fisheries, the total allowable mortality was set between 20,000 to 30,000 coho, and for the Juan de Fuca gillnets and seines it was set between 65,000 to 75,000 coho. These ceilings represented a reduction to all commercial gear sectors, as well as the recreational fishery. The forecast of low diversion of sockeye (31%) through Juan de Fuca Strait would also limit fishing opportunities in this area.

The Department of Fisheries and Oceans employed a number of different strategies to reduce and monitor coho mortalities for the 1997 season. The seine fleet was subject to mandatory non-retention of coho, chinook and steelhead. Trained personnel (monitors) observed and collected incidental catch information from the seine and gillnet fisheries. Additional management actions included implementation of fishing boundaries, use of resuscitation boxes, a post-release mortality study, and limited fishery openings. This report focuses on the incidental catch monitoring program conducted in the Juan de Fuca Strait seine and gillnet, and Johnstone Strait seine commercial fisheries. For the Johnstone Strait gillnet fisheries, a separate study on mesh size comparison, included the incidental catch component.

1.1 Goals

In keeping with coho conservation priorities, the DFO and the commercial fishing industry agreed to implement an on-grounds monitoring program for the 1997 fishing season. The goal was to estimate catch, release and survival of non-target salmon species (coho, chinook, chinook jacks, steelhead) from commercial seine and gillnet fisheries in Juan de Fuca Strait (Area 20) and Johnstone Strait (Areas 12 and 13) (Figure 1).

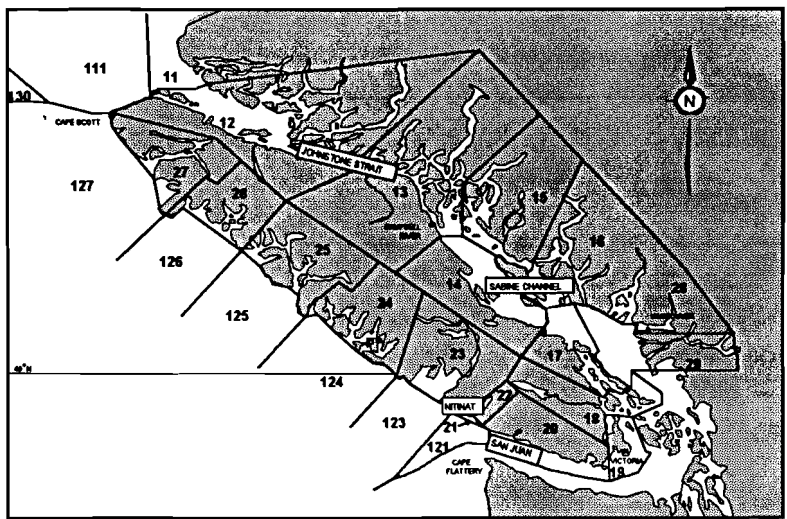


Figure 1. Fisheries and Oceans Canada Statistical Areas.

The program would yield in-season estimates of incidental catch and associated mortality. Managers could then utilize this information to track and minimize incidental catch, while maintaining a harvest on target species (sockeye and pink salmon). The catch levels were part of a "yellow line - red line" strategy discussed in section 3.3. In keeping with the DFO policy to reduce the overall coho harvest in southern B.C., particular

attention was focused on coho encounters and release information. Monitoring was to take place primarily in Statistical Areas 12, 13 and 20, but was also conducted in Sabine Channel (Area 16) and Nitinat (Area 21) (Figure 1).

2.0 PROGRAM BACKGROUND

The structure of the 1997 program differed from similar projects conducted in the past. Previously, zodiacs randomly delivered monitors to vessels throughout the fishery, and the monitors remained on board the vessel while the fish were brought in. In the current program, monitors generally remained on board the same vessel for the entire fishery opening. The DFO project coordinator or fishery manager contacted the skipper of the vessel before the opening to obtain permission for the monitor to board, and arrange transportation details. There were two reasons for changing the structure of the monitoring process in 1997. First, the placement of a monitor on board for the entirety of each opening would reduce the costs associated with operating a high-speed inflatable with a driver. Secondly, fisheries managers hoped that the planning process involved in monitor placement would encourage cooperation between the DFO and Industry in addressing by-catch issues.

2.1 Fishing History

Juan de Fuca Strait

Major commercial fishing in Juan de Fuca Strait has been conducted since the mid-1930s (Roos 1991) with the primary target being sockeye and pink salmon returning to the Fraser River. The Juan de Fuca Strait fishery is almost exclusively an interception fishery targeting non-local stocks.

The International Pacific Salmon Fisheries Commission (IPSFC) has managed the Juan de Fuca Strait commercial fishery from 1946 to 1985. In 1985, Canada and the United States signed the Pacific Salmon Treaty. Under the provisions of the Treaty, Juan de Fuca Strait became the responsibility of the Fraser River Panel (FRP) of the Pacific Salmon Commission (PSC). The PSC is a governing body which represents both Canada and the U.S. in fisheries management issues. The FRP generally manages the Panel waters from June to October, while Canada's Department of Fisheries and Oceans manages the area for the remainder of the year. For the 1997 season, a Canada/U.S. agreement was not reached and, consequently, Canada alone managed the Juan de Fuca Strait commercial fishery.

Johnstone Strait

The Johnstone Strait commercial fishery currently represents the largest interception fishery in British Columbia (Stefanson et al. 1993). However, this was a minor fishery during the 1910s to 1930s (Roos 1991) due to reduced sockeye runs to the Fraser River and hence low sockeye migrations through Johnstone Strait. This is likely the reason why the waters of Johnstone Strait have been excluded from the 1930 Convention of the IPSFC (Roos 1991).

Although fishing intensity in Johnstone Strait has increased from 1946 through 1955, Fraser salmon stocks were not greatly affected. However in 1958, over 4,000,000 Fraser sockeye were taken at the northern end of the Strait of Georgia before the fish reached Convention waters (Roos 1991). In addition, since 1978, a larger than average segment of the Fraser sockeye population has migrated through Johnstone Strait (Stefanson et al. 1989), with an 80% diversion reported in 1983 (Roos 1991). The increasing diversion rates and the large troll catches taken in non-convention waters off the west coast of Vancouver Island, were the key factors in terminating the IPSFC and establishing the Pacific Salmon Treaty in 1985 (Roos 1991). The new Treaty required that Canada and the U.S. must each account for their catch of the Fraser River sockeye (Stefanson et al. 1989). For the 1997 season, Canada managed the Johnstone Strait commercial fishery in the absence of a Canada/U.S. agreement.

2.2 Catches and Fishing Effort in Juan de Fuca Strait and Johnstone Strait

In the last two decades (1977-1997), the majority of catch of the target species (sockeye and pink) has occurred in Johnstone Strait, with Juan de Fuca Strait averaging only about a third of the total catch (Table 1). This difference is attributed to the characteristics of the fishing areas, and to increasing diversion of target species, particularly sockeye, towards the Johnstone Strait route. Also, nearly all the target fisheries for chum salmon have occurred in Johnstone Strait as the majority of chum return along this route. By contrast, the abundance of incidental species, particularly coho, is far greater in Juan de Fuca Strait than Johnstone Strait, resulting in the high historical catch of non-target species in Juan de Fuca waters (Table 1).

Table 1. Average annual commercial salmon catch by species in Juan de Fuca Strait and Johnstone Strait seine and gillnet fisheries, 1977 – 1997.

SPECIES	JUAN DE FUCA STRAIT				JOHNSTONE STRAIT			
	SEINES		GILLNETS		SEINES		GILLNETS	
	Number	%	Number	%	Number	%	Number	%
Sockeye	783,024	51.0	191,984	75.0	1,843,761	40.8	464,426	62.9
Pink	611,925	39.9	20,569	8.0	2,074,115	45.9	112,449	15.2
Coho	118,035	7.7	33,533	13.1	82,257	1.8	32,065	4.3
Chum	5,871	0.4	5,528	2.2	497,756	11.0	123,292	16.7
Chinook Adult	5,569	0.4	2,860	1.1	9,655	0.2	4,456	0.6
Chinook Jack	10,835	0.7	1,370	0.5	7,145	0.2	751	0.1
Steelhead	223	0	140	0.1	152	0	482	0.1

During 1977 to1997, fishing effort in Johnstone Strait has been significantly greater than in Juan de Fuca Strait (Table 2). The average daily gear counts for Johnstone Strait seines and gillnets were 184 and 141, respectively, compared to 58 and 40 for Juan de Fuca Strait. In addition, Johnstone Strait had more fishery openings, with a mean annual total of 17 seine days and 21 gillnet days, compared to 10 seine and 11 gillnet days for Juan de Fuca Strait (Table 2).

