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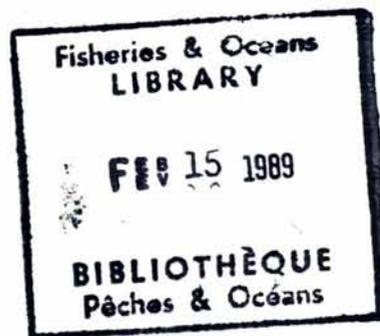


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Stock Assessments for British Columbia Herring in 1987 and Forecasts of the Potential Catch in 1988

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STOCK ASSESSMENTS FOR BRITISH COLUMBIA
HERRING IN 1987 AND FORECASTS OF THE
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by

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ABSTRACT

Haist, V., J. F. Schweigert and D. Fournier. 1988. Stock assessments for British Columbia herring in 1987 and forecasts of the potential catch in 1988. Can. MS Rep. Fish. Aquat. Sci. 1990: 63 p.

Herring stock abundance in British Columbia waters was assessed for 1987, and forecasts were made for 1988 using two analytical methods: (1) escapement model, and (2) age-structured model. Diving spawn survey data was utilized in the escapement model wherever available.

Forecasts of pre-fishery biomass are obtained by weighting the estimates from the two models. The forecasts, are for 79,680 tonnes to the northern and 86,210 tonnes to the southern stock assessment regions. These estimates represent a slight decrease from 1987 levels, reflecting below average recruitments to all the southern areas during the last spawning run.

The recommended 1988 catch (20% of the 1988 forecast herring run for stocks above CUTOFF levels) for the entire B.C. coast is 30,750 tonnes. All areas except the Queen Charlotte Islands should be available to the fishery in 1988.

Key words: Clupea harengus pallasii, Pacific herring, stock assessment, forecasts, age-structured analysis

RÉSUMÉ

Haist, V., J. F. Schweigert and D. Fournier. 1988. Stock assessments for British Columbia herring in 1987 and forecasts of the potential catch in 1988. Can. MS Rep. Fish. Aquat. Sci. 1990: 63 p.

L'abondance du stock de harengs dans les eaux de la Colombie-Britannique a été évaluée pour l'année 1987 et des prévisions ont été établies pour 1988 à l'aide de deux méthodes d'analyse: 1) un modèle d'échappée et 2) un modèle de structure par âge. Les données des relevés de la fraie par plongée ont été utilisées dans le modèle d'échappée lorsqu'elles étaient disponibles.

Des prévisions sur la biomasse antérieure à la pêche ont été obtenues en pondérant les estimations établies grâce aux deux modèles. Ces prévisions sont de 79 680 tonnes dans les régions du nord et de 86 210 tonnes dans les régions du sud. Ces estimations constituent une légère augmentation par rapport au niveau de 1987 et témoignent de recrutements inférieurs à la moyenne dans toutes les régions du sud au cours de la dernière fraie.

La prise recommandée pour 1988 (20% des prévisions de 1988 pour la remontée de harengs pour les stocks que se situent au-dessus des niveaux CUTOFF) pour toute la côte de la Colombie-Britannique est de 30 750 tonnes. Toutes les régions, sauf les îles Reine-Charlotte, devraient être ouvertes à la pêche en 1988.

Mots clés: Clupea harengus pallasii, hareng du Pacifique, évaluation des stocks, prévisions, analyse en fonction de la structure par âge

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FOREWORD

This report was prepared by the Population Dynamics Program of the Herring Section (Biological Sciences Branch), and contains proposed catch levels for herring for the 1987/88 season. These recommended catches are based primarily on biological considerations, and may vary with those finally adopted by the PSARC Herring Sub-Committee. The final fishing plans adopted by Fisheries Management will be based not only on biological considerations, but also economic, social, enforcement, and other factors.

Results contained in this report were presented to the PSARC Herring Sub-Committee in September of 1987.

ACKNOWLEDGMENTS

This document represents not only the efforts of the Population Dynamics Program. Numerous other members of the departmental staff play key roles in the collection and processing of data. Herring ages were determined by Margaret Burke and Kathy Rutherford of the Pacific Biological Station Ageing Unit. Lorena Rosenfeld processed the catch, sample, and spawn data and maintained the pertinent data bases. Also, Fisheries Branch personnel and contractors contribute to the sampling effort.

1. INTRODUCTION

1.1 GENERAL

Forecasting the potential catch that can be removed from herring stocks requires an assessment of the present stock status and the determination of factors which affect stock dynamics, in particular, recruitment. Traditionally, equilibrium based methods such as yield models have been favoured. They assume constancy in age structure, growth, and mortality. However, herring are strongly affected by changes in environmental conditions thus making equilibrium models unattractive. The methods we use estimate current stock conditions on the basis of which potential catches are recommended. Catch levels have been formulated to ensure conservation of the stocks.

In this report we present two methods to assess present herring stock status: 1) an escapement model (Schweigert and Stocker 1988); and 2) an age-structured model (Fournier and Archibald 1982). Both methods use a 37-year time series of catch and spawn deposition information and age structure and size-at-age data obtained from biological samples.

1.2 DATA BASE

The primary data sources for the stock assessments are spawn survey data, commercial catch landing data, and age composition data from biological samples of commercial fishery, pre-fishery charter, and research catches. These data are available on computer files for the period 1950 to 1987. This time span includes the reduction fishery period to 1968 and the subsequent roe fishery period starting in the early 1970s.

Of the three data sets, the spawn data contain the largest measurement errors. We feel that the quality of spawn surveys has improved greatly over the 37-year span of these observations. This improvement is a result of increased numbers of people and vessels being involved in spawn surveys, increased attention to data measurements, increased coverage of subtidal spawnings, and increased research on estimating egg deposition from spawn observations. The consistent observations made during the 37 years of spawn surveys are the length, the width, and a measure of intensity of spawnings. The escapement model estimates absolute egg numbers from these observations and includes a width conversion to adjust for the inability to survey subtidal spawns adequately. In recent years some spawns have been surveyed using SCUBA methods. We assume these surveys provide reasonably accurate estimates of spawn width and egg density and these data have been used in the escapement model where available. The age-structured model uses a spawn index which sums lengths multiplied by standardized widths and intensities.

Catch information was obtained from landing slip data. Both models use the landing slip data summed by season (seasons run from July 1 to June 30). The 1986/87 catch figures are based on hailed estimates because sales slip data were not available for timely analysis. The sales slips record catch in tonnes. Numbers of fish in the catch were calculated using the average fish weight from catch samples for the season.

Age structure data are used in both models. The information from catch samples are used for years when there were commercial fisheries. For years with no fisheries, or when catch samples do not appear to be representative, pre-fishery and research samples are also used. Additional data used in the age-structured model are age specific fecundities and average weights at age.

1.3 STOCK CONSIDERATIONS

We continue to use the stock concept introduced for the 1985 assessment (Haist et al. 1986) with minor modifications this year (Figs 1.1 and 1.2). In the Queen Charlotte Islands, herring spawning in the area from Skincuttle Inlet and Selwyn Inlet are treated as one stock. The stock concept for the Prince Rupert District remains unchanged encompassing Statistical Areas 3 to 5. The revised central coast stock concept separates the migratory stocks from the local stocks. The migratory component used in the current analysis includes all of Statistical Area 7 plus Kitasu Bay in Area 6 and Kwakshua Channel in Area 8. The Strait of Georgia is separated into two stock groupings. The northern area includes all of Statistical Areas 14 to 16, Area 17N and Deepwater Bay and Okisollo Channel in Area 13. The southern stock comprises Areas 17S, 18 and 19. The two stock groupings used for the west coast of Vancouver Island are southern (Areas 23 and 24) and northern (Areas 25 to 27).

Additionally, biomass estimates from the escapement model are presented for minor and resident stocks. The level of geographic aggregation used for these estimates is the section (Haist and Rosenfeld 1988).

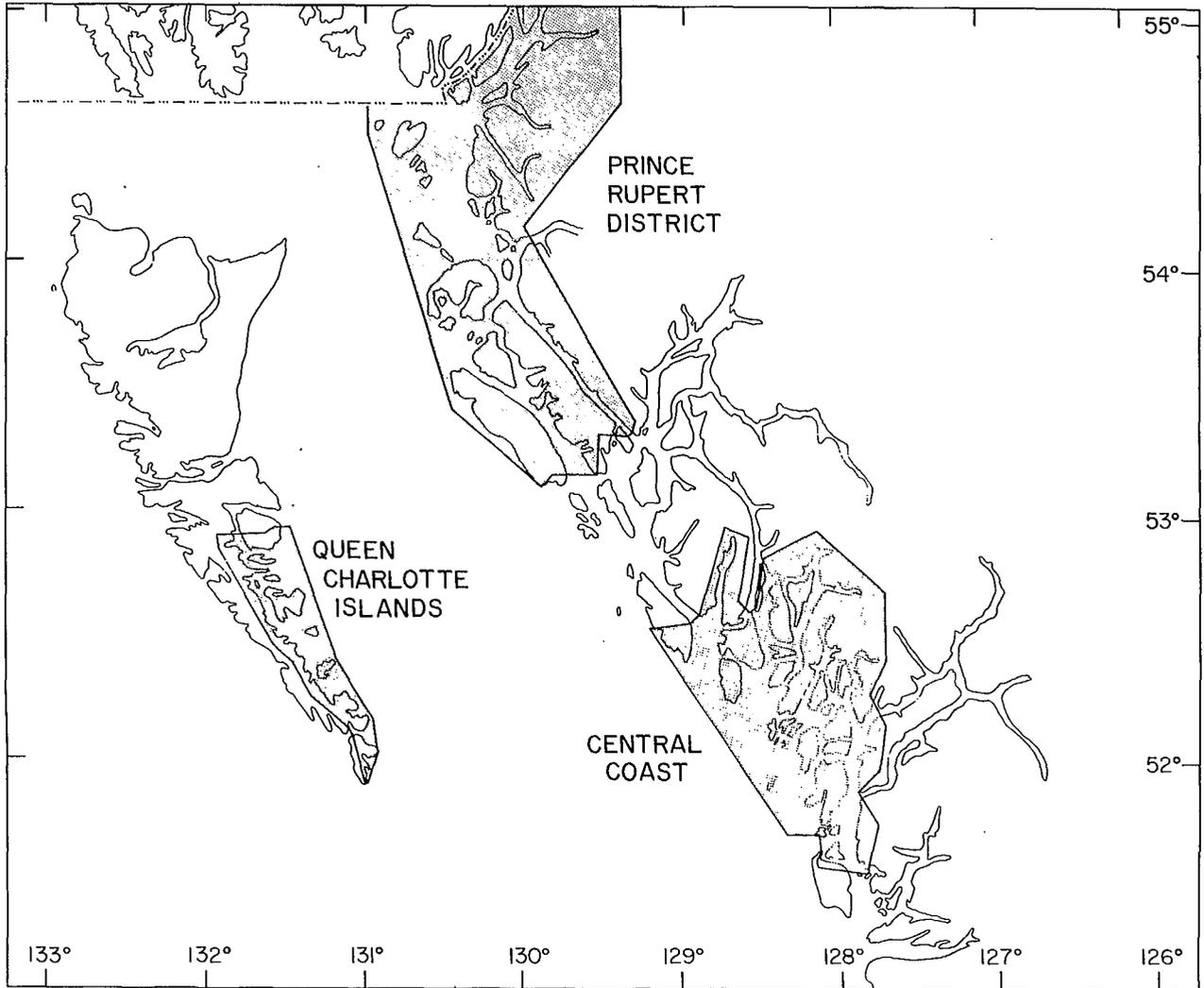
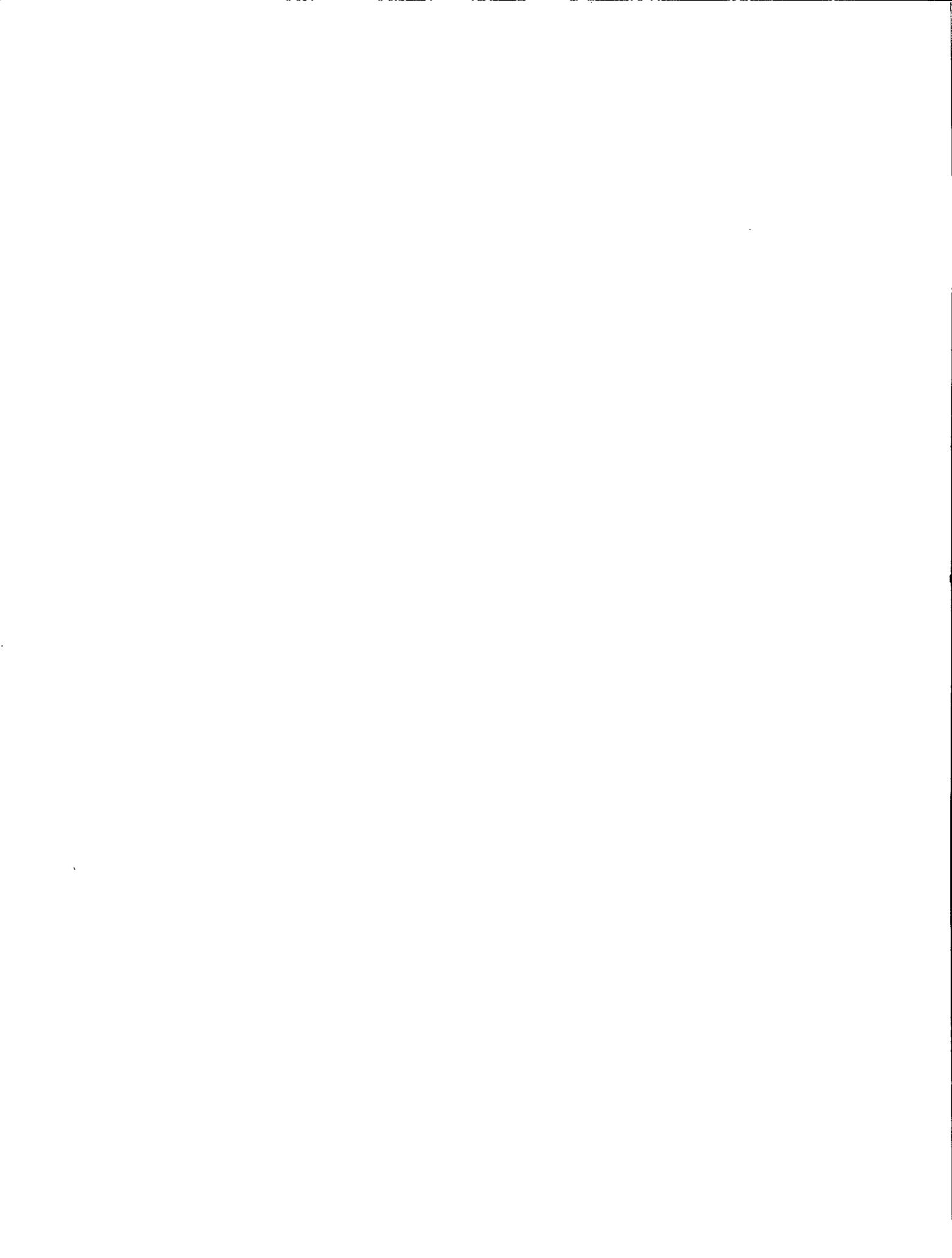


Fig. 1.1. Herring stock assessment regions in northern B.C.



