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The Distribution, Abundance, and Feeding Habits of Chinook and Coho Salmon on the Fishing Banks off Southwest Vancouver Island, May 23 - June 5, September 26 - 30, and October 23 - 30, 1988

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THE DISTRIBUTION, ABUNDANCE, AND FEEDING HABITS OF CHINOOK AND COHO SALMON ON THE FISHING BANKS OFF SOUTHWEST VANCOUVER ISLAND, MAY 23 - JUNE 5, SEPTEMBER 26-30, AND OCTOBER 23-30, 1988

by

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ABSTRACT

Morris, J. F. T. and M. C. Healey. 1990. The distribution, abundance, and feeding habits of chinook and coho salmon on the fishing banks off southwest Vancouver Island, May 23 - June 5, September 26-30, and October 23-30, 1988. Can. Tech. Rep. Fish. Aquat. Sci. 1759: 75 p.

Three surveys by commercial troller, from May 23 - June 5, September 26-30, and October 23-30, 1988, were conducted to determine how chinook (Onchorynchus tshawyscha) and coho (O. kisutch) salmon were distributed on the offshore banks off southwest Vancouver Island and whether their distribution was related to oceanographic events. This report summarizes data gathered during these cruises as well as data from similar surveys conducted in the fall of 1987 and from commercial troll log books for 1982 and 1983. In May 1988, chinook and coho catch rates were very high on 7 and 12 Mile Bank and Swiftsure Bank and lower on Finger Bank. However, chinook and coho catch rates were much higher over all the offshore banks in May 1988 compared with May 1982 and 1983. In September 1988, chinook and both adult coho and juvenile coho catch rates were relatively high on 12 Mile Bank and Swiftsure Bank and low on South Bank. The abundance pattern was similar in September, 1987. In October 1988, chinook and juvenile coho catch rates were high on Swiftsure Bank and low elsewhere. That the pattern of chinook and coho abundances among the offshore banks was similar between September and October suggests that distributions prior to the fall transition are relatively stable.

In May, September, and October, 1988, chinook and coho stomach contents did not differ significantly among the offshore banks. In May, coho stomach content to body weight ratios were significantly higher than those of chinook. In the fall of 1987, chinook stomach contents did not differ among the banks, but coho stomach contents were lower on Pachena than the other banks. In May, chinook fed mainly on crab larvae, euphausiids, and fish whereas in fall they fed mainly on fish and euphausiids. In May, coho fed mainly on crab larvae, pteropod molluscs, euphausiids, fish, and amphipods whereas in the fall they fed mainly on pteropod molluscs, euphausiids, and amphipods.

Chinook fork lengths averaged 59.1 cm, 56.6 cm, and 50.4 cm in May, September, and October, and they ranged from 25 to 93 cm over the three surveys. Most chinook were aged 0.1 or 0.2. Juvenile coho averaged 42.7 cm, 33.8 cm, and 33.2 cm in May, September, and October. Adult coho were caught in substantial numbers in September, and they averaged 57.9 cm.

In May, chinook greater than 40 cm in fork length were caught at a mean depth 37.6 m, and chinook less than or equal to 30 cm were caught at mean depths of 26.5 m. In September and October, chinooks were caught at mean depths of 40.4 m and 36.7 m, respectively. Coho were caught at shallower mean depths than chinook. Coho were caught at 24.6 m in May, adult coho were

caught at 21.9 m in September, and juvenile coho were caught at 15.6 m and 10.1 m in September and October, respectively.

Of the sixty two coded wire tags recovered from juvenile chinook and coho in 1987 and 1988, fifty nine originated from Washington and Oregon hatcheries, which means that United States stocks must contribute significantly to the juvenile populations on the offshore banks of southwest Vancouver Island.

RESUME

Morris, J. F. T. and M. C. Healey. 1990. The distribution, abundance, and feeding habits of chinook and coho salmon on the fishing banks off southwest Vancouver Island, May 23 - June 5, September 26-30, and October 23-30, 1988. Can. Tech. Rep. Fish. Aquat. Sci. 1759: 75 p.

On a fait 3 relevés au bateau de pêche commerciale à la traîne, soit du 23 mai au 5 juin, du 26 au 30 septembre et du 23 au 30 octobre 1988, pour déterminer la distribution du saumon quinnat (Onchorynchus tshawyscha) et du saumon coho (O. kisutch) des bancs hauturiers du sud-ouest de l'île de Vancouver et pour voir si elle est reliée à des phénomènes océanographiques. On présente ici le résumé des données recueillies lors de ces expéditions avec les résultats de relevés du même genre effectués en automne 1987 et des données tirées du journal de bord de 1982 et 1983 de bateaux de pêche commerciale à la traîne. En mai 1988, le taux de capture de saumons quinnat et coho était très élevé aux bancs 7 Mile, 12 Mile et Swiftsure et il était bas au banc Finger, mais pour l'ensemble des bancs hauturiers, il était beaucoup plus élevé à cette époque qu'en mai 1982 et 1983. En septembre 1988, le taux de capture de saumons quinnat et de saumons coho adultes et juveniles était relativement élevé aux bancs 12 Mile et Swiftsure et il était bas au banc South. Le profil d'abondance était comparable en septembre 1987. En october 1988, le taux de capture de saumons quinnat et de saumons coho juvéniles était élevé au bac Swiftsure et bas ailleurs. Le fait que le profil des 2 espèces de saumons dans les bancs hauturiers soit resté le même entre les mois de septembre et octobre porte à penser que la distribution est relativement stable avant la transition automnale.

D'après l'analyse du contenu stomacal de saumons quinnat et coho, il n'y avait pas de différence significative entre les bancs hauturiers aux mois de mai, septembre et octobra 1988. En mai, le rapport contenu stomacal-poids corporel était significativement plus élevé pour le saumon coho que pour le saumon quinnat. En automne 1987, le contenu stomacal des saumons quinnat ne différait pas d'un banc à l'autre, mais dans le cas du saumon coho, il était moins important au banc Pachena qu'aux autres bancs. En mai, les saumons quinnat se sont principalement nourris de larves de crabes, d'euphausiacés et de poissons, tandis qu'en automne leur menu se composait essentiellement de poissons et d'suphausiacés. En mai, les saumons coho se sont nourris surtout de larves de crabes, de ptéropodes, d'euphausiacés, de poissons et d'amphipodes, tandis qu'en automne, ils ont principalement consommé des ptéropodes, des euphausiacés et des amphipodes.

La longueur à la fourche des saumons quinnat a atteint en moyenne 59,1 cm, 56,6 cm et 50,4 cm aux mois de mai, septembre et octobre, les valeurs allant de 25 à 93 cm pour l'ensemble des 3 relevés. La plupart des saumons quinnat appartenaient aux classes d'âges 0,1 ou 0,2. Quant au saumon coho juvénile, il a atteint en moyenne 42,7 cm, 33,8 cm et 33,2 cm aux mois de mai,

septembre et octobre. Il s'est capturé un nombre considérable de saumons coho adultes en septembre; ils mesuraient en moyenne 57,9 cm.

En mai, on a capturé des saumons quinnat de plus de 40 cm (longueur à la fourche) à une profondeur moyenne de 37,6 m et des spécimens de 30 cm ou moins à une profondeur moyenne de 26,5 m. Aux mois de septembre et octobre, on a capturé des saumons quinnat à 40,4 m et 36,7 m de profondeur moyenne, respectivement. Quant aux saumons coho, ils ont été capturés à des profondeurs moyennes moindres: en mai, on en a capturé à 24,6 m, en septembre on a pris des adultes à 21,9 m et en septembre et octobre, on a capturé des juvéniles à 15,6 m et 10, 1 m, respectivement.

L'examen des soixante-deux étiquettes de fil métallique codées récupérées de saumons juvéniles quinnat et coho en 1987 et 1988, a révélé que cinquante-neuf des poissons marqués provenaient de pisciculture des États de Washington et d'Orégon, ce qui signifie que les populations de juvéniles des bancs hauturiers du sud-ouest de l'île de Vancouver sont enrichies dans une mesure significative par les stocks américains.

I. INTRODUCTION

The surveys described in this report were a major component of the Chinook and Coho on the Offshore Banks project of the Marine Survival of Salmon program. The general objective of the project was to investigate the relationship between coho (Onchorynchus kisutch) and chinook (O. tshawyscha) salmon survival in the ocean and oceanographic events. Our basic assumption was that the survival of salmon in the ocean is intimately connected with their distributional patterns and that their distribution is a consequence of their responses to oceanographic water properties and circulation. Operating under this basic assumption, we are attempting to elucidate the mechanisms underlying correlations in the literature between salmon survival and physical factors in the ocean environment by better understanding the relationship between salmon dispersion and oceanographic events.

Of special interest is how oceanographic factors effect the aggregating behaviour of juvenile coho and chinook on the fishing banks off southwest Vancouver Island. Data collected during 1982 and 1983 revealed that high numbers of juvenile coho and chinook were most frequently caught at four particular locations - on Swiftsure Bank, on the tip of Finger Bank, on South Bank near the wreck, and along the eastern edge of 7 and 12 Mile Bank (Fig. 1). Freeland (1988a) hypothesized that juveniles may aggregate in these locations in response to the presence of eddies and that juveniles could save energy by using eddies to help maintain their geographical position within coastal currents. Another possibility is that these locations represent rich feeding areas.

We are also interested in the apparent redistribution of chinook salmon that occurs sometime either late in their first year in the ocean or in their second year. Historical data suggest that chinook reside within 100 km or so of their natal stream during their first summer in the ocean but are found 1000 km or more away from their natal stream during their third ocean year. We hypothesize that the fall transition, during which the coastal circulation pattern off Vancouver Island changes from the summer to the winter regime, triggers this redistribution. The dispersal and change in distribution should be indicated by changes in the relative abundance of chinook salmon and changes in stock composition on the offshore banks during the fall transition.

In 1988 we conducted three troll surveys of chinook and coho salmon populations on the shallow banks off southwest Vancouver Island to investigate fish distributions and seasonal changes in distribution. The surveys took place from May 23 to June 5, from September 25-29, and from October 23-30, 1988.

The May and October surveys coincided with Institute of Ocean Sciences CTD and Acoustic Doppler Current Profiler (ADCP) surveys over the La Perouse grid to enable us to relate our catch results with oceanographic events. The October survey also coincided with a series of surface current

measurements by HF ground wave radars (CODAR) over Swiftsure Bank. Details of the oceanography will be presented elsewhere.

This report summarizes data gathered during these cruises on chinook and coho abundances, spatial distributions, vertical distributions, size composition, age composition, stock composition, feeding activity, and diet. We also present data on chinook and coho age composition, stock composition, feeding activity, and diet from surveys conducted in the fall of 1987. Data on catch composition and depth distributions of species from the 1987 surveys were presented in an earlier report (Olsen et al. 1988). In addition, we extracted catch information for the banks off southwest Vancouver Island from 1982 and 1983 troll fishermen logbook records for the May 23 - June 5 period. The logbook data combined with our data from May 1988 let us compare the chinook and coho catch rates among fishing areas both within and between years.

II. METHODS

We designed the sampling of coho and chinook in 1988 to take advantage of coordinated oceanographic surveys and to provide data comparable with 1987 sampling. During the May and October surveys, we concentrated our fishing effort over Swiftsure Bank so that we would be able to compare the catch results to the detailed, highly-resolved circulation features provided by the ADCP and CODAR. We also fished on Finger Bank and 7 and 12 Mile Bank to provide regional comparisons of catch rate and catch composition. During the September survey, we fished on Swiftsure Bank, 7 and 12 Mile Bank, and on South Bank so that we could compare the distributions of juvenile chinook and coho on these banks with the distributions observed during September, 1987 (Olsen et al. 1988). We also wanted to compare the September, 1988 distributions, when the summer current patterns prevailed, to the late October distributions, when the winter current patterns were expected to prevail.

We chartered the Cowichan, a 42 ft. commercial troller, skippered by Gordon Brooks, to conduct the surveys. The troller fished using a standard commercial troll gear set up - six lines with seven lures per line. The seven lures on each line were arranged as follows- a flasher and hootchie combination on a six foot leader was the bottom lure at position 7, another flasher and hootchie combination on a twelve foot leader was at position 6, a spoon or plug was at position 5, a spoon or plug was at position 4, a flasher and hootchie combination on a twelve foot leader was at position 3, a spoon or plug was at position 2, and a spoon or plug was at position 1. We fished most of the time with the bottom lure at the 54.0 metre mark on the lines, but we also fished with the bottom lure at the 39.6, 46.8, 50.4, and 68.4 metre marks, depending on bottom topography. When the bottom lure was at the 39.6

metre mark, the two bottom lures at positions 6 and 7 were 3.6 metres apart, the lures at positions 6 through 2 were 7.2 metres apart, and the lures at positions 1 and 2 were 3.6 metres apart. The top lure, or the lure at position number 1, was at the 3.6 metre mark. When the bottom lure was at the 46.8, 50.4, or 54.0 metre marks, the lures at position 6 and 7 were 3.6 metres apart and the lures at positions 6 through 1 were 7.2 metres apart. The top lures were at the 7.2, 10.8, and 14.4 metre marks, respectively. When the bottom lure was at the 68.4 metre mark, the lures at positions 6 and 7 were 3.6 metres apart and the lures at positions 6 through 1 were 10.8 metres apart. The top lure was at the 10.8 metre mark.

We used barbless hooks to keep coho and chinook juvenile mortalities to a minimum.

We classified chinook in this report as adults if they were greater than or equal to 67 cm in fork length, and as juveniles if they were less than 67 cm. We classified all coho caught in May as adults regardless of fork length; but we classified coho caught in September and October as adults if they were greater than or equal to 48 cm in fork length, and as juveniles if they were less than 48 cm. These coho classifications ensured that between month comparisons of adult coho were on the same 1.1 age population group since the most of the coho caught in May were age 1.1 but they ranged in fork length from 34 cm to 58 cm and had a mean fork length of 44.1 cm, and most of the adult coho caught in September and October were also age 1.1. Most of the juvenile coho caught in September and October were age 1.0.

For each adult chinook and coho, we recorded fork length, sex, and capture depth. For each juvenile chinook and coho, we recorded fork length and capture depth. We retained up to 25 juvenile chinook and coho per day including all adipose clipped fish and for these fish, we also recorded sex, and collected scales for age determinations and stomachs for diet analysis. We released all other juveniles.

To obtain depth of capture, we recorded the lure position called out by the fishermen when they unhooked and hauled aboard a fish as they were pulling up the lines. These data were sufficient to provide a description of species preferences for depth in the water column but they include some bias from two sources. First, the number of fish recorded as being caught at each depth except the shallowest depth was a slight over-estimate, and the positive bias increased with depth because, as the lines were being pulled up, the deeper lures that were unoccupied must have caught fish as they passed through shallower depth strata. Second, the recorded depths of capture were greater than the true depths of capture because the lines trailed behind the fishing vessel at an angle that was a function of the weight of the cannon ball at the end of the line, the number and type of lures on each line, the speed and direction of the tide in relation to the vessel, and the speed of the fishing vessel. We estimated that the angle that the lines trailed the vessel during most of the survey was 30°. Therefore we multiplied the metre mark on the

line corresponding to the recorded position number by the cosine of 30° to obtain truer of depth of capture information.

We recorded loran coordinates approximately every 15 minutes during the day so that we could plot the fishing tacks. We also recorded weather and sea conditions, sea colour, and sea surface temperatures three or four times a day.

We analyzed coho and chinook diets by visually estimating the percent contribution by volume of each major prey item in each stomach and by weighing the dried stomach contents and relating stomach weight to body weight.

III. RESULTS

(i) CATCH RESULTS

(a) May 23 - June 4

Fishing tacks of the FV Cowichan during the May 23 - June 4 survey are shown in Figure 2.

In May, combined adult and juvenile chinook catch rates averaged 11.74/hour over all the banks. Chinook greater than 50 cm were the most abundant and they made up 77.4% of the chinook catch. Adult chinook that were equal to or greater than 67 cm in fork length and juvenile chinook from 61 to 66 cm, 51 to 60 cm, 41 to 50 cm, 31 to 40 cm, and 21 to 30 cm made up 26.7%, 23.16%, 27.54%, 11.86%, 9.99%, and 0.75% of the chinook catch, respectively (Table 1, Fig. 6a). Coho catch rates were much lower than chinook and averaged just 1.81/hour. The coho averaged 42.7 cm and were mostly age 1.1 (Tables 1, 6, Fig. 7).

The most striking feature of our fishing results in May was the very high catch rate of chinook greater than 50 cm in fork length on 7 and 12 Mile Bank (Table 1). Adult chinook catch rates on 7 and 12 Mile Bank on May 26, May 27, and June 1 were 7.63/hour, 8.38/hour, and 6.00/hour, respectively. Catch rates declined to 1.00/hour on June 4, but the overall adult chinook catch rate on 7 and 12 Mile Bank was still high at 5.75/hour. By comparison, adult chinook catch rates ranged from 0.89 to 4.47/hour and averaged 2.28/hour on Swiftsure Bank, averaged 1.50/hour on one tack off Pachena, and ranged from 0.00 to 2.51/hour and averaged 0.84/hour on Finger Bank. Differences in adult chinook catch rates among fishing banks were significant ($F = 7.10$, $df = 2/14$, $P < 0.0074$).

Juvenile chinook from 61 to 66 cm and from 51 to 60 cm were distributed on the banks in a pattern similar to that of adult chinook. Catch rates of juvenile chinook from 61 to 66 cm were highest on 7 and 12 Mile Bank, ranging from 1.33/hour to 6.50/hour and averaging 4.07/hour. Catch rates were second highest on Swiftsure Bank, ranging from 0.63/hour to 5.00/hour and averaging 2.54/hour. They were lowest on Finger Bank, ranging from 0.48/hour to 1.37/hour and averaging 0.95/hour (Table 1). Catch rates were significantly higher on 7 and 12 Mile Bank than on Finger Bank, but were not significantly different between 7 and 12 Mile Bank and Swiftsure Bank, or between Swiftsure Bank and Finger Bank ($F = 3.04$, $df = 2/14$, $P < 0.0798$). Catch rates of juvenile chinook from 51 to 60 cm was also highest on 7 and 12 Mile Bank, ranging from 3.00/hour to 5.50/hour and averaging 4.29/hour, were second highest on Swiftsure Bank, ranging from 0.89/hour to 4.94/hour and averaging 3.35/hour, and were lowest on Finger Bank, ranging from 0.00/hour to 1.03/hour and averaging 0.50/hour (Table 1). Catch rates were not significantly different between 7 and 12 Mile Bank and Swiftsure Bank, but they were significantly higher on these two banks than on Finger Bank ($F = 7.42$, $df = 2/14$, $P < 0.0063$). Adult chinook catch rates were significantly correlated with catch rates of juvenile chinook from 61 to 66 cm and from 51 to 60 cm ($r = 0.846$, $df = 17$, $P < 0.0001$ and $r = 0.574$, $df = 17$, $P < 0.0159$); and catch rates of juvenile chinook from 61 to 66 cm and from 51 to 60 cm were significantly correlated ($r = 0.6737$, $df = 17$, $P < 0.003$).

Juvenile chinook less than or equal to 50 cm were more uniformly distributed among the offshore banks and there were no significant differences among the banks in catch rates of juvenile chinook from 41 to 50 cm, 31 to 40 cm, and 21 to 30 cm. Catch rates of juveniles within these size categories averaged 1.52/hour, 1.41/hour, and 0.10/hour, respectively, over all the banks (Table 1). Catch rates of juvenile chinook from 41 to 50 cm and 31 to 40 cm were significantly correlated ($r = 0.7255$, $df = 17$, $P < 0.001$), but neither was correlated with catch rates of juvenile chinook from 21 to 30 cm.

Coho catch rates averaged only 1.81/hour over the offshore banks (Table 1). There were no significant differences in catch rates among the banks. However, coho catch rates were relatively high on four occasions: 3.33/hour along the inside edge of Swiftsure Bank on May 24; 3.85/hour on the southeastern edge at the tip of Finger Bank on May 26; 4.50/hour along the inside of the 100 m contour off Pachena Point on May 28; and 3.33/hour on 7 Mile Bank on June 4. Coho catch rates were not significantly correlated with catch rates of any size category of chinook.

(b) <u>September 26-30</u>

Fishing tracks of the F.V. Cowichan during the September 26-30 survey are shown in Figure 3.

Both adult and juvenile chinook catch rates were much lower in September than in May, averaging just 0.94/hour and 3.16/hour, respectively

(Table 2). Juvenile chinook catch rates were also much more similar among the fishing banks. On the other hand, adult coho catch rates were higher in September than in May, averaging 3.57/hour. Juvenile coho catch rates averaged 2.45/hour in September. Most of these juvenile coho would have been age 0.1.

The age and size structure of the chinook populations differed between September and May. In September, adult chinook and juvenile chinook size classes 51-60 cm and 41-50 cm were predominant and made up 22%, 31%, and 34% of the chinook catch (Table 2, Fig. 6). Most of the juvenile chinook within the 51-60 cm and 41-50 cm size classes were age 0.1 (Table 6). The size classes 61-66 cm and 31-40 cm made up just 11% and 2% of the chinook catch. No juvenile chinook within the size class 21-30 cm were caught (Table 2, Fig. 6). By comparison, in May, adult chinook and juvenile chinook within the size classes 51-60 cm and 61-66 cm were the most numerous and most of the juvenile chinook within these two size classes were age 0.2 (Tables 1, 6, Fig. 6).

The age and size structure of the coho populations in September and May were also very different. In September, coho were made up of two distinct groups - adult coho that were age 1.1 and that had a mean fork length of 57.9 cm; and juvenile coho that were age 1.0 and that had a mean fork length of 33.8 cm (Fig. 7). In May, all the coho were adults that were mostly age 1.1 (Table 6, Fig. 7).