Juan de Fuca Strait

The average annual commercial catch of all salmon species in Juan de Fuca Strait for the period 1977 to 1997 was approximately 1.8 million, with seines taking about 1.5 million and gillnets the remainder (Table 1). Sockeye and pink salmon were the primary species targeted, constituting approximately 90% of the total annual net catch (Table 1). Occasionally in the past (e.g., 1987), fisheries have targeted on coho salmon. This species constituted approximately 152,000 pieces or 9% of the overall Juan de Fuca Strait average salmon catch per year for the 1977 - 1997 period. Historical catch data presented here are derived from recorded catch landings which are part of the sales slip information system.

Johnstone Strait

The average annual catch of all salmon species taken in Johnstone Strait during 1977 to 1997 was approximately 5.2 million, with seine catch approximately 4.5 million and gillnet catch approximately 738,000 (Table 1). As in Juan de Fuca Strait, sockeye and pink salmon were the primary target species, constituting about 87 % of the total annual net catch. Coho, as a target and/or incidental species, constituted approximately 114,000 pieces or 2 % of the total average salmon net catch per year for the 1977 - 1997 period. As for Juan de Fuca Strait, the historical catch data for Johnstone Strait are derived from recorded catch landings which are part of the sales slip information system.

Table 2. Average daily annual gear count and total days open in Juan de Fuca Strait and Johnstone Strait seine and gillnet fisheries, 1977 - 1997¹.

YEAR	JUAN DE FUCA STRAIT				JOHNSTONE STRAIT			
	Average Daily Gear Count		Total Days Open		Average Daily Gear Count		Total Days Open	
	Seine	Gillnet	Seine	Gillnet	Seine	Gillnet	Seine	Gillnet
1977	61	50	21	21	58	61	39	35
1978	40	72	10	10	109	111	41	39
1979	75	36	12	12	61	68	27	24
1980	23	63	18	18	152	180	23	22
1981	37	31	16	16	92	64	29	28
1982	68	72	8	8	155	132	25	28
1983	15	1	3	3	162	74	20	26
1984	35	24	12	12	102	90	14	16
1985	65	42	16	16	115	111	21	23
1986	80	90	8	8	169	153	14	19
1987	80	63	7	7	166	167	8	13
1988	58	59	7	7	166	246	10	11
1989	54	37	20	26	160	119	18	30
1990	74	40	7	10	206	169	12	21
1991	69	80	6	14	207	117	9	24
1992	11	11	19	21	342	208	6	15
1993	89	36	2	7	288	149	9	21
1994	24	21	12	19	456	161	6	21
1995	91	0	4	0	280	353	7	8
1996	46	0	2	0	159	111	2	5
1997	122	14	4	4	269	117	10	16
AVG. 77 - 97	58	40	10	11	184	141	17	21

2.3 Management Actions

Since the late 1970s, the DFO has implemented management strategies to reduce by-catch of incidental species in both Juan de Fuca Strait and Johnstone Strait. These actions included gear restrictions (e.g., in 1981, 100 mm mesh size for seines in Juan de Fuca Strait), implementation of voluntary beach / ribbon type boundaries, use of revival boxes, mandatory/voluntary catch releases, catch ceilings, area closures and limited fishery openings. Catch monitoring is a relatively new strategy

¹ Gear counts represent the average number of vessels fishing per day. Fishing days are organized by statistical week for all openings for the year. A statistical week is a calendar week of 7 days beginning on Sunday. Numbers representing average days open for Johnstone Strait seines were calculated by dividing the annual total days open for Areas 12 and 13 by 2. In the case of gillnet gear, the total days open for the year were divided by 3 since gillnet vessels fish Areas 11, 12 and 13. Averages were not calculated for Juan de Fuca Strait since days open apply to one area only.

The definition of an open fishing day in Table 2 differs according to the area where the fishery occurred. In Johnstone Strait, a day is any amount of time greater than 17 hours, during openings that occur between statistical week 7/5 to 9/2. For openings that occur after statistical week 9/2 until the end of the fishery, a day is calculated as follows: 12 hours = 0.9 days, 10 hours = 0.8 days, and 6 hours = 0.7 days. In Juan de Fuca Strait, a day is 12 hours. The difference in the definitions of a fishing day was based on the length of time a vessel will typically fish in a given area, as determined by review of the data for the past 20 years.

developed in response to by-catch conservation concerns. The DFO has conducted incidental catch monitoring programs at sea since 1986 (Nagtegaal et al. 1988), with the most recent programs conducted in Juan de Fuca Strait during 1994 and 1995 (Hop Wo et al. 1997).

The DFO has adopted additional management approaches due to ongoing concerns regarding the depletion of coho, chinook and steelhead stocks. In 1994, fishing restrictions specified voluntary non-retention of coho, chinook and steelhead. In 1995-1996, restrictions were escalated to mandatory non-retention of steelhead and chinook, with voluntary release of coho. In 1997, coho were included in the mandatory non-retention/non-possession policy for all commercial seine fisheries; gillnet fisheries were encouraged to release by-catch that were in good condition.

The 1997 season represented a modified combination of past management actions. These actions consisted of the yellow line-red line strategy, mandatory non-retention of non-target species (seine), the option to brail sets, the use of resuscitation boxes, sub-area closures, reduction in fishing time, post-release mortality experiments and by-catch monitoring. Due to the low incidental catch of coho in 1997, no actions were taken regarding mandatory brailing or fishery closures.

3.0 MONITORING PROGRAM, 1997

The incidental catch monitoring program provided additional information required to adjust boundaries during the fishery, based on the observed incidental catch by area. In 1997, many operators of the commercial seine and gillnet vessels agreed to accept a monitor on board for the duration of the opening. The duties of the monitors were to record information on incidental catch, and assist in placing coho, chinook, and steelhead in resuscitation boxes for later release.

3.1 Mortality Estimation

Mortality of salmon released from seines and gillnets is poorly understood. Net handling, fish condition, weather, and geographic location are just a few of the factors which can contribute to the survival of released fish. Previous estimations of mortality were generally equated to landed catch numbers, since non-retention was not a requirement. With the introduction of mandatory non-retention, the mortality rates for released fish could not be estimated by conventional means (i.e., landing slips). Accordingly, the DFO applied pre-set mortality rates to the estimated number of fish released. The mortality rates for seine and gillnet catches were set as follows:

Seines

Estimated mortality rates were set according to the conditions of capture associated with a given fishery. Previous studies involving the North Coast commercial selective seine fishery have suggested a 6.3% mortality rate for coho captured and released (Thomas 1996). A pre-season mortality rate of 50% was assigned to other areas in

the North Coast where no special fishing procedures were required. Post-season analysis suggests an approximate rate of 30% overall mortality (combined retained catch and release mortality) (S. Cox-Rogers, pers. comm.).

The fishing conditions anticipated for the Juan de Fuca Strait and Johnstone Strait net fisheries could result in totally different mortality rates. Expected conditions in southern commercial seine fisheries were as follows:

- large catches during the peak of the season,
- increased set size in Juan de Fuca Strait due to non-salmon volume (mackerel),
- substantial scale loss in captured coho,
- rough sea conditions, hindering release procedures and causing reduced fish survival.

In considering these conditions, a mortality rate of 20% to 50% was utilized, depending on weather conditions and size of sets. If catch per set was high and the weather conditions poor, a higher mortality rate was assigned. Conversely, if catches were smaller and weather conditions calm, a lower mortality rate was used. Smaller catches and good weather conditions would facilitate effective fish sorting and release, thereby reducing the overall mortality.

Gillnets

Generally, if all coho captured in gillnet fisheries were to be released, the mortality rate would average 70% (Pacific Salmon Commission 1995). However, this rate can vary greatly depending on such factors as time between capture and release, size and tension of meshes, and stress level of captured fish. In the past, gillnet non-retention was voluntary (since salmon captured incidentally frequently died) and gillnet fishermen were asked to release non-target species if they appeared likely to survive. Anecdotal information suggests that fishermen released up to 50% of their incidental catch. Based on this information, and the mortality rate of 70% utilized by the Pacific Salmon Commission, a 35% mortality rate was arbitrarily assigned to released gillnetted fish. This mortality does not include the fish retained (i.e., landed catch) which are assigned a 100% mortality.