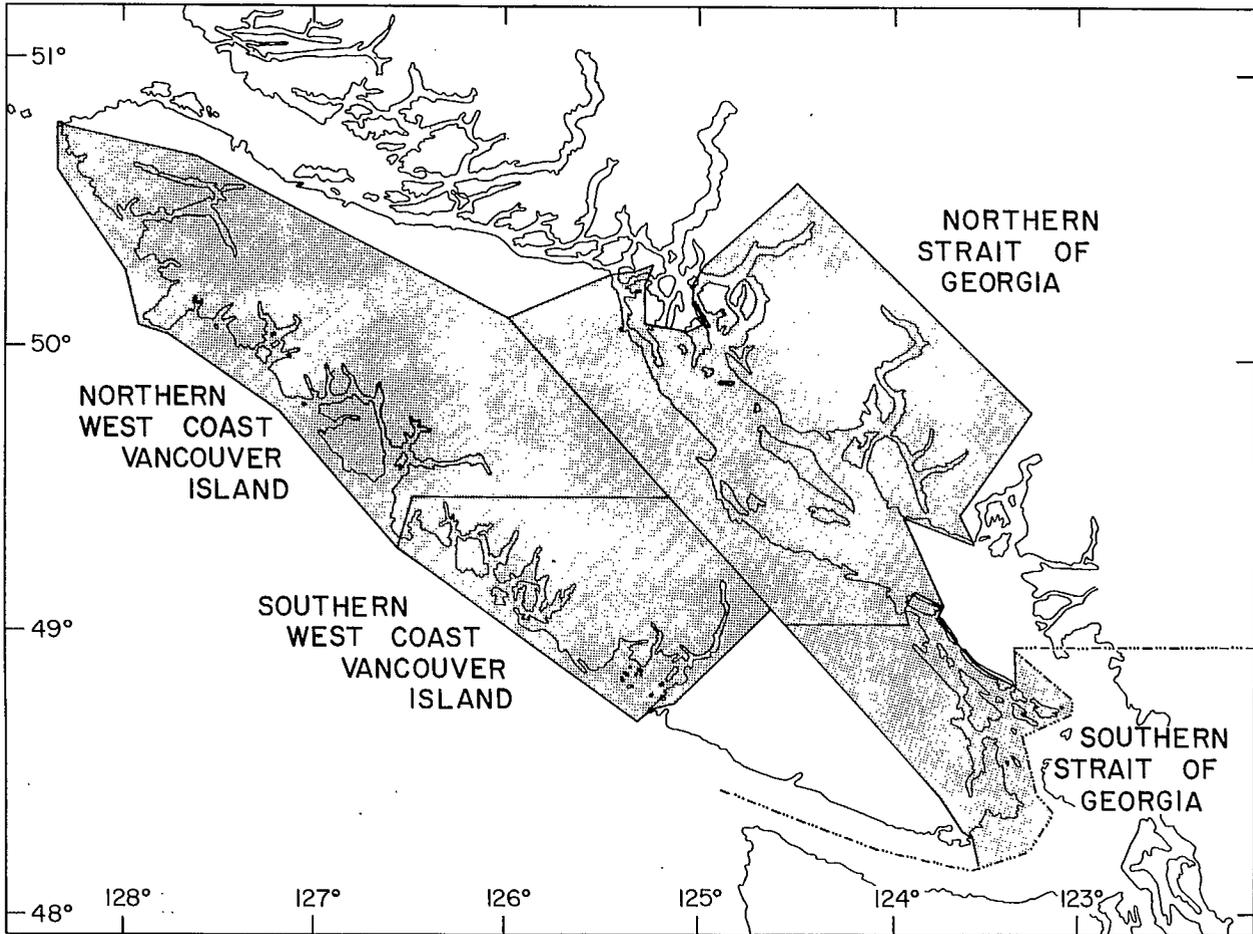
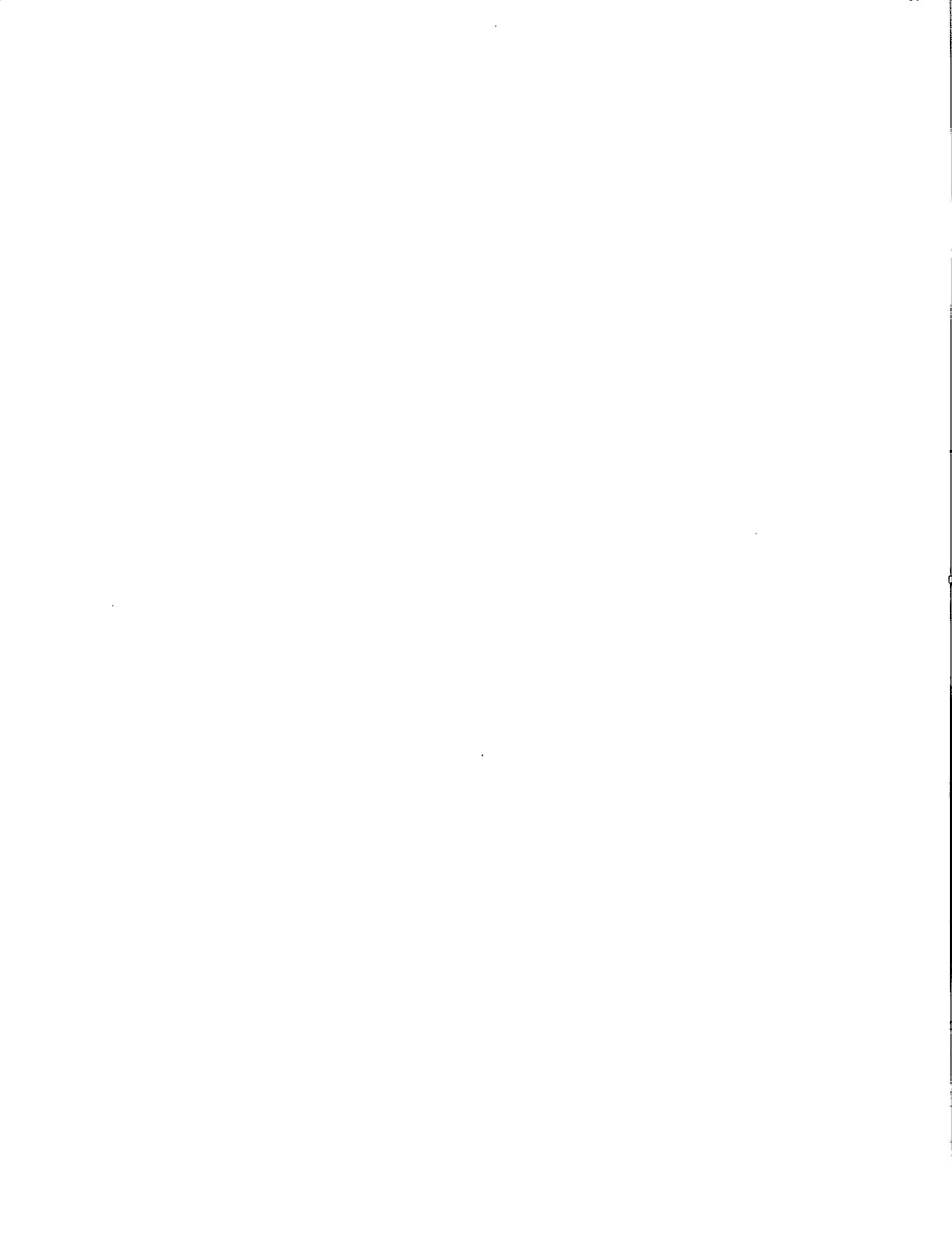


Fig. 1.2. Herring stock assessment regions in southern B.C.



2. ESCAPEMENT MODEL

The escapement model was developed for the 1984 assessments (Haist et al. 1985; Schweigert and Stocker 1988). Subsequently, it has been modified to incorporate age structure information which allows separation of the growth and recruitment components of stock productivity. This also facilitates comparison of estimates with those from the age-structured model. As in past years, when diver spawn survey information is available it is used in preference to surface survey data. In 1987, fishery officers conducted visual dive surveys of the major herring spawns on the south coast. Additionally, in the Queen Charlotte Islands, Pacific Biological Station personnel completed a detailed dive survey of all spawnings. Where dive survey data are not available surface survey data is adjusted as described below. In this year's assessment estimates are again presented for the 7 major stock assessment regions which contain distinct migratory stocks. Stock estimates are also presented for all sections which are not included in the major stock assessment regions. These minor or resident stocks may be capable of supporting very small fisheries, impoundments, or spawn-on-kelp operations.

2.1 METHODS

In the escapement model, estimates of the potential catch in each stock assessment region are calculated as 20 percent of the forecast run size. The forecast run size is the product of the estimated escapement in the previous year and an average annual survival rate (0.64) plus an estimate of anticipated recruitment to each stock. Recruitment is estimated as poor, average, and good by calculating the means of the third poorest, the middle third, and the third best recruitments observed during the historical time series of recruitment estimates from 1951-1987. The estimates of total catch (tonnes) and spawning escapement (billions of eggs) are converted to fish at age based on the sampling data for each area. For each area the age structure and average weight at each age are calculated from all samples available for that region. In some years, no data is available from a region and information from an adjacent area is utilized in the analysis. Estimates of repeat spawners and recruiting fish are converted back to tonnages using average weights at age for the current year. Estimates of spawning biomass in 1987 and forecasts for 1988 are presented for the seven stock assessment regions.

The estimated escapements for each region are derived from information on spawn deposition. Dive survey observations are used directly while surface survey observations are adjusted to render them comparable to dive estimates based on calibration equations derived from duplicate surveys. The calibration equations utilized for the 1987 assessments and 1988 forecasts differ slightly from those used in the previous year (Haist et al. 1987). This year we have incorporated new data derived from the detailed dive survey conducted in the Queen Charlotte Islands during 1987 (Haegeler and Schweigert 1987).

The equation used to adjust surface survey spawn width estimates to diver width estimates is:

$$\text{Adjusted width} = 74.727 + 0.816 \cdot \text{Surface survey width}$$

This equation is virtually identical to that used in last year's assessment. The regression equation used to estimate the average density of eggs for each spawn from the estimate of average egg layers is:

$$\text{Eggs/m}^2 = 183.252 + 76.738 \cdot \text{Average surface layers} \cdot 1000.$$

This relationship differs from the exponential equation used last year but provides the best fit to the data. Other forms of relationship were examined and all provided similar estimates of total spawning biomass.

Surface survey data are adjusted using the foregoing equations in all areas except for Johnstone Strait (Statistical Areas 9-13). In this area no adjustment is applied to the spawn widths as previous dive surveys in the area (Schweigert and Haegele 1988a, b) indicated that widths were accurately assessed from the surface. Egg deposition is estimated from the product of total spawn length, adjusted width, and egg density as estimated from the average surface layer estimate. The total egg deposition is converted to tonnes of spawners based on the average estimate of 100 eggs per gram of spawning fish. Escapement plus catch provides an estimate of the total pre-fishery spawning stock biomass.

Estimates of egg deposition from the diver survey are based on a two-stage sampling design (Schweigert et al. 1985). Spawn lengths and widths are determined by exploratory raking, snorkelling, or by swimming along transects. Egg density for each spawn is estimated from the mean of a series of quadrats located along the transects. For each quadrat observations are made on several variables: dominant vegetation type, proportion of the quadrat covered by vegetation, number of layers of eggs on vegetation, proportion of the bottom substrate covered by eggs, and an estimate of the number of egg layers on bottom substrate. For the vegetation, egg density is estimated from the following equation:

$$\text{Eggs/m}^2 = 868.2080 \cdot L^{0.7812} \cdot p^{1.5599} \cdot V_i \cdot Q_j \cdot 1000.$$

where L = number of layers of eggs on the dominant vegetation type

P = proportion of quadrat covered by vegetation

V₁ = 1.1742 parameter for sea grasses

V₂ = 0.8651 parameter for rockweed

V₃ = 0.8385 parameter for flat kelp

V₄ = 0.9566 parameter for other brown algae

V₅ = 0.9284 parameter for leafy red and green algae

V₆ = 1.000 parameter for stringy red algae

Q₁ = 0.9071 parameter for 1.00 m² quadrats

Q₂ = 0.6050 parameter for 0.50 m² quadrats

Q₃ = 1.000 parameter for 0.25 m² quadrats

Eggs on rock are estimated from the product of proportion of the quadrat covered by eggs, number of egg layers, times 340,000 egg/m² (Haegele et al. 1979). Total egg density for each quadrat is the sum of eggs on vegetation plus eggs on rock.