Adult chinook catch rates were highest on 12 Mile Bank at 3.71/hour and much lower on the other banks. Catch rates ranged from 0.33/hour to 0.97/hour and averaged 0.55/hour on Swiftsure Bank and averaged 0.25/hour on 7 Mile Bank. No adult chinook were caught on South Bank (Table 2).

Juvenile chinook catch rates were higher on Swiftsure Bank and 12 Mile Bank than on 7 Mile and South Bank, although the relative differences among the banks was not as great as in May. Juvenile chinook catch rates ranged from 3.01/hour to 5.09/hour and averaged 3.84/hour on Swiftsure Bank and averaged 3.71/hour on 12 Mile Bank, 2.00/hour on South Bank, and 1.75/hour on 7 Mile Bank (Table 2).

Catch rates of juvenile chinook within the size class 61-66 cm ranged from 0.36/hour to 0.67/hour and averaged 0.51/hour on Swiftsure Bank and averaged 1.14/hour on 12 Mile Bank, 0.00/hour on 7 Mile Bank, and 0.14/hour on South Bank (Table 2).

Catch rates of juvenile chinook within the size class 51-60 cm, which was the second most numerous size class, ranged from 0.67/hour to 1.79/hour and averaged 1.31/hour on Swiftsure Bank and averaged 1.14/hour on 12 Mile Bank, 0.50/hour on 7 Mile Bank, and 1.14/hour on South Bank Table 2.

Catch rates of juvenile chinook within the size class 41-50 cm, which was the most numerous size class, ranged from 1.14/hour to 3.27/hour and averaged 2.03/hour on Swiftsure Bank and averaged 1.43/hour on 12 Mile Bank, 1.00/hour on 7 Mile Bank, and 0.57/hour on South Bank (Table 2).

Only two juvenile chinook within the size class 31-40 cm were caught - one on 7 Mile Bank and the other on South Bank. No juvenile chinook within the size class 21-30 cm were caught (Table 2).

Adult coho were relatively more abundant on Swiftsure Bank and 12 Mile Bank than on 7 Mile Bank and South Bank. Adult coho catch rates varied widely on Swiftsure Bank, ranging from 0.73/hour to 10.71/hour and averaging 5.48/hour. Catch rates were also high on 12 Mile Bank at 4.86/hour, low on South Bank at 0.14/hour, and no adult coho were caught on 7 Mile Bank (Table 2).

Juvenile coho were also relatively more abundant on Swiftsure Bank and 12 Mile Bank than on 7 Mile Bank and South Bank. Juvenile coho catch rates ranged from 1.82/hour to 5.00/hour and averaged 3.46/hour on Swiftsure Bank and averaged 3.43/hour on 12 Mile Bank, 0.75/hour on 7 Mile Bank, and 0.14/hour on South Bank (Table 2).

(c) October 23-30

Fishing banks for the FV Cowichan during the October 23-30 survey are shown in Figure 4.

Adult chinook catch rates during October were the lowest observed in 1988, having decreased with each successive survey from 2.80/hour in May to 0.94/hour in September and 0.32/hour in October. Juvenile chinook catch rates were higher in October (5.90/hour) than in September (3.16/hour), but lower than in May (8.94/hour) (Tables 1, 2, 3). The size composition of juvenile chinooks in October was similar to that in September and size classes 41-50 cm and 51-60 cm made up 39.78% and 36.80% of the catch. The size classes 21-30 cm, 31-40 cm, and 61-66 cm made up only 3.35%, 8.92%, and 6.69% of the October catch (Tables 2, 3, Fig. 6).

Adult coho catch rates declined substantially from 3.57/hour in September to 0.30/hour in October, reflecting the return migration of age 1.1 coho to their spawning rivers. However, juvenile coho catch rates also declined from 2.45/hour in September to 1.48/hour in October (Tables 2, 3). Most of these juvenile coho would have been 1.0.

Adult chinook catch rates ranged from 0.00/hour to 1.00/hour and averaged only 0.53/hour on Swiftsure Bank. No adult chinooks were caught off Pachena Point, off Barkley Sound, or on 7 Mile Bank (Table 3).

Juvenile chinook catch rates ranged from 3.00/hour to 12.00/hour and averaged 8.81/hour on Swiftsure Bank and averaged 1.77/hour off Pachena, 0.55/hour off Barkley Sound, and 1.89/hour on 7 Mile Bank (Table 3). Juvenile and adult chinook catch rates were significantly correlated ($r = 0.7304$, $n = 10$, $P < 0.0164$).

Catch rates of the two most numerous size classes of juvenile chinook - 41-50 cm and 51-60 cm - were higher on Swiftsure Bank than on the other banks. Catch rates of juvenile chinook from 41 to 50 cm ranged from 1.33/hour to 5.20/hour and averaged 3.32/hour on Swiftsure Bank and averaged 0.44/hour off Pachena Point, 0.00/hour off Barkley Sound, and 1.56/hour on 7 Mile Bank. Catch rates of juvenile chinooks from 51 to 60 cm ranged from 1.00/hour to 5.64/hour and averaged 3.55/hour on Swiftsure Bank and averaged 1.11/hour off Pachena Point, 0.54/hour off Barkley Sound, and 0.07/hour on 7 Mile Bank (Table 3).

Catch rates of the three least numerous size classes of juvenile chinook - 21-30 cm, 31-40 cm, and 61-66 cm - were also higher on Swiftsure Bank than on the other banks. Catch rates of juvenile chinook from 21 to 30 cm ranged from 0.00/hour and 1.20/hour and averaged 0.39/hour on Swiftsure Bank. No juvenile chinook from 21 to 30 cm were caught off Pachena Point, off Barkley Sound, or on 7 Mile Bank. Catch rates of juvenile chinook from 31 to 40 cm ranged from 0.00/hour to 2.40/hour and averaged 0.81/hour on Swiftsure Bank and averaged 0.22/hour off Pachena Point, 0.00/hour off Barkley Sound, and 0.27/hour on 7 Mile Bank. Catch rates of juvenile chinook from 61 to 66 cm ranged from 0.00/hour to 1.82/hour and averaged 0.75/hour on Swiftsure Bank. No juvenile chinooks from 61 to 66 cm were caught off Pachena Point, off Barkley Sound, or on 7 Mile Bank (Table 3).

Catch rates of neighbouring chinook size classes were strongly correlated. Adult chinook catch rates were significantly correlated with catch rates of juvenile chinook from 61 to 66 cm and from 51 to 60 cm ($r = 0.807$, $df = 10$, $P < 0.0047$ and $r = 0.875$, $df = 10$, $P < 0.0009$). Catch rates of juvenile chinook from 61 to 66 cm and from 51 to 60 cm were significantly correlated ($r = 0.742$, $df = 10$, $P < 0.014$). Catch rates of juvenile chinook from 51 to 60 cm and 41 to 50 cm were significantly correlated ($r = 0.833$, $df = 10$, $P < 0.0028$). Catch rates of juvenile chinook from 41 to 50 cm were significantly correlated with those of juvenile chinook from 31 to 40 cm and from 21 to 30 cm ($r = 0.682$, $df = 10$, $P < 0.0298$ and $r = 0.743$, $df = 10$, $P < 0.0139$). Catch rates of juvenile chinook from 31 to 40 cm and from 21 to 30 cm were significantly correlated ($r = 0.894$, $df = 10$, $P < 0.0005$).

Adult coho catch rates ranged from 0.00/hour to 0.75/hour and averaged 0.38/hour on Swiftsure Bank and averaged 0.22/hour off Pachena Point, 0.00/hour off Barkley Sound, and 0.22/hour on 7 Mile Bank (Table 3). Adult coho and adult chinook catch rates were significantly correlated ($r= 0.6965$, $df = 10$, $P < 0.0253$). However, adult coho and juvenile chinook catch rates were not significantly correlated.

Juvenile coho catch rates ranged from 0.00/hour to 7.75/hour and averaged 2.14/hour on Swiftsure Bank and averaged 0.22/hour off Pachena, 0.00/hour off Barkley Sound, and 0.87/hour on 7 Mile Bank (Table 3). Juvenile and adult coho catch rates were significantly correlated ($r = 0.772$, $df = 10$, $P < 0.0089$). Juvenile coho catch rates were not significantly correlated with either adult or juvenile chinook catch rates.

(ii) COMPARISON OF CHINOOK AND COHO CATCHES BETWEEN THE FALLS OF 1987 AND 1988

We had previously conducted troll surveys in September and October, 1987, (Olsen et al. 1988) and this allowed us to compare chinook and coho distributions on the banks in the falls of 1987 and 1988. The sampling methods in 1987 differed from those in 1988 in that we measured fork lengths only of juvenile coho and chinook that were 40 cm or less in fork length. In addition we recorded the catch of larger coho and chinook. Therefore, we had to re-cast the 1988 chinook catch data into the 1987 format to make proper comparisons. In the following discussion, small chinook are defined as being 40 cm or less and large chinook as being greater than 40 cm.

The September distributions of large chinook were similar in 1987 and 1988 in that catch rates were high on Swiftsure Bank and 7 and 12 Mile Bank and low on Amphitrite Bank. Catch rates averaged 4.45/hour on Swiftsure Bank, 4.84/hour on 7 and 12 Mile Bank, and 1.59/hour on Amphitrite Bank over the two years. The October distributions of large chinook were also similar in 1987 and 1988 in that catch rates were high on Swiftsure Bank and low on 7 and 12 Mile Bank. Catch rates averaged 5.26/hour on Swiftsure Bank and 1.21/hour on 7 and 12 Mile Bank over the two years (Table 4).

The September catch rates of small chinook were much higher in 1987 than in 1988 and the distributions were not the same. In 1987, the average catch rate was 0.36/hour on Swiftsure Bank, 0.73/hour on Amphitrite Bank, and no small chinook were caught on 7 and 12 Mile Bank. In 1988, the average catch rate was 0.13/hour on 7 and 12 Mile Bank, 0.14/hour on Amphitrite Bank and no small chinook were caught on Swiftsure Bank (Table 4).

The October distributions of small chinook were also different in 1987 and 1988. In 1987, the average catch rate was 0.63/hour on 7 and 12 Mile Bank and 0.33/hour on Swiftsure Bank. In 1988, the average catch rate was 1.01/hour on Swiftsure Bank and 0.27/hour on 7 and 12 Mile Bank (Table 4).

The September adult coho catch rates were higher in 1987 than in 1988 but the distributions were similar. The average catch rate was highest on Swiftsure Bank at 15.29/hour in 1987 and 5.48/hour in 1988, second highest on 7 and 12 Mile Bank at 5.63/hour and 2.43/hour, and lowest on Amphitrite Bank at 0.65/hour and 0.14/hour (Table 4).

The October adult coho catch rates were also higher in 1987 than in 1988 and the distributions were different. In 1987, the average catch rate was 3.27/hour on Swiftsure Bank and 0.32/hour on 7 and 12 Mile Bank. In 1988, the average catch rate was 0.38/hour on Swiftsure Bank and 0.25/hour on 7 and 12 Mile Bank (Table 4).

The juvenile coho catch rates were higher in 1987 than in 1988 but the distributions were similar for all surveys. The September average catch rate was highest on Swiftsure Bank at 5.54/hour in 1987 and 3.86/hour in 1988, second highest on 7 and 12 Mile Bank at 2.75/hour and 2.09/hour, and lowest on Amphitrite Bank at 1.09/hour and 0.14/hour. The October average catch rate was also highest on Swiftsure Bank at 12.87/hour in 1987 and 2.13/hour and lower on 7 and 12 Mile Bank at 0.95/hour and 0.87/hour in 1988 (Table 4).

(iii) COMPARISON AMONG BANKS USING THE 1982 AND 1983 LOG BOOK DATA

In 1982 and 1983, troll fishermen that participated in the British Columbia Troll Logbook Program supplied information on catch, hours fished, and fishing locations three times daily during the salmon troll season. We selected records for trollers that fished the southwest coast of Vancouver Island from May 23 to June 5, in 1982 and 1983 from the program's databases. The selection produced two hundred thirty five catch records from twelve trollers in 1982 and one hundred thirty eight catch records from nine trollers in 1983. We posted the fishing locations from the loran coordinates in each record onto a computer generated chart of the waters off the southwest coast of Vancouver Island and thereby constructed distribution maps that showed where the trollers fished in 1982 and 1983 (Fig. 5). In 1982, the posting of the trollers' positions generated relatively dense clusters on Finger Bank and the Central Slope of La Pérouse Bank; moderately dense clusters on Swiftsure Bank, Pachena, Amphitrite Bank, the Gullies on La Pérouse Bank, and 7 and 12 Mile Bank; and a scatter of points on South Bank and off Tofino. In 1983, the posting of the trollers' positions generated moderately dense clusters on Finger Bank, the Gullies, Pachena, and Swiftsure Bank; and a scatter of points off Tofino, on the West Slope of La Pérouse Bank, South Bank, and 7 and 12 Mile Bank. We accumulated catch data for each of the areas for each year and then compared catch rates among the fishing banks.

We performed one-way analysis of variance to determine if the catch rates of adult chinook, juvenile chinook, and juvenile coho were significantly different among the fishing banks for 1982 and 1983, and Tukey studentized range tests to group the fishing banks on the basis of mean catch rate differences. The significance level for all tests was 0.05.

In 1982, adult chinook catch rates differed significantly among the offshore banks ($F = 5.04$, $df = 8/208$, $P < 0.0001$). Adult chinook catch rates were significantly higher on Pachena and Swiftsure Bank, where they

averaged 1.66/hour and 1.45/hour, than on South Bank and Amphitrite Bank, where they averaged 0.61/hour and 0.58/hour (Table 5). Adult chinook catch rates were also significantly higher on the Central Slope, where they averaged 1.43/hour, than on Amphitrite Bank. Adult chinook catch rates were not significantly different within the following three groups - Pachena, Swiftsure Bank, Finger Bank, 7 and 12 Mile Bank, Tofino, and the Gullies, where they ranged from 0.85/hour to 1.66/hour; the Central Slope, Finger Bank, 7 and 12 Mile Bank, Tofino, the Gullies, and South Bank, where they ranged from 0.61/hour to 1.43/hour; and Finger Bank, 7 and 12 Mile Bank, Tofino, Gullies, South Bank, and Amphitrite Bank, where they ranged from 0.58/hour to 1.12/hour.

In 1982, juvenile chinook catch rates were significantly higher on Swiftsure Bank, where they averaged 1.88/hour, than on the other banks , where they ranged from 0.15/hour to 0.93/hour ($F = 11.58$, df = 8/208, $P < 0.0001$) (Table 5).

In 1982, juvenile coho catch rates were significantly higher on the Gullies, where they averaged 0.97/hour than off Tofino where they averaged 0.07/hour ($F = 2.09$, df = 8/208, $P < 0.0380$) (Table 5). Juvenile coho catch rates were not significantly different within the following two groups - Gullies, South Bank, Finger Bank, 7 and 12 Mile Bank, Pachena, the Central Slope, Swiftsure Bank, and Amphitrite Bank, where they ranged from 0.13/hour to 0.97/hour; and South Bank, Finger Bank, 7 and 12 Mile Bank, Pachena, Central Slope, Swiftsure Bank, Amphitrite Bank, and off Tofino, where they ranged from 0.07/hour to 0.66/hour.

Adult chinook, juvenile chinook, and coho catch rates were not significantly correlated in 1982.

In 1983, adult chinook catch rates were significantly higher on Finger Bank, where they averaged 1.03/hour, than on South Bank, where they averaged 0.11/hour ($F = 2.33$, df = 8/120, $P > F = 0.0229$) (Table 5). Adult chinook catch rates were not significantly different within the following two groups - Finger Bank, the Gullies, Pachena, Swiftsure Bank, 7 and 12 Mile Bank, the West Slope, Amphitrite Bank, and off Tofino, where they ranged from 0.51/hour to 1.03/hour; and the Gullies, Pachena, Swiftsure Bank, 7 and 12 Mile Bank, the West Slope, Amphitrite Bank, and off Tofino, where they ranged from 0.51/hour to 1.00/hour.

In 1983, juvenile chinook catch rates differed significantly among the fishing banks ($F = 11.71$, df = 8/120, $P < 0.0001$) (Table 5). Juvenile chinook catch rates were significantly higher on Swiftsure Bank where they averaged 1.97/hour than on 7 and 12 Mile Bank, Finger Bank, Amphitrite Bank, South Bank, the Gullies, the West Slope, and off Tofino, where they ranged from 0.17/hour to 0.43/hour. Juvenile chinook catch rates were not significantly different between Swiftsure Bank and Pachena where they averaged 1.97/hour and 1.16/hour; and they were not significantly different among

Pachena, 7 and 12 Mile Bank, Finger Bank, Amphitrite Bank, South Bank, the Gullies, the West Slope, and off Tofino.

In 1983, juvenile coho catch rates were significantly higher on Swiftsure Bank, where they averaged 2.01/hour, than on Finger Bank and off Tofino, where they averaged 0.17/hour and 0.11/hour ($F = 5.79$, $df = 8/120$, $P > F = 0.0001$) (Table 5). Juvenile coho catch rates were not significantly different within the following two groups -Swiftsure Bank, South Bank, 7 and 12 Mile Bank, Pachena, Amphitrite Bank, the Gullies, and the West Slope, where they ranged from 0.56/hour to 2.01/hour; and South Bank, 7 and 12 Mile Bank, Pachena, Amphitrite Bank, the Gullies, the West Slope, Finger Bank, and off Tofino, where they ranged from 0.11/hour to 1.65/hour.

There were no significant correlations between average adult chinook, juvenile chinook, and coho catch rates among the banks in 1983.

We performed two-way analysis of variance to determine if the catch rates of adult chinook, juvenile chinook, and juvenile coho were significantly different for both between years and among the fishing banks for 1982 and 1983 combined, and Tukey studentized range tests to group the fishing banks on the basis of mean catch rate differences. The significance level for all tests was 0.05.

Adult chinook catch rates were significantly higher over all the offshore banks in 1982 than in 1983, when they averaged 1.13/hour and 0.80/hour ($F = 12.55$, $df = 1/328$, $P < 0.0005$) (Table 5). Juvenile chinook catch rates did not differ significantly in 1982 and 1983, when they averaged 0.75/hour and 0.74/hour ($F = 0.20$, $df = 1/328$, $P = 0.653$). Juvenile coho catch rates were significantly lower in 1982 than in 1983, when they averaged 0.49/hour and 0.95/hour ($F = 17.85$, $df = 1/328$, $P < 0.0001$).

Adult chinook catch rates differed significantly among the offshore banks for 1982 and 1983 combined ($F = 5.39$, $df = 9/328$, $P < 0.0001$) (Table 5). However, we can not make firm conclusions about the significance of these differences since the fishing bank - year interaction term was significant ($F = 2.33$, $df = 7/328$, $P > F = 0.025$). Nevertheless, Tukey's studentized range tests indicated that adult chinook catch rates were significantly higher on the Central Slope and Pachena, where they averaged 1.43/hour and 1.32/hour over the two years, than on the West Slope, Amphitrite Bank, and South Bank, where they ranged from 0.52/hour to 0.57/hour. Adult chinook catch rates were not significantly different within the following two groups - the Central Slope, Pachena, Swiftsure Bank, Finger Bank, the Gullies, 7 and 12 Mile Bank, and off Tofino, where they ranged form 0.74/hour to 1.43/hour; and Swiftsure Bank, Finger Bank, the Gullies, 7 and 12 Mile Bank, off Tofino, the West Slope, Amphitrite Bank, and South Bank, where they ranged from 0.52/hour to 1.12/hour.

Juvenile chinook catch rates differed significantly among the offshore banks for 1982 and 1983 combined ($F = 19.57$, $df = 9/328$, $P < 0.0001$)

and the fishing bank - year interaction term was not significant ($F = 1.13$, $df = 7/328$, $P > F = 0.34$) (Table 5). Juvenile chinook catch rates were significantly higher on Swiftsure Bank, where it averaged 1.92/hour, than all the other offshore banks. Juvenile chinook catch rates were significantly higher on Pachena, where it averaged 1.03/hour, than on the Gullies, Amphitrite Bank, off Tofino, and on the West Slope, where they ranged from 0.21/hour to 0.26/hour. Juvenile chinook catch rates were not significantly different within the two following groups - Pachena, Finger Bank, 7 and 12 Mile Bank, South Bank, and the Central Slope, where they ranged from 0.42/hour to 1.03/hour; and Finger Bank, 7 and 12 Mile Bank, South Bank, the Central Slope, the Gullies, Amphitrite Bank, off Tofino, and the West Slope, where they ranged from 0.21/hour to 0.72/hour.

Juvenile coho catch rates differed significantly among the offshore banks for 1982 and 1983 combined ($F = 2.17$, $df = 9$, $P > F = 0.024$) (Table 5). However, we can not make firm conclusions about the significance of these differences since the fishing bank - year interaction term was significant ($F = 7.49$, $df = 7$, $P > F = 0.0001$). Nevertheless, Tukey's studentized range tests indicated that juvenile coho catch rates were significantly higher on Swiftsure Bank, where they averaged 1.01/hour, than off Tofino, where they averaged 0.09/hour. Juvenile coho catch rates were not significantly different within the following two groups - Swiftsure Bank, South Bank, the Gullies, Pachena, 7 and 12 Mile Bank,the West Slope, the Central Slope, Amphitrite Bank, and Finger Bank, where they ranged from 0.46/hour to 1.01/hour; and South Bank, the Gullies, Pachena, 7 and 12 Mile Bank,the West Slope, the Central Slope, Amphitrite Bank, Finger Bank, and off Tofino, where they ranged from 0.09/hour to 0.82/hour.