3.2 Resuscitation Experiment

The goals of the resuscitation experiment were to study the short-term mortality rates of coho captured in a commercial fishery, and provide additional data regarding in-season incidental catch and release estimates. This experiment represented a moderate expansion of the monitors' primary duties and involved no further interference with fishing operations. Monitors selected all coho captured from a single set and placed them in a revival box filled with seawater. Revival boxes are live tank containers of various dimensions, kept on board some vessels to revive the incidental catch prior to release. Upon boarding their assigned vessel, monitors measured the dimensions of the boxes and, if a deck hose was available, used it to aerate the water in the box. Monitors also measured the hose flow in gallons per

minute by recording the time required to fill a bucket of known capacity. The recorded information assisted in determining the fish loading capacities for the boxes. Guidelines for loading were as follows:

Flow US gal/min	Water Temperature (Celsius)			
	12- 13	14 -15	16-17	18-19
25	238	200	175	150
20	190	160	140	120
15	143	120	105	90
10	95	80	70	60
5	48	40	35	30

The numbers in the body of the table represent Fish Loading (pounds) for a particular flow and temperature regime. These loading densities were calculated based on general guidelines provided by Kreiberg (1997).

Monitors placed the fish in the box, then recorded set number, location of set, resuscitation start time, number of coho in the box, time of release and fish condition upon release. Monitors were instructed to hold coho in the boxes for as long as possible. A minimum of 2 hours holding time was suggested. This was based on previous studies which indicated that mortality was highest within 2 to 4 hours after capture (Thomas 1996, Parker and Black 1959). The maximum holding time was not specified and was subject to the crews' need to use the deck hose, the holding box dimensions, and the number of coho placed in the boxes.

3.3 Mortality Ceiling Strategy “Yellow Line – Red Line”

Each major fishery was assigned a maximum coho mortality ceiling which was not to be exceeded. The strategy to manage commercial net fisheries followed the “ yellow line - red line “ approach previously described by Hop Wo et al. (1997). Briefly, the strategy consists of a series of actions aimed at reducing the incidental catch, yet allowing continued catch of target species. This generally involves monitoring the cumulative catch during the fishery and comparing this to an established range of cumulative projected catches. For example:

- If the projected catch is below the projected lower range catch, no regulatory action is required.
- If the projected catch exceeds the projected lower range (yellow line), some conservation action is required to reduce the actual catch to below the lower range.
- If the projected catch continues to increase above the lower catch range towards the projected upper catch range (red line), additional regulatory actions are required.

The 1997 commercial net fisheries were managed not to exceed a ceiling of 87,000 to 108,000 coho mortalities. The total allowable coho net mortality in Juan de Fuca Strait was between 62,000 and 70,000 for seines, and between 3,000 to 5,000 for gillnets. For the Johnstone Strait net fisheries, the total allowable mortality was between 20,000 and 30,000 coho; the seine and gillnet fleet were each allowed a pre-season mortality of 10,000, while the remaining 10,000 pieces allowable mortality would be apportioned according to in-season coho mortality estimates.

Several other management actions were used to reduce coho by-catch and mortality in the Johnstone Strait and Juan de Fuca Strait fisheries. Gillnet fisheries in both areas were subject to voluntary non-retention of incidental species, and voluntary non-fishing during dark hours in Juan de Fuca Strait. The DFO and Area D² (Statistical Areas 11 to 15 and 23 to 27) gillnet fishermen conducted an experiment to determine whether a selectivity difference exists between 60 and 90 mesh nets with regard to certain salmon species. Coho encounters by area were tracked by onboard monitors and vessel log books, and fishing areas adjusted if encounters were high. In addition, an environmental consulting firm (J.O. Thomas and Associates) monitored landed coho numbers. This program provided a means of comparing observed coho encounters to coho actually landed. All of the above information was used during the season to estimate total catch mortality of coho.

3.4 Advisory Process - Industry, pre / in / post-season

The commercial advisory process is instrumental in developing fishing plans and programs. Throughout the year, numerous meetings are conducted with fishermen. Prior to the season, fishermen from each commercial sector (troll, gillnet, seine) are consulted. The discussions cover a number of issues, such as salmon abundance forecasts, conservation concerns, review of past fishing activities, and updates on international, aboriginal and recreational issues.

Pre-season meetings for the 1997 monitoring program were held with both seine and gillnet groups. Topics included discussion on the need for the program, logistics of the operation, and soliciting ideas and assistance to help achieve the program goals. Meetings concerning by-catch focused on commercial fishing in Juan de Fuca Strait due to the historically high coho encounters in this area (Table 1). Post-season, the information was briefly summarized and presented at subsequent fishery reviews.

3.5 Monitoring and Catch Estimation - Juan de Fuca Strait and Johnstone Strait

Monitors reported data while the fishery was ongoing. Managers could then respond immediately if coho by-catch reached a "yellow line level". If the rate of catch continued and reached a "red line level", then further actions would be implemented. Placement of monitors on board fishing vessels was essential to provide continued monitoring in order to determine the appropriate actions for reducing incidental catch.

Monitors on board the vessel recorded information from each set landed. The data were recorded on forms which contained the following fields: date, vessel, sampler, resuscitation box size, water flow, set number, location, time of set, depth of set (Juan

² Area D is a gillnet license area that includes Statistical Areas 11 to 15 and 23 to 27 (Figure 1). Generally speaking, these Statistical Areas are referred to as Johnstone Strait and West Coast of Vancouver Island, respectively. The gillnet mesh study was conducted in Johnstone Strait.

de Fuca Strait only), ramp or brail³, number of commercial species caught (sockeye, pink, chum), number of incidental species caught and released (coho, steelhead, chinook, chinook jack), time of start/release of coho in resuscitation boxes, and number of coho mortalities in resuscitation boxes.

Catch per Set

Catch information was generally relayed by phone during the fishery. At the end of each opening, data sheets were delivered to the program coordinator for review and electronic entry. Catch rates (average number of fish caught per set by species) were then calculated and discussed among fishery managers to assess the fishing plan. Estimates of total catch of non-target species for that day were based on the remaining projected fishing time and the number of vessels operating in the area. In addition, catch rates by zone were assessed to determine if there was a geographical difference in the catch rate within the existing boundary lines.

Monitors kept track of all salmon species by standing next to the seine drum and recording all fish as they were brought onto the vessel (it was difficult to observe all species when large catches were made). In the case of chinook, monitors also recorded whether the fish were adult or jack. Adult chinook were those fish greater than about 5 pounds (2.27 kg), while all smaller chinook were considered jack. Monitors also recorded whether chinook, coho and steelhead were landed or released.

Number of Sets per Vessel Day

Monitors were usually transported to their assigned vessel on the evening before the fishery opened. Consequently, they were present to record all sets made prior to their return to port. In Johnstone Strait, monitors frequently left prior to fishery closure to allow for return to port before nightfall. To estimate the number of sets made after monitors had left the vessel, sets were extrapolated to the end of the fishery, based on the number of previously recorded sets with monitors on board (expansion method).

Number of Vessels Fishing

Gear counts were made each day of the fishery. In Juan de Fuca Strait, the number of vessels fishing were based on boat radar counts by Coast Guard patrol and visual estimates. In Johnstone Strait, overflights were used to count the vessels.

³ Most seine vessels are equipped with a stern ramp that is hinged, and therefore can be raised or lowered. When fish in the net are brought to the stern of the vessel, the ramp is sometimes raised to lift the last portion the net out of the water. This practice is referred to as 'ramping' the catch.

A brailer is a large dip net that is lowered and raised with the aid of power from the ship. If the catch is to be brailed, the crew guides the brailer into the larger seine net, and brails (dips) fish out of the net. Brailing the catch on board is an alternative to ramping the entire catch on board.

Location of Sets

In Juan de Fuca Strait, a monitor on board the fishing vessel recorded the latitude and longitude of set locations using either electronic plotters or Loran C bearings. Vessel position was also taken directly from nautical charts.

In Johnstone Strait, set locations were recorded by reference to the actual geographic location of where the set was made. Unlike Juan de Fuca Strait, Johnstone Strait is not an open ocean fishery. It is therefore possible to specify a set site by reference to a charted or well known location.

3.6 Other Areas - Sabine, Nitinat

In addition to Johnstone Strait and Juan de Fuca Strait, harvesting of Fraser River sockeye stocks also took place in Sabine Channel (Area 16). Again, fishing vessels were made available for monitoring on a voluntary basis. Monitoring was limited in this area as coho by-catch was expected to be low.