2.2 RESULTS

The 1988 forecast spawning run to the lower east coast of the Queen Charlotte Islands is 11,000 tonnes assuming average recruitment (Table 2.6). This stock has been declining since 1981 when the very strong 1977 year-class became fully recruited to the stock (Fig. 2.1). Poor recruitments to this area in the intervening years have accentuated the stock decline. Another poor recruitment to this stock would yield a spawning run of about 9,400 tonnes while a very good recruitment could produce a run of 19,000 tonnes of spawners. The intensive diving survey of this area yielded a 1987 spawning biomass estimate of 13,963 tonnes which was an increase from the previous year. However, the 1986 spawn survey was felt to be incomplete due to poor weather which hampered efforts to survey the spawn. In addition, about 25% of the spawn in this area occurs on Macrocystis sp. which cannot be surveyed accurately using the traditional surface survey. The dive survey of the area in 1987 probably found more spawn than would have been observed with a surface survey. Nevertheless, the spawning biomass forecast with even an average recruitment is below the CUTOFF level for this area, indicating that conservation measures are needed to rebuild this stock.

The forecast runs for the Prince Rupert District with average and good recruitments are for 31,800 and 41,700 tonnes, respectively (Table 2.6). This stock is now at or near historically high levels and has maintained itself at this level for the past few years. The 1987 spawning biomass estimate of 38,586 tonnes is the highest observed over the time period of our analysis, 1951-1987 (Table 2.1, Fig. 2.1).

Forecast run sizes for the Central Coast are for 24,700 tonnes with average or 21,100 tonnes with poor recruitment. This stock has remained at levels of 30-40,000 tonnes since 1980 and appears to be in relatively good condition (Fig. 2.1). The spawning biomass estimate for 1987 of 28,123 tonnes is up slightly from the previous two years, suggesting that similar to higher levels may be anticipated in 1988 (Table 2.1, 2.6).

The forecast run sizes for south coast stocks continue to surpass the levels of the early 1980s. The northern Strait of Georgia forecast run is for 31,400 and 43,600 tonnes with average and good recruitment, respectively (Table 2.6). The forecast with average recruitment indicates a level similar to that of 1987 but down substantially from 1986 when the strong 1983 year-class recruited to the stock (Table 2.2, Fig. 2.2). Spawning biomass in 1987 was 26,432 tonnes, down substantially from the 55,447 tonnes in 1986. The southern Strait of Georgia stock forecast with average recruitment is 9700 tonnes and with good recruitment 12,500 tonnes. The downward trend in this

stock has slowed with the appearance of the good 1983 year-class. The spawning biomass of 8783 tonnes in 1987 is up slightly from 1986 levels (Table 2.2, Fig. 2.2) but down from the 20,000 tonne level observed in 1979 (Table 2.2).

The stocks on the southern west coast of Vancouver Island are forecast at 23,400 and 32,600 tonnes of spawners with average and good recruitment, respectively (Table 2.6). The stock levels appear to be approaching the long term average but they are down from 1985 and 1986 biomasses when the good 1981 and 1982 year-classes were prominent (Table 2.2, Fig. 2.2). Even poor recruitment should result in 19,000 tonnes of spawners in the area, a level well above the CUTOFF of 15,400 tonnes recommended for this area. Stock biomass levels forecast for the northern west coast of Vancouver Island are 12,300 and 21,800 tonnes with average and good recruitment. This stock is now only slightly below historical average levels, having recovered from the low levels of 1983 and 1984 (Table 2.2). Poor recruitment could result in about 9200 tonnes of spawners returning to the area, again well above the cutoff level of 6000 tonnes required for this stock.

The minor and resident stock abundance estimates are presented in Tables 2.3 to 2.5. There are problems in assessing the stocks in many of the more remote locations due to inadequate spawn survey coverage and a general absence of age composition data, so absolute estimates of abundance are probably not very accurate. However, the abundance trends generally follow those of the nearby migratory stocks. No areas which could support substantial fisheries are in evidence. The stocks in Area 2W are stable but lower than historical levels. The minor stocks in the Central Coast assessment region are also not surveyed with sufficient regularity to discern possible trends, but no major fishable biomasses are apparent. The Johnstone Strait stocks are in many instances below the long term average, reflecting perhaps irregular and incomplete spawn survey coverage of some of the areas in this region.

Table 2.1. Estimates of spawner biomass, catch, and total stock abundance (tonnes) for the Northern stock assessment regions for 1951-1987.

| Season | Queen Charlotte Is. | | | North Coast | | | Central Coast | | |
|--------|---------------------|-------|-------|-------------|-------|-------|---------------|-------|-------|
| | Spawners | Catch | Stock | Spawners | Catch | Stock | Spawners | Catch | Stock |
| 50/51 | 4299 | 2847 | 7146 | 29183 | 45865 | 75049 | 21477 | 41898 | 63376 |
| 51/52 | 3122 | 10147 | 13269 | 10361 | 52379 | 62740 | 10609 | 32526 | 43134 |
| 52/53 | 5764 | 0 | 5764 | 14599 | 1865 | 16464 | 20751 | 768 | 21519 |
| 53/54 | 11684 | 1786 | 13470 | 10197 | 27277 | 37473 | 16925 | 24164 | 41089 |
| 54/55 | 5936 | 1234 | 7171 | 12997 | 17806 | 30802 | 16086 | 11542 | 27628 |
| 55/56 | 5556 | 77589 | 83144 | 12822 | 10182 | 23004 | 11284 | 43455 | 54739 |
| 56/57 | 1513 | 23247 | 24760 | 19895 | 28035 | 47929 | 6069 | 23261 | 29329 |
| 57/58 | 790 | 11166 | 11956 | 8666 | 4523 | 13189 | 8250 | 9849 | 18100 |
| 58/59 | 7112 | 7027 | 14139 | 16747 | 10224 | 26971 | 7029 | 27870 | 34899 |
| 59/60 | 3558 | 0 | 3558 | 13414 | 18476 | 31890 | 20970 | 3631 | 24601 |
| 60/61 | 6568 | 653 | 7222 | 14626 | 42746 | 57372 | 8545 | 21564 | 30109 |
| 61/62 | 4394 | 7632 | 12026 | 20475 | 27660 | 48135 | 22973 | 8910 | 31883 |
| 62/63 | 4549 | 14980 | 19529 | 15419 | 40228 | 55647 | 10690 | 35823 | 46512 |
| 63/64 | 3248 | 26962 | 30210 | 16698 | 30340 | 47037 | 11934 | 30019 | 41954 |
| 64/65 | 1472 | 32423 | 33895 | 6298 | 44211 | 50508 | 4528 | 15436 | 19964 |
| 65/66 | 3551 | 2746 | 6297 | 5857 | 17295 | 23152 | 5010 | 35530 | 40540 |
| 66/67 | 771 | 161 | 932 | 3051 | 7998 | 11049 | 8451 | 21083 | 29534 |
| 67/68 | 734 | 80 | 814 | 6420 | 2144 | 8563 | 8896 | 1459 | 10354 |
| 68/69 | 1865 | 0 | 1865 | 915 | 547 | 1462 | 3654 | 100 | 3754 |
| 69/70 | 2887 | 0 | 2887 | 11839 | 1498 | 13337 | 19770 | 209 | 19979 |
| 70/71 | 4592 | 0 | 4592 | 9737 | 3500 | 13237 | 6496 | 3614 | 10110 |
| 71/72 | 2897 | 1260 | 4157 | 10917 | 4494 | 15411 | 8511 | 8131 | 16642 |
| 72/73 | 2424 | 2231 | 4654 | 11252 | 1607 | 12859 | 23974 | 7777 | 31751 |
| 73/74 | 6980 | 2277 | 9257 | 8821 | 3819 | 12640 | 19533 | 8773 | 28306 |
| 74/75 | 3972 | 4408 | 8380 | 10625 | 1702 | 12326 | 18661 | 8722 | 27382 |
| 75/76 | 9214 | 9425 | 18638 | 16009 | 4307 | 20316 | 29962 | 12068 | 42030 |
| 76/77 | 11245 | 10024 | 21270 | 15358 | 8142 | 23500 | 27218 | 11106 | 38324 |
| 77/78 | 10059 | 9489 | 19547 | 7375 | 8588 | 15962 | 16747 | 14046 | 30793 |
| 78/79 | 7677 | 7953 | 15630 | 13803 | 4317 | 18120 | 14263 | 5 | 14268 |
| 79/80 | 24553 | 2274 | 26828 | 16985 | 3425 | 20411 | 30658 | 538 | 31196 |
| 80/81 | 23834 | 5631 | 29465 | 17181 | 3090 | 20271 | 32915 | 2573 | 35488 |
| 81/82 | 19373 | 3778 | 23151 | 14926 | 1984 | 16910 | 34139 | 6370 | 40509 |
| 82/83 | 16979 | 5597 | 22576 | 26146 | 0 | 26146 | 41710 | 5640 | 47350 |
| 83/84 | 20176 | 4719 | 24894 | 27921 | 3761 | 31681 | 28162 | 7193 | 35355 |
| 84/85 | 15624 | 6109 | 21733 | 32690 | 6747 | 39437 | 24266 | 5209 | 29475 |
| 85/86 | 5846 | 4536 | 10382 | 35353 | 8418 | 43771 | 23460 | 5179 | 28639 |
| 86/87 | 13963 | 1720 | 15683 | 38586 | 5552 | 44138 | 28123 | 3231 | 31354 |

Table 2.2. Estimates of spawner biomass, catch, and total stock abundance (tonnes) for the Southern stock assessment regions for 1951-1987.

| Season | Georgia Strait - N | | | Georgia Strait - S | | | WCVI - South | | | WCVI - North | | |
|--------|--------------------|-------|-------|--------------------|-------|-------|--------------|-------|-------|--------------|-------|-------|
| | Spawners | Catch | Stock | Spawners | Catch | Stock | Spawners | Catch | Stock | Spawners | Catch | Stock |
| 50/51 | 31889 | 17787 | 49677 | 3633 | 26011 | 29644 | 6464 | 15914 | 22378 | 13135 | 6117 | 19252 |
| 51/52 | 28828 | 17635 | 46462 | 14392 | 28211 | 42603 | 6492 | 10630 | 17122 | 3303 | 16415 | 19719 |
| 52/53 | 34728 | 4376 | 39104 | 53093 | 4037 | 57130 | 8997 | 20 | 9017 | 25713 | 0 | 25713 |
| 53/54 | 23762 | 20258 | 44020 | 36987 | 45207 | 82194 | 5279 | 28699 | 33978 | 11125 | 8875 | 20000 |
| 54/55 | 30819 | 26818 | 57637 | 31712 | 41823 | 73535 | 6384 | 6041 | 12425 | 10438 | 6524 | 16962 |
| 55/56 | 13987 | 27273 | 41260 | 14844 | 44789 | 59633 | 8910 | 17098 | 26008 | 13015 | 508 | 13523 |
| 56/57 | 12925 | 21374 | 34299 | 6992 | 38235 | 45227 | 6344 | 2600 | 8944 | 18939 | 491 | 19430 |
| 57/58 | 8149 | 9012 | 17160 | 17385 | 11616 | 29001 | 11551 | 513 | 12063 | 7282 | 43 | 7325 |
| 58/59 | 16148 | 34189 | 50337 | 16285 | 15836 | 32121 | 6049 | 37385 | 43434 | 5632 | 32370 | 38002 |
| 59/60 | 20530 | 21949 | 42479 | 9457 | 45497 | 54954 | 5577 | 17652 | 23229 | 3717 | 38145 | 41861 |
| 60/61 | 16956 | 15675 | 32631 | 9247 | 30430 | 39678 | 7968 | 13489 | 21457 | 5531 | 17356 | 22887 |
| 61/62 | 16624 | 30356 | 46980 | 5558 | 34945 | 40503 | 9076 | 15597 | 24673 | 14794 | 12777 | 27571 |
| 62/63 | 16646 | 33746 | 50392 | 8725 | 35101 | 43826 | 8764 | 4019 | 12783 | 4289 | 17230 | 21520 |
| 63/64 | 15482 | 36798 | 52280 | 6689 | 40179 | 46868 | 17749 | 20230 | 37978 | 8537 | 1914 | 10450 |
| 64/65 | 13602 | 27234 | 40836 | 2505 | 19888 | 22393 | 7052 | 14063 | 21115 | 8980 | 4741 | 13721 |
| 65/66 | 4792 | 20965 | 25758 | 2723 | 12337 | 15059 | 3346 | 8169 | 11516 | 2861 | 4207 | 7068 |
| 66/67 | 6715 | 11136 | 17851 | 2504 | 19885 | 22389 | 2100 | 9171 | 11271 | 4655 | 6260 | 10915 |
| 67/68 | 7026 | 949 | 7975 | 5247 | 981 | 6227 | 4073 | 0 | 4073 | 3628 | 0 | 3628 |
| 68/69 | 9246 | 314 | 9560 | 7377 | 420 | 7797 | 5530 | 0 | 5530 | 9256 | 0 | 9256 |
| 69/70 | 22791 | 519 | 23311 | 12793 | 365 | 13157 | 17157 | 0 | 17157 | 8344 | 0 | 8344 |
| 70/71 | 27787 | 946 | 28733 | 10764 | 745 | 11509 | 17946 | 0 | 17946 | 8496 | 0 | 8496 |
| 71/72 | 14022 | 5814 | 19835 | 8946 | 2368 | 11315 | 17549 | 4285 | 21835 | 13100 | 2609 | 15709 |
| 72/73 | 15192 | 6585 | 21777 | 9647 | 970 | 10617 | 6167 | 10409 | 16576 | 10983 | 7894 | 18877 |
| 73/74 | 28003 | 3211 | 31214 | 15660 | 791 | 16451 | 13408 | 6371 | 19780 | 5549 | 10489 | 16038 |
| 74/75 | 35638 | 5114 | 40752 | 16951 | 1063 | 18014 | 21043 | 18593 | 39636 | 11512 | 7515 | 19027 |
| 75/76 | 39198 | 8163 | 47361 | 9453 | 4075 | 13528 | 28724 | 33441 | 62165 | 5363 | 5520 | 10883 |
| 76/77 | 47444 | 11304 | 58747 | 5988 | 6205 | 12193 | 29326 | 26453 | 55779 | 7312 | 3688 | 11000 |
| 77/78 | 53734 | 13874 | 67608 | 13558 | 10129 | 23686 | 18687 | 18050 | 36737 | 16769 | 4846 | 21615 |
| 78/79 | 73842 | 8638 | 82480 | 19318 | 11699 | 31018 | 28795 | 9876 | 38671 | 36820 | 9510 | 46330 |
| 79/80 | 54920 | 4524 | 59444 | 11720 | 1294 | 13014 | 27500 | 2276 | 29776 | 32089 | 2226 | 34315 |
| 80/81 | 32161 | 7375 | 39536 | 12197 | 4645 | 16842 | 24790 | 4928 | 29718 | 13033 | 3833 | 16866 |
| 81/82 | 63276 | 5705 | 68981 | 8024 | 7086 | 15110 | 11142 | 3110 | 14252 | 14294 | 2947 | 17242 |
| 82/83 | 32037 | 16220 | 48257 | 11613 | 949 | 12562 | 11094 | 6141 | 17234 | 12332 | 2597 | 14930 |
| 83/84 | 15645 | 9869 | 25515 | 11947 | 1175 | 13122 | 16115 | 5718 | 21833 | 6394 | 1032 | 7426 |
| 84/85 | 21142 | 6228 | 27370 | 7644 | 791 | 8435 | 26016 | 178 | 26194 | 3837 | 0 | 3837 |
| 85/86 | 55447 | 281 | 55729 | 7776 | 307 | 8083 | 33326 | 204 | 33530 | 16000 | 0 | 16000 |
| 86/87 | 26558 | 5304 | 31862 | 8783 | 3831 | 13614 | 23103 | 13106 | 36209 | 10993 | 2448 | 13441 |