There were no significant correlations between the two year average adult chinook, juvenile chinook, and coho catch rates among the banks.

In summary, adult chinook, juvenile chinook, and juvenile coho catch rates over 1982 and 1983 were higher on the fishing banks that lie south of 48° 45' N (Table 5). Adult chinook catch rates exceeded the two year average over all the banks on the Central Slope, Pachena, Swiftsure Bank, and Finger Bank that lie to the south of 48° 45' N, but were less than average on South Bank, Amphitrite Bank, and off Tofino. Juvenile chinook catch rates exceeded the overall average on just Swiftsure Bank and Pachena. Juvenile coho catch rates exceeded the overall average on the Swiftsure Bank, the Gullies, and Pachena. The only exception to the trend was the high juvenile coho catch rates on South Bank.

(iv) CHINOOK AND COHO FORK LENGTHS

In May, chinook fork lengths ranged from 28 to 93 cm and the mean fork length was 59.1 cm (S.D. = 12.6). In September, chinook fork lengths

ranged from 37 to 82 cm and the mean fork length was 56.6 cm (S.D. = 10.64). In October, chinook fork lengths ranged from 25 to 82 cm and the mean fork length was 50.4 cm (S.D. = 8.88) (Fig. 6). The decline in mean fork lengths may be due to the size selectivity as the season progressed of the commercial troll fleet, the migration of mature chinooks from the offshore banks to their spawning rivers in the fall, and the immigration of juveniles onto the fishing banks in the fall.

In May, coho ranged from 34 to 58 cm in fork length and averaged 42.7 cm (S.D.= 4.34). In September, coho ranged from 27 to 73 cm in fork length and the length frequency was bimodal - one peak corresponded to coho juveniles that had a mean fork length of 33.8 cm and the other to adult coho that had a mean fork length of 57.9 cm. Juvenile and adult coho made up 36.5 and 63.5% of the coho catch, respectively. In October, coho ranged from 24 to 77 cm in fork length and the length distribution had a strong negative skew with a large peak of juveniles at 30 - 40 cm and a few adults at 50 - 80 cm (Fig. 7). The percentage of juveniles increased to 84.0% of the coho caught, probably because most of the adult coho that had been present in September had moved on to their spawning rivers. Juveniles and adults had a mean fork lengths of 33.2 and 64.2 cm, respectively.

(v) CHINOOK AND COHO AGE DISTRIBUTIONS

(a) Chinook ages

We determined the ages of one hundred thirty four juvenile chinook equal to or less than 67 cm in fork length that were sampled in May. The Aging Unit at the Pacific Biological Station resolved the ages of one hundred five through the analysis of scale samples and we obtained the ages of twenty nine from release information associated with coded wire tags on the Department of Fisheries and Oceans' Salmon Stock Assessment database (Table 6). The age composition of these juvenile chinook was as follows - 39.5% were age 0.1, 40.3% were age 0.2, and 7.5% were age 0.3, which means that 87.3% of the juveniles had been 0. age smolts; and 7.5% were age 1.1 and 5.2% were age 1.2, which means that 12.7% had been 1. age smolts.

The age 0.1 juvenile chinook ranged in fork length from 28 to 48 cm and had a mean fork length of 36.7 (S.D. = 4.3). The age 0.2 juvenile chinook ranged in fork length from 40 to 61 cm and had a mean fork length of 51.7 cm (S.D. = 4.9). Age 0.2 fork lengths were significantly greater than those of age 0.1 ($t = 16.7$, $df = 105$, $P < 0.05$). The age 0.3 juvenile chinook ranged in fork length from 53 to 63 cm and had a mean fork length of 56.1 cm (S.D. = 3.7). Two adult chinooks that were sampled were age 0.3 and had fork lengths of 71 and 81 cm, respectively, and so we did not make statistical size at age comparisons between age 0.3 and other age classes of juvenile chinook. The age 1.1 juvenile chinook ranged in fork length from 38 to 57 cm and had a

mean fork length of 46.4 cm (S.D. = 6.2). Age 1.1 fork lengths were significantly greater than those of age 0.1 ($t = 5.96$, $df = 61$, $P < 0.05$), and significantly less than those of age 0.2 ($t = 2.98$, $df = 62$, $P < 0.05$). The age 1.2 juvenile chinook ranged in fork length from 52 to 60 cm and had a mean fork length of 55.8 cm (S.D. = 2.9). Age 1.2 fork lengths were significantly greater than those of age 1.1 ($t = 5.08$, $df = 15$, $P < 0.05$). Age 1.2 and 0.2 fork lengths were not significantly different ($t= 2.14$, $df = 59$, $P > 0.05$).

We used the age structure of the one hundred thirty four juvenile chinooks that were sampled to determine what age classes contributed to the 10 cm fork length intervals used in the fork length frequency histograms (Fig. 6). All except one of the chinooks that were less than or equal to 40 cm were in their second year of marine life. Of the forty four chinooks in that size category, forty were age 0.1, two were age 1.1, and one was age 0.2. However, it was not possible to assign a unique age to any of the 10 cm intervals above 40 cm because the fork length ranges of the age classes overlapped to a considerable extent over 40 cm. Of the thirty eight chinooks in the 41 to 50 cm interval, twelve were age 0.1, five were age 1.1, twenty were age 0.2, and one was age 0.3. Of the forty nine chinook in the 51 to 60 cm interval, three were age 1.1, thirty one were age 0.2, seven were 1.2, and eight were 0.3. Of the three chinooks in the 61 to 66 cm interval, two were age 0.2 and one was age 0.3.

We determined the ages of twenty four juvenile chinooks that we sampled in September - twenty three from scale analysis and one from its coded wire tag (Table 6). Twenty one were age 0.1, one was age 1.1, and two were age 0.2. The age 0.1 juvenile chinook ranged in fork length from 37.5 to 56.5 cm and had a mean fork length of 47.1 cm (S.D. = 4.8). This means that age 0.1 chinook had grown an average of 10.3 cm from May to September. The age 1.1 juvenile chinook had a fork length of 57.0 cm. The age 0.2 juvenile chinook had fork lengths of 56.0 and 60.0 cm.

We determined the ages of forty one juvenile chinook that were caught in October - thirty five from scale analysis and six from coded wire tags (Table 6). Three were age 0.0, thirty six were age 0.1, and two were age 1.1. The age 0.0 juvenile chinook had fork lengths of 25.0, 27.0, and 27.3 cm. The age 0.1 juvenile chinook ranged in fork length from 37.0 to 58.0 cm and had a mean fork length of 45.7 cm (S.D. = 4.6). The decrease in mean fork length of age 0.1 juvenile chinook from 47.1 cm in September to 45.7 cm in October was not significant ($t =1.033$, $df = 55$, $P > 0.05$). The age 1.1 juvenile chinooks had fork lengths of 61.0 and 54.5 cm, respectively.

We determined the ages of thirty six juvenile chinook less than 40 cm in fork length that were caught in the fall of 1987 - thirty two from scale analysis and four from coded wire tags (Table 6). Twenty one were age 0.0, three were age 1.0, and twelve were age 0.1. The age 0.0 juvenile chinook ranged in fork length from 19.6 to 28.9 cm and had a mean fork length of 24.4 cm (S.D. = 2.6). The age 1.0 juvenile chinook had fork lengths of 26.8, 30.2, and 31.1 cm. Mean fork lengths were not determined for 0.1 age juvenile

chinook because the 1988 surveys revealed that a high proportion of this age class exceed the upper sampling limit of 40 cm fork length that was in effect for the 1987 surveys.

(b) Coho ages

We determined the ages of forty three coho that were caught in May - thirty nine by the analysis of scale samples and four from coded wire tags (Table 6). One was age 0.1, forty were age 1.1, and two were age 2.1. The age 0.1 coho had a fork length of 48 cm. The age 1.1 coho ranged in fork length from 34 to 58 cm and had a mean fork length of 44.1 cm (S.D. = 5.0). The two age 2.1 coho had fork lengths of 48 and 55 cm.

We determined the ages of five coho that were caught in September - three by the analysis of scale samples and two from coded wire tags (Table 6). Four were age 1.0 and one was age 1.1. Two of the four age 1.0 coho were "jacks" or precociously maturing males that had fork lengths of 27 and 40 cm, and two were females that had fork lengths of 29 and 34 cm. The age 1.1 coho was a mature male and had a fork length of 39 cm.

We determined the age of three coho that were caught in November - one by the analysis of scales and two from coded wire tags (Table 6). All three were age 1.0 and they had fork lengths of 42, 40, and 37 cm.

(vi) SEX FREQUENCIES

Chi-square tests demonstrated that sex frequencies for juvenile chinook, adult chinook, juvenile coho, and adult coho that were caught in May, September, and October were not significantly different from the expected 1:1 ratio at the 0.05 level of significance.

(vii) CAPTURE DEPTHS

We performed one-way analysis of variance tests to determine if mean capture depths of adult chinook, juvenile chinook, and adult and juvenile chinook combined were different in May, October, and November; if mean capture depths were different among size categories of chinook in May, September, and October; if mean capture depths of adult coho in May, September and October were different; and if mean capture depths were different between adult and juvenile coho in September and October. If there was a significant difference among groups, we performed Tukey studentized range tests to determine which

means differed from one another. The significance level for all tests was 0.05.

Adult chinook were caught at significantly different depths among the May, September, and October surveys ($F = 3.12$, $df = 2/306$, $P < 0.0454$), when mean depths of capture were 38.2, 40.9, and 31.2 m, respectively (Table 7). Adult chinook were not caught at significantly different depths in May and September nor in May and October, but they were caught at significantly shallower depths in October than in September. Juvenile chinook were caught at significantly different depths among the May, September, and October surveys ($F = 3.26$, $df = 2/1074$, $P < 0.0386$), when mean depths of capture were 37.2, 40.2, and 37.0 m, respectively (Table 7). Juvenile chinook were not caught at significantly different depths in May and October, but they were caught at significantly deeper depths in September than in either May or October. Adult and juvenile chinook combined were caught at significantly different depths among the May, September, and October surveys ($F = 4.56$, $df = 2/1383$, $P < 0.0107$), when mean capture depths were 37.5, 40.4, and 36.7 m, respectively. Chinook were not caught at significantly different depths in May and October, but they were caught at significantly deeper depths in September than in either May or October.

Chinook of different size classes were caught at significantly different depths in May ($F = 5.79$, $df = 5/1039$, $P < 0.001$) (Table 7). Although, adult chinook and juvenile chinook between 31-40 cm, 41-50 cm, 51-60 cm, and 61-66 cm in fork length were caught at an overall mean depth of 37.6 m and the differences among them were not significant, juvenile chinook between 21 and 30 cm were caught at a significantly shallower mean depth of 26.5 m. Chinook of the different size classes were not caught at significantly different depths in September, ($F = 0.42$, $df = 4/95$, $P = 0.7962$), and the overall mean depth of capture was 40.4 m. Chinook of the different size classes were also not caught at significantly different depths in October ($F = 1.90$, $df = 5/226$, $P < 0.0958$) (Table 7), and the overall mean depth of capture was 36.7 m.

The true mean capture depths of chinook may be deeper than the values presented. Chinook in all size classes in May, September, and October, where the number of chinook was equal to or exceeded 30, were caught with increasing frequency with increasing depth to 45 m and with decreasing frequency from 45 to 60 m (Fig. 8, 9, 10). This may be deceptive in that the gear was lowered to this depth range on only a few occasions in May and no fishing was done below 45 m in September and October. We did not fish deeper than 60 m because, in the trollers' judgement, it was not necessary to fish any deeper to catch chinook on the offshore banks where depths ranged from 70 to 100 m.

Coho were caught at significantly shallower depths than chinook in May and both adult and juvenile coho were caught at significantly shallower depths than chinook in September and October ($F = 85.46$, $df = 2/1191$, $P < 0.0001$; $F = 80.57$, $df = 3/255$, $P < 0.0001$; $F = 202.27$, $df = 3/312$,

$P < 0.0000$). In May, coho and chinook were caught at mean depths of 24.6 and 37.5 m, respectively. In September, adult coho, juvenile coho, and chinook were caught at mean depths of 21.9, 15.6, and 40.4 m. In October, adult coho, juvenile coho, and chinook were caught at mean depths of 11.3, 10.1, and 37.7 m (Table 7).

Adult coho were caught at significantly different depths in May, September, and October ($F = 7.11$, $df = 2/253$, $P > 0.0010$), when they were caught at mean depths of 24.6, 21.9, and 11.3 m, respectively. Adult coho were not caught at significantly different depths in May and September, but they were caught at significantly shallower depths in October than in either May or September. Juvenile coho were caught at significantly shallower depths in October than in September ($F = 12.16$, $df = 1/125$, $P < 0.0007$), when they were caught at 10.1 and 15.6 m, respectively. Adult coho were caught at significantly deeper depths than juveniles in September ($F = 9.63$, $df = 1/157$, $P > 0.0023$), but not in October ($F = 0.32$, $df = 1/80$, $P = 0.5718$) (Table 7).

(viii) CWT RECOVERIES

In May, we recovered thirty three coded-wire tags - twenty nine from juvenile chinook and four from coho salmon (Table 8). We caught twenty-three of the tagged chinook on Swiftsure Bank and six on 7 and 12 Mile Bank. All twenty nine tagged chinook were from U.S.A. stocks - seventeen originated from hatcheries located on tributary rivers of the lower Columbia River, one from the upper Columbia River region, two from the Snake River region, two from northern Oregon coastal streams, and six from rivers flowing into Puget Sound, Hood Canal, and lower Georgia Strait. One chinook was tagged by the Oregon Department of Fish and Wildlife but no release information was available within the Salmon Stock Assessment databases. Of the twenty nine juvenile chinook, five were age 0.1, five were age 1.1, twelve were age 0.2, two were age 1.2, and five were age 0.3. Of the four tagged coho, three originated from Washington State hatcheries in the Puget Sound, Hood Canal, and lower Georgia Strait production areas. The remaining tag was Canadian and came from the Millstone River, near Nanaimo, British Columbia. One was age 0.1, four were age 1.1, and two were age 2.1.

In September and October, we recovered coded-wire tags from five coho and five chinooks. Of the five tagged chinook, four were from U.S.A. hatcheries - three from the lower Columbia River and one from the Snake River. The remaining chinook tag was from the Canadian Department of Fisheries and Oceans' Chehalis River hatchery on the Fraser river system. Three tagged chinook from the Chehalis River, Tanner Creek in the lower Columbia River region in Oregon, and the Cowlitz River in the lower Columbia River region in Washington were age 0.1. Two tagged chinook from the Snake River and the Cowlitz River were age 0.2. All five coho were produced in Washington State hatcheries - one from the lower Columbia River region, one from Quinault Lake

situated near the coast, and three from as yet unknown regions because there is no release information on these tagcodes in the Salmon Stock Assessment database. Four coho were age 1.0. The tagged coho from a Cowlitz River stock within the lower Columbia River system was age 1.1.

In the fall of 1987, we captured fifteen tagged coho and four tagged chinook (Table 8). We made proportionally fewer tagged chinook recoveries in 1987 than in 1988 because of differences in sampling protocol - in 1987, we sampled only juvenile chinook less than 40 cm in length and released all the other chinooks before they were brought aboard where they could have been examined; in 1988, we brought all the chinooks aboard for a quick fork length measurement. All four tagged chinooks were produced in U.S.A. hatcheries - one was from the Columbia River region, two were from the Snake River region, and one was from the Coos River in south coastal Oregon State. Three chinook were age 1.0 and had fork lengths of 28, 31, 30 cm. The chinook from the Coos River in Oregon State was a late release that was age 0.1 and it had a fork length of 43 cm. Of the fifteen tagged coho, fourteen were produced in U.S.A. hatcheries. Six were from the lower Columbia River region and seven were from the Puget Sound, Hood River, and lower Georgia Strait production areas. The remaining tag was released by the Oregon Department of Fisheries and Wildlife but because there was no release information available the production area and stock are not yet known. The one Canadian tagged coho was produced in the Kanaka hatchery in the lower Fraser River production area. All the U.S.A. coho were age 1.1 and were between 31 and 35 cm in fork length. The Canadian coho was age 1.1, a maturing female, and larger at 38 cm.

(ix) COMPARISON OF FEEDING ACTIVITY AMONG THE OFFSHORE BANKS

We performed Kruskal-Wallis rank sum tests to determine if stomach content dry weight to body wet weight ratios were different between chinook and coho in May, September, and October, 1988 and in the fall of 1987; and if either or both the chinook and coho ratios were different among the fishing banks in May, September, and October, 1988 and in the fall of 1987. The significance level for these tests was 0.05. We decided to use the non-parametric Kruskal-Wallis test in lieu of ANOVA because the stomach content dry to body weight ratio distributions were negatively skewed with a high proportion of values at or close to zero.

We did not expect such a high proportion of empty stomachs and stomachs with low content weights, and these observations are disturbing since they suggest a level of food intake that is not sufficient to support the documented growth of juvenile chinook and coho in their first and second years of marine life. It is possible that salmon that have no or very little food in their stomachs are more likely to go after the fishing gear. It is also possible that hooked salmon regurgitate their stomach contents before they are

landed. We did not observe any signs of regurgitation in the holding bins on board the troller, but Terrence Gjernes at the Pacific Biological Station said that it was very common for sport caught salmon to regurgitate their stomach contents just before being netted and in tanks during a 24 hour observation period following capture (personnel communication). The third possibility is that the results reflect the reality of very low feeding on the offshore banks.

In May, 1988 coho and chinook stomach content dry weight to body wet weight ratios differed significantly and the medians were 0.056 and 0.010 mg/g, respectively (Chisq = 6.43, $P < 0.05$). However, they did not differ significantly in September and October and the medians were both 0.000 mg/g (Chisq = 0.20, P = 0.6569) (Table 9).

In the fall of 1987, coho and chinook stomach content dry weight to body wet weight ratios did not differ significantly and the median values were 0.053 and 0.012 mg/g, respectively (Chisq = 3.49, $P > 0.05$). Thirteen juvenile pink salmon that were caught on the November, 1987 survey had a median stomach content dry weight to body wet weight ratio of 1.917 mg/g (Table 9).

Chinook stomach content dry weight to body wet weight ratios did not differ significantly among fishing banks in May, 1988, when the overall median was 0.010 mg/g (Chisq = 5.28, $P > 0.05$), in September when the overall median was 0.000 mg/g (Chisq = 1.79, $P > 0.4080$), or in October when the overall median was 0.000 mg/g (Chisq = 3.38, $P > 0.3365$) (Table 9).

Coho stomach content dry weight to body wet weight ratios did not differ significantly among banks in May, 1988 when the overall median was 0.056 mg/g, (Chisq = 1.98, $P > 0.5770$), in September when the overall median was 0.000 mg/g (Chisq = 0.57, $P > 0.7510$), or in October when the overall median was 0.000 mg/g (Chisq = 1.24, $P > 0.5386$) (Table 9).

In the fall of 1987, chinook stomach content dry weight to body wet weight ratios did not differ significantly among banks and the overall median was 0.012 mg/g (Chisq = 5.16, $P > 0.2709$). However, coho stomach content dry weight to body wet weight ratios did differ significantly among banks in 1987 and the medians were 0.063 mg/g for 7 and 12 Mile, 0.042 mg/g for Amphitrite, 0.000 mg/g for Barkley Sound and Pachina, and 0.075 mg/g for Swiftsure (Chisq = 16.68, $P < 0.0022$) (Table 9). The significant difference was primarily due to the low stomach content to body weight ratios on Pachena, reflected in a low mean Wilcoxon rank score of 61.17 relative to those of 129.09, 117.35, and 119.56 on 7 and 12 Mile Bank, Amphitrite Bank, and Swiftsure Bank, respectively.

We found no significant correlations at the 0.05 level between adult chinook, juvenile chinook, adult coho, and juvenile coho daily catch rates, and daily median stomach content dry weight to body wet weight ratios

in May or in the fall, that would have suggested an association between apparent fish densities and feed concentrations.

(x) PERCENT FREQUENCY OF OCCURRENCE OF DIET ITEMS

In May, 1988, the principal diet item of coho was crab larvae that were observed in 84.5% of stomachs (Table 10). The second most common diet item was pteropod molluscs at 53.5%. Euphausiids, fish, and amphipods were found in 35.2, 29.6, and 22.5% of stomachs, respectively. The principal diet items of chinook were crab larvae, euphausiids, and fish that were found in 45.3, 42.7, and 37.6% of stomachs, respectively. Chinook, in contrast to coho, fed very little on pteropod molluscs and amphipods.

In the fall of 1988, the principal diet items of coho were pteropod molluscs, euphausiids, and amphipods that were found in 57.1, 54.3, and 54.3% of stomachs, respectively (Table 10). Secondary diet items were fish and crab larvae. Chinooks fed almost exclusively on fish and euphausiids at this time of the year. Chinook, in contrast to coho, were not feeding at all on pteropod molluscs, amphipods, and crab larvae.

In the fall of 1987, the principal diet items of coho were fish, euphausiids, pteropods, and amphipods (Table 10). In contrast to 1988 no crab larvae were found in the coho stomachs. From September to November, 1987, fish increased in importance in the diet of coho whereas euphausiids decreased. Amphipods increased in importance in coho diets from September to October, then decreased substantially in November. Pteropod molluscs showed the reverse pattern - they decreased in importance from September to October then increased in November. Since only 23 chinook stomachs were analyzed from the September, October, and November surveys in 1987, the diet information was pooled. The principal diet items were fish, euphausiids, and amphipods that were found in 52.2, 26.1, and 21.7% of stomachs, respectively. Pteropod molluscs and squid were minor diet components. Thirteen pink salmon were caught in November. All had pteropods in their stomachs and twelve had been feeding heavily. Amphipods and euphausiids were minor diet components.