The Nitinat (Area 21) chum fishery was monitored in order to provide consistent tracking of incidental catches in all fisheries. Coho encounters were expected to be low since the chum fishery occurred near the end of October when coho migration through Area 21 was virtually complete.

4.0 RESULTS OF THE MONITORING PROGRAM

4.1 Coverage of Fishery Openings

The 1997 monitoring program was conducted from July 29 to October 21, and produced a total of 1,253 observations (Tables 3 and 4), involving 34 different

Table 3. Summary of monitoring coverage for commercial seine fisheries, 1997.

SEINE FISHERIES				
AREA	TOTAL SETS MONITORED	MONITORING DAYS	WEEKS FISHED	EST. COVERAGE
Juan de Fuca Strait	313	47	3	10%
Johnstone Strait	748	71	9	3%
Sabine Channel	48	3	3	1%
Nitinat	86	6	3	1%
TOTAL	1,195	127	-	-

Table 4. Summary of monitoring coverage for commercial gillnet fisheries, 1997.

GILLNET FISHERIES				
AREA	TOTAL SETS MONITORED	MONITORING DAYS	WEEKS FISHED	EST. COVERAGE
Juan de Fuca Strait	47	16	3	10%
Sabine Channel	11	3	3	1%
TOTAL	58	19	-	-

vessels. Table 5 lists by area, the 1997 fishery openings that were monitored during the course of the program.

Table 5. Fishery openings monitored in 1997 (not including Area D mesh study).

FISHERY	OPENINGS
JUAN DE FUCA STRAIT SEINE	1. August 14 and 15 (2 x 12 hrs, 0600 to 1800) 2. August 22 and 23 (2 x 12 hrs, 0700 to 1900) 3. August 25 and 26 (2 x 12 hrs, 0700 to 1900) 4. August 28 and 29 (2 x 12 hrs, 0700 to 1900)
JOHNSTONE STRAIT SEINE	5. July 29 (12 hrs, 0600 to 1800) 6. August 4 (12 hrs, 0600 to 1800, ext. 3 hrs) 7. August 11 (12 hrs, 0600 to 1800, ext. 3 hrs) 8. August 19 (12 hrs, 0700 to 1900) 9. August 25 (12 hrs, 0700 to 1900, ext. 2 hrs) 10. August 31 (13 hrs, 0700 to 2000, ext. 24 hrs) 11. September 8 (13 hrs, 0700 to 2000) 12. September 14 and 15 (2 x 12 hrs, 0700 to 1900) 13. September 22 and 23 (24 hrs, 1600 to 1600)
JUAN DE FUCA STRAIT GILLNET	14. August 11 to 13 (38 hrs, 0600 to 0800) 15. August 20 to 22 (37 hrs, 0600 to 0700)
SABINE CHANNEL SEINE	16. August 31 (13 hrs, 0700 to 2000, ext. 24 hrs) 17. September 8 (13 hrs, 0700 to 2000)
SABINE CHANNEL GILLNET	18. August 18 to 19 (24 hrs, 0800 to 0800)
NITINAT SEINE	19. October 20 (10 hrs, 0800 to 1800) 20. October 21 (10 hrs, 0800 to 1800)

All seine openings in Juan de Fuca Strait and Johnstone Strait were fully monitored, as were all gillnet openings in Juan de Fuca Strait. Johnstone Strait gillnet openings were not monitored in this program as these were involved in a separate mesh comparison study that included an incidental catch component.

The Sabine Channel (Area 16) fishery was subject to 3 monitoring days (one monitor on board a vessel for 3 separate openings). The Nitinat (Area 21) fishery was subject to 6 monitoring days (three monitors employed for 2 fishing days).

The Juan de Fuca seine fleet received the maximum monitor coverage at 10% (Table 3). The Johnstone Strait coverage was lower at 3% because more vessels were fishing in more openings, while the number of available monitors remained constant. Johnstone Strait also received lower coverage when a concurrent seine opening occurred in Juan de Fuca Strait on August 25th (monitors stationed in Juan de Fuca Strait for the August 23rd opening remained there to work on the 25th).

Gillnet fisheries were subjected to fewer monitoring days than the seine fisheries (19 versus 127 days, Tables 3 and 4). Gillnet monitoring was minimal because of the low number of vessels expected to be operating in this fishery. The Area 16 gillnet fishery was subject to minimal coverage since in-season estimates for coho encounters in this area were very low.

4.2 1997 Juan de Fuca Strait Monitoring Data

Incidental Catch Encounters

Monitoring of the Juan de Fuca Strait commercial seine fishery was conducted from August 14 to August 29, 1997. Monitors collected information from 313 sets

(Table 6). Incidental catches in these sets included 1,784 coho (for an average of 6 coho per set), 587 chinook (adults and jacks), and 12 steelhead (Table 6). Monitors and crew released all of the incidental catches.

Table 6. Summary of incidental and target catch monitoring, Juan de Fuca Strait seine fisheries, 1997.

JUAN DE FUCA STRAIT SEINES								
WEEK	# SETS	FISH ENCOUNTERED / RELEASED				FISH RETAINED		
		Coho	Chinook A	Chinook J	Stlhd	Sockeye	Pink	Chum
8/2	48	199	185	16	2	1,483	1,618	5
8/3	104	409	162	12	5	15,489	10,406	26
8/4	161	1,176	189	23	5	10,349	12,957	21
TOTAL	313	1,784	536	51	12	27,321	24,981	52

Data for the Juan de Fuca Strait gillnet fishery are provided in Table 7. The gillnet fisheries encountered few non-target species and released 84% of the coho which were encountered. However, due to minimal gillnet monitoring, these results may not be representative of the overall fishery.

Table 7. Summary of incidental and target catch monitoring, Juan de Fuca Strait gillnet fisheries, 1997.

JUAN DE FUCA STRAIT GILLNETS												
WEEK	# SETS	Coho		Chinook A		Chinook J		Steelhead		Sockeye	Pink	Chum
		Rel.*	Retain	Rel.	Retain	Rel.	Retain	Rel.	Retain	Retain	Retain	Retain
8/2	29	11	2	5	3	2	0	3	1	882	33	12
8/3	18	4	0	5	0	1	0	0	0	126	13	0
TOTAL	47	15	2	10	3	3	0	3	1	1,008	46	12

* Rel. - Release

The recorded locations of seine sets (commercial and test fisheries) in Juan de Fuca Strait were grouped by zone (Table 8). The process of dividing Juan de Fuca Strait into smaller zones allowed for a more detailed analysis of catch per set. Table 8 lists the average weekly coho catch per set by zone. The weekly average was calculated by dividing the total number of coho captured that week by the total number of sets monitored that week. The highest average weekly catch was observed for week 8/4 when the seine fleet averaged 7.1 coho per set (Table 8). For the fishing season, Zone B (Blue Line to West Point, inside 180 meters) showed the highest monitored fishing effort (303 seine sets) and the highest seasonal coho catch per set (5.7 fish).

Table 8. Average weekly coho catch per seine set by zone in Juan de Fuca Strait, 1997.

JUAN DE FUCA STRAIT SEINES														
WEEK	ZONE A		ZONE B		ZONE C		ZONE D		ZONE E		UNK		Avg. Coho/ Set	Total Sets*
	Coho / Set	# Sets	Coho / Set	# Sets	Coho / Set	# Sets	Coho / Set	# Sets	Coho / Set	# Sets	Coho / Set	# Sets		
8/2	—	—	4.3	46	2.5	2	6.0	2	2.7	3	3.1	7	4.1	60
8/3	—	—	3.9	109	3.5	2	—	—	—	—	3.0	1	3.8	112
8/4	4.0	1	7.5	148	4.7	16	1.0	4	—	—	9.0	6	7.1	175
Avg. Coho / Set	4.0		5.7		4.4		2.7		2.7		5.6		5.6	
Total Sets		1		303		20		6		3		14		347*

LEGEND:

ZONE A - Southwest corner of Blue Line.

ZONE B - Blue Line to West Point, inside 180 meters.

ZONE C - Blue Line to West Point, outside 180 meters (Corner not incl.).

ZONE D - Owen (West) Point south to Sombrio.

ZONE E - Sombrio south to Sherringham.

UNK - Fishing location was not clearly indicated by the data.

Coho per set = Total Coho/Number of Sets.