Table 2.3. Estimates of the total biomass and average reduction and roe catches (tonnes) for minor and resident stocks in the Queen Charlotte Islands for 1951-1987.

| Season | Section | | | | | | Total Area 2W | Section | |
|------------------------|---------|------|------|-----|------|------|------------------|---------|------|
| | 001 | 002 | 003 | 004 | 005 | 006 | | 022 | 023 |
| 50/51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 848 | 0 |
| 51/52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 492 | 0 |
| 52/53 | 0 | 0 | 790 | 163 | 0 | 0 | 953 | 1976 | 0 |
| 53/54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25360 | 0 |
| 54/55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19017 | 0 |
| 55/56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5895 | 93 |
| 56/57 | 0 | 0 | 147 | 0 | 0 | 464 | 611 | 1195 | 0 |
| 57/58 | 0 | 0 | 221 | 0 | 40 | 0 | 261 | 87 | 0 |
| 58/59 | 1672 | 1164 | 1614 | 0 | 1024 | 1078 | 6552 | 11196 | 0 |
| 59/60 | 92 | 667 | 1411 | 0 | 116 | 3738 | 6024 | 3627 | 0 |
| 60/61 | 1127 | 410 | 520 | 0 | 379 | 2094 | 4530 | 4320 | 0 |
| 61/62 | 403 | 1962 | 1620 | 0 | 301 | 970 | 5256 | 8031 | 0 |
| 62/63 | 0 | 2407 | 0 | 0 | 0 | 0 | 2407 | 3034 | 0 |
| 63/64 | 430 | 1375 | 772 | 187 | 164 | 3595 | 6523 | 3653 | 0 |
| 64/65 | 285 | 0 | 308 | 103 | 1486 | 3455 | 5637 | 5951 | 0 |
| 65/66 | 0 | 62 | 24 | 0 | 21 | 0 | 107 | 3713 | 0 |
| 66/67 | 80 | 1203 | 0 | 0 | 157 | 66 | 1506 | 777 | 184 |
| 67/68 | 0 | 6 | 107 | 0 | 75 | 85 | 273 | 256 | 0 |
| 68/69 | 24 | 280 | 327 | 0 | 949 | 0 | 1580 | 1107 | 0 |
| 69/70 | 0 | 417 | 363 | 0 | 807 | 412 | 1999 | 1222 | 5109 |
| 70/71 | 0 | 159 | 805 | 0 | 580 | 1833 | 3377 | 2069 | 6727 |
| 71/72 | 0 | 452 | 476 | 0 | 2022 | 3375 | 6325 | 3573 | 7577 |
| 72/73 | 0 | 130 | 1505 | 0 | 2334 | 5380 | 9349 | 1151 | 9421 |
| 73/74 | 0 | 0 | 1388 | 0 | 3016 | 4014 | 8418 | 1632 | 6277 |
| 74/75 | 0 | 306 | 1401 | 253 | 1567 | 5768 | 9295 | 2239 | 5318 |
| 75/76 | 0 | 405 | 491 | 0 | 1855 | 9197 | 11948 | 3028 | 5079 |
| 76/77 | 0 | 283 | 647 | 207 | 2484 | 5379 | 9000 | 3097 | 4205 |
| 77/78 | 651 | 0 | 2071 | 0 | 2200 | 3579 | 8501 | 3994 | 3559 |
| 78/79 | 1293 | 50 | 682 | 102 | 873 | 987 | 3987 | 1642 | 3624 |
| 79/80 | 1151 | 1384 | 1864 | 0 | 2375 | 2870 | 9644 | 31 | 0 |
| 80/81 | 1193 | 3954 | 2089 | 406 | 1204 | 1174 | 10020 | 695 | 2076 |
| 81/82 | 0 | 6174 | 3542 | 437 | 4124 | 2258 | 16535 | 877 | 544 |
| 82/83 | 254 | 3491 | 4268 | 543 | 5288 | 1362 | 15206 | 581 | 1756 |
| 83/84 | 591 | 2648 | 1115 | 0 | 2167 | 735 | 7256 | 2295 | 1765 |
| 84/85 | 0 | 2176 | 882 | 36 | 1947 | 1093 | 6134 | 407 | 1212 |
| 85/86 | 0 | 1109 | 298 | 0 | 1413 | 0 | 2820 | 2609 | 920 |
| 86/87 | 0 | 2040 | 0 | 0 | 730 | 564 | 3334 | 810 | 1717 |
| Avg Biomass | 280 | 1052 | 962 | 74 | 1264 | 1986 | 5617 | 4015 | 2035 |
| Avg Catch (1951-67) | 35 | 0 | 6 | 0 | 57 | 322 | 420 | 5193 | 5 |
| Avg Catch (1972-87) | 0 | 12 | 143 | 0 | 316 | 665 | 1136 | 177 | 956 |

Table 2.4. Estimates of the total biomass and average reduction and roe catches (tonnes) for minor and resident stocks in the Central Coast and northern Johnstone Strait for 1951-1987.

| Season | Section | | | | | | | | | | Area 9 | Area 10 | Total |
|-----------------------|---------|------|------|------|------|------|------|------|------|-------|-----------|------------|-------|
| | 061 | 062 | 063 | 064 | 065 | 066 | 081 | 082 | 083 | 084 | | | |
| 50/51 | 0 | 0 | 12 | 116 | 0 | 3180 | 0 | 9 | 0 | 560 | 762 | 191 | 4830 |
| 51/52 | 0 | 0 | 0 | 104 | 211 | 0 | 2374 | 10 | 0 | 669 | 557 | 70 | 3995 |
| 52/53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 675 | 875 |
| 53/54 | 0 | 181 | 0 | 810 | 223 | 59 | 309 | 994 | 0 | 453 | 2170 | 489 | 5688 |
| 54/55 | 0 | 367 | 95 | 2923 | 2118 | 113 | 709 | 274 | 279 | 406 | 5334 | 1401 | 14019 |
| 55/56 | 0 | 271 | 48 | 16 | 62 | 8 | 0 | 307 | 18 | 879 | 164 | 153 | 1926 |
| 56/57 | 4906 | 149 | 22 | 54 | 1983 | 0 | 1505 | 766 | 0 | 0 | 3077 | 2158 | 14620 |
| 57/58 | 1890 | 295 | 18 | 1 | 324 | 0 | 0 | 1753 | 0 | 0 | 642 | 470 | 5393 |
| 58/59 | 1748 | 233 | 694 | 58 | 67 | 366 | 75 | 1134 | 0 | 334 | 2870 | 1232 | 8811 |
| 59/60 | 19 | 615 | 2523 | 250 | 1644 | 0 | 0 | 330 | 26 | 406 | 405 | 586 | 6804 |
| 60/61 | 0 | 672 | 680 | 11 | 3666 | 0 | 289 | 457 | 0 | 10140 | 1037 | 911 | 17863 |
| 61/62 | 152 | 2298 | 90 | 0 | 5055 | 138 | 6478 | 24 | 0 | 6799 | 5827 | 1495 | 28356 |
| 62/63 | 377 | 2506 | 1282 | 181 | 65 | 0 | 2345 | 1169 | 0 | 8728 | 4105 | 536 | 21294 |
| 63/64 | 633 | 1578 | 2117 | 0 | 934 | 31 | 1509 | 953 | 529 | 2045 | 8282 | 1171 | 19782 |
| 64/65 | 1812 | 1237 | 137 | 0 | 656 | 40 | 353 | 673 | 169 | 233 | 1603 | 377 | 7290 |
| 65/66 | 4209 | 1966 | 599 | 277 | 37 | 147 | 3251 | 822 | 819 | 1952 | 5664 | 1326 | 21069 |
| 66/67 | 3045 | 1760 | 130 | 117 | 191 | 0 | 270 | 270 | 1176 | 807 | 3166 | 2488 | 13420 |
| 67/68 | 1511 | 59 | 52 | 1 | 0 | 0 | 0 | 913 | 51 | 289 | 409 | 1490 | 4775 |
| 68/69 | 0 | 0 | 6 | 34 | 0 | 0 | 282 | 16 | 0 | 307 | 115 | 46 | 806 |
| 69/70 | 0 | 0 | 71 | 62 | 14 | 27 | 672 | 272 | 8 | 0 | 1603 | 335 | 3064 |
| 70/71 | 0 | 0 | 44 | 15 | 29 | 0 | 264 | 493 | 211 | 1635 | 623 | 819 | 4133 |
| 71/72 | 0 | 0 | 14 | 0 | 0 | 444 | 169 | 429 | 258 | 1148 | 1031 | 1164 | 4657 |
| 72/73 | 0 | 79 | 43 | 0 | 0 | 0 | 147 | 137 | 1217 | 151 | 3804 | 138 | 5716 |
| 73/74 | 0 | 40 | 37 | 0 | 0 | 0 | 62 | 129 | 641 | 240 | 1050 | 300 | 2499 |
| 74/75 | 0 | 0 | 39 | 0 | 5 | 0 | 368 | 126 | 1152 | 336 | 884 | 299 | 3209 |
| 75/76 | 0 | 193 | 0 | 0 | 30 | 0 | 115 | 141 | 922 | 131 | 732 | 180 | 2444 |
| 76/77 | 0 | 0 | 30 | 0 | 2 | 0 | 0 | 134 | 499 | 827 | 657 | 59 | 2208 |
| 77/78 | 57 | 0 | 4 | 0 | 0 | 0 | 37 | 64 | 249 | 0 | 419 | 212 | 1042 |
| 78/79 | 0 | 208 | 0 | 0 | 0 | 168 | 0 | 41 | 223 | 0 | 118 | 80 | 838 |
| 79/80 | 0 | 0 | 0 | 0 | 0 | 573 | 0 | 141 | 0 | 0 | 302 | 241 | 1257 |
| 80/81 | 189 | 27 | 0 | 0 | 0 | 0 | 0 | 75 | 111 | 163 | 71 | 191 | 827 |
| 81/82 | 482 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 964 | 754 | 2238 |
| 82/83 | 0 | 119 | 0 | 0 | 0 | 0 | 0 | 15 | 133 | 185 | 228 | 591 | 1271 |
| 83/84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 287 | 0 | 54 | 704 | 1080 |
| 84/85 | 10 | 269 | 0 | 0 | 0 | 0 | 0 | 0 | 87 | 0 | 144 | 222 | 732 |
| 85/86 | 0 | 828 | 0 | 0 | 0 | 0 | 0 | 100 | 53 | 0 | 1989 | 601 | 3571 |
| 86/87 | 387 | 205 | 0 | 0 | 0 | 609 | 0 | 213 | 182 | 794 | 1451 | 78 | 3919 |
| Average Biomass | 649 | 490 | 266 | 152 | 525 | 179 | 654 | 408 | 282 | 1231 | 1894 | 734 | 7464 |
| Av Catch (1951-67) | 1105 | 829 | 471 | 264 | 1013 | 144 | 1144 | 576 | 130 | 1913 | 2475 | 749 | 0 |
| Av Catch (1972-87) | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 132 | 90 | 223 | 96 | 0 |