IV. DISCUSSION

Healey and Morris (1987) hypothesized that the ocean survival of the chinook and coho populations off the southwest coast of Vancouver Island is intimately linked to their patterns of dispersal and aggregating behaviour on the offshore banks and that these behaviours are a response to

oceanographic conditions. Results presented here indicate strong seasonal patchiness in distribution of coho and chinook - a condition prerequisite to being able to test associations between aggregating behaviour, survival, and oceanography.

Chinook and coho were markedly more abundant over all the offshore banks in May, 1988 than during the same period in 1982 and 1983. Adult chinook catch rates averaged 2.80/hour in 1988 and just 0.97/hour in 1982 and 1983; juvenile chinook catch rates averaged 8.94/hour in 1988 and just 0.75/hour in 1982 and 1983; and coho catch rates averaged 1.81/hour in 1988 and 0.49/hour and 0.95/hour in 1982 and 1983, respectively.

The distribution of chinooks over 7 and 12 Mile Bank, Swiftsure Bank, and Finger Bank was different between May, 1988, and May, 1982 and 1983. Adult chinook catch rates were high on 7 and 12 Mile Bank and Swiftsure Bank and low on Finger Bank in 1988 but they were not significantly different among these three banks in 1982 and 1983. Juvenile chinook catch rates were also high on 7 and 12 Mile Bank and Swiftsure Bank and low on Finger Bank in 1988 but they were significantly higher on Swiftsure Bank than on all the other offshore banks in 1982 and 1983.

Coho and chinook distributional patterns differed in May, 1988, in that coho were more uniformly distributed among the banks. However, this difference may not occur every spring because the 1982 and 1983 troll log book program indicated that coho catch rates can vary as much as chinook catch rates among the banks.

Chinook and coho distributions in September 1988 were similar to those observed in 1987 (Olsen et al. 1988). Chinook greater than 40 cm in fork length were more abundant on Swiftsure Bank and 7 and 12 Mile Bank than on Amphitrite Bank whereas chinooks less than 40 cm were low in abundance over all three banks. Adult and juvenile coho were more abundant on 7 and 12 Mile Bank and Swiftsure Bank than on Amphitrite Bank.

In October 1988, we concentrated most of our fishing effort on Swiftsure Bank to coincide with an intensive Acoustic Doppler Current Profiler (ADCP) survey and a series of surface current measurements by high frequency ground wave radars (CODAR) from stations on the beach. We were also restricted to fishing near shore by bad weather.

We had hypothesized that the chinook distributions or population characteristics on the offshore banks might undergo a shift triggered by the fall transition, reflecting the movement of chinooks along the coast away from their natal streams to as far as 1000 km. We planned to test this hypothesis by comparing results of the September survey, which should have pre-dated the fall transition, with the October survey, which should have post-dated the fall transition. However, the oceanographic survey in October revealed that the fall transition had not yet taken place and that a summer-like circulation pattern still prevailed (Freeland 1988b).

While we were not given the opportunity to test the fall transition hypothesis, the October and September surveys had similar chinook and coho distributional patterns and so indicated that the pre-transition distribution was relatively stable. In September and October, juvenile chinook and juvenile and adult coho catch rates were higher on Swiftsure than 7 and 12 Mile Bank Adult chinook catch rates in September were higher on 12 Mile Bank but in October were higher on Swiftsure, so that adult chinook did not show the same stability as the other three species/size categories.

It is unclear whether juvenile chinook distributions among the fishing banks are more similar between years than those of adult chinook and coho because the results of different analyses were contradictory. Two-way ANOVA's of May, 1982 and 1983 catch data demonstrated that there was no significant fishing bank - year interaction for the juvenile chinook catch rates and significant interaction for adult chinook and coho catch rates, as well as significant differences in catch rate among banks. This suggests that juvenile distributions were more similar from year to year than adult. However, comparison of the catch data from the autumn of 1987 and 1988 suggested that the distribution of chinook greater than 40 cm in fork length among the fishing banks was more similar between years than that of smaller chinook.

The results of correlation analyses on chinook and coho catch rates suggest that age and size categories within the same species tend to have similar habitat preferences and aggregate at the same locations, but that large and small chinook and chinook and coho may have different habitat preferences. For example, catch rates of chinooks within neighbouring size classes were often significantly correlated whereas those in distant size classes were not. In May, 1982 and 1983, catch rates of legal sized chinook were not correlated with catch rates of sub-legal sized chinook. In October, 1988, adult and juvenile coho catch rates were significantly correlated. (All the coho were of the same size and age class in May and there were not enough data points in September to permit a correlation analysis.) However, coho catch rates were not significantly correlated with either adult and juvenile chinook catch rates in May, 1982, 1983, and 1988. In October, 1988 coho catch rates were significantly correlated with adult chinook catch rates but they were not significantly correlated with juvenile chinook catch rates.

Chinook and coho catch rates were not significantly correlated with stomach content weights in May, September, and October, 1988 suggesting that chinook and coho are not aggregating where the feeding conditions are good. Furthermore, we have no evidence that feeding conditions were better on some banks than others. In fact, our results suggest that feeding conditions were poor on all the banks fished both in May and the fall because stomach content weights were always very low in proportion to body weights.

The predominant age classes of chinook < 67 cm fork length in May, 1988 were 0.1 and 0.2. Larger chinook tended to be age 0.2 and older. Almost ninety percent of the chinook had migrated to sea as 0. age smolts. Most of

the chinook juveniles captured in the fall were age 0.1. Almost all the coho captured in the spring were age 1.1, but there were two age classes in the fall - juvenile coho that were age 1.0 and adult coho that were age 1.1.

Chinook and coho mean sizes changed between sampling periods but this probably reflects a combination of growth and size dependant immigration and emigration. The changes cannot, therefore, be used to infer growth. Chinook mean fork lengths decreased from 59.1 cm in May to 50.4 cm in October. Adult coho fork lengths increased with time from 42.7 cm in May to 64.2 cm in October. Juvenile coho sizes decreased from 36.5 cm in September to 33.2 cm in October.

The depth distributions of chinook and coho were different - chinook were caught at average depths between 30 and 40 m and coho were caught between 10 and 25 m in May, September, and October. The data suggest that both adult and juvenile coho move toward the surface in the autumn. Average adult coho depths of capture decreased successively in May, September, and October and juvenile coho decreased from September to October. Chinook, on the other hand, showed no consistent time trend in depth of capture, being caught deeper in September than in May and October. Juvenile chinook less than 40 cm appear to move deeper with time but the sample sizes in September and October were small.

Coded-wire tag recoveries suggest that most of the chinook and coho that reside on the banks off southwest Vancouver Island, including those in their first ocean year, originate from Washington and Oregon States. Ninety-five percent of the combined chinook and coho recoveries were from the United States. This raises the question of where the Nitinat and Robertson Creek hatchery-produced chinook and coho, spend their first ocean year. They probably migrate to the northwest along the coast of Vancouver Island soon after leaving Nitinat Lake and Barkley Sound. If this hypothesized migratory behaviour is true, then the advantage of it is unclear since the fish would by-pass excellent local nursery areas to go elsewhere.

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VI. REFERENCES

Freeland, H. J. 1987. Fishing banks studies: eddy circulation over fishing banks off southwest Vancouver Island, p. 41-42. In: The Marine survival of Salmon Program, Annual Progress Report, 1987 (produced by the Biological Sciences Branch, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6).

Freeland, H. J. 1988a. Derived Lagrangian statistics on the Vancouver Island continental shelf and implications for salmon migration. Atmosphere-Ocean 26(2). 267-281.

Freeland, H. J. 1988b. Fishing banks studies: physical oceanography, p. 56-60. In: The Marine Survival of Salmon Program, Annual Progress Report, 1988 (produced by the Biological Sciences Branch, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6).

Healey, M. C and J. F. T. Morris. 1987. Fishing banks studies: aggregations of juvenile coho and chinook on fishing banks off southwest Vancouver Island, p. 42-48. In: The Marine Survival of Salmon Program, Annual Progress Report, 1987 (produced by the Biological Sciences Branch, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6).

Healey, M. C., M. Abrahams, J. Morris, and B. Waddell. 1988. Fishing banks studies: juvenile salmon on offshore banks, p. 61-71. In: The Marine Survival of Salmon Program, Annual Progress Report, 1988 (produced by the Biological Sciences Branch, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6).

Morris, J. F. T., M. C. Healey, and B. J. Waddell. 1989. Continental Shelf studies: chinook and coho populations on the offshore banks, p. 48-57. In: The Marine Survival of Salmon Program, Annual Progress Report, 1989 (produced by the Biological Sciences Branch, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6).

Olsen, N. H., J. F. T. Morris, and M. C. Healey. 1988. Swiftsure and Amphitrite Banks juvenile salmon survey, September 25-29, October 9-13, November 23-25, 1987. Can. Tech. Rep. Fish. Aquat. Sci. 1615.

Table 1. Catch rates (fish/hour) on different banks for adult chinook, juvenile chinook, and coho, May 23-June 5, 1988.

DATE	LOCATION	TACK	HOURS	ADULT CHINOOK	JUVENILE CHINOOK	JUVENILE CHINOOK SIZE CLASSES (CM) 61-66	51-60	41-50	31-40	21-30	ALL CHINOOK	ALL COHO
MAY 23	SWIFTSURE		8.50	4.47	12.59	4.71	4.94	1.65	1.29	0.00	17.06	2.71
MAY 24	SWIFTSURE	A	4.50	2.67	7.11	2.22	2.89	1.11	0.89	0.00	9.78	3.33
MAY 24	SWIFTSURE	B	4.75	2.11	8.00	2.95	3.58	0.84	0.63	0.00	10.11	1.47
MAY 28	SWIFTSURE	A	3.00	2.67	11.00	5.00	4.00	0.67	1.33	0.00	13.67	0.67
MAY 29	SWIFTSURE		5.00	3.60	10.60	3.60	4.60	1.20	1.00	0.20	14.20	0.38
MAY 31	SWIFTSURE	A	4.75	1.05	5.68	0.63	2.11	1.68	1.05	0.21	6.74	1.26
MAY 31	SWIFTSURE	B	4.75	1.47	10.74	0.84	3.58	3.16	3.16	0.00	12.21	1.90
JUNE 4	SWIFTSURE	C	2.25	0.89	3.11	1.33	0.89	0.00	0.89	0.00	4.00	0.00
JUNE 5	SWIFTSURE		5.00	1.60	8.00	1.60	3.60	1.80	1.00	0.00	9.60	0.80
	MEAN			2.28	8.54	2.54	3.35	1.35	1.25	0.05	10.82	1.39
MAY 28	PACHENA	B	4.00	1.50	16.25	3.00	6.75	3.75	2.50	0.25	17.75	4.50
MAY 25	FINGER		8.75	2.51	3.65	1.37	1.03	0.57	0.57	0.11	6.17	1.26
MAY 26	FINGER	A	4.16	0.00	3.60	0.48	0.48	1.20	1.44	0.00	3.61	3.85
JUNE 4	FINGER	B	1.00	0.00	4.00	1.00	0.00	1.00	2.00	0.00	4.00	2.00
	MEAN			0.84	3.75	0.95	0.50	0.92	1.34	0.04	4.59	2.37
MAY 26	7+12	B	6.16	7.63	12.66	5.52	3.73	1.30	1.95	0.16	20.29	1.30
MAY 27	7+12		8.00	8.38	14.38	6.50	5.50	1.88	0.50	0.00	22.75	0.88
JUNE 1	7+12		5.50	6.00	10.36	2.91	4.91	1.09	1.09	0.36	16.36	1.09
JUNE 4	7+12	A	3.00	1.00	10.33	1.33	3.00	3.00	2.67	0.33	11.33	3.33
	MEAN			5.75	11.93	4.07	4.29	1.82	1.55	0.21	17.68	1.65
OVERALL MEAN				2.80	8.94	2.65	3.27	1.52	1.41	0.10	11.74	1.81

Table 2. Catch rates (fish/hour) on different banks for adult chinook, juvenile chinook, adult coho, and juvenile coho, September 26-30, 1988.

OATE	LOCATION	TACK	HOURS	AOULT CHINOOK	JUVENILE CHINOOK	JUVENILE CHINOOK SIZE CLASSES (CM) 61-66	51-60	41-50	31-40	21-30	ALL CHINOOK	AOULT COHO	JUVENILE COHO	ALL
SEPT 26	SWIFTSURE		6.16	0.97	3.42	0.49	1.79	1.14	0.00	0.00	4.38	10.71	3.57	14.29
SEPT 30	SWIFTSURE	A	3.00	0.33	3.01	0.67	0.67	1.67	0.00	0.00	3.33	5.00	5.00	10.00
SEPT 30	SWIFTSURE	B	2.75	0.36	5.09	0.36	1.46	3.27	0.00	0.00	5.46	0.73	1.82	2.54
	MEAN			0.55	3.84	0.51	1.31	2.03	0.00	0.00	4.39	5.48	3.46	8.94
SEPT 27	7 MILE	A	4.00	0.25	1.75	0.00	0.50	1.00	0.25	0.00	2.00	0.00	0.75	0.75
SEPT 27	12 MILE	B	3.50	3.71	3.71	1.14	1.14	1.43	0.00	0.00	7.43	4.86	3.43	8.29
	MEAN			1.98	2.73	0.57	0.82	1.22	0.13	0.00	4.72	2.43	2.09	4.52
SEPT 29	SOUTH BANK		7.00	0.00	2.00	0.14	1.14	0.57	0.14	0.00	2.00	0.14	0.14	0.29
OVERALL MEAN				0.94	3.16	0.47	1.12	1.51	0.07	0.00	4.10	3.57	2.45	6.05

Table 3. Catch rates (fish/hour) on different banks for adult chinook, juvenile chinook, adult coho, and juvenile coho, October 23-30, 1988.

DATE	LOCATION	TACK	HOURS	ADULT CHINOOK	JUVENILE CHINOOK	JUVENILE CHINDOK SIZE CLASSES (CM) 61-66	51-60	41-50	31-40	21-30	ALL CHINOOK	ADULT COHO	JUVENILE COHO	ALL COHO
OCT 23	SWIFTSURE		2.50	0.40	13.60	0.80	4.00	5.20	2.40	1.20	14.00	0.00	0.00	0.00
OCT 24	SWIFTSURE	A	4.00	0.75	10.00	0.00	4.50	4.00	0.75	0.75	10.75	0.75	7.75	8.50
OCT 24	SWIFTSURE	B	3.00	0.00	3.00	0.00	1.00	1.33	0.67	0.00	3.00	0.33	2.67	3.00
OCT 26	SWIFTSURE		8.00	0.13	7.27	0.38	2.63	3.00	0.88	0.38	7.38	0.13	0.25	0.38
OCT 27	SWIFTSURE		5.50	0.91	12.00	1.82	5.64	4.36	0.18	0.00	12.91	0.55	1.64	2.18
OCT 28	SWIFTSURE	A	2.00	1.00	7.00	1.50	3.50	2.00	0.00	0.00	8.00	0.50	0.50	1.00
	MEAN			0.53	8.81	0.75	3.55	3.32	0.81	0.39	9.34	0.38	2.14	2.51
OCT 28	PACHENA	B	4.50	0.00	1.77	0.00	1.11	0.44	0.22	0.00	1.78	0.22	0.22	0.44
OCT 25	7 MILE		7.50	0.00	2.66	0.00	0.13	2.00	0.53	0.00	2.67	0.27	1.73	2.00
OCT 29	7 MILE		4.50	0.00	1.11	0.00	0.00	1.11	0.00	0.00	1.11	0.22	0.00	0.22
	MEAN			0.00	1.89	0.00	0.07	1.56	0.27	0.00	1.89	0.25	0.87	1.11
OCT 30	BARKLEY S.		5.50	0.00	0.55	0.00	0.55	0.00	0.00	0.00	0.55	0.00	0.00	0.00
OVERALL MEAN				0.32	5.90	0.45	2.31	2.34	0.56	0.23	6.21	0.30	1.48	1.77

Table 4. Catch rates (fish/hour) on different banks for chinook greater than 40 cm (large chinook), chinook less than or equal to 40 cm (small chinook), adult coho, and juvenile coho, September and October, 1987 and 1988.

LOCATION	SEPTEMBER 87	SEPTEMBER 88	SEPTEMBER MEAN	OCTOBER 87	OCTOBER 88	OCTOBER MEAN	SEPTEMBER 87	SEPTEMBER 88	SEPTEMBER MEAN	OCTOBER 87	OCTOBER 88	OCTOBER MEAN
	LARGE CHINOOK/HOUR:						SMALL CHINOOK/HOUR:					
SWIFTSURE	4.50	4.39	4.45	2.89	7.62	5.26	0.36	0.00	0.18	0.33	1.01	0.67
7 & 12 MILE	5.08	4.59	4.84	0.79	1.62	1.21	0.00	0.13	0.07	0.63	0.27	0.45
AMPHITRITE	1.33	1.86	1.59	1.43			0.73	0.14	0.44	0.49		
	3.64	3.61	3.63	1.70	4.62	3.24	0.36	0.09	0.23	0.48	0.64	0.56
	ADULT COHO/HOUR:						JUVENILE COHO/HOUR:					
SWIFTSURE	15.29	5.48	10.39	3.27	0.38	1.83	5.54	3.86	4.70	12.87	2.13	7.50
7 & 12 MILE	5.63	2.43	4.03	0.32	0.25	0.29	2.75	2.09	2.42	0.95	0.87	0.91
AMPHITRITE	0.65	0.14	0.40	0.30			1.09	0.14	0.63	1.45		
	7.18	2.68	4.94	1.30	0.32	1.06	3.13	2.03	2.58	5.09	1.50	4.21

Table 5. Catch rates (fish/hour) on different banks for legal-sized (adult) and sub-legal sized (juvenile) chinook and coho, May 1982 and 1983. Data from the troll logbook program.

LOCATION: MAY 23 - JUNE 5	ADULT CHINOOK/HR 1982	1983	82/83	JUVENILE CHINOOK/HR 1982	1983	82/83	COHO/HR 1982	1983	82/83
CENTRAL SLOPE	1.43	----	1.43	0.42	----	0.42	0.49	----	0.49
PACHENA	1.66	0.86	1.32	0.93	1.16	1.03	0.52	1.12	0.77
SWIFTSURE	1.45	0.72	1.12	1.88	1.97	1.92	0.19	2.01	1.01
FINGER BANK	1.12	1.03	1.09	0.87	0.40	0.71	0.60	0.17	0.46
GULLIES	0.85	1.00	0.94	0.23	0.29	0.26	0.97	0.67	0.80
7 AND 12 MILE	0.94	0.60	0.88	0.74	0.43	0.69	0.59	1.43	0.74
TOFINO	0.90	0.51	0.74	0.27	0.17	0.23	0.07	0.11	0.09
WEST SLOPE	----	0.57	0.57	----	0.21	0.21	----	0.56	0.56
AMPHITRITE	0.58	0.53	0.56	0.15	0.36	0.23	0.13	1.04	0.49
SOUTH BANK	0.61	0.11	0.52	0.48	0.30	0.45	0.66	1.64	0.82
	----	----	----	----	----	----	----	----	---
OVERALL MEAN	1.13	0.80	1.01	0.75	0.74	0.74	0.49	0.95	0.66

Table 6. Age distribution and size at age for juvenile chinook and coho, May, September, October, 1988 and the fall of 1987.

DATE	SPECIES	AGE	N	FORK LENGTH STATISTICS MEAN	STD	MIN	MAX
MAY, 1988	CHINOOK	0.1	53	36.7	4.3	28.0	48.0
	CHINOOK	0.2	54	51.7	4.9	40.0	61.0
	CHINOOK	0.3	10	56.1	3.7	53.0	63.0
	CHINOOK	1.1	10	46.4	6.2	38.0	57.0
	CHINOOK	1.2	7	55.8	2.9	52.0	60.0
	COHO	0.1	1	48.0	---	----	----
	COHO	1.1	40	44.1	5.0	34.0	58.0
	COHO	2.1	2	51.5	4.9	48.0	55.0
SEPTEMBER, 1988	CHINOOK	0.1	21	47.1	4.8	37.5	56.5
	CHINOOK	1.1	1	57.0	---	----	----
	CHINOOK	0.2	2	58.0	2.8	56.0	60.0
	COHO	1.0	4	32.5	5.8	27.0	40.0
	COHO	1.1	1	39.0	---	----	----
OCTOBER, 1988	CHINOOK	0.0	3	26.4	1.3	25.0	27.3
	CHINOOK	0.1	36	45.7	4.6	37.0	58.0
	CHINOOK	1.1	2	57.8	4.6	54.5	61.0
	COHO	1.0	3	39.3	2.4	37.3	42.0
FALL, 1987	CHINOOK	0.0	21	24.4	2.6	19.6	28.9
	CHINOOK	0.1	12	34.4	3.9	28.9	43.2
	CHINOOK	1.0	3	29.4	2.3	26.8	31.1
	COHO	1.0	4	32.5	5.8	27.0	40.0
	COHO	1.1	1	39.0	---	----	----

Table 7. Mean depths of capture for chinook and coho, May, September, and October, 1988.