* Note : Results include information from both commercial and test fishing. Test fishing was conducted prior to commercial openings

Table 9 shows the average seasonal catch per set by zone for each salmon species (zone definitions as in Table 8). Zone B which had the highest seasonal catch per set of coho (5.7 fish), also showed the highest average catch per set of target species (sockeye and pink); exceptions were Zone A where only one set was monitored, and the unknown area where a high average catch of pinks per set was reported. Note that in Zone B, the average catch of other non-target species (chinook, chinook jacks, steelhead) ranged from 0.0 to 1.5 fish, well below the mean coho catch per set in that zone (Table 8).

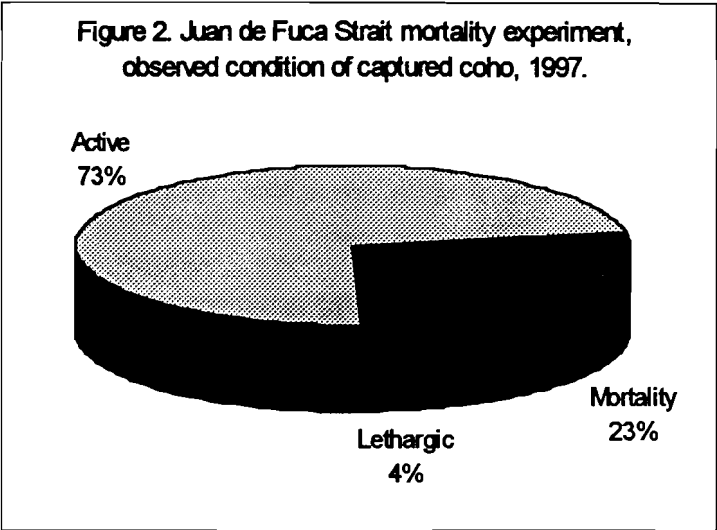
Table 9. Average salmon catch per seine set by zone for Juan de Fuca Strait 1997 fishing season (zone definitions as in Table 8).

JUAN DE DUCA STRAIT SEINES							
ALL WEEKS FISH / SET	ZONE A	ZONE B	ZONE C	ZONE D	ZONE E	UNK	ALL ZONES
Sockeye	240.0	93.5	30.5	12.0	90.7	62.9	87.6
Pink	160.0	83.5	45.1	9.8	41.3	89.1	80.1
Chum		0.2	0.1			0.1	0.2
Coho	4.0	5.7	4.4	2.7	2.7	5.6	5.6
Chinook A	4.0	1.5	1.3	0.5	23.7	1.3	1.7
Chinook J	1.0	0.2	0.1	0.2	0.0		0.2
Steelhead		0.0					0.0
TOTAL SETS	1	303	20	6	3	14	347

Mortality Experiment

The onboard mortality experiment provided data for determining the mortality rate applied to coho caught and released in the Juan de Fuca Strait seine fishery.

Monitors observed 374 coho in holding boxes. Of the observed fish, 86 died before release, giving a mortality rate of 23%; an additional 4% of the observed coho were subjectively assessed as lethargic or sluggish at release; and 73% were assessed as active at release (Figure 2). The 23% mortality was achieved under conditions of small sets (average of 195 salmon of all species per set) and generally calm sea conditions. Coho remained in the holding box for intervals ranging from a few minutes to 8:18 hrs, for an average interval of 1:14 hrs.



4.3 1997 Johnstone Strait Monitoring Data

Incidental Catch Encounters

Monitoring of the Johnstone Strait seine fishery was conducted from July 29 to September 23, 1997. A total of 748 seine sets were monitored (Table 10). Monitors encountered a total of 453 coho (for an average of 0.6 coho per set), 293 chinook (adults and jacks) and 12 steelhead (Table 10). Monitors released all non-target species; however, a small number were inadvertently retained when they slipped into the hold in the course of ramping a large set. Coho encounters in the Area D gillnet mesh study are discussed in a separate paper.

Table 10. Summary of incidental and target catch monitoring, Johnstone Strait seine fisheries, 1997.

JOHNSTONE STRAIT SEINES								
WEEK	# SETS	FISH ENCOUNTERED / RELEASED				FISH RETAINED		
		Coho	Chinook A	Chinook J	Steelhead	Sockeye	Pink	Chum
7/5	87	37	25	25	0	7,199	1,067	9
8/1	92	66	9	12	1	10,346	1,764	8
8/2	81	40	42	22	1	37,306	3,538	36
8/3	91	29	16	10	1	19,750	3,689	54
8/4	46	22	11	2	0	5,964	3,727	97
9/1	139	112	57	8	2	15,723	10,686	343
9/2	35	36	13	6	0	2,395	12,678	205
9/3	81	59	4	18	2	2,738	7,082	309
9/4	96	52	8	5	5	1,687	1,801	1,738
TOTAL	748	453	185	108	12	103,108	46,032	2,799

Incidental seine catch of non-target species was much lower in Johnstone Strait than in Juan de Fuca Strait. Although approximately twice as many seine sets were monitored in Johnstone Strait compared to Juan de Fuca Strait (Table 3), the monitored catch in Johnstone Strait had only about a quarter as many coho and about half as many chinook (Tables 6 and 10). Exceptions were the chinook jack encounters, which were approximately twice as high in Johnstone Strait compared to Juan de Fuca Strait. Steelhead encounters in both Areas were the same (12 fish).

As with Juan de Fuca Strait, the coho catch data for Johnstone Strait suggest a geographical difference in catch by zone (Table 11). The average weekly coho catch per set in this area varied according to the week fished, the geographic location of the sets, and the number of sets observed in that geographic location. Statistical analysis of the raw data was not completed to verify these findings; however, the recorded data did exhibit a weekly variability among zones.

Table 11. Average weekly coho catch per seine set by zone in Johnstone Strait, 1997.

JOHNSTONE STRAIT SEINES																		
	A12 AP		A12 AR		A12 GC		A12 NS		A12 RB		A12 UJ		A13 DB		A13 LJ		Avg.	Total Sets
WEEK	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	# Sets	Coho/ Set	
7/5	0.9	15	0.2	9			3.0	3	0.0	2	0.3	23	0.1	15	0.2	20	0.4	87
8/1	2.1	10					1.2	17	0.1	15	0.9	19	0.2	11	0.2	20	0.7	92
8/2			0.5	13			0.6	30	0.3	13	0.2	13	0.9	7	0.4	5	0.5	81
8/3							0.0	4			0.5	32	0.3	37	0.2	18	0.3	91
8/4							0.3	9			0.9	16			0.2	21	0.5	46
9/1	0.4	41					0.2	15	0.9	8	1.4	27	0.7	21	1.3	27	0.8	139
9/2							0.5	16			2.2	9			0.8	10	1.0	35
9/3	0.3	18	1.4	10					1.2	14	0.8	21	0.04	18			0.7	81
9/4			0.7	6	0.2	36	0.4	12	0.3	7	0.3	3	0.7	18	1.4	14	0.5	96
Avg. Coho/ Set	0.6		0.7		0.2		0.6		0.5		0.8		0.4		0.6		0.6	
Total Sets		84		38		36		106		59		163		127		135		748

LEGEND:

A12 AP - Area 12 Airport.

A12 AR - Area 12 Adams River.

A12 GC - Area 12 Gordon Channel.

A12 NS - Area 12 North Shore.

A12 RB - Area 12 Robson Bight.

A12 UJ - Area 12 Upper Johnstone Strait.

A13 DB - Area 13 Deepwater Bay.

A13 LJ - Area 13 Lower Johnstone Strait.

Coho per set = Total Coho / Number of Sets.

Note : Information is from commercial fishing only

The average seasonal catch of coho per set was low for all zones (range 0.2 to 0.8 fish). However in some zones, the average catch in the early portion of the season (commencing in weeks 7/5 and 8/1) was higher than the seasonal average (see below and Table 11).