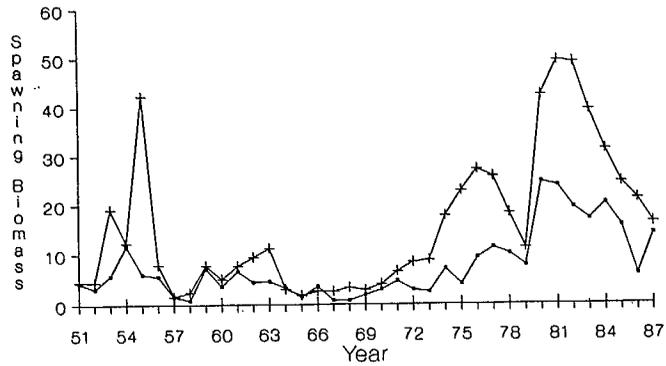
Table 2.5. Estimates of total biomass and average reduction and roe catches (tonnes) for minor and resident stocks in southern Johnstone Strait for 1951-1987.

| Season | Area 11 | Section 126 | Section 127 | Other Area 12 | Other Area 13 | Total |
|------------------------|------------|----------------|----------------|------------------|------------------|-------|
| 50/51 | 1 | 986 | 339 | 3236 | 128 | 4690 |
| 51/52 | 5 | 2292 | 347 | 5632 | 88 | 8364 |
| 52/53 | 0 | 214 | 264 | 1365 | 181 | 2024 |
| 53/54 | 2 | 871 | 415 | 5102 | 408 | 6798 |
| 54/55 | 6515 | 323 | 1083 | 1138 | 374 | 9433 |
| 55/56 | 257 | 565 | 198 | 313 | 592 | 1925 |
| 56/57 | 13 | 638 | 129 | 12723 | 83 | 13586 |
| 57/58 | 15 | 29 | 183 | 4323 | 0 | 4550 |
| 58/59 | 145 | 3436 | 1093 | 1624 | 380 | 6678 |
| 59/60 | 675 | 979 | 2516 | 5543 | 1909 | 11622 |
| 60/61 | 272 | 819 | 282 | 1656 | 810 | 3839 |
| 61/62 | 780 | 112 | 749 | 9853 | 419 | 11913 |
| 62/63 | 2187 | 591 | 1039 | 5869 | 772 | 10458 |
| 63/64 | 82 | 448 | 5706 | 9385 | 1823 | 17444 |
| 64/65 | 1271 | 996 | 2940 | 12270 | 4075 | 21552 |
| 65/66 | 1171 | 297 | 2108 | 14309 | 708 | 18593 |
| 66/67 | 253 | 139 | 997 | 13408 | 3300 | 18097 |
| 67/68 | 8 | 51 | 156 | 4492 | 5 | 4712 |
| 68/69 | 21 | 198 | 187 | 1477 | 235 | 2118 |
| 69/70 | 48 | 303 | 239 | 2742 | 186 | 3518 |
| 70/71 | 71 | 154 | 91 | 1867 | 511 | 2694 |
| 71/72 | 31 | 1502 | 1163 | 4172 | 1476 | 8344 |
| 72/73 | 11 | 1143 | 3651 | 8864 | 373 | 14042 |
| 73/74 | 7 | 569 | 3640 | 1765 | 314 | 6295 |
| 74/75 | 28 | 1170 | 3358 | 1867 | 921 | 7344 |
| 75/76 | 33 | 1229 | 2042 | 822 | 266 | 4392 |
| 76/77 | 15 | 415 | 1696 | 1157 | 186 | 3469 |
| 77/78 | 16 | 570 | 574 | 250 | 253 | 1663 |
| 78/79 | 60 | 61 | 67 | 175 | 350 | 713 |
| 79/80 | 14 | 246 | 395 | 831 | 417 | 1903 |
| 80/81 | 9 | 184 | 278 | 486 | 1412 | 2369 |
| 81/82 | 0 | 138 | 549 | 67 | 2750 | 3504 |
| 82/83 | 17 | 93 | 241 | 101 | 3381 | 3833 |
| 83/84 | 9 | 163 | 477 | 644 | 2 | 1295 |
| 84/85 | 0 | 476 | 1068 | 126 | 239 | 1909 |
| 85/86 | 37 | 162 | 194 | 488 | 46 | 927 |
| 86/87 | 12 | 144 | 167 | 473 | 322 | 1118 |
| Avg Biomass | 427 | 688 | 1231 | 4261 | 900 | 7507 |
| Avg Catch (1951-67) | 35 | 0 | 6 | 0 | 57 | 322 |
| Avg Catch (1972-87) | 0 | 12 | 143 | 0 | 316 | 665 |

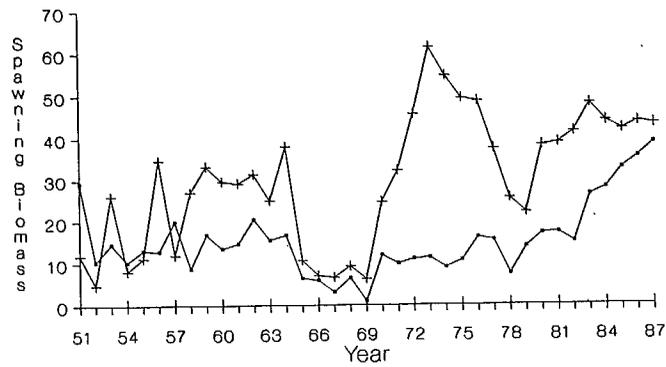
Table 2.6. Estimates of 1987 spawning biomass and forecasts of age 4+ and recruit biomass in 1988 (in thousands of tonnes) from escapement model analysis.

| Stock Assessment Region | 1987 Spawning Biomass | Age 4+ | 1987 Forecasts | | |
|-----------------------------|-----------------------|--------|----------------|---------|------|
| | | | Age 3 recruits | | |
| | | | Poor | Average | Good |
| Queen Charlotte Islands | 13.8 | 8.8 | 0.6 | 2.2 | 10.2 |
| Prince Rupert District | 38.3 | 27.6 | 1.2 | 4.2 | 14.1 |
| Central Coast | 27.5 | 18.5 | 2.6 | 6.2 | 17.4 |
| Strait of Georgia | | | | | |
| Northern stock | 25.0 | 18.9 | 6.3 | 12.5 | 24.7 |
| Southern stock | 6.6 | 5.5 | 2.7 | 4.2 | 7.0 |
| West Coast of Vancouver Is. | | | | | |
| Northern stock | 20.2 | 15.7 | 3.3 | 7.7 | 16.9 |
| Southern stock | 9.8 | 7.4 | 1.8 | 4.9 | 14.4 |

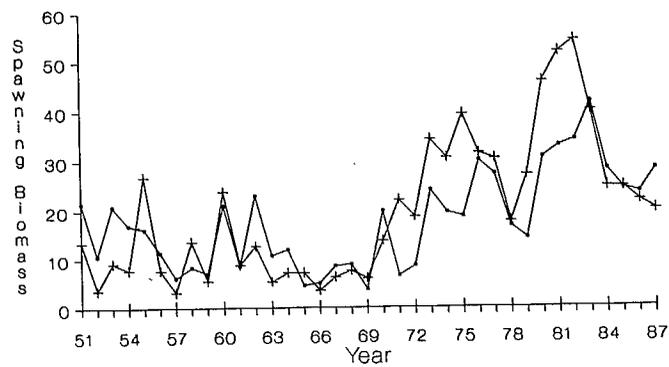
Queen Charlotte Islands



Prince Rupert District

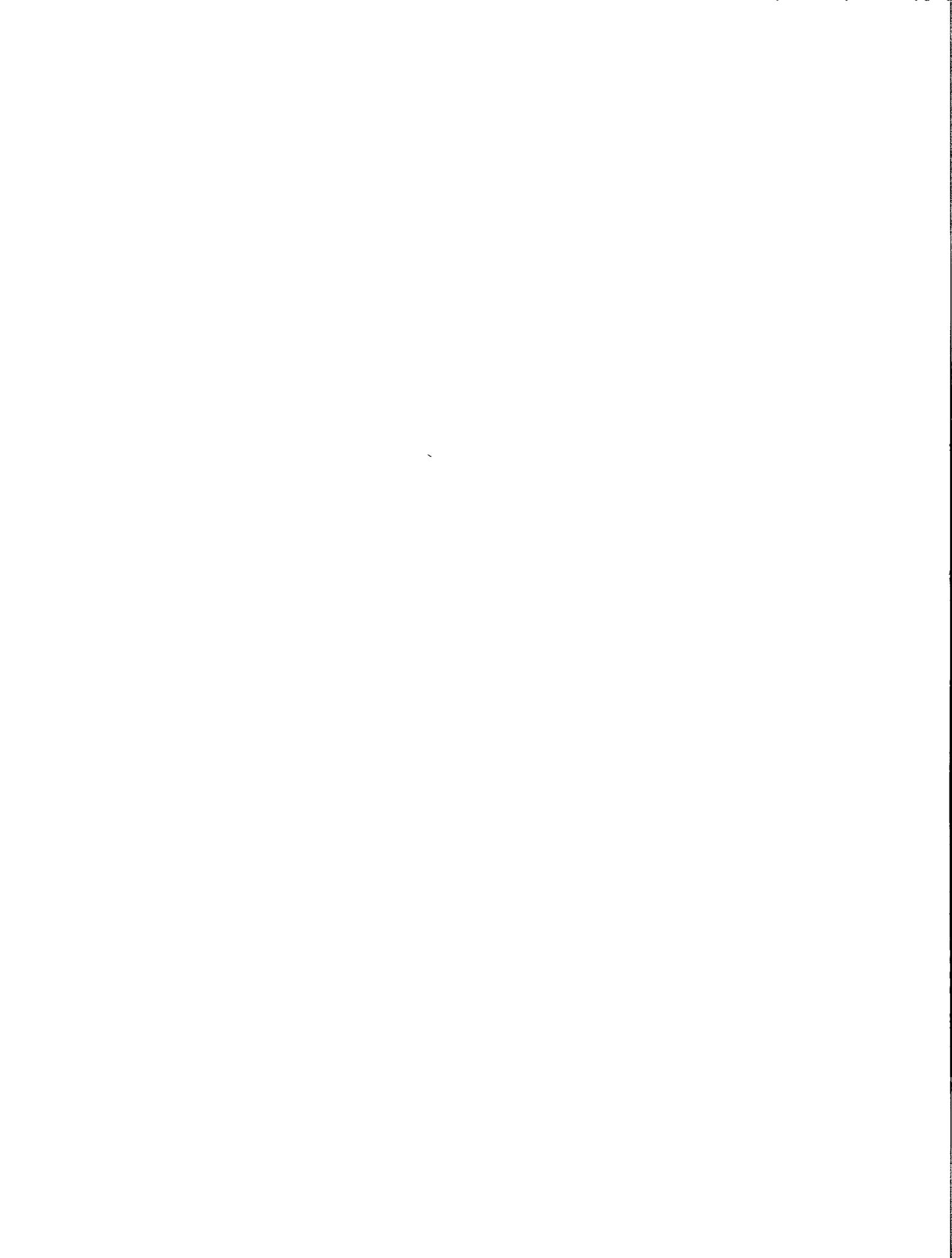


Central Coast

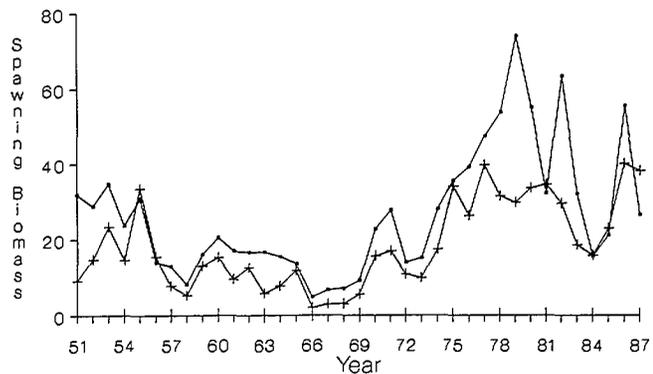


— Escapement Model + Age-structure Model

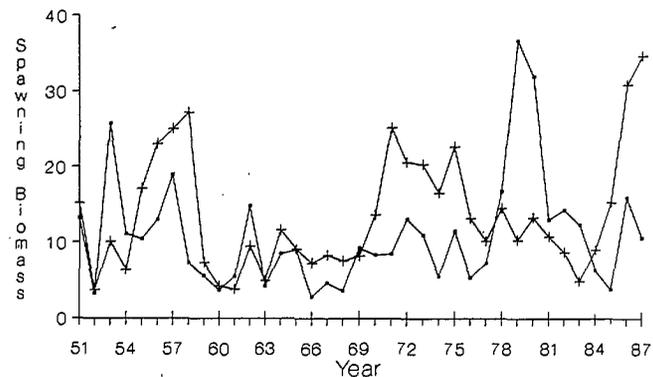
Fig. 2.1. Estimated spawning biomass (tonnes) for the northern stock assessment regions for 1951-1987.