MEAN DEPTHS OF CAPTURE IN METRES		
SPECIES AND SIZE GROUP	N	DEPTH
MAY, 1988:		
ADULT CHINOOK	276	38.2
JUVENILE CHINOOK 61-66	242	37.8
JUVENILE CHINOOK 51-60	287	38.8
JUVENILE CHINOOK 41-50	126	36.6
JUVENILE CHINOOK 31-40	106	33.6
JUVENILE CHINOOK 21-30	8	26.5
ALL CHINOOK	1054	37.5
COHO	142	26.5
SEPTEMBER, 1988:		
ADULT CHINOOK	22	41.0
JUVENILE CHINOOK 61-66	11	37.7
JUVENILE CHINOOK 51-60	31	40.6
JUVENILE CHINOOK 41-50	34	40.9
JUVENILE CHINOOK 31-40	2	40.0
JUVENILE CHINOOK 21-30	0	----
ALL CHINOOK	100	40.4
ADULT COHO	101	21.9
JUVENILE COHO	58	15.6
OCTOBER, 1988:		
ADULT CHINOOK	11	31.2
JUVENILE CHINOOK 61-66	16	35.1
JUVENILE CHINOOK 51-60	85	36.3
JUVENILE CHINOOK 41-50	96	37.8
JUVENILE CHINOOK 31-40	18	39.1
JUVENILE CHINOOK 21-30	6	32.2
ALL CHINOOK	232	36.7
ADULT COHO	13	11.3

Table 8. Coded wire tag release and recapture data for chinook and coho recaptured in 1988 and 1987.

SPEC	PROV/ STATE	BY	REL DATE	PROD AREA	HATCHERY	STOCK	RELEASE SITE	CAPTURE DATE & SITE	AGE	FL	SEX	AGEN	TAGCODE
MAY 23 - JUNE 5, 1988													
CHIN	WASH	84	05/85	WA04	COLL FISHERIES	UNIV. OF WASH.	PORTAGE BAY	31/05/88	SWIF	0.3	49	M	UW	111721
CHIN	WASH	84	05/86	HDCO	ROCKY REACH	SNAKExPRIEST	COLUMBIA R/WA	01/06/88	7+12	1.2	52	F	WDF	632858
CHIN	WASH	84	06/85	LOCO	WASHOUGAL R.	GRAYS R.	WASHOUGAL R.	23/05/88	SWIF	0.3	57	M	WDF	633428
CHIN	WASH	84	06/85	LOCO	WASHOUGAL R.	WASHOUGAL R.	WASHOUGAL R.	01/06/88	7+12	0.3	55	F	WDF	633335
CHIN	WASH	84	06/85	LOCO	WASHOUGAL R.	WASHOUGAL R.	WASHOUGAL R.	05/06/88	SWIF	0.3	57	-	WDF	633334
CHIN	WASH	84	10/85	LOCO	LEWIS R.	LEWIS R.	LEWIS R. N FK	28/05/88	SWIF	0.3*	57	F	WDF	633410
CHIN	WASH	85	04/87	SNAK	LYONS FERRY	SNAKE R/WA	SNAKE R/WA	28/05/88	SWIF	1.1	44	M	WDF	634159R1
CHIN	WASH	85	04/87	LOCO	COWLITZ R.	COWLITZ R.	COWLITZ R.	27/05/88	7+12	1.1	54	-	WDF	633835
CHIN	WASH	85	04/87	LOCO	COWLITZ R.	COWLITZ R.	COWLITZ R.	29/05/88	SWIF	1.1	53	F	WDF	633834
CHIN	WASH	85	04/87	SNAK	LYONS FERRY	SNAKE/WA	SNAKE/WA	28/05/88	SWIF	1.1	45	-	WDF	634156R3
CHIN	WASH	85	05/86	WA04	GROVERS CR.	GROVERS CR.	GROVERS CR.	01/06/88	7+12	0.2	53	F	SUQ	211901R1
CHIN	WASH	85	05/86	WA05	ADAMS R.	S SOUND/HOOD CAN	PURDY CR.	29/05/88	SWIF	0.2	57	M	COO	633504
CHIN	WASH	85	05/86	WA05	ENETAI CR.	DESCHUTES R/WA	ENETAI CR.	31/05/88	SWIF	0.2	54	M	SKO	211917
CHIN	WASH	85	06/86	WA01	LUMMI SEA PONDS	SAMISH R.	LUMMI BAY	31/05/88	SWIF	0.2	42	F	LUM	211902R3
CHIN	WASH	85	06/86	LOCO	WASHOUGAL R.	WASHOUGAL R.	WASHOUGAL R.	29/05/88	SWIF	0.2	52	M	WDF	634113R1
CHIN	WASH	85	06/86	LOCO	WASHOUGAL R.	WASHOUGAL R.	WASHOUGAL R.	23/05/88	SWIF	0.2	51	M	WDF	634113R3
CHIN	WASH	85	06/86	LOCO	ELOKOMIN R.	ELOKOMIN + KALAMA	ELOKOMIN R.	28/05/88	SWIF	0.2	55	M	WDF	633819
CHIN	WASH	85	06/87	WA04	HUPP SPRINGS	WHITE R/WA	HUPP SPRINGS	24/05/88	SWIF	1.1	44	-	WDF	633131
CHIN	WASH	85	09/86	LOCO	WASHOUGAL R.	WASHOUGAL R.	WASHOUGAL R.	01/06/88	7+12	0.2*	48	F	WFD	633830
CHIN	WASH	86	04/87	LOCO	SPRING CR. NFH	SPRING CR.	COLUMBIA R/WA	23/05/88	SWIF	0.1	41	F	FWS	051861
CHIN	WASH	86	04/87	LOCO	SPRING CR. NFH	SPRING CR.	COLUMBIA R/WA	25/05/88	SWIF	0.1	40	M	FWS	051861
CHIN	WASH	86	04/87	LOCO	SPRING CR. NFH	SPRING CR.	COLUMBIA R/WA	23/05/88	SWIF	0.1	39	M	FWS	051861
CHIN	WASH	86	07/87	LOCO	MCNARY	COLUMBIA R/WA	COLUM R BEL BONNEV	26/05/88	7+12	0.1	33	M	NMF	232001
CHIN	ORE	84	05/86	LOCO	KLASKANINE R. S F	BONNEVILLE DAM	YOUNGS BAY	28/05/88	SWIF	1.2	54	-	ODF	072935
CHIN	ORE	85	09/86	UPOR	ELK R.	ELK R.	ELK R.	29/05/88	SWIF	0.2*	49	-	ODF	073940
CHIN	ORE	85	10/86	LOCO	BONNEVILLE DAM	UPRIGHT BRIGHT	TANNER CR.	28/05/88	SWIF	0.2*	48	M	ODF	073634
CHIN	ORE	85	10/86	LOCO	BONNEVILLE DAM	UPRIVER BRIGHT	TANNER CR.	01/06/88	SWIF	0.2*	48	F	ODF	073634
CHIN	ORE	86	08/87	UPOR	FALL CR/ALSEA	FALL CR/ALSEA	FALL CR/ALSEA	29/05/88	SWIF	0.1*	34	-	ODF	074425R1
CHIN	ORE	86						05/06/88	SWIF	0.1	33	M	ODF	073460
COHO	B.C.	85	07/86	GSVI	MILLSTONE R. SPU	MILLSTONE R.	MILLSTONE R.	25/05/88	FING	1.1	48	-	CDF	023918
COHO	WASH	85	04/87	WA05	GEORGE ADAMS R.	GEORGE ADAMS R.	PURDY CR.	23/05/88	SWIF	1.1	41	M	WDF	634226R3
COHO	WASH	85	05/87	WA01	NOOKSACK R.	NOOKSACK R.	KENDALL CR.	04/06/88	7+12	1.1	48	F	WDF	633626
COHO	WASH	85	06/87	WA02		SKAGIT R.	ETACH CR.	24/05/88	SWIF	1.1	42	-	SSC	212137R3

Table B (cont'd)

SPEC	PROV/ STATE	BY	REL DATE	PROD AREA	HATCHERY	STOCK	RELEASE SITE	CAPTURE DATE & SITE	AGE	FL	SEX	AGEN	TAGCODE
FALL, 1988													
CHIN	B.C.	86	05/87	LWFR	CHEHALIS R/BC	HARRIS + CHEHALIS	CHEHALIS R/BC	24/10/88 SWIF	0.1	53	M	CDF	0244D6
CHIN	WASH	85	04/87	SNAK	LYONS FERRY	SNAKE R/WA	SNAKE R/WA	29/09/88 SOUT	1.1	57	F	WDF	634159R3
CHIN	WASH	85	04/87	LOCO	COWLITZ R.	COWLITZ R.	COWLITZ R.	28/10/88 SWIF		54	F	WDF	633833
CHIN	WASH	86	05/87	WA04	GROVERS CR.	GROVERS CR.	GROVERS CR.	24/10/88 SWIF		45	M	SUQ	211961
CHIN	WASH	86	06/87	LOCO	COWLITZ R.	COWLITZ R.	COWLITZ R.	24/10/88 SWIF	0.1	41	F	WDF	634126R2
CHIN	WASH	86		UPWA	SOLEDUCK R.	SOLEDUCK R.	SOLEDUCK R.	23/10/88 SWIF	0.1	38	M	WDF	633322
CHIN	ORE	86	09/87	LOCO	BONNEVILLE DAM	COLUMBIA R TULE/OR	TANNER CR.	23/10/88 SWIF	0.1*	43	F	ODF	074735R1
COHO	WASH	85	05/87	LOCO	COWLITZ R.	TYPE-N	COWLITZ R.	25/11/88 SWIF	1.1	35	F	WDF	63413BR1
COHO	WASH	86						27/09/88 7+12	1.0	34	F	WDF	633716
COHO	WASH	86						26/09/88 SWIF	1.0	29	F	WDF	634701R1
COHO	WASH	86		UPWA	QUINAULT LAKE			24/10/88 SWIF	1.0	40	F	QDN	212516R4
COHO	WASH	86						25/10/88 7+12	1.0	37	M	WDF	63472B
FALL, 1987													
CHIN	WASH	85	--/87			COLUMBIA R.		11/10/87 SWIF	1.0	28	M	?	B-1-3-9
CHIN	WASH	85	04/87	SNAK	LYONS FERRY	SNAKE R/WA	SNAKE R/WA	11/10/87 SWIF	1.0	31	M	WDF	634156R2
CHIN	WASH	85	04/87	SNAK	LYONS FERRY	SNAKE R/WA	SNAKE R/WA	09/10/87 AMPH	1.0	30	M	WDF	634156R2
CHIN	ORE	85	09/86	LWOR	BUTTE FALLS	COOS R.	COOS R.	23/11/87 AMPH	0.1*	43	F	ODF	073609
COHO	B.C.	84	05/86	LWFR	KANAKA CR. PIP	KANAKA CR.	KANAKA CR.	10/10/87 SWIF	1.1	38	F	CDF	022B51
COHO	WASH	85	03/87	WA04	GREEN R/PUGET	GREEN R/PUGET	GREEN R/PUGET	27/09/87 SWIF	1.0	34	F	WDF	633709
COHO	WASH	85	04/87	WA04	PUYALLUP R.	PUYALLUP R.	PUYALLUP R.	11/10/87 SWIF	1.0	31	M	WDF	633706
COHO	WASH	85	04/87	WA05	GEORGE ADAMS R.	GEORGE ADAMS R.	PURDY CR.	11/10/87 SWIF	1.0	31	F	WDF	634226R1
COHO	WASH	85	05/87	WA03	SKYKOMISH R.	WALLACE R.	WALLACE R.	10/10/87 SWIF	1.0	31	M	WDF	634228R2
COHO	WASH	85	05/87	WA03	OAK HARBOUR PENS	CLARK CR.	OAK HARBOUR	10/10/87 SWIF	1.0	31	F	WDF	633623
COHO	WASH	85	05/87	LOCO	COWLITZ R.	TYPE-N	COWLITZ R.	25/11/87 SWIF	1.0	35	F	WDF	634138R1
COHO	WASH	85	05/87	WA04	PUYALLUP R.	PUYALLUP R.	VOIGHT CR.	11/10/87 SWIF	1.0	31	F	WDF	633704
COHO	WASH	85	06/87	LOCO	KLICKITAT R.	TYPE-N	KLICKITAT R.	10/10/87 SWIF	1.0	32	M	WDF	633649
COHO	WASH	85	06/87	LOCO	KLICKITAT R.	TYPE-N	KLICKITAT R.	25/11/87 SWIF	1.0	35	M	WDF	633649
COHO	ORE	85	04/87	LOCO	SANDY R.	SANDY R.	CEDAR CR.-SANDY	10/10/87 SWIF	1.0	34	F	ODF	074114R1
COHO	ORE	85	05/87	LOCO	KLASKANINE R.	TANNER CR.	KLASKANINE R.	10/10/87 SWIF	1.0	33	M	ODF	073614
COHO	ORE	85	05/87	LOCO	BIG CR.	BIG CR.	COLUMBIA R/OR	11/10/87 SWIF	1.0	29	M	ODF	073963
COHO	ORE	85	06/87	LOCO	BIG CR.	BIG CR.	BIG CR.	27/09/87 SWIF	1.0	33	F	ODF	07354B
COHO	ORE	85	05/87					11/10/87 SWIF	1.0	34	F	ODF	073613

* - AUGUST, SEPTEMBER, AND OCTOBER OREGON AND WASHINGTON CHINOOK RELEASES GO TO SEA DIRECTLY AND FORM A MARINE ANNULUS IN THEIR FIRST YEAR. THESE ARE OCEAN TYPE CHINOOK AND GO TO SEA AS 0. SMOLTS.

Table 8 (cont'd)

AGENCY KEY:

WDF - WASHINGTON DEPARTMENT OF FISHERIES
ODFW - OREGON OEPARTMENT OF FISHERIES AND WILDLIFE
CDFO - CANADIAN DEPARTMENT OF FISHERIES AND OCEANS
SSC - SKAGIT SYSTEM COOPERATIVE
COOP - WASHINGTON DEPARTMENT OF FISHERIES COOPERATIVE
LUMM - LUMMI INDIAN TRIBE
SUQ - SUQUAMISH INDIAN TRIBE
SKOK - SKOKOMISH INDIAN TRIBE
QDNR - QUINAULT DEPARTMENT OF NATURAL RESOURCES
TULA - TULALIP INDIAN TRIBE

PRODUCTION AREA KEY:

LDCO - LOWER COLUMBIA RIVER
HDCO - HEAD COLUMBIA RIVER
SNAK - SNAKE RIVER
WADO - PUGET SOUND, HOOD CANAL
UPWA - NORTHERN WASHINGTON COAST
UPOR - NORTHERN OREGON COAST
LWOR - SOUTHERN OREGON COAST
LWFR - LOWER FRASER RIVER
GSVI - GEORGIA STRAIT

Table 9. Range of values and median values for stomach weight/fish weight (mg/g) for chinook, coho, and pink salmon on different banks, May, September, and October, 1988 and the fall of 1987.

			STOMACH CONTENT DRY WEIGHT TO BODY WET WEIGHT RATIOS (mg/gm)					
			FISHING AREA					
SURVEY	SPECIES	STATISTIC	SWIFTSURE	SOUTH	7+12 MILE	FINGER	BARKLEY S.	PACHENA
MAY-JUNE,1988	COHO	N	48	-	21	19	-	5
		MEDIAN	0.054	-	0.048	0.051	-	0.123
		MINIMUM	0.000	-	0.000	0.000	-	0.011
		MAXIMUM	1.567	-	6.970	1.323	-	0.398
MAY-JUNE,1988	CHINOOK	N	99	-	52	26	-	11
		MEDIAN	D.016	-	0.D03	0.009	-	D.D26
		MINIMUM	0.0D0	-	D.000	0.00D	-	D.D00
		MAXIMUM	15.269	-	1.223	2.073	-	1.999
SEP 25-29,1988	COHO	N	29	1	12	-	-	-
		MEDIAN	0.000	D.000	0.000	-	-	-
		MINIMUM	0.00D	-	0.000	-	-	-
		MAXIMUM	2.099	-	1.838	-	-	-
SEP 25-29,1988	CHINOOK	N	12	8	9	-	-	-
		MEDIAN	0.000	0.012	0.000	-	-	-
		MINIMUM	0.000	D.0D0	D.D00	-	-	-
		MAXIMUM	6.2D1	0.961	1.560	-	-	-
OCT 23-30,1988	COHO	N	44	-	11	-	-	1
		MEDIUM	0.000	-	0.000	-	-	0.000
		MINIMUM	0.000	-	0.000	-	-	-
		MAXIMUM	3.518	-	1.905	-	-	-
OCT 23-30,1988	CHINOOK	N	37	-	12	-	3	2
		MEDIAN	0.00D	-	0.000	-	0.891	0.143
		MINIMUM	0.000	-	0.000	-	0.000	0.000
		MAXIMUM	13.708	-	1.385	-	1.170	0.285

Table 9 (cont'd).

			STOMACH CONTENT DRY WEIGHT TO BODY WET WEIGHT RATIOS (mg/gm)				
					FISHING AREA		
SURVEY	SPECIES	STATISTIC	SWIFTSURE	AMPHITRITE	7+12 MILE	BARKLEY S.	PACHENA
FALL, 1987	COHO	N	128	48	35	4	15
		MEDIAN	0.075	0.042	0.063	0.000	0.000
		MINIMUM	0.000	0.000	0.000	0.000	0.000
		MAXIMUM	5.079	6.653	5.452	0.003	0.601
FALL, 1987	CHINOOK	N	12	26	2	5	4
		MEDIAN	0.059	0.014	2.309	0.000	0.006
		MINIMUM	0.000	0.000	0.074	0.000	0.000
		MAXIMUM	4.566	1.830	4.543	1.437	0.090
NOVEMBER, 1987	PINK	N	2	10	1	-	-
		MEDIAN	6.262	3.111	0.030	-	-
		MINIMUM	0.000	0.286	-	-	-
		MAXIMUM	12.524	10.228	-	-	-

Table 10. Principal diet items of chinook and coho, May, September, and October, 1988 and fall of 1987.

DATE	SPECIES	N	% FREQUENCY OF OCCURRENCE					
			FISH	EUPHAUSIIDS	CRAB LARVAE	PTEROPODS	AMPHIPODS	SQUID
MAY 1988	COHO	71	29.6	35.2	84.5	53.5	22.5	0.0
	CHINOOK	117	37.6	42.7	45.3	6.8	3.4	3.4
SEP 1988	COHO	16	18.8	68.8	18.8	56.3	50.0	0.0
	CHINOOK	8	87.5	12.5	0.0	0.0	0.0	0.0
OCT 1988	COHO	19	21.1	42.1	26.3	57.9	57.9	0.0
	CHINOOK	16	62.5	25.0	0.0	0.0	0.0	6.3
SEP, OCT 1988 COMBINED	COHO	35	20.0	54.3	22.9	57.1	54.3	0.0
	CHINOOK	24	70.8	20.8	0.0	0.0	0.0	4.2
SEP 1987	COHO	60	26.7	51.7	0.0	23.3	58.3	8.3
	CHINOOK	4	50.0	25.0	0.0	0.0	0.0	25.0
OCT 1987	COHO	53	37.7	39.6	0.0	11.3	67.9	0.0
	CHINOOK	9	44.4	22.2	0.0	0.0	55.5	0.0
NOV 1987	COHO	37	43.2	18.9	0.0	37.8	21.6	0.0
	CHINOOK	10	60.0	30.0	0.0	20.0	3.4	10.0
	PINK	12	0.0	8.3	0.0	100.0	33.3	0.0
SEP, OCT, NOV 1987 COMBINED	CHINOOK	23	52.2	26.1	0.0	8.7	21.7	8.7

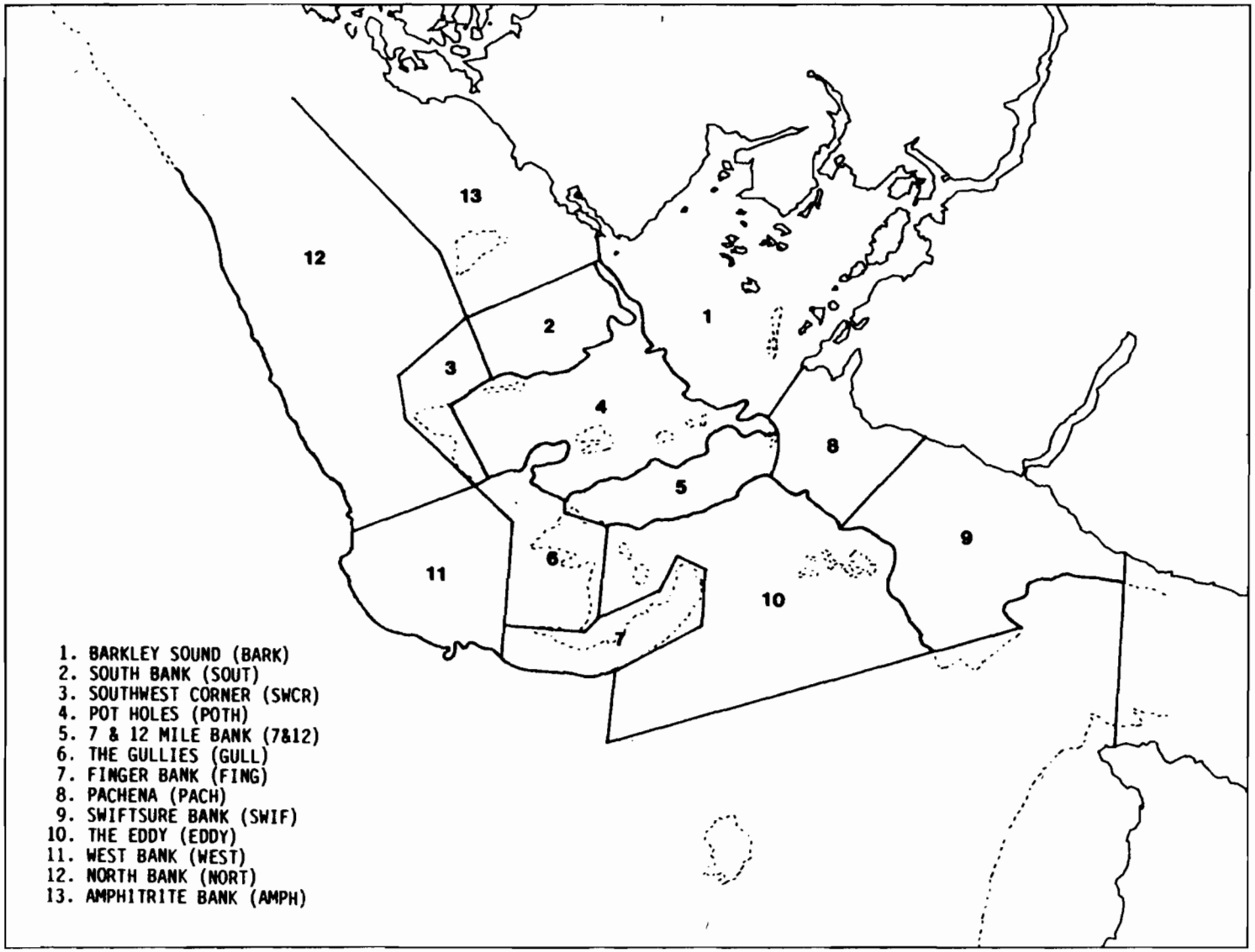


Fig. 1. Map of the study area showing the locations and names of the fishing banks referred to in the text.