	Area 12 Airport (A12AP)	Area 12 North Shore (A12NS)
Week 7/5	0.9 coho / set (15 sets)	3.0 coho / set (3 sets)
Week 8/1	2.1 coho / set (10 sets)	1.2 coho / set (17 sets)
Season	0.6 coho / set (84 sets)	0.6 coho / set (106 sets)

Generally, zones that showed relatively high average coho catch per set, also showed

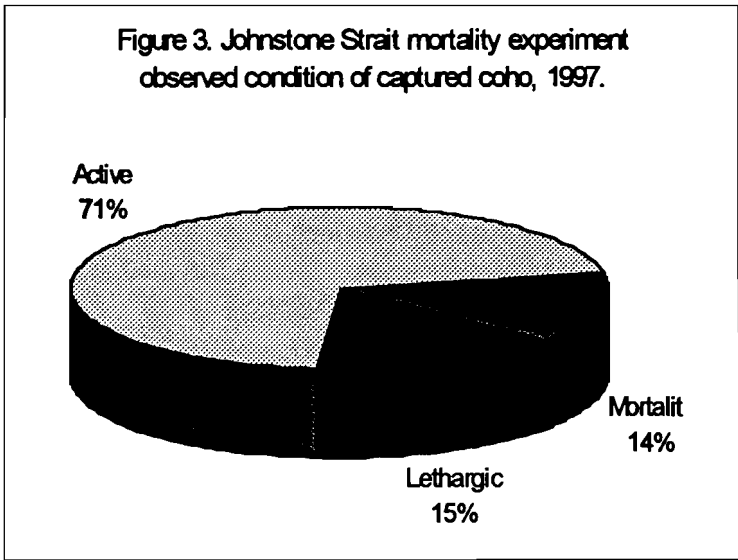
Table 12. Average salmon catch per seine set by zone for Johnstone Strait 1997 fishing season (zone definitions as in Table 11).

JOHNSTONE STRAIT SEINES									
ALL WEEKS FISH / SET	A12AP	A12AR	A12GC	A12NS	A12RB	A12UJ	A13DB	A13LJ	ALL ZONES
Sockeye	114.2	79.0	11.9	171.3	140.0	145.0	155.1	150.7	137.8
Pink	47.1	52.5	5.3	58.2	49.6	88.4	41.4	82.4	61.5
Chum	2.1	4.2	12.1	2.7	3.2	2.3	3.6	5.4	3.7
Coho	0.6	0.7	0.2	0.6	0.5	0.8	0.4	0.6	0.6
Chinook A	0.1	0.0	0.1	0.2	0.3	0.5	0.1	0.2	0.2
Chinook J	0.4	0.1	0.0	0.3	0.1	0.1	0.1	0.1	0.1
Steelhead	0.0	0.1	0.0	0.0		0.0	0.0	0.0	0.0
TOTAL SETS	84	38	36	106	59	163	127	135	748

high average target catch per set. For example, seine vessels fishing in zone A12NS had a high coho catch per set in the first two weeks of the season (Table 11) and also the highest relative average sockeye catch per set for the 1997 season (Table 12).

Mortality Experiment

Monitors also conducted an onboard mortality experiment for the Johnstone Strait seine fishery. Of the 164 coho observed, 23 died before release, giving a mortality rate 14%; an additional 15% of the observed coho were subjectively assessed as lethargic at release; and 71 % were assessed as active at release (Figure 3). The



interval coho remained in the holding box ranged from zero minutes to 3:55 hrs, for an average interval of 1:06 hrs.

The above study suggests a minimum mortality rate of 14% for coho captured in Johnstone Strait seine fishery. The average size of sets in the 1997 program was 204 pieces (i.e., 152,697 fish of all species captured in 748 sets). Weather conditions were generally calm throughout the course of this program.

4.4 Other Areas

The Sabine Channel (Area 16) seine fishery was conducted from the end of August to mid-September of 1997. This fishery was monitored on August 31, September 1 and September 8 (Table 5). Coho encounters were low, with 48 fish encountered and released. Encounters of other non-target species were also low (chinook adults 7, chinook jacks 2, steelhead 0). All non-target species were released.

The Sabine Channel gillnet fishery was conducted over a 3-week period from mid-August to early September of 1997. Only 1 adult chinook was encountered and released. There were no encounters of other non-target species.

The Nitinat chum seine fishery was monitored for the first week only. During this time, only 1 coho was encountered and released. There were no encounters of other non-target species. DFO discontinued monitoring of the rest of the fishery due to low incidental catch.

4.5 Total Mortality and Catch Estimation

Total Mortality

The total mortality arising from a fishery consists of two main components: Retained catch + Fish that die after release. Total mortality is greater than retained catch mortality alone since total mortality numbers include that portion of fish that die after release. The catch retained by fishermen was estimated in 1997 by dockside monitoring (via Mark Recovery Program). The numbers of fish that die after release were calculated by applying a mortality rate to the estimated total fish released. The total fish released for the 1997 season was estimated indirectly, by subtracting the total retained catch (Dockside Monitoring) from the total estimated encounters (1997 Monitoring Program, with sub-samples expanded to represent the entire fishery). The above indirect approach was taken because it could not be assumed that the entire seine fleet released all non-target salmon (those crew members with monitors on board the vessel may have been more diligent in releasing non-target fish).

In assigning a mortality rate to the released fish, conditions of the fishery which affect release mortality (i.e., overall volume of catch and weather), were taken into account. The estimated mortality rates for released fish are shown below for each fishery (also shown are the results of the mortality experiments conducted on board the vessels).

Fishery	% Mortality Used *	% Average Mortality	(% Mortality Experiments)
Johnstone Strait Seine	20-50%	38.3%	(14%)
Johnstone Strait Gillnet	35%	-	-
Juan de Fuca Strait Seine	20-30%	25%	(23%)
Juan de Fuca Strait Gillnet	35%	-	-

* See Section 3.1.

The pre-set mortality rate applied to the Juan de Fuca seine fishery (20-30%) was lower than the rate for the Johnstone Strait seine fishery (20-50%). The lower rate for Juan de Fuca was set in the anticipation of reduced fishing opportunities in this area.

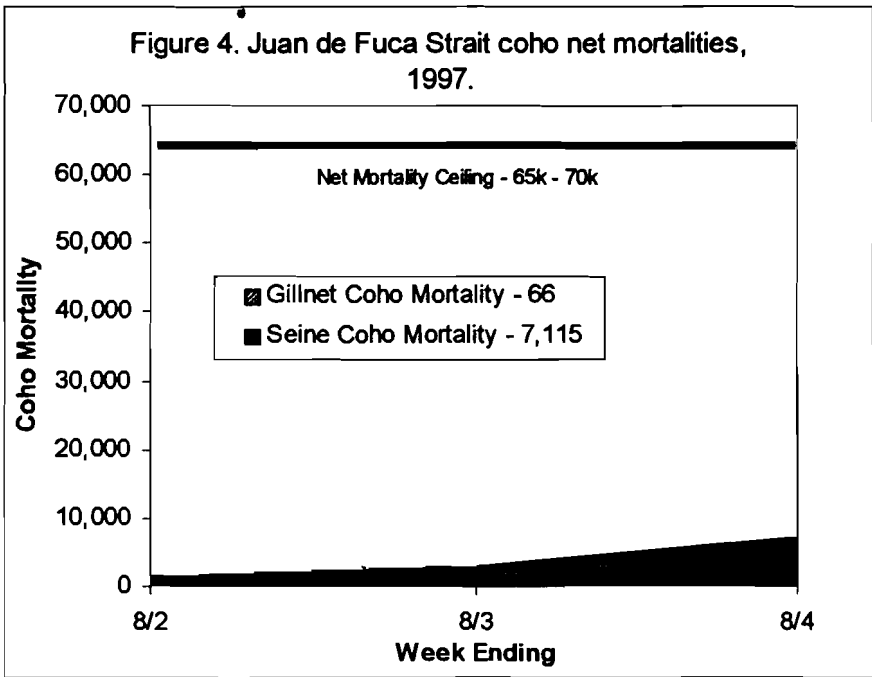
Catch Estimation

Catch estimates represent the numbers of fish retained and do not include the mortality estimates for released fish. Any estimation of catch during the season (i.e., in-season estimates) depends on several significant factors, including number of vessels operating and sample size, average catch per vessel, precision of species identification, and volume of catch per set. In-season catch estimates are calculated using information obtained from port sampling, catch hails, and catch monitoring. Post-season catch estimates are based on sales slip records.

The difference between in-season and post-season catch estimates may not be attributed entirely to the monitoring procedure. Sales slip records used for the post-season estimates, may underestimate the “actual catch” in the fishery. For example, fish (especially those of low commercial value), are frequently not reported and kept for personal use. The magnitude of such unreported catch is not known for these fisheries and could account for some of the catch difference.

Juan de Fuca Strait Total Mortality Estimation

The total cumulative coho mortality (i.e., retained catch plus release mortality) in Juan de Fuca Strait net fisheries was approximately 7,500 which is considerably below the ceiling of 65,000-70,000 (Figure 4). The low diversion of sockeye through Juan de



Fuca Strait in 1997 has led to reduced overall harvesting and a significantly reduced incidental catch.