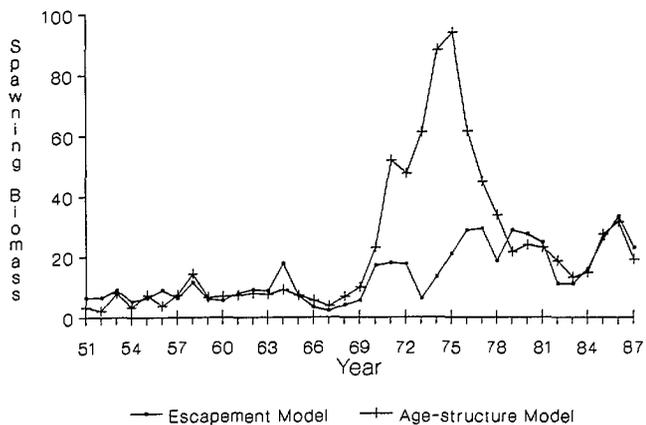
Georgia Strait - North



W.C. Vancouver Is. - North



W.C. Vancouver Is. - South



Georgia Strait - South

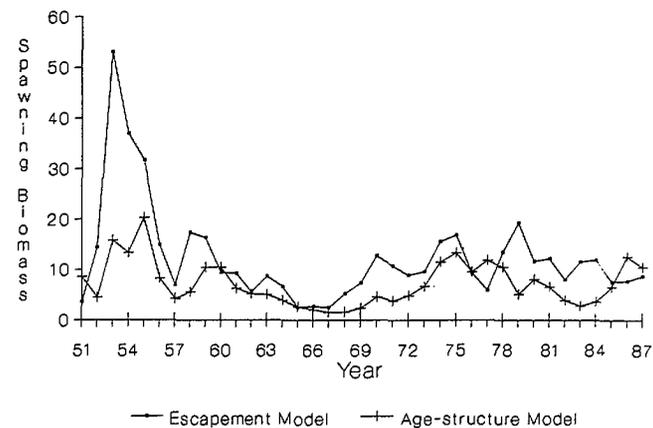
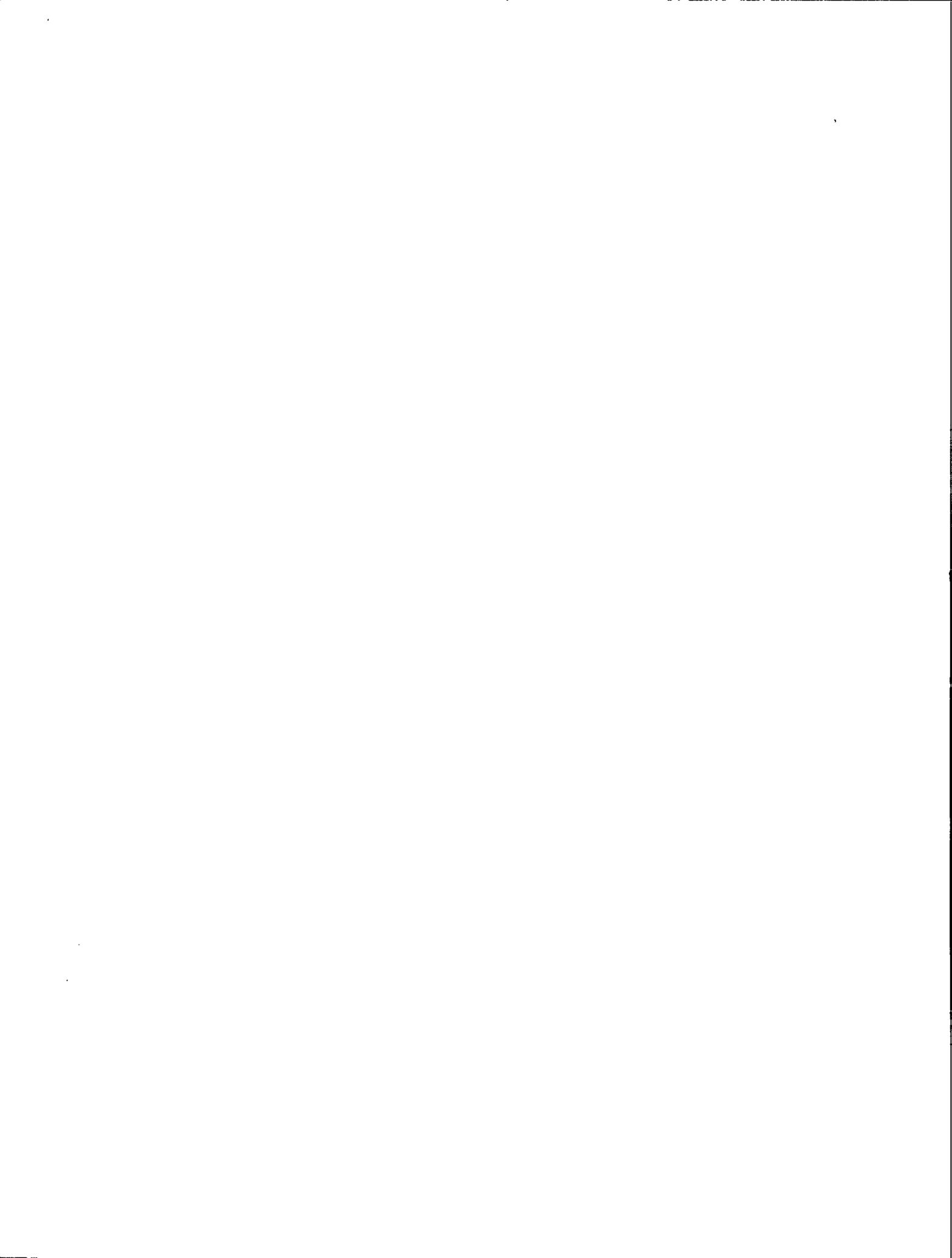


Fig. 2.2. Estimated spawning biomass (tonnes) for the southern stock assessment regions for 1951-1987.



3. AGE-STRUCTURED MODEL

3.1 INTRODUCTION

A modified version of the age-structured model described in Fournier and Archibald (1982), has been used to assess B.C. herring stocks since 1982. The model has undergone numerous revisions to make it more consistent with the life history of herring and the fisheries being analyzed. The current version which is described here, incorporates auxiliary information in the form of spawn survey data, separates catch at age data by gear type, and includes an availability term to model partial recruitments to the spawning stock. The model includes realistic assumptions about the form of both measurement and process error. A maximum likelihood method is used to simultaneously estimate all model parameters.

3.2 METHODS

The Population Model

Two types of fishing gear are commonly used in B.C. herring fisheries. Of these, seine nets are assumed to be non-selective while gillnets are selective for larger, older fish. Herring fisheries have primarily concentrated on spawning fish or fish migrating to spawning grounds, so the relative availability of age classes to the non-selective gear should be equivalent to the partial recruitment of age-classes to the spawning stock. We have therefore developed a model which explicitly separates availability (partial recruitment) and selectivity. Seine and gillnet fisheries are temporally separate so catch-at-age data is partitioned into fishing periods, separating data for the different gears.

Let FN_{ij} be the total number of fish in age class j at the beginning of season i , and λ_{ij} be the proportion of age j fish which are available. Then N_{ij1} , the total number of age class j fish which are available in year i is given by

$$N_{ij1} = \lambda_{ij} FN_{ij} \quad (3.1)$$

To model the fishing process we assume that the Baranov (1918) catch equations are valid for the available fish,

$$C_{ijr} = \frac{F_{ijr}}{F_{ijr} + M_r} [1 - \exp(-F_{ijr} - M_r)] N_{ijr},$$

and, for $r < p$

$$N_{ijr+1} = N_{ijr} \exp(-F_{ijr} - M_r),$$

where C_{ijr} is the catch of age class j in season i for period r
 F_{ijr} is the fishing mortality of age class j in season i for period r
 M_r is the natural mortality for period r
 N_{ijr} is the number of fish in age class j in season i for period r
 p is the number of fishing periods.
 n is the number of seasons.

$N_{i+1,j+1}$ is defined by equation 3.1 where for $j+1 < K$

$$FN_{i+1,j+1} = N_{ijp} \exp(-F_{ijp} - M_r) + FN_{ij} (1 - \lambda_{ij}) \exp(\sum_r -M_r). \quad (3.2)$$

In our model the last age class, k , accumulates fish aged k and older so for $j+1=k$ equation 3.2 is replaced by

$$FN_{i+1,k} = N_{ik-1p} \exp(-F_{ik-1p} - M_p) + FN_{ik-1} (1 - \lambda_{ik-1}) \exp(\sum_r -M_r) +$$

$$N_{i,k,p} \exp(-F_{i,k,p} - M_p) + FN_{i,k} (1 - \lambda_{ik}) \exp(\sum_r -M_r).$$

To reduce the number of parameters to be estimated we make certain restricting assumptions with respect to the availabilities and mortalities. We make the assumption that availability increases with age, reaching a value of 1 when the entire cohort attains sexual maturity. The age of full maturity has been somewhat arbitrarily set at age 7. Additionally we assume that the availability of fish age 4 and older does not vary from year to year. However, the proportion of mature 3-year olds mature does vary between years (Haist and Stocker 1985) and some fisheries have targeted on immature 2-year old stocks (eg. 1957/58 Queen Charlotte Islands fishery, Appendix Table 1.1). We therefore parameterize availability for these two age classes with annual deviations from an average availability for the age class $\bar{(\lambda_j)}$. Availability for ages 2 and 3 for years 1 to $n-1$ is

$$\lambda_{ij} = \bar{\lambda}_j + d_{ij},$$

where the d_{ij} are constrained such that

$$\sum_{i=1}^{n-1} d_{ij} = 0.$$

For ages 4 to 6 and ages 2 and 3 in year n

$$\lambda_{ij} = \bar{\lambda}_j,$$

and for ages 7 and older,

$$\lambda_{ij} = 1.$$

For selective fisheries we assume that fishing mortality is separable into an age selectivity component and a fishing intensity component. Following Doubleday (1976),

$$\log_e F_{ijr} = a_{ir} + b_{jr}$$

where a_{ir} represents the general level of fishing mortality due to fishery r in season i , and b_{jr} represents the relative vulnerability of age class j in fishery r . For non-selective fisheries the model is

$$\log_e F_{ijr} = a_{ir}$$

We assume that natural mortality is constant over ages and seasons.

Additional structure is built into the model through the inclusion of annual spawning stock egg production data (spawn index) and the assumption of a stock-recruit relationship. Spawning occurs at the end of the season so the number of spawners at age j in season i (SN_{ij}) is estimated by

$$SN_{ij} = N_{ijp} \exp(-F_{ijp} - M_p)$$

and the reproductive potential (R_i) in season i is

$$R_i = \sum_j SN_{ij} f_j,$$

where f_j is the relative fecundity at age j . We assume the error in spawn index observations (SI_i) is multiplicative so that

$$SI_i = R_i q \exp(\epsilon_i) \quad (3.3)$$

where q is a spawn index conversion factor and ϵ_i is a normally distributed random variable with mean 0 and variance σ_1^2 . We assume a standard Ricker stock-recruit relationship with multiplicative error,

$$FN_{i+1,1} = \alpha R_i \exp(-\beta R_i) \exp(\epsilon_i), \quad (3.4)$$

where ϵ_i is a normally distributed random variable with mean 0 and variance σ_2^2 .

For the model described above the parameters to be estimated are:

- FN_{i1} , for all seasons i
- FN_{1j} , for age classes 2 to k
- $\bar{\lambda}_j$, for age classes 2 to 7
- d_{ij} , for age classes 2 and 3, for seasons 1 to $N-1$
- a_{ir} , for all fisheries i,r
- b_{jr} , for all selective fisheries
- $\alpha, \beta,$ and q .

The $\bar{\lambda}_j$ and d_{ij} are reparameterized to constrain the values of λ_{ij} between 0 and 1. The parameters σ_1^2 and σ_2^2 are not estimated in the reconstructions, but are fixed at specified values as discussed later on.

The Objective Function

Data input to the stock reconstruction are:

S_{ijr} , the number of sampled fish aged j in season i for period r

O_{ir} , the estimated number of fish caught in period r of season i

f_j , the estimated fecundity at age j

We assume the same error structure for the observations S_{ijr} and O_{ir} as employed by Fournier and Archibald (1982), that is:

- 1) The S_{ijr} are obtained from ageing a random sample of fish from the catch and there are no ageing errors (i.e. a multinomial sampling distribution).
- 2) The error structure for the estimated number of fish caught (O_{ir}) is log-normal. That is

$$O_{ir} = C_{ir} \exp(\epsilon_i),$$

where C_{ir} is the actual number of fish caught in period j in season i ($C_{ir} = \sum_j C_{ijr}$) and the ϵ_i are independent normally

distributed random variables with mean 0 and variance σ_3^2 .

- 3) The random variables S_{ijr} and O_{ir} are independent.

Given the above stochastic assumptions the log-likelihood function for the parameters P_{ijr} ($P_{ijr} = C_{ijr}/C_{ir}$), C_{ir} , and σ_3^2 is

$$\sum_{ijr} S_{ijr} \log P_{ijr} - \sum_{ir} \frac{1}{2} \left(\frac{\log O_{ir} - \log C_{ir}}{\sigma_3^2} \right)^2 - n \log \sigma_3. \quad (3.5)$$

The assumptions of log-normal measurement error in the observed spawn - actual spawn relationship and log-normal process error in the spawn-recruit relationship introduce the following contributions to the log - likelihood function

$$- \sum_i \frac{1}{2} [\log SI_i - \log (R_i q)]^2 / \sigma_1^2, \quad (3.6)$$

from equation 3.2, and

$$- \sum_j \frac{1}{2} (\log FN_{i+1,1} - \log R_i - \log \alpha + \beta R_i)^2 / \sigma_2^2, \quad (3.7)$$

from equation 3.3.

The objective function described above (eq. 3.5 + 3.6 + 3.7) incorporates both measurement (observational) and process (deviations from modelled relationships) error assumptions, with the relative magnitude of the errors related through the variance terms σ_1^2 , σ_2^2 , and σ_3^2 , and the sample sizes $\sum_r S_{ijr}$. Because there is not enough information in the data to estimate the relative error in either the observations or processes, with the exception of scaling the S_{ijr} , the variance terms are not estimated but are held at fixed values. We assume the following variances:

$$\begin{aligned} \sigma_1^2 &= .05, \\ \sigma_2^2 &= .25, \\ \sigma_3^2 &= .0025. \end{aligned}$$

These correspond to approximately a 4% average error in estimating the total number of fish caught, an 18% average error in spawn index observations, and a 45% average deviation from the spawn-recruit relationship.