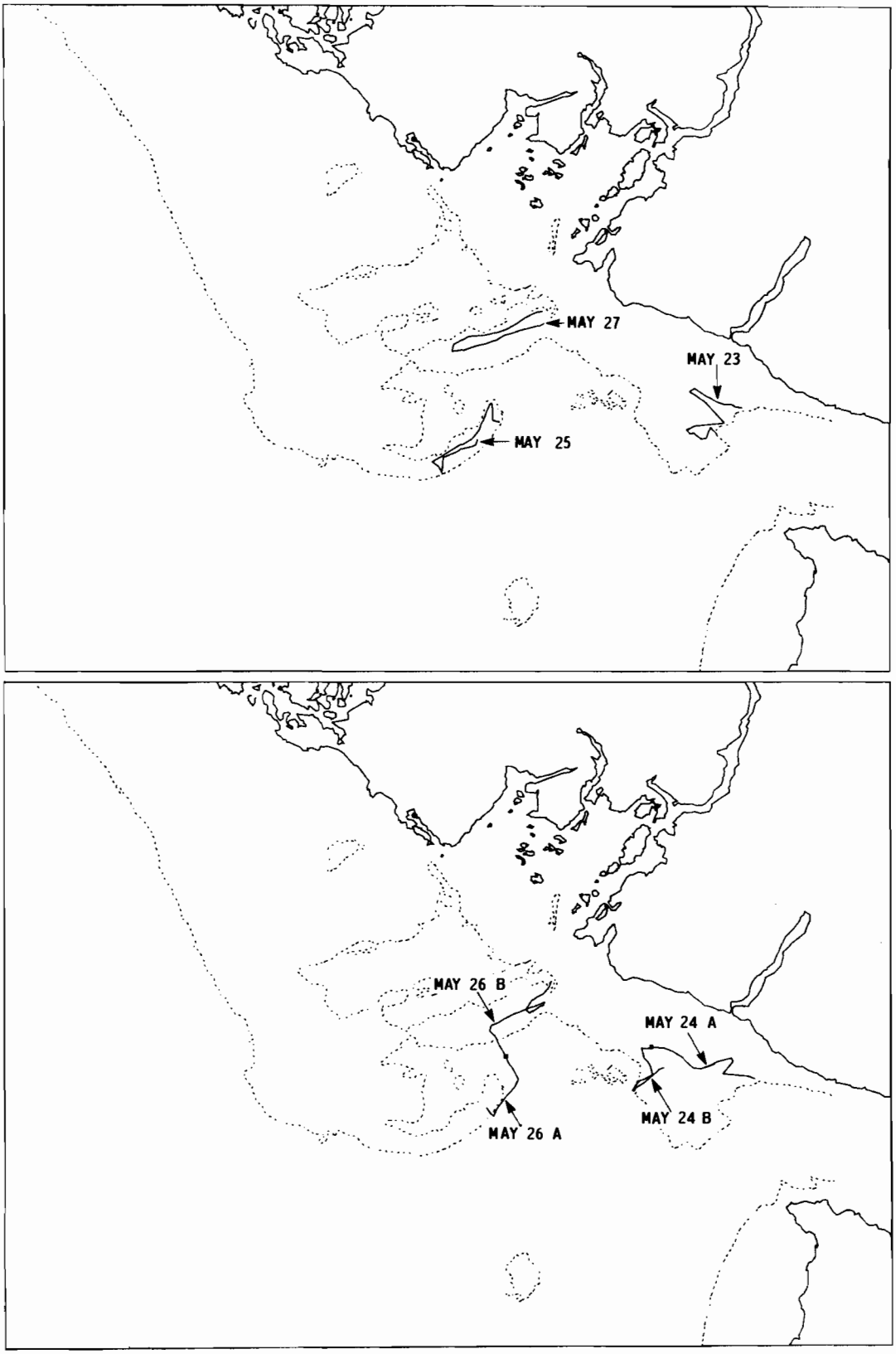


Fig. 2a-e. Fishing tacks for the May 23-June 5, 1988, cruise (top = 2a, bottom = 2b).

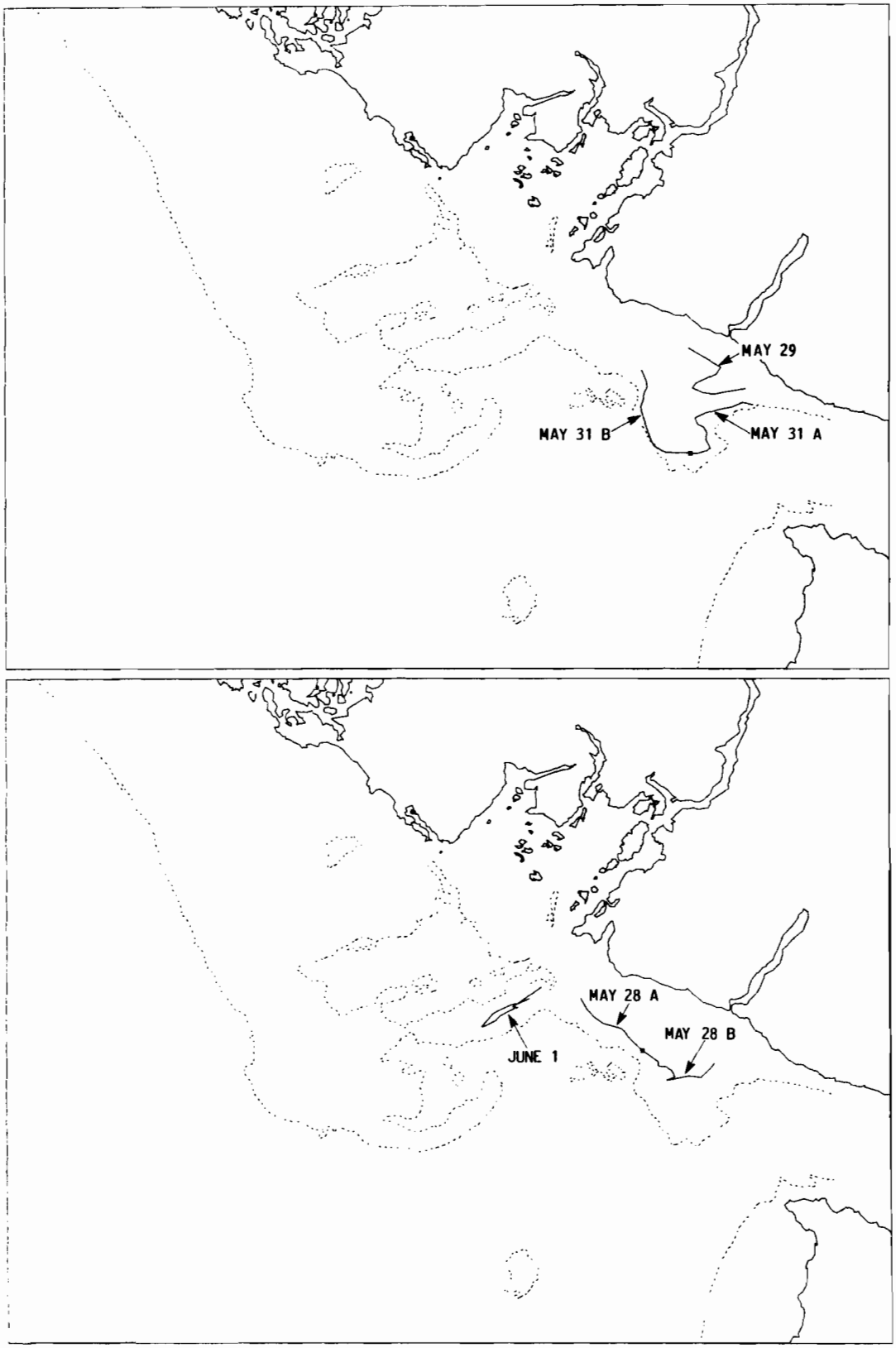


Fig. 2c (top) and 2d (bottom).

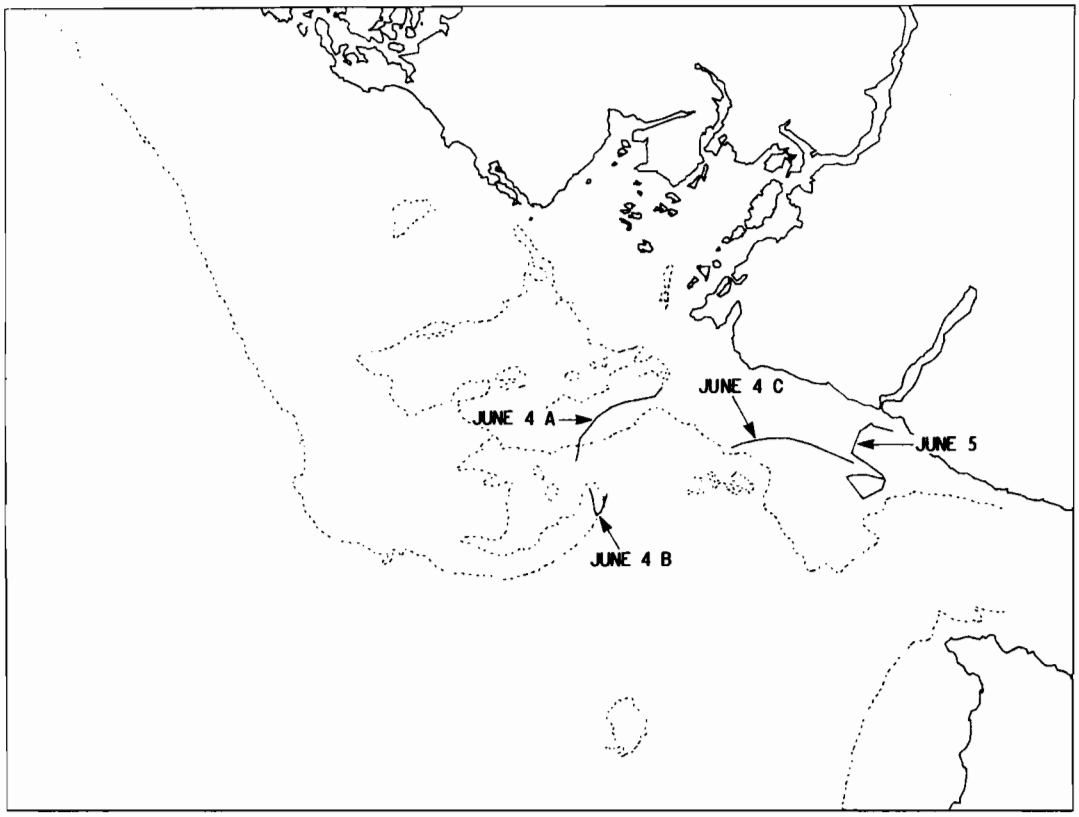


Fig. 2e.

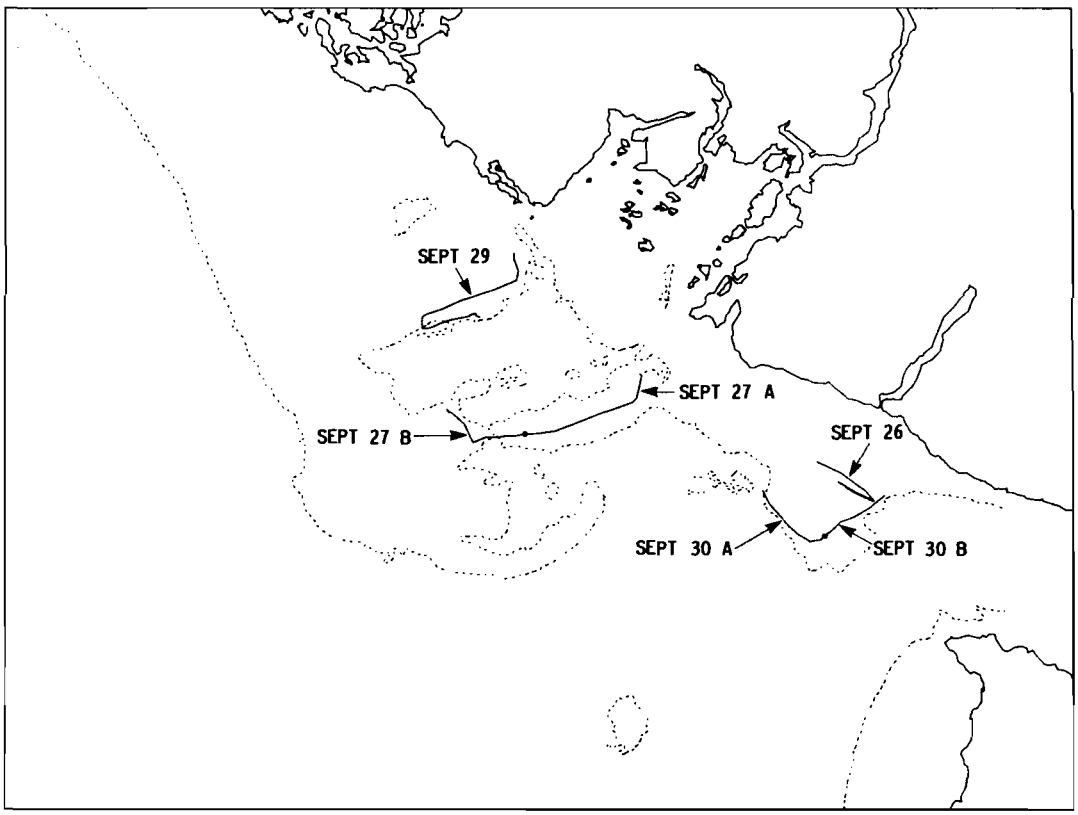


Fig. 3. Fishing tacks for the September 26-30, 1988, cruise.

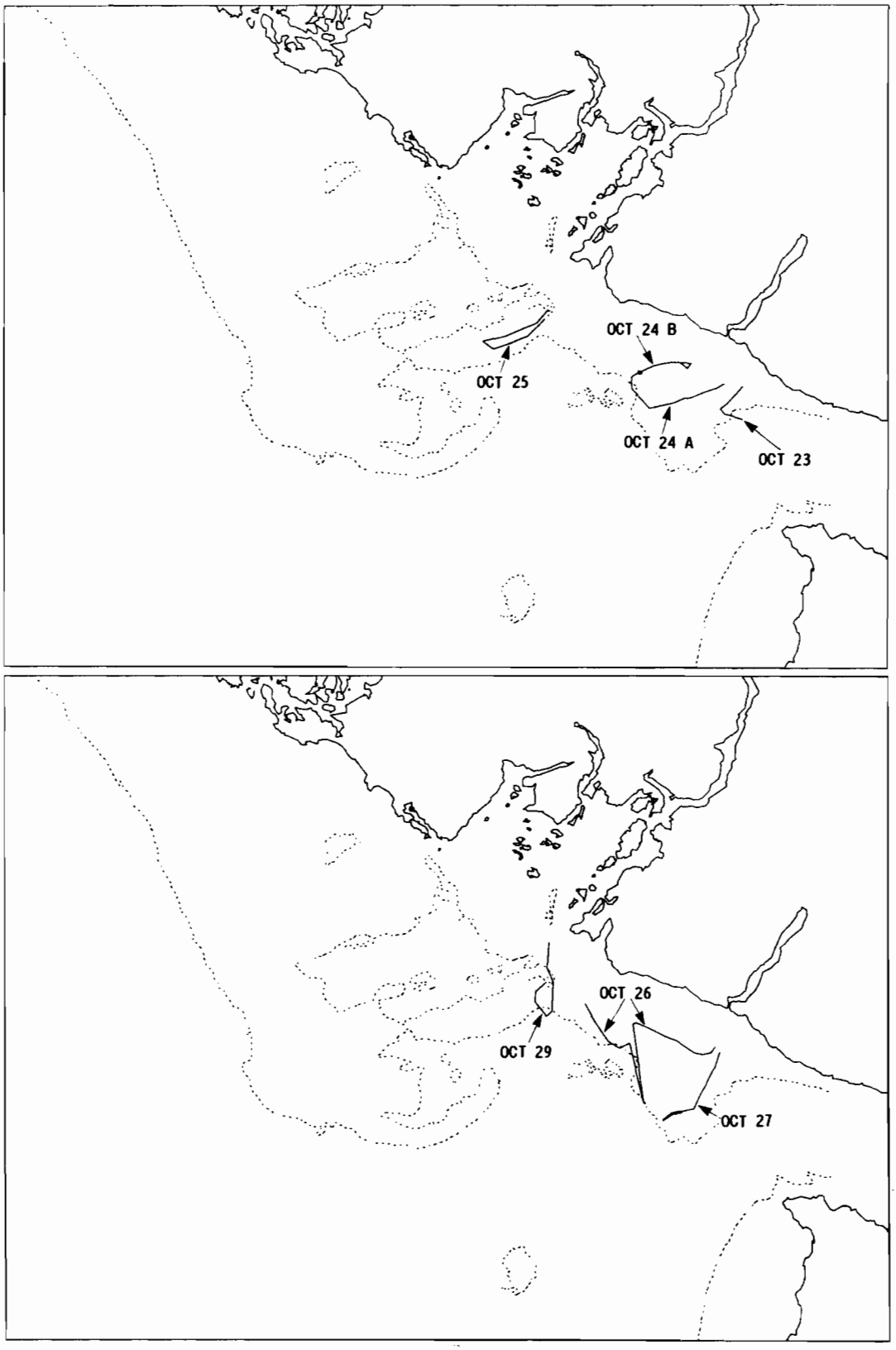


Fig. 4a-c. Fishing tacks for the October 23-30, 1988, cruise (top = 4a, bottom = 4b).