Juan de Fuca Strait Catch Estimation

Table 13 compares the in-season and post-season catch estimates for the 1997 Juan de Fuca Strait seine and gillnet fisheries. The post-season estimates were based on sales slip data which included test fishing catches.

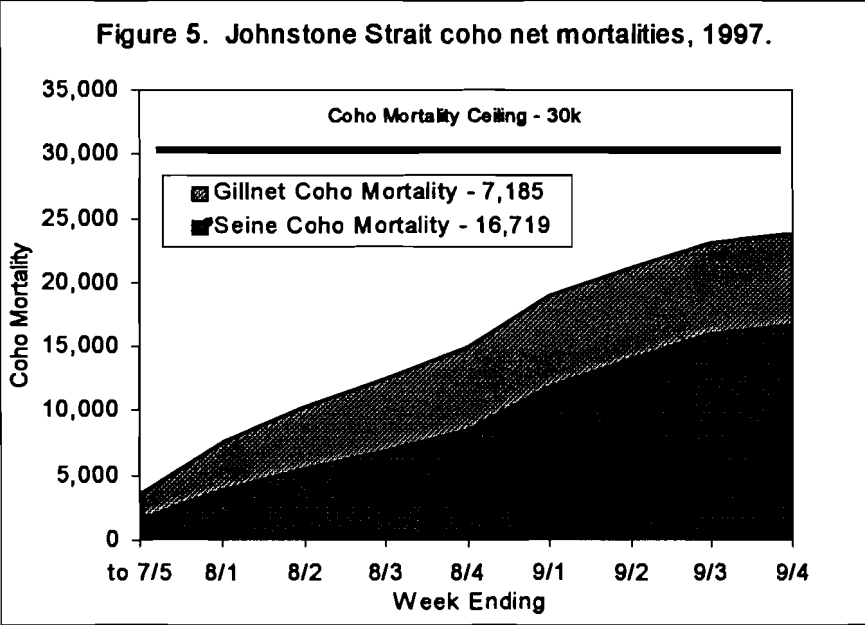
For coho salmon, the in-season estimates exceeded the post-season estimates for both seines and gillnets by 2,572 and 58 respectively.

Table 13. Comparison between in-season and post-season catch estimates for Juan de Fuca Strait net fisheries, 1997. Brackets () indicate negative values.

JUAN DE FUCA STRAIT						
SPECIES	SEINES			GILLNETS		
	In-season	Post-Season	Difference	In-season	Post-Season	Difference
Sockeye	274,670	253,767	20,903	5,111	11,746	(6,635)
Pink	284,783	326,270	(41,487)	490	631	(141)
Chum	527	322	205	42	41	1
Coho	2,613	41	2,572	25	83	(58)
Chinook A	26	0	26	37	146	(109)
Chinook J	106	0	106	0	9	(9)
Steelhead	10	0	10	0	1	(1)
TOTAL	562,735	580,400	(17,665)	5,705	12,648	(6,943)

Johnstone Strait Total Mortality Estimation

The total cumulative coho mortality (i.e., retained catch plus release mortality) in Johnstone Strait net fisheries was approximately 24,000. This is within the 20,000 to 30,000 pre-season ceiling set for the 1997 Total Allowable Mortality (Figure 5). This



total mortality was divided between gillnets and seines, with gillnets accounting for less than a third of the total or approximately 7,000 coho. The diversion of sockeye through Johnstone Strait was extremely high in 1997, resulting in the majority of sockeye commercial TAC being harvested in this area.

Johnstone Strait Catch Estimation

Table 14 compares the in-season and post-season catch estimates for the 1997 Johnstone Strait seine and gillnet fisheries. The estimated catches were derived in the same manner as for Juan de Fuca Strait above. The in-season catch estimates for coho again exceeded the post-season estimates by 11,722 for seines and 1,154 for gillnets.

Table 14. Comparison between in-season and post-season catch estimates for Johnstone Strait net fisheries, 1997. Brackets () indicates negative values.

JOHNSTONE STRAIT						
SPECIES	SEINES			GILLNETS*		
	In-season	Post-Season	Difference	In-season	Post-Season	Difference
Sockeye	3,668,345	3,673,157	(4,812)	810,113	832,468	(22,355)
Pink	2,725,365	2,660,580	64,785	77,199	70,919	6,280
Chum	79,186	72,284	6,902	6,942	5,702	1,240
Coho	12,675	953	11,722	5,857	4,703	1,154
Chinook A	1,746	87	1,659	963	683	280
Chinook J	1,900	11	1,889	0	68	(68)
Steelhead	148	2	146	338	56	282
TOTAL	6,489,365	6,407,074	82,291	901,412	914,599	(13,187)

* Incidental gillnet catch data for Johnstone Strait derived from Area D gillnet mesh study, logbook data and hail data.

5.0 DISCUSSION and RECOMMENDATIONS

5.1 Monitoring Program

The monitoring program allowed fisheries managers to receive direct information that summarized incidental catch encounters from vessels participating in the commercial fishery. These observations can be utilized to provide total catches (retained and released) in the fishery. This information, received while the fishery is ongoing, is essential for estimating the amount of catch released in a non-retention fishery. The timeliness of the catch information throughout the fishery was a major advantage of the observer program, allowing for an immediate response if coho catch rates increased above a specific level. Potential management actions included time and/or area modifications to the fishery.

The program was assisted by the participation and cooperation of vessel masters in the fishing industry. Issues, such as scheduling monitor transportation to and from vessels, were at times difficult. As well, the cooperative framework of the 1997 program placed some constraints on program delivery. Extensive discussions were sometimes necessary to locate vessels and arrange the logistics of monitor transportation (permission of vessel operators was required to place monitors on board the vessel). In addition, the area of coverage was limited to the area actually fished by the participating vessel, as opposed to an even distribution that can be achieved by transporting monitors by zodiac from vessel to vessel.

In the future, coverage of fisheries should be less dependent on the willingness of vessel operators to participate. Monitor placement on board the vessels should be broad based, at least until the conservation concerns regarding non-target species are reduced. Specifically, the requirement to have a monitor on board should be a

pre-condition of fishing. While every vessel may not require a monitor, information is required from all fishing areas to adequately cover the fishery.

Deployment of monitors in Johnstone Strait was also an area of concern. Water taxis were the primary method of dispatching the monitors. Although this was an effective way of delivering personnel to fishing grounds, the return trip frequently commenced before the closure of the fishery (to allow for return to port before nightfall). When monitors departed before fishery closure, the last sets of the day were not monitored. In addition, the participating vessels experienced some disruption in their fishing routine when the taxis arrived early.

Monitor deployment and placement need to be re-examined. Transporting monitors primarily by water taxi is cost prohibitive and disruptive to program delivery. More efficient and less costly logistic solutions are necessary for the program to succeed. Industry could assist in this process by encouraging the fleet to transport monitors to and from the designated vessels. As part of the pre-season advisory process, the DFO should outline the need for improved monitor transport and give Industry the opportunity to offer solutions. This will take the Industry one step closer to becoming accountable for self-regulation.

5.2 Monitor Training

Other deficiencies in data collection may include change in fishing pattern when the monitor is on board the vessel, and inability of the monitor to inspect and record all fish species caught and released. When large sets were ramped, the occasional non-target fish did escape the monitor and slip into the hold. The inability of monitors to accurately identify species was also a problem that was more evident when large sets were ramped onto the deck. Coho are probably more difficult to distinguish from other species because their size is similar to that of sockeye, and their appearance is less conspicuous than that of other species (e.g., steelhead or chinook).

The 1997 training course for monitors was a one-day classroom session. This should be expanded, and more emphasis placed on species identification. In addition, future courses could be conducted on board a test vessel to allow monitors to practice species identification in an environment closely resembling that of commercial fishing.

On September 12, 1997, a review meeting was conducted in Victoria, B.C., with those monitors resident in the city. The meeting emphasized the need to improve the training course. Monitors wished to know if they should perform deckhand duties in addition to their information-gathering role. They also expressed concern over the flexibility sometimes required on a commercial fishing vessel. These questions pointed to a need to modify the training course. Accordingly, training should include a session that addresses the monitor's role in relation to the crew, and any additional duties that it might entail. In addition, DFO should address a letter to the Industry that outlines the monitoring program and defines the expected role of monitors while on board the vessels.