The actual number of fish aged, S_{ijr} , could be used in the objective function, however, we do not feel this would give a realistic estimate of the precision of the proportion at age data. That is, we do not feel the sampling process strictly adheres to binomial sampling assumptions. The between load (samples from different catching vessels) variability in age composition is significantly different between years, and this is more related to the spatial and temporal distribution of the fisheries than to the number of loads sampled or total fish aged. Therefore, we make use of the information in the subsamples (between load samples) which are pooled to obtain an estimate of the age composition for a given fishery.

The theoretical variance of the observed proportion of fish at age j (\hat{p}_j) for a random sample of size S is

$$\sigma_{\hat{p}_j}^2 = \frac{p_j (1 - p_j)}{S}$$

where p_j is the true proportion at age j . We can calculate an estimate of the variance of \hat{p}_j ,

$$s_{\hat{p}_j}^2 = \sum_m \frac{(p_{jm} - \hat{p}_j)^2}{M - 1}$$

where p_{jm} is the proportion at age j in subsample m and M is the number of subsamples. This variance between subsamples results from the variance generated by randomly sampling an individual catch plus the variance \hat{p}_j in the true proportion at age between individual vessel catches. Using \hat{p}_j as the best estimate for p_j we calculate the theoretical sample size (S') which would generate the observed variance at age j as,

$$S' = \frac{\hat{p}_j(1 - \hat{p}_j)}{s^2_{\hat{p}_j}}$$

We use these theoretical sample sizes, calculated from the between sample variance for 4-year old fish (Appendix Table 1), in the objective function.

Stock Forecasts

Forecasts of stock abundance for 1988 are calculated by assuming all natural mortality for the first period will occur prior to the fisheries. The numbers of fish at age prior to the fisheries are then the numbers estimated at the beginning of the 1987/88 season multiplied by survival for the first period and the estimated availability at age. Recruitment is calculated for three scenarios based on estimated numbers at age 3 for the 1951-87 time series. Poor, average, and good recruitment are calculated as the mean of the lowest 33%, the mid 33%, and the highest 33% of historic age 3 numbers. Biomass is calculated using the average weights at age for roe seine fisheries in the final season.

To investigate the bias and variance of the estimated parameters, in particular current stock estimates and the stock forecast, we applied bootstrap techniques (Efron and Gong 1983) to each of the seven data sets. The bootstrap technique involves resampling the original data set with replacement to generate a new data matrix which has the same statistical properties as the original data set. To resample the age composition data we used a two stage procedure. First random subsamples were selected from the original data set, then individual fish were randomly selected from the subsample. Because we have no information about the error structure of the spawn observations or the total catch estimates these data were resampled under the same assumptions as used in the analytical model. That is, we assumed log normal errors with a variance of 0.05 and 0.0025 for the observed spawn and observed catch, respectively. The data for each stock grouping were resampled 50 times and reanalyzed producing 50 sets of parameter estimates.

Input data used for age-structured model analysis are shown in Appendix Table 1 for all stock groupings. Where no sample data are available, but catches were taken, the catch is included with an alternate fishery where age-structure data are available. The same spawn index is used as for last year's assessments. This index sums the lengths of spawnings multiplied by a width/intensity factor, standardized by section (Hay and Kronlund 1985).

3.3 RESULTS

Results from age-structured model stock reconstructions are shown in Appendix Table 2 for the seven major stock assessment regions. Estimates of spawning biomass in 1987 and forecasts of age 4 and recruit biomass for 1988 are shown in Table 3.1, and results of the bootstrap analysis are shown in Table 3.2.

To evaluate if the age-structured analysis produced biased estimates of current stock size and forecast stock biomass we applied a t-test under the null hypothesis that the bootstrap mean was no different than the original estimate. Only the Central Coast bootstrap mean was significantly different from the original estimate at the 5 percent level. Additional bootstrap runs should be conducted to verify this result. In general the age-structured model estimates of current stock size do not appear to be biased. The standard error of the estimated biomasses range from 10% of the mean for the Prince Rupert District to 17% of the mean for the northern west coast of Vancouver Island stock assessment region.

For the Queen Charlotte Islands stock the reconstructions show a steady decline in spawning biomass over the past five seasons. The 1987 spawning biomass is only 33% of the biomass estimated for 1981; the decline in the spawn index is however, not as great. The 1987 spawning biomass was estimated at 16,200 tons and assuming average recruitment the forecast for 1988 is 15,000 t.

For the Prince Rupert District, age-structured analysis shows a stable spawning biomass since 1984 with an estimated 43,000 t of spawners in 1987. Current spawn levels are well above the long term average. Given average recruitment a run size of 44,500 t is forecast for this area.

The estimated 1987 spawning biomass for the Central coast is 20,000 tonnes from age-structured analysis. This represents a significant decline from the 1982 levels, which were estimated as the highest ever. However, the spawn index has not shown a major decline over the same time period. Forecast stock abundance for the Central coast in 1988 is estimated at 22,900 t given average recruitment.

Spawning biomass estimates for both the northern and southern Strait of Georgia are down slightly from 1986 levels. While this trend is consistent with the observed spawn index for the northern stock the spawn index for the southern stock increased in 1987. Forecasts for the northern and southern stocks in 1988, given average recruitment, are 41,200 and 13,600 t, respectively.

The spawning estimate for the southern west coast of Vancouver Island is down substantially from the 1986 biomass estimate. This is the result of an apparent poor recruitment of 3-year olds and a high catch rate. The forecast 1988 stock abundance is 22,600 t with average recruitment.

Age-structured model stock reconstructions for the northern west coast of Vancouver Island suggest a substantial increase in stock size over the past 4 seasons to a 1987 spawning biomass of 34,900 t. This estimate seems overly high given spawning estimate from synoptic dive surveys and in-season hydroacoustic estimates. Age-structured model estimates may be influenced by the high proportion of age 2 fish in this stock over the past four seasons. In addition, the bootstrap results indicate the greatest variability in 1987 spawning biomass for this stock, with estimates ranging from 24,600 to 47,500 t.

Table 3.1. Estimates of 1987 spawning biomass and forecasts of age 4+ and recruit biomass in 1988 (in thousands of tonnes) from age-structured model analysis.

| Stock Assessment Region | 1987 Spawning Biomass | Age 4+ | 1988 Forecasts | | |
|-----------------------------|-----------------------|--------|----------------|---------|------|
| | | | Age 3 recruits | | |
| | | | Poor | Average | Good |
| Queen Charlotte Islands | 16.2 | 12.2 | 0.9 | 2.8 | 10.1 |
| Prince Rupert District | 43.0 | 39.1 | 2.0 | 5.4 | 17.9 |
| Central Coast | 19.9 | 16.9 | 2.9 | 6.0 | 13.9 |
| Strait of Georgia | | | | | |
| Northern stock | 38.2 | 31.6 | 4.2 | 9.6 | 18.5 |
| Southern stock | 10.6 | 7.7 | 1.5 | 3.3 | 6.2 |
| West Coast of Vancouver Is. | | | | | |
| Southern stock | 19.1 | 14.8 | 3.7 | 7.8 | 19.0 |
| Northern stock | 34.9 | 27.9 | 1.8 | 5.7 | 11.2 |

Table 3.2. Bootstrap results of estimates of 1987 spawning biomass (tonnes) and forecast 1988 age 4+ biomass (tonnes) for herring stock assessment areas. For both parameters the original estimate, the bootstrap mean, the bootstrap standard deviation, and the bootstrap range are given.

| | 1987 Spawning Biomass | 1988 Age 4+ Biomass Forecast |
|---------------------------|--------------------------|---------------------------------|
| Queen Charlotte Islands | 16,240 | 12,162 |
| bootstrap - mean | 16,317 | 12,214 |
| - st. dev. | 2,362 | 1,736 |
| - range | 11,054 - 21,703 | 8,301 - 16,052 |
| Prince Rupert District | 43,026 | 39,075 |
| bootstrap - mean | 43,813 | 39,618 |
| - st. dev. | 4,310 | 3,859 |
| - range | 34,637 - 51,557 | 32,127 - 46,637 |
| Central Coast | 19,938 | 16,931 |
| bootstrap - mean | 19,287 | 16,348 |
| - st. dev. | 2,329 | 1,947 |
| - range | 13,307 - 23,377 | 11,662 - 19,774 |
| Strait of Georgia | | |
| Northern Stock | 38,189 | 31,565 |
| bootstrap - mean | 39,034 | 32,315 |
| - st. dev. | 4,456 | 3,629 |
| - range | 29,287 - 47,052 | 23,971 - 39,166 |
| Southern Stock | 10,545 | 7,744 |
| bootstrap - mean | 10,406 | 7,704 |
| - st. dev. | 1,417 | 1,049 |
| - range | 7,945 - 14,155 | 6,053 - 11,019 |
| W. Coast Vancouver Island | | |
| Southern Stock | 19,120 | 14,773 |
| bootstrap - mean | 19,245 | 14,821 |
| - st. dev. | 2,381 | 1,804 |
| - range | 15,105 - 25,101 | 11,599 - 19,310 |
| Northern Stock | 34,874 | 27,907 |
| bootstrap - mean | 33,999 | 27,134 |
| - st. dev. | 5,622 | 4,320 |
| - range | 24,565 - 47,456 | 19,336 - 38,346 |

4. CATCH RECOMMENDATIONS

We recommend catch levels at 20% of the forecast stock biomass for those stocks that are well above CUTOFF. The 20% harvest rate is based on an analysis of stock dynamics which indicates this level will stabilize both catch and spawning biomass while foregoing minimum yield over the long term. A fixed escapement policy would theoretically produce higher yields and spawning stock stability but is not attainable at the operational level. For those stocks which are marginally above CUTOFF we recommend the following reduced catch level:

$$\text{Catch} = \text{Weighted Run} - \text{CUTOFF}$$

This will provide for smaller fisheries for areas where the 20% harvest rate would bring the escapement down to levels below the CUTOFF.

CUTOFF levels are established at one-fourth the unfished equilibrium biomass. The unfished equilibria were estimated from computer simulations. For the seven stock assessment regions the following CUTOFF levels have been estimated:

| | |
|--------------------------|----------|
| Queen Charlotte Islands | 13,100 t |
| Prince Rupert District | 8,900 t |
| Central Coast | 11,100 t |
| Strait of Georgia-north | 14,600 t |
| Strait of Georgia-south | 6,200 t |
| W.C. Vancouver Is.-south | 15,400 t |
| W.C. Vancouver Is.-north | 6,000 t |

To determine the "best" stock forecasts we used a two step procedure. First, for each of the two assessment methods, and for each stock group, one recruitment estimate was chosen, either poor, average, or good. The information used to choose the particular recruitment estimate included forecasts from either a stock-environment-recruitment model or time-series model and recent trends in stock and recruitment levels. Secondly, we assigned subjective probabilities to the alternate assessment models. Based on intuition and past performance, we believe the age-structured model makes the most likely predictions of forecast runs. The escapement model incorporates diving survey information on most major spawns in the south coast in 1987, and we feel these direct estimates of egg deposition provide a reasonably accurate estimate of current stock size. Hence, we used equal probabilities for the two models in most assessment regions. The only exception to this was for the northern west coast of Vancouver Island where age-structured analysis has produced inconsistent forecasts in recent years. This may result from a limited number of representative ageing samples for this area. Consequently, we felt that the age-structured model estimates for this region may be biased and we used a 80:20 weighting in favour of the escapement model for this area.

The assigned probabilities were used to weight the forecast "best" runs obtained from each method to provide a single "weighted run" for each of the stock groupings (Table 4.1).

The predicted level of recruitment to the Queen Charlotte Islands stock assessment region was average from a stock-environment-recruitment model (Stocker et al. 1988). However, because this stock has decreased steadily since 1981 and the trend of poor recruitments since the strong 1977 year-class has continued this year, the assumption of average recruitment may be too optimistic. Therefore, a recruitment level midway between poor and average was selected, resulting in a weighted forecast run of 12,130 tonnes. This forecast is marginally below the CUTOFF level so we recommend that no roe fishery take place in the Queen Charlotte Islands in 1988.

The Prince Rupert District spawning stock continues to be at historically high levels. Given the average to good recruitment levels in recent years, we feel an optimistic recruitment assumption may be warranted for 1988. Therefore, we assume a recruitment level midway between average and good for a forecast biomass of 43,750 tonnes. This produces a recommended catch of 8750 tonnes for the Prince Rupert District in 1988.

The recruitment forecast for the Central Coast based on the stock-environment model was for good recruitment from the 1985 year-class. Other stock indicators suggested that an average recruitment level was more probable and so a weighted forecast run with average recruitment of 23,800 tonnes was projected. The recommended catch for this region is 4760 tonnes.

The south coast stocks declined relative to 1986 when the strong 1983 year class boosted biomass levels in most areas. Recruitment forecasts to all stocks from time-series analysis predict average levels. The weighted forecast runs to the northern Strait of Georgia in 1988 was for 36,300 tonnes and to the southern strait 10,350 tonnes. The recommended catches for these areas are 7260 and 2070 tonnes, respectively.

The forecast run to the southern west coast of Vancouver Island is 23,000 tonnes for an allowable catch of 4600 tonnes. The forecast for the northern area, even with the low weighting on the age-structured model, is 16,560 tonnes for a recommended catch of 3310 tonnes.

The catch levels recommended in this summary are based purely on biological considerations, reflecting the best biological analyses given the available data bases. Management of the various fisheries has practical constraints not considered in this report. As well, there are economic considerations which are beyond the scope of our analysis. Hence, the quotas ultimately adopted by DFO may differ from those recommended herein.

Table 4.1. Summary of 1988 predicted stock biomass (1000t) from age-structured and escapement models and weighted runs for poor, average, and good recruitment levels.

| | AGE STRUCTURED MODEL | | | | ESCAPEMENT MODEL | | | | WEIGHTED RESULTS | | | |
|--|----------------------|------|------|------|---------------------|------|------|------|------------------------|-------|-------|-------|
| | Stock + recruitment | | | | Stock + recruitment | | | | Stock with recruitment | | | |
| | AGE 4+ | Poor | Avg. | Good | AGE 4+ | Poor | Avg. | Good | Rel Weight | Poor | Avg. | Good |
| Queen Charlotte Islands | 12.2 | 13.1 | 15.0 | 22.3 | 8.8 | 9.4 | 11.0 | 19.0 | 50:50 | 11.25 | 13.00 | 20.65 |
| Prince Rupert District | 39.1 | 41.1 | 44.5 | 57.0 | 27.6 | 28.8 | 31.8 | 41.7 | 50:50 | 34.95 | 38.15 | 49.35 |
| Central Coast migratory stock | 16.9 | 19.8 | 22.9 | 30.8 | 18.5 | 21.1 | 24.7 | 35.9 | 50:50 | 20.45 | 23.80 | 33.35 |
| Strait of Georgia northern stock | 31.6 | 35.8 | 41.2 | 50.1 | 18.9 | 25.2 | 31.4 | 43.6 | 50:50 | 30.50 | 36.30 | 46.85 |
| southern stock | 7.7 | 9.2 | 11.0 | 13.9 | 5.5 | 8.2 | 9.7 | 12.5 | 50:50 | 8.70 | 10.35 | 13.20 |
| West Coast of Vancouver Is. southern stock | 14.8 | 18.5 | 22.6 | 33.8 | 15.7 | 19.0 | 23.4 | 32.6 | 50:50 | 18.75 | 23.00 | 33.20 |
| northern stock ^a | 27.9 | 29.7 | 33.6 | 39.1 | 7.4 | 9.2 | 12.3 | 21.8 | 20:80 | 13.30 | 16.56 | 25.26 |

^aRecruitment estimates based on data from roe fishery only.

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Appendix Table 1.1. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the Queen Charlotte Islands stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|-----|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.0 | 0.1 | 15.3 | 52.9 | 15.3 | 11.5 | 4.2 | 0.6 | 0.1 | 0.0 | 1476 | 1544 | 317.44 |
| 1951/52 | REDUCTION | 1.2 | 16.9 | 21.5 | 33.8 | 21.3 | 4.1 | 1.1 | 0.1 | 0.0 | 0.0 | 2251 | 165 | 1136.50 |
| 1953/54 | REDUCTION | 0.1 | 3.0 | 29.0 | 21.3 | 33.6 | 10.2 | 1.9 | 0.7 | 0.2 | 0.1 | 0 ^a | 25 | 231.77 |
| 1954/55 | REDUCTION | 0.0 | 8.7 | 14.1 | 39.4 | 18.1 | 14.8 | 4.4 | 0.3 | 0.1 | 0.1 | 0 ^a | 25 | 131.14 |
| 1955/56 | REDUCTION | 0.0 | 0.1 | 16.0 | 9.6 | 62.2 | 8.4 | 2.7 | 0.7 | 0.0 | 0.1 | 1348 | 681 | 6562.62 |
| 1956/57 | REDUCTION | 0.2 | 21.1 | 23.7 | 15.7 | 9.5 | 26.9 | 2.3 | 0.4 | 0.1 | 0.0 | 4649 | 2106 | 2234.96 |
| 1957/58 | REDUCTION | 0.0 | 81.9 | 16.4 | 1.2 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 2838 | 514 | 2149.80 |
| 1958/59 | REDUCTION | 0.0 | 1.1 | 63.2 | 28.4 | 7.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 95 | 6 | 757.14 |
| 1960/61 | REDUCTION | 0.0 | 4.2 | 32.6 | 36.0 | 24.8 | 1.3 | 0.4 | 0.2 | 0.4 | 0.0 | 0 ^a | 25 | 66.89 |
| 1961/62 | REDUCTION | 0.0 | 3.0 | 37.6 | 41.4 | 9.6 | 6.5 | 1.6 | 0.2 | 0.0 | 0.0 | 428 | 170 | 693.85 |
| 1962/63 | REDUCTION | 0.0 | 0.4 | 50.0 | 27.1 | 18.2 | 2.1 | 2.0 | 0.0 | 0.1 | 0.1 | 804 | 411 | 1367.40 |
| 1963/64 | REDUCTION | 0.0 | 0.9 | 15.3 | 59.5 | 17.8 | 5.3 | 1.1 | 0.0 | 0.0 | 0.0 | 528 | 297 | 2347.93 |
| 1964/65 | REDUCTION | 0.0 | 1.6 | 79.8 | 11.0 | 4.4 | 2.1 | 0.9 | 0.2 | 0.0 | 0.0 | 1053 | 165 | 3132.24 |
| 1965/66 | REDUCTION | 1.7 | 18.0 | 32.2 | 16.1 | 10.2 | 7.3 | 5.8 | 4.8 | 2.0 | 1.7 | 0 ^a | 25 | 213.13 |
| 1966/67 | REDUCTION | 0.0 | 0.9 | 67.3 | 26.5 | 2.7 | 2.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 14.23 |
| 1967/68 | REDUCTION | 0.8 | 29.7 | 50.2 | 17.1 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 8.48 |
| 1971/72 | ROE-SN | 0.0 | 4.7 | 37.6 | 46.5 | 4.5 | 4.5 | 1.5 | 0.4 | 0.2 | 0.0 | 465 | 54 | 90.92 |
| 1972/73 | ROE-SN | 0.0 | 0.3 | 37.3 | 19.7 | 32.8 | 6.8 | 2.4 | 0.7 | 0.0 | 0.0 | 702 | 869 | 148.90 |
| 1973/74 | ROE-SN | 0.0 | 0.3 | 59.7 | 23.4 | 9.6 | 5.3 | 1.1 | 0.4 | 0.1 | 0.0 | 697 | 272 | 195.48 |
| | ROE-GN | 0.0 | 0.0 | 1.4 | 37.5 | 29.2 | 25.0 | 5.6 | 0.0 | 0.0 | 1.4 | 72 | 72 | 4.02 |
| 1974/75 | ROE-SN | 0.0 | 0.1 | 33.3 | 45.4 | 13.5 | 5.3 | 1.7 | 0.5 | 0.2 | 0.0 | 3026 | 788 | 370.01 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 22.5 | 40.0 | 30.0 | 5.0 | 2.5 | 0.0 | 0.0 | 40 | 40 | 6.19 |
| 1975/76 | ROE-SN | 0.0 | 0.3 | 2.9 | 52.8 | 33.5 | 7.6 | 2.2 | 0.6 | 0.0 | 0.0 | 2629 | 1293 | 690.30 ^e |
| 1976/77 | ROE-SN | 0.0 | 0.0 | 17.3 | 10.3 | 43.1 | 22.6 | 5.5 | 1.0 | 0.2 | 0.0 | 1824 | 653 | 688.84 ^{ce} |
| 1977/78 | ROE-SN | 0.0 | 0.1 | 24.7 | 17.1 | 11.1 | 33.0 | 12.2 | 1.7 | 0.0 | 0.0 | 784 | 1347 | 661.74 ^e |
| 1978/79 | ROE-SN | 0.0 | 5.6 | 4.4 | 31.6 | 18.7 | 21.3 | 15.1 | 2.8 | 0.4 | 0.1 | 1020 | 441 | 387.56 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 25.1 | 25.1 | 25.1 | 20.1 | 3.5 | 0.5 | 0.5 | 199 | 65 | 128.20 |
| 1979/80 | ROE-SN | 0.0 | 0.3 | 85.3 | 4.5 | 4.9 | 2.5 | 1.8 | 0.6 | 0.1 | 0.0 | 2223 | 1399 | 143.46 |
| | ROE-GN | 0.0 | 0.0 | 4.5 | 4.0 | 40.5 | 20.5 | 24.5 | 5.0 | 1.1 | 0.0 | 756 | 1008 | 60.13 |

Appendix Table 1.1 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | ROE-SN | 0.0 | 0.2 | 3.0 | 85.3 | 5.4 | 3.2 | 2.0 | 0.7 | 0.2 | 0.1 | 4586 | 424 | 331.01 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.2 | 74.8 | 8.3 | 9.4 | 4.9 | 1.9 | 0.6 | 0.0 | 905 | 339 | 121.41 |
| 1981/82 | ROE-SN | 0.0 | 0.5 | 3.4 | 3.7 | 87.6 | 2.1 | 1.4 | 0.8 | 0.5 | 0.1 | 2813 | 1889 | 186.62 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.2 | 3.4 | 88.2 | 3.4 | 2.7 | 1.1 | 0.8 | 0.2 | 526 | 341 | 99.20 |
| 1982/83 | ROE-SN | 0.0 | 4.1 | 4.8 | 3.5 | 6.4 | 74.9 | 3.7 | 1.5 | 0.8 | 0.2 | 1706 | 1282 | 316.02 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 1.3 | 2.8 | 89.0 | 3.1 | 2.5 | 0.7 | 0.5 | 747 | 637 | 58.91 |
| 1983/84 | OTHER | 0.0 | 5.9 | 36.6 | 2.2 | 4.3 | 8.6 | 39.2 | 2.2 | 0.5 | 0.5 | 186 | 186 | 16.18 |
| | ROE-SN | 0.0 | 1.9 | 35.8 | 4.8 | 2.7 | 10.4 | 42.9 | 1.1 | 0.4 | 0.2 | 3013 | 1473 | 313.87 |
| | ROE-GN | 0.0 | 0.0 | 2.8 | 1.3 | 4.6 | 9.0 | 80.1 | 1.8 | 0.3 | 0.3 | 391 | 427 | 34.59 |
| 1984/85 | ROE-SN | 0.0 | 1.3 | 14.9 | 31.8 | 4.0 | 4.5 | 11.4 | 31.5 | 0.4 | 0.1 | 3556 | 699 | 311.61 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 15.3 | 2.1 | 4.2 | 11.1 | 66.7 | 0.7 | 0.0 | 144 | 83 | 85.78 |
| 1985/86 | ROE-SN | 0.0 | 0.2 | 2.8 | 22.0 | 40.2 | 4.0 | 3.3 | 8.0 | 19.1 | 0.3 | 4733 | 2821 | 168.19 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 11.9 | 50.6 | 5.4 | 5.2 | 10.4 | 16.0 | 0.5 | 405 | 383 | 49.29 |
| 1986/87 | ROE-SN | 0.0 | 1.8 | 9.9 | 5.4 | 25.1 | 37.9 | 3.8 | 4.3 | 5.7 | 6.1 | 3096 | 1221 | 109.00 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | Fishery | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 11.7 | 52.0 | 84.4 | 106.6 | 126.0 | 147.7 | 156.8 | 172.2 | 147.3 | 183.5 | | | |
| | ROE-SN | 0.0 | 66.8 | 99.1 | 127.3 | 151.5 | 173.9 | 189.4 | 202.1 | 211.1 | 210.0 | | | |
| | ROE-GN | 0.0 | 0.0 | 117.5 | 139.9 | 151.7 | 168.0 | 176.7 | 188.6 | 188.8 | 193.4 | | | |
| | OTHER | 11.7 | 60.6 | 93.6 | 119.6 | 142.3 | 165.6 | 179.0 | 194.4 | 200.2 | 202.3 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.2. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the Prince Rupert District stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|------|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.0 | 4.3 | 18.2 | 58.5 | 10.4 | 5.6 | 2.6 | 0.3 | 0.0 | 0.0 | 4684 | 2202 | 4954.74 |
| 1951/52 | REDUCTION | 0.1 | 4.8 | 8.8 | 33.7 | 45.2 | 6.1 | 1.0 | 0.3 | 0.0 | 0.0 | 5925 | 2500 | 4392.63 |
| 1952/53 | REDUCTION | 0.0 | 1.2 | 38.1 | 23.0 | 25.4 | 11.1 | 1.0 | 0.1 | 0.0 | 0.0 | 1419 | 752 | 173.50 |
| 1953/54 | REDUCTION | 0.0 | 2.1 | 28.4 | 29.1 | 24.0 | 13.2 | 2.6 | 0.6 | 0.0 | 0.0 | 2656 | 891 | 2522.89 |
| 1954/55 | REDUCTION | 0.0 | 2.7 | 4.9 | 70.3 | 15.6 | 5.2 | 1.1 | 0.2 | 0.0 | 0.0 | 1131 | 467 | 1698.85 |
| 1955/56 | REDUCTION | 0.0 | 10.0 | 58.1 | 9.5 | 19.0 | 2.6 | 0.5 | 0.2 | 0.1 | 0.0 | 1683 | 555 | 1218.10 |
| 1956/57 | REDUCTION | 0.0 | 11.5 | 17.8 | 39.8 | 13.2 | 16.0 | 1.4 | 0.3 | 0.0 | 0.0 | 3491 | 515 | 2827.98 |
| 1957/58 | REDUCTION | 0.0 | 45.8 | 30.2 | 8.0 | 11.8 | 1.8 | 2.4 | 0.0 | 0.0 | 0.0 | 847 | 123 | 644.16 |
| 1958/59 | REDUCTION | 0.0 | 3.1 | 56.7 | 20.9 | 5.8 | 9.9 | 1.7 | 1.9 | 0.1 | 0.0 | 1741 | 349 | 1037.09 |
| 1959/60 | REDUCTION | 0.0 | 49.1 | 6.3 | 28.2 | 8.9 | 4.1 | 2.5 | 0.7 | 0.2 | 0.0 | 4206 | 337 | 2451.31 |
| 1960/61 | REDUCTION | 0.0 | 9.7 | 58.3 | 7.3 | 18.0 | 4.3 | 1.6 | 0.6 | 0.1 | 0.0 | 4300 | 763 | 4815.52 |
| 1961/62 | REDUCTION | 0.0 | 3.0 | 30