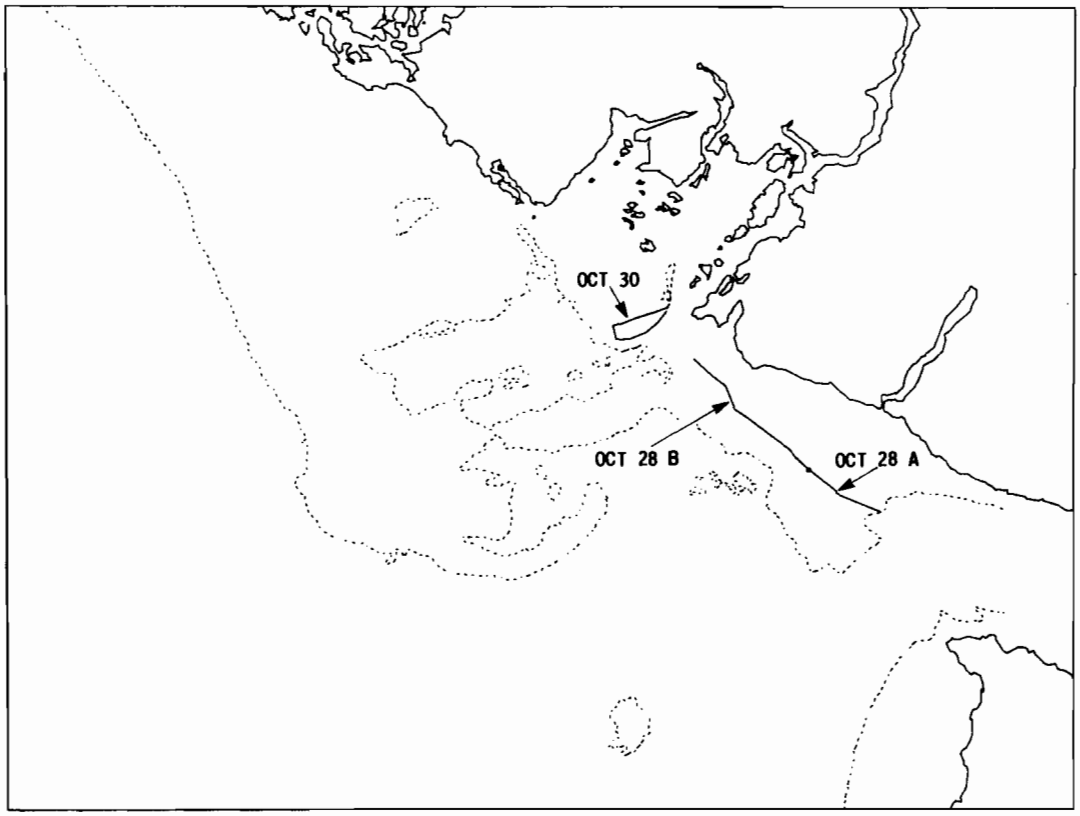
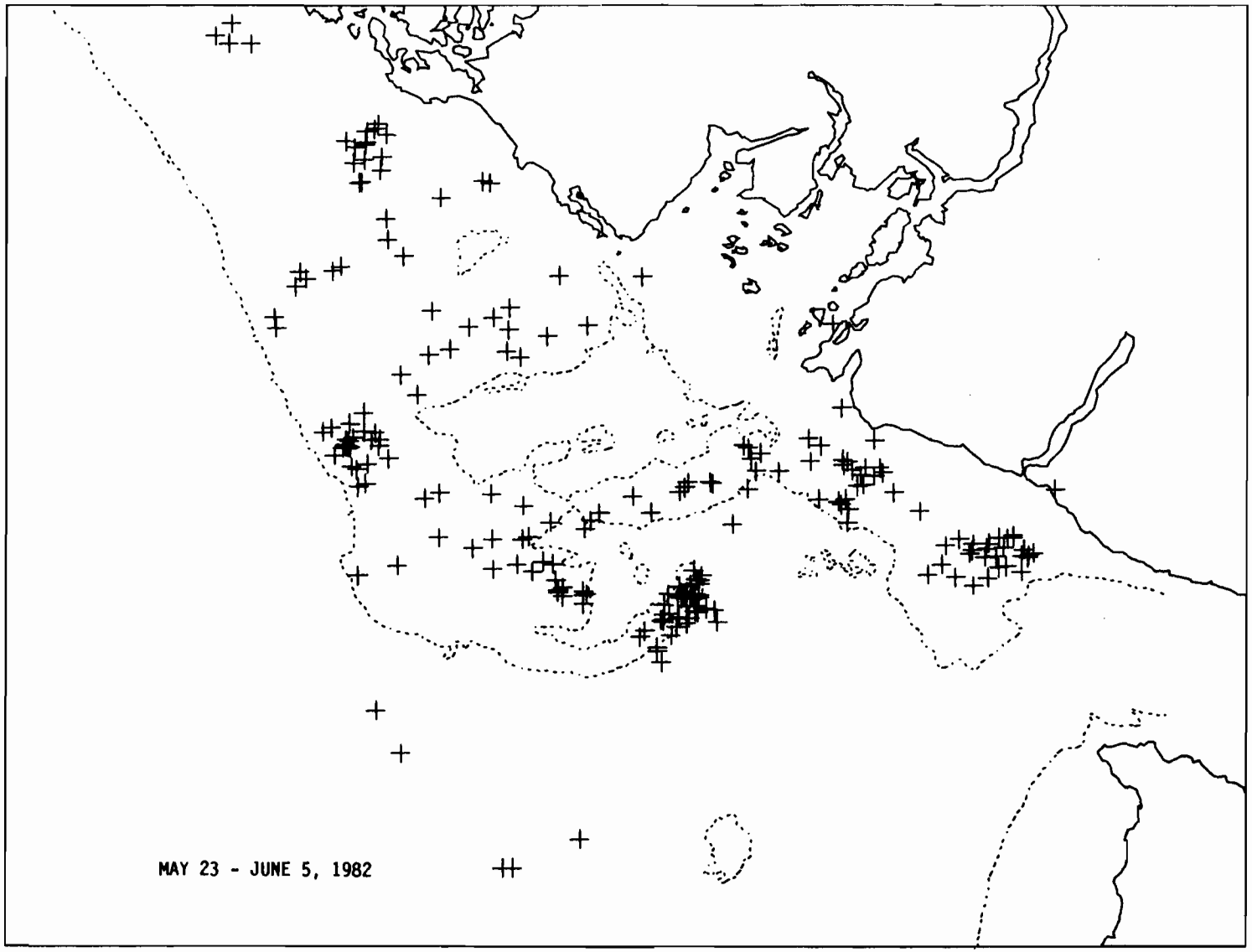
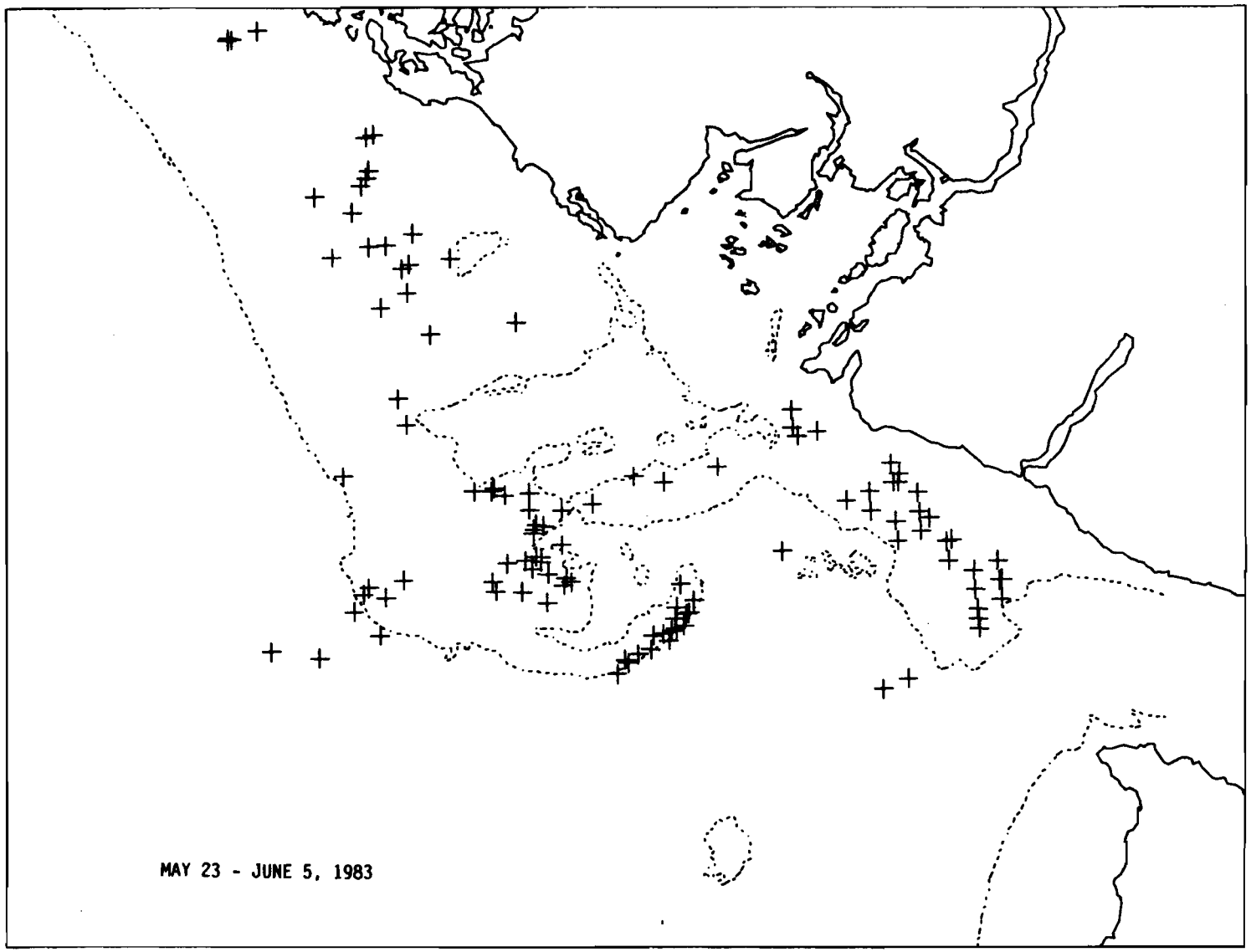


Fig. 4c.

Fig. 5a-b. The distribution of fishing effort among fishing banks by logbook trollers, May 1982 and 1983.



5a



5b

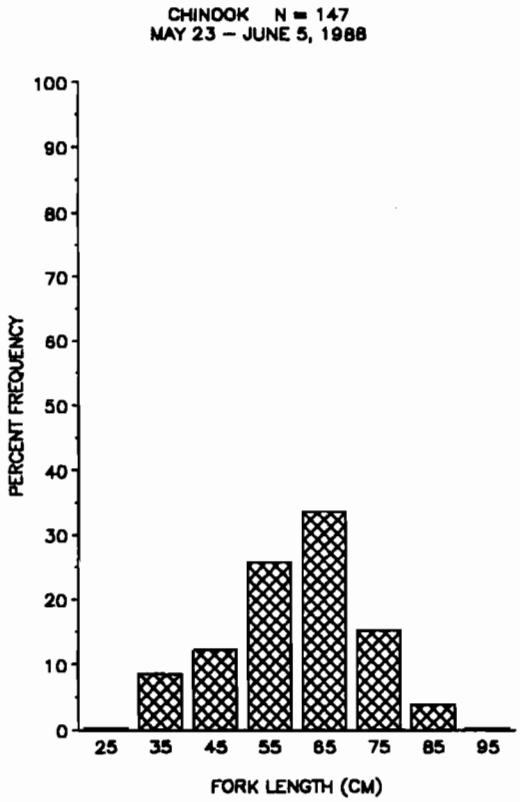


Fig. 6a.

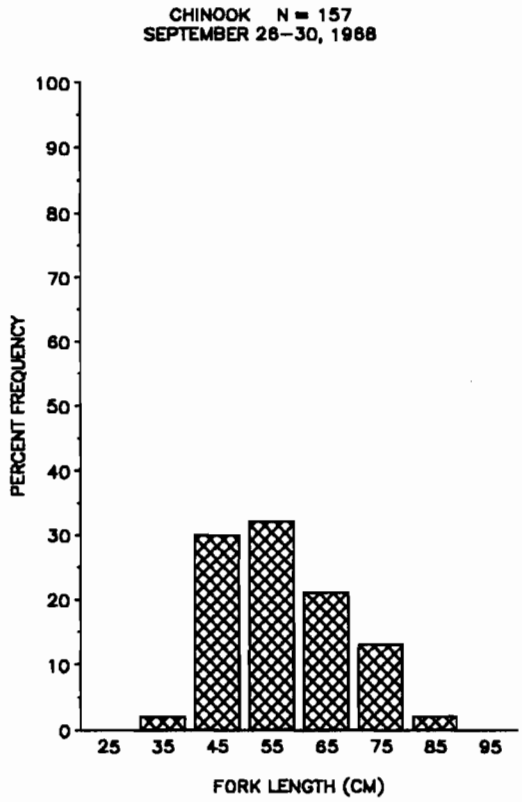


Fig. 6b.

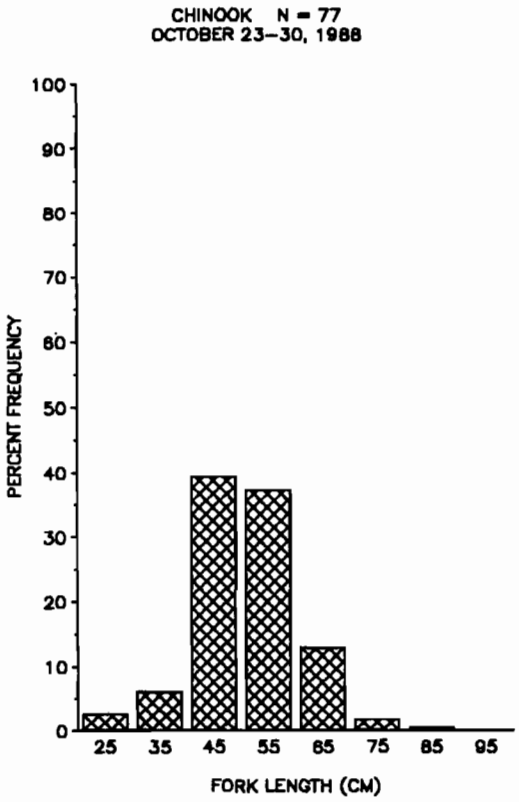


Fig. 6c.

Fig. 6a-c. The distribution of chinook fork lengths, May, September and October, 1988.

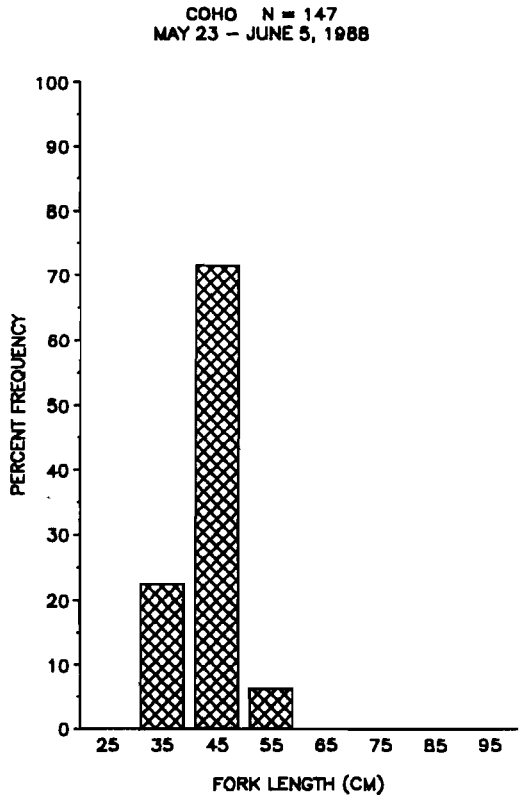


Fig. 7a.

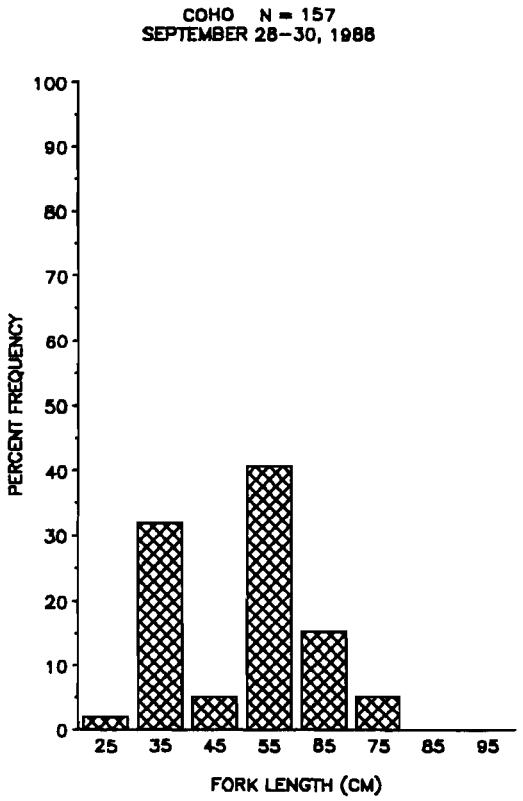


Fig. 7b.

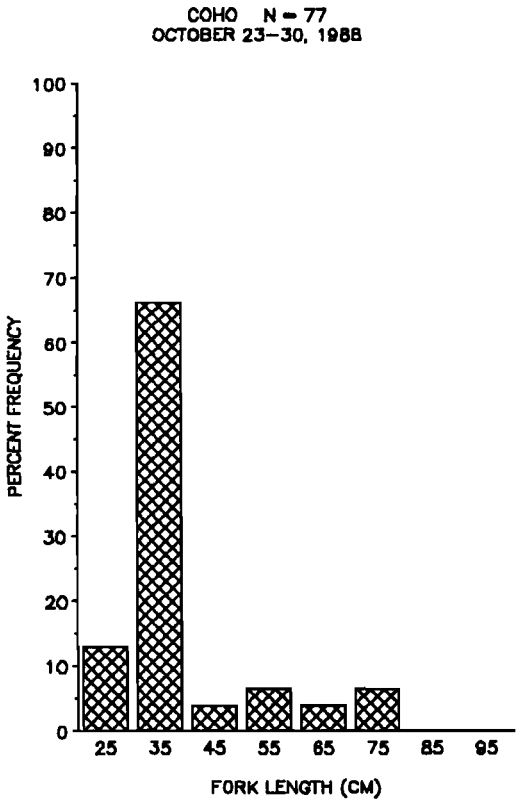


Fig. 7c.

Fig. 7a-c. The distribution of coho fork lengths, May, September and October, 1988.

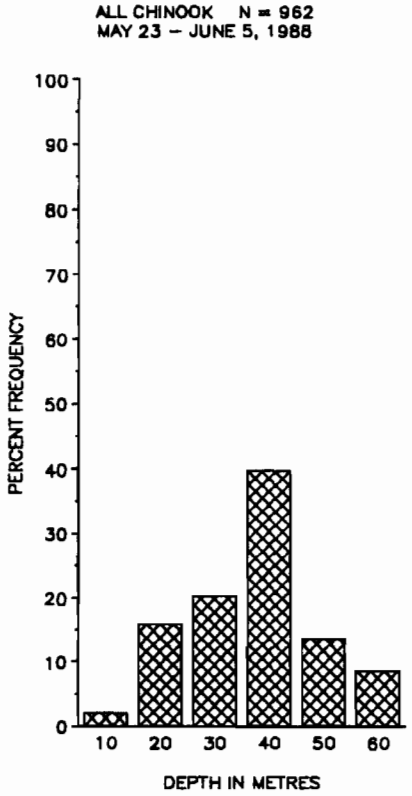


Fig. 8a.

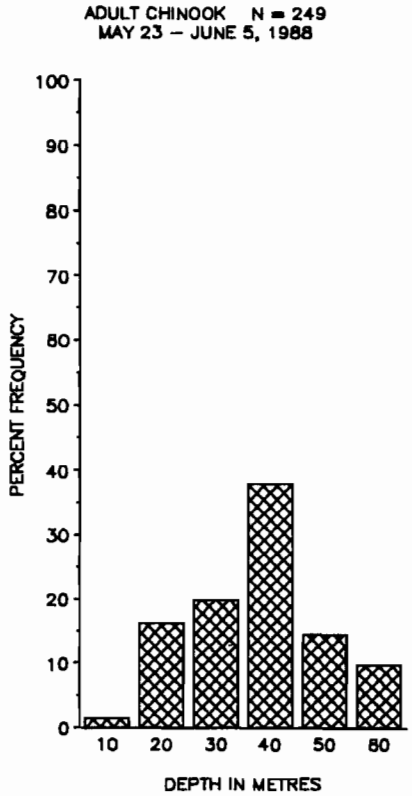


Fig. 8b.

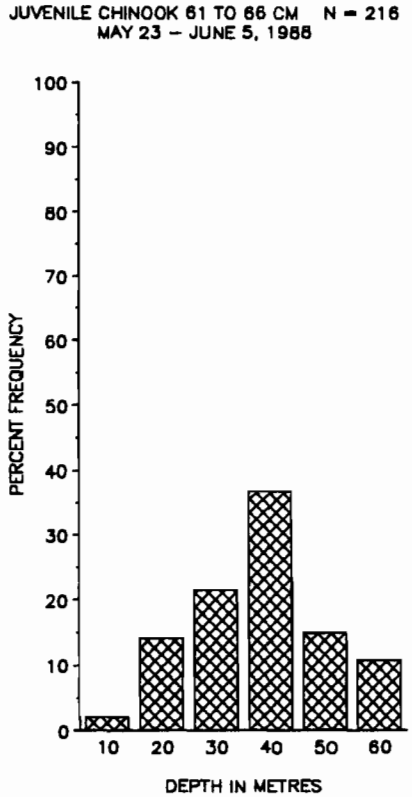


Fig. 8c.

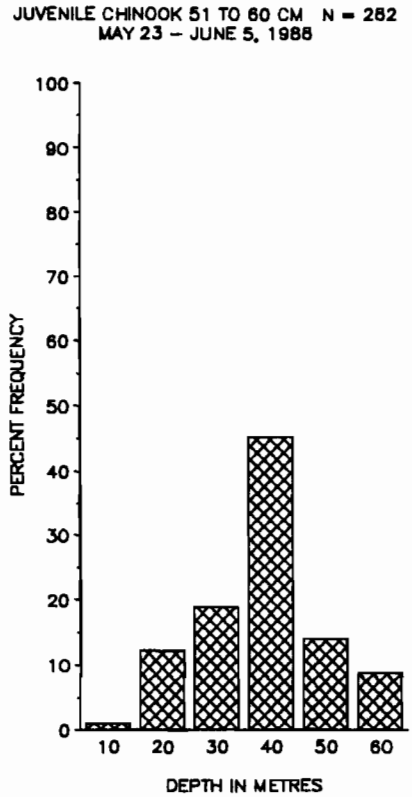


Fig. 8d.

Fig. 8a-g. The distribution of captures by depth for adult chinook and juvenile chinook of different sizes, May 1988.

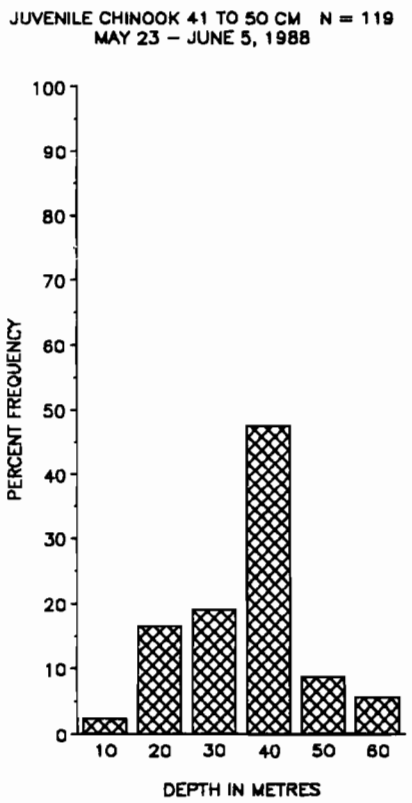


Fig. 8e.