5.3 Coho Mortality and Release Compliance

The coho mortality of 24,000 pieces estimated for the Johnstone Strait net fisheries in 1997 was within the assigned pre-season Total Allowable Mortality of 20,000 to 30,000 pieces. However, landed coho monitoring information revealed that some vessels were not complying with the coho non-retention regulations. In-port monitors reported that some vessels had up to 50 coho in their hold indicating that some fishermen were making little effort to release non-target species. Stringent enforcement measures could remedy this breach of non-retention regulations. However, the use of individual deterrence for non-compliance is only a short-term solution due to limited enforcement staff and extensive fishing area. For a long-term solution, a change in perspective regarding coho mortality is required within the Industry. The likelihood of repeat offences should be reduced if Industry adopts an increased sense of stewardship for the resource.

Education will play an essential role in changing the fleet's perception regarding incidental catch encounters and mortality. The Department of Fisheries and Oceans has produced a communications package designed to educate vessel crews and monitors concerning incidental catch issues. The package consists of a pamphlet and a video. Both items address such topics as fish handling, gear retrieval, sorting and the use of resuscitation boxes. The material will be ready for presentation before the commencement of the 1998 season. The goals of the presentation are to increase Industry awareness of conservation concerns and facilitate successful live release through proper fish handling techniques.

The need to educate vessel crews was highlighted by the differences between in-season and post-season estimates. Given that both methods represent estimates of catch, some discrepancy may be expected between the estimated and actual catch numbers. The in-season estimate of coho catch for the combined Johnstone and Juan de Fuca Strait seine fisheries was 15,288. The combined post-season catch estimate for the two fisheries was 994 coho (Tables 13 and 14). The majority of commercial fishermen are aware of incidental catch issues and are supportive of the monitoring program. However, the in-season coho estimate demonstrates that some skippers and crew continue to practice fishing techniques that do not enhance the release of incidental species. The substantial difference between the in-season and post-season coho catch estimates suggests that the incidental coho catch is not being completely reported or disclosed when vessels off-load their fish. An understanding by skippers and crews of the general procedures for a successful release of fish and of overall conservation concerns should reduce the numbers of retained coho.

5.4 Resuscitation Experiment

In the resuscitation experiment, the released fish were assessed subjectively using terms, such as lethargic, sluggish, moving on one side, or active and moving quickly away. This subjectivity can vary between monitors, and is not eliminated when fish are placed in holding tanks for long periods. Another concern is the mortality difference between those fish released immediately and those placed in revival boxes

prior to release. The general assumption is that fish that are stressed but given time (in the revival box) to become calm, show better survival than those fish released immediately. Tagging data on immediately released fish versus box-held fish may provide additional information on differences in mortality.

Release mortality may vary considerably depending on fishing methods and area. For example, salmon behavior may differ in estuaries compared to approach areas, in areas with large tidal/current differences, and in rearing/feeding areas compared to migratory corridors. Finally, a released fish may also be more susceptible to dangers in its natural environment than one that has not undergone the stress of capture. Accordingly, mortality assessment should also cover these specific issues.

5.5 Yellow Line - Red Line Strategy

In both fishing areas (Johnstone and Juan de Fuca straits), the estimated coho mortality for 1997 was below or within the allocated ceiling. The current strategy works on the assumption that the goal lies in not achieving the allocated by-catch ceiling for a series of fisheries. If the ceiling appears to be within reach, then the rate of catch must be reduced. This requires taking appropriate management actions in a timely manner, such that the critical situation is detected and the catch rate reduced before the ceiling is reached.

Difficulties with this strategy may occur if the time-frame is too small (i.e., too few fisheries to react to), or the by-catch ceiling is too high since the true potential of reducing the by-catch may not be realized. Conversely, if the by-catch ceiling is too low, fishermen may endure unnecessary hardship. These problems can be addressed by allowing the ceiling to vary according to estimated in-season coho abundance.

A benefit to the present strategy is that fishermen are made aware of the consequences of high by-catch rates. In addition, fishermen can pace the by-catch rates throughout the season. These rates can vary, depending on the complexity of fishing (i.e., strict actions to reduce by-catch rate can be scheduled prior to the peak of fishing when more time is available, and as a compensation for unexpected by-catch increases later in the season). If parameters of allocated ceilings and a workable time interval continue to apply, the yellow line-red line strategy may be the appropriate strategy.

5.6 Advisory Process

The cooperative framework of the 1997 Program continued DFO's long term goal of creating opportunities for Industry to become more involved in the management of non-target stocks. The logistical demands of dispatching monitors to vessels resulted in the immediate exchange of ideas among DFO personnel, skippers, vessel owners and fish processors. Discussions included the merits of by-catch monitoring, and its importance in fisheries management. Pre-season meetings with all Industry stakeholders would provide a good opportunity to continue this dialogue. DFO and

Industry could jointly address such issues as monitor deployment with a view to increasing fishery coverage and reducing interruptions to fishing operations. Input from Industry at the program planning stage would foster a sense of responsibility for the operation of successful selective fisheries.

The Department has initiated steps to obtain input from the Industry for the 1998 monitoring program. In February of 1998, the program coordinator mailed a questionnaire to all skippers who participated in the 1997 program. They were asked to evaluate the 1997 program and offer suggestions for improvement. Most of the questionnaires have been returned and contain valuable comments that will assist in the 1998 program planning. Consultation with the Industry sector will continue in the form of pre-season meetings, and training sessions employing the fish-handling video and information pamphlet. Several items will be addressed, including monitor deployment, minimizing disruption to fishery operations, gilling of non-target species, vessel participation and compensation. These meetings will also provide a good forum for explaining DFO's commitment to reducing the incidental harvest of non-target species.

All strategies should be developed / carried out in consultation with the Industry advisors to promote an understanding of the management goals and allow the fishermen's input into the proposed actions.

5.7 Monitoring Program Design

Planning of future monitoring programs is essential. The collaboration with fishing advisors, monitoring personnel and other agencies is crucial to the program delivery. The educational program discussed above will assist fishermen with fish release techniques. Training of monitors will focus on improving reporting procedures and data recording (e.g., identifying salmon species, categorizing chinook salmon as to juveniles, jacks or adults, and standardizing vessel location references). In addition, a concurrent log book program will be initiated in 1998 to supplement catch information obtained from the monitoring program.

5.8 Management Strategy

The monitoring data suggest that some fishing zones in each of Juan de Fuca Strait and Johnstone Strait show higher average coho catch per set than other zones (Tables 8 and 11). These high by-catch zones also tend to show the highest relative catch of target species (Tables 9 and 12), suggesting that coho conservation measures may restrict fishing opportunities in areas of high target catch. Although the relative catch differences among zones have not been statistically verified, these figures should be taken into account when planning future openings. One method to identify and avoid zones of high coho concentration would be to conduct test fishing prior to opening a fishery.

Additional actions for minimizing by-catch mortality will include the continuation of the "revival box" strategy which allows for pre-release monitoring of fish caught

incidentally. Many commercial fishermen are already using this equipment in some commercial salmon fisheries. Other options to reduce incidental mortality also need to be explored (e.g., daylight only gillnet fisheries, brail only purse seine fisheries, and gear modification, such as fish sorting equipment). An enforcement program must complement the management strategy to assist in achieving program goals.

5.9 Summary of Recommendations

- 1. Work with Industry to develop stringent on-grounds and port-side enforcement measures to remedy the breach of non-retention regulations.**
- 2. Educate fishing crews on methods to reduce incidental catch and facilitate successful live release of non-target species.**
- 3. Provide Industry with the opportunity to play a more active role in planning catch monitoring programs.**
- 4. Supplement catch monitoring with a concurrent log book program.**
- 5. Train monitors regarding their role in relation to the crew, and any additional responsibilities that may arise. The DFO should address a letter to the Industry explaining the monitoring program and outlining the duties of monitors.**
- 6. Emphasize species identification in future monitor training courses, and include training on board test fishing vessels.**
- 7. The requirement of vessels to take monitors on board should be a condition of the license. The number of vessels monitored in any given fishery would be at the discretion of DFO.**
- 8. Assess mortality information from individual fisheries and design a mortality experiment to help reduce the number of variables that affect experimental results.**
- 9. Set workable parameters for the Yellow Line - Red Line Strategy. The parameters should address conservation concerns and allow managers and fishermen to respond to daily incidental catch information.**

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Marine Star	Harvey Pike	Western Roamer	Kim Inrig
Nicole Joy	Bob Charlie		
Nordic Queen	Rick Sewid		
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