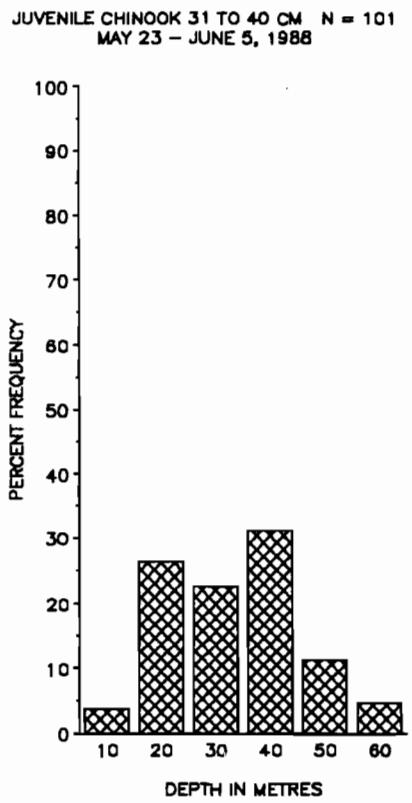


Fig. 8f.

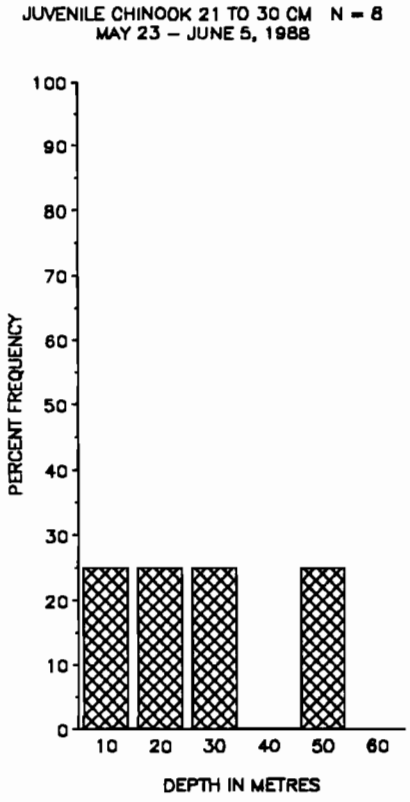


Fig. 8g.

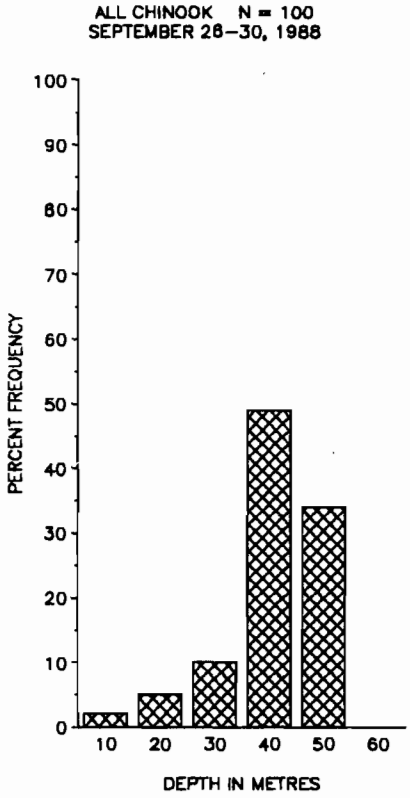


Fig. 9a.

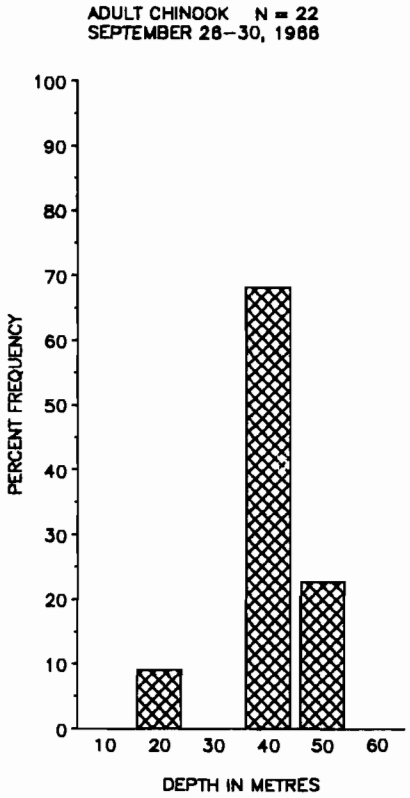


Fig. 9b.

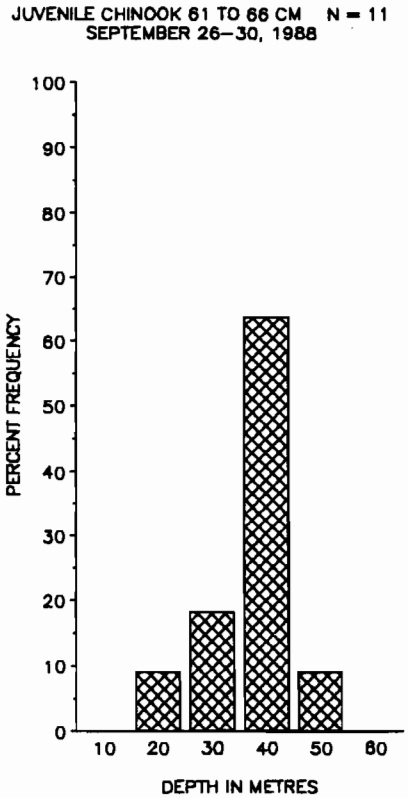


Fig. 9c.

Fig. 9a-f. The distribution of captures by depth for adult chinook and juvenile chinook of different sizes, September 1988.

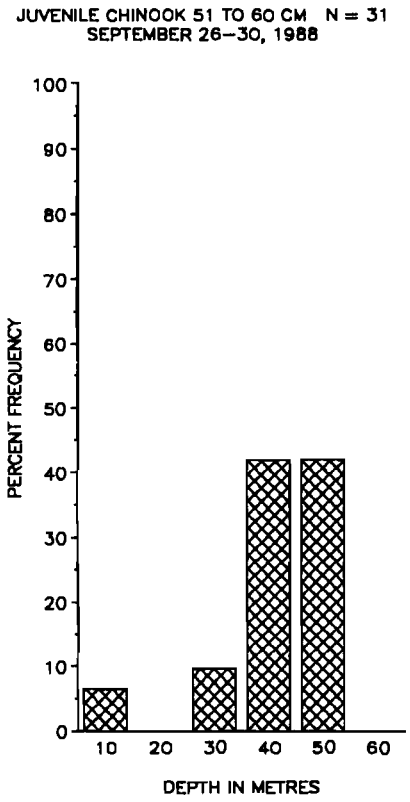


Fig. 9d.

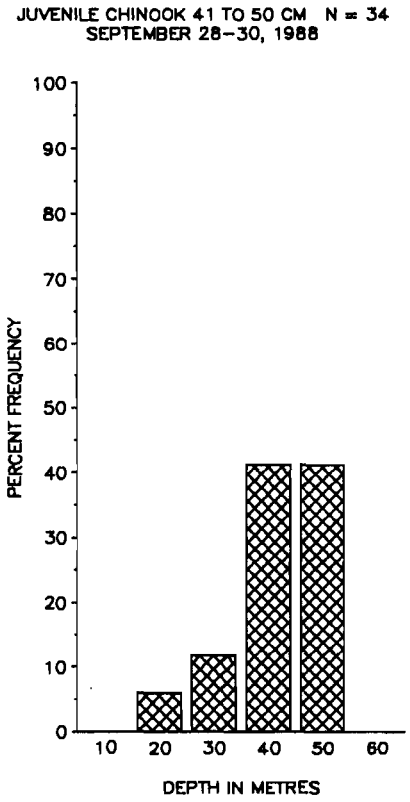


Fig. 9e.

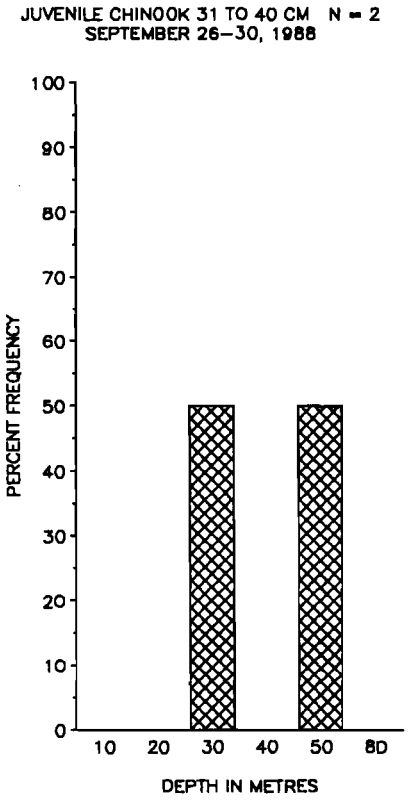


Fig. 9f.

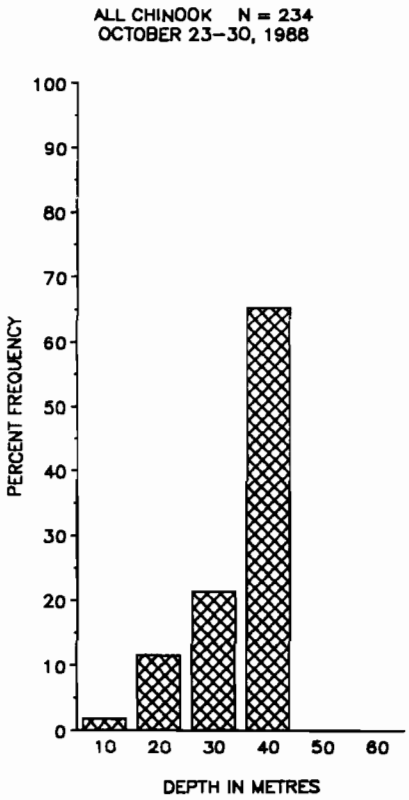


Fig. 10a.

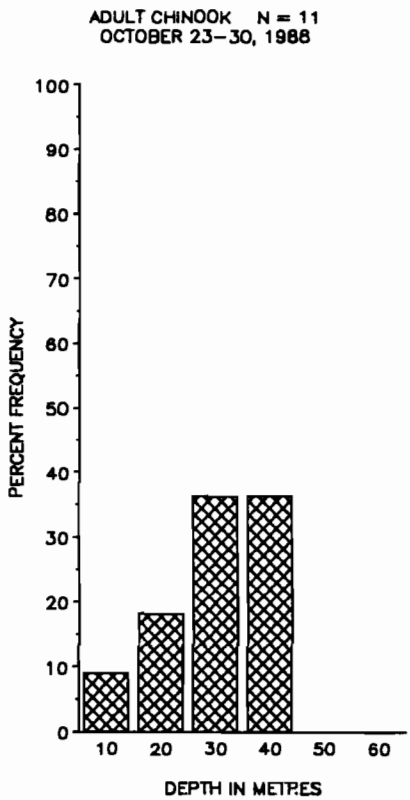


Fig. 10b.

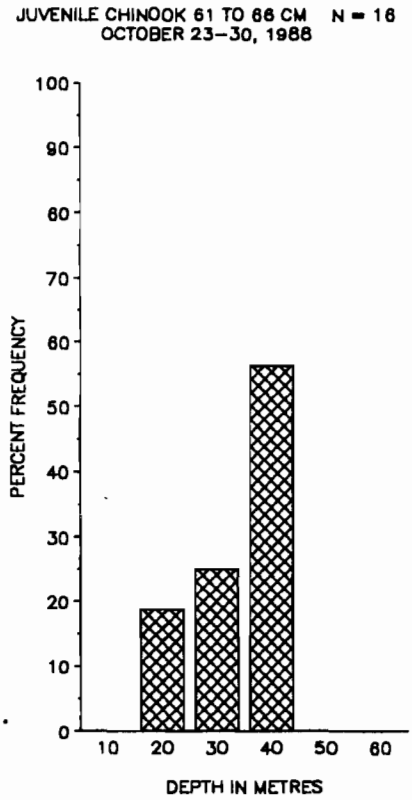


Fig. 10c.

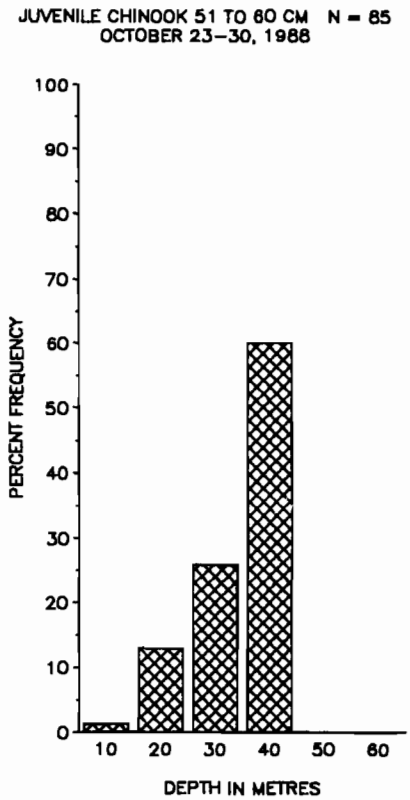


Fig. 10d.

Fig. 10a-g. The distribution of captures by depth for adult chinook and juvenile chinook of different sizes, October 1988.

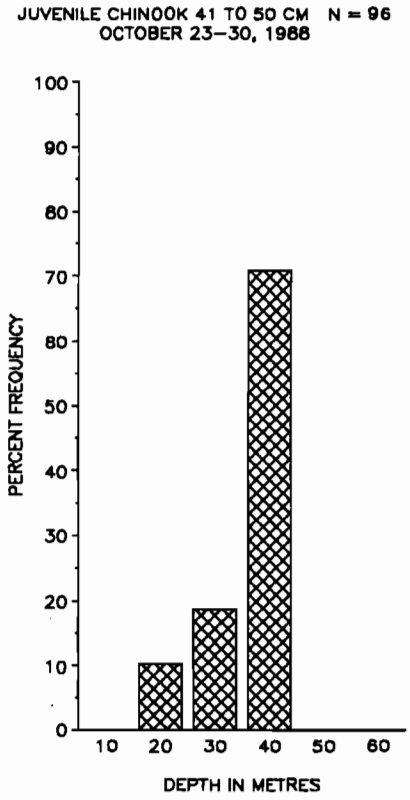


Fig. 10e.

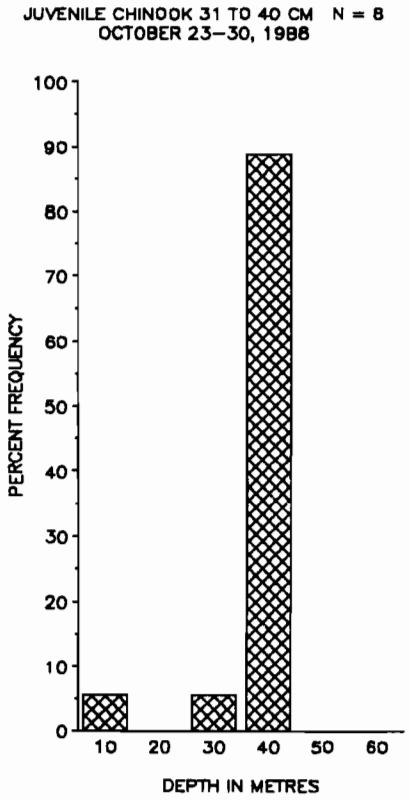


Fig. 10f.

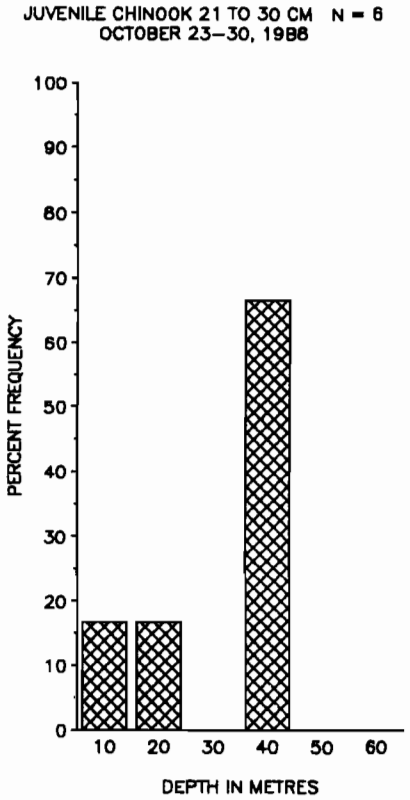


Fig. 10g.

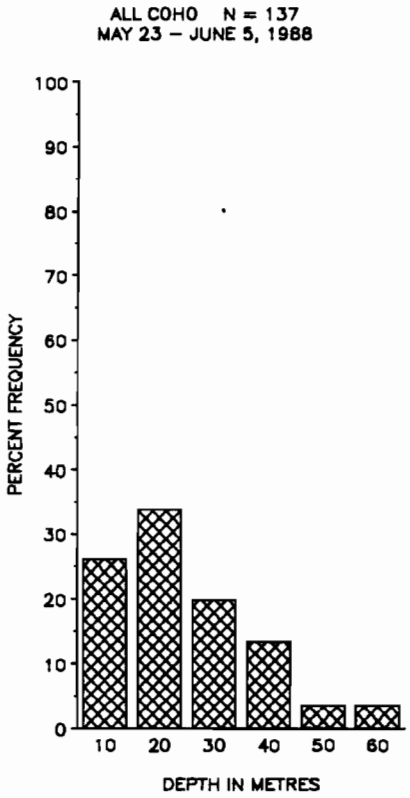


Fig. 11a.

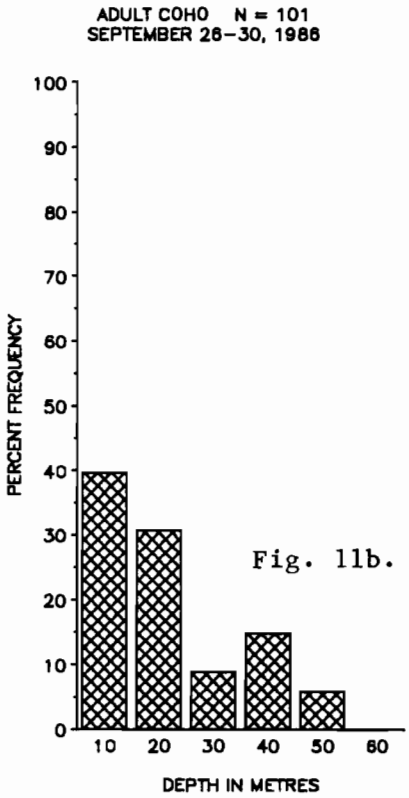


Fig. 11b.

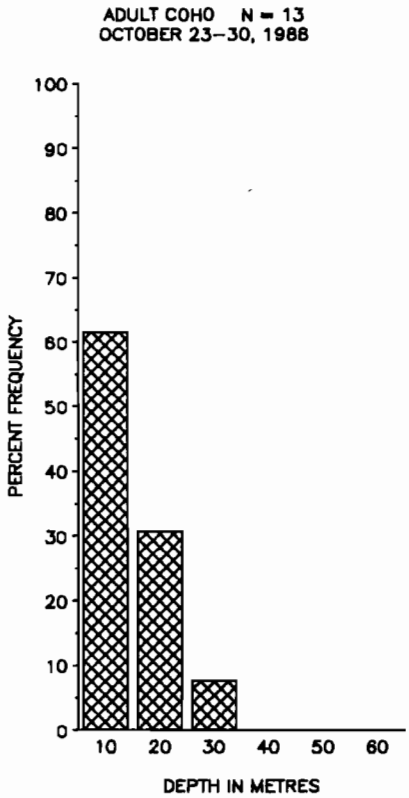


Fig. 11c.

Fig. 11a-e. The distribution of captures by depth for adult coho and juvenile coho, May, September and October 1988.

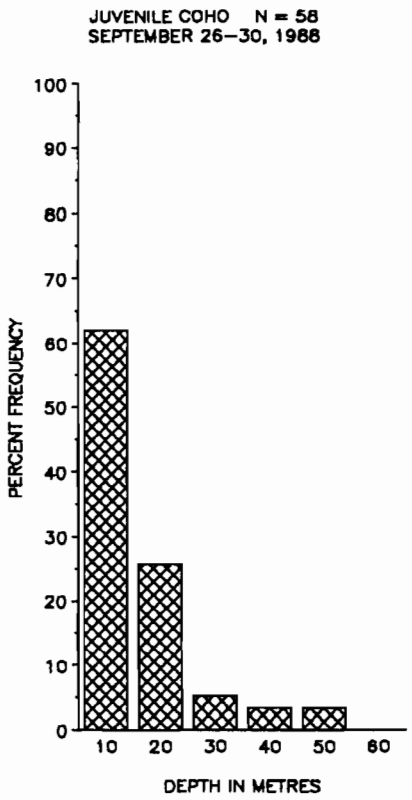


Fig. 11d.

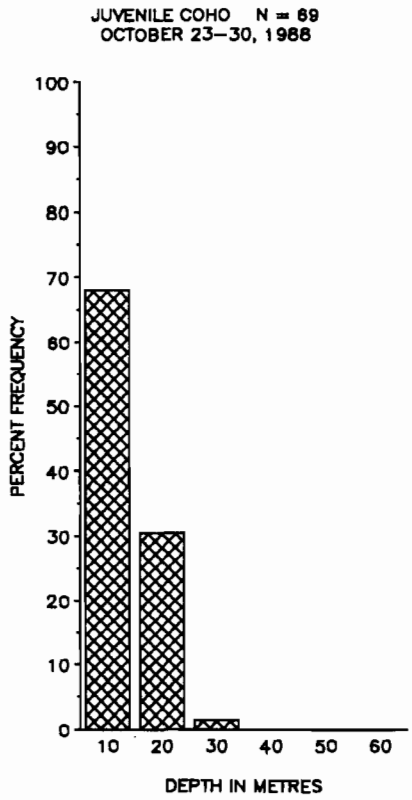


Fig. 11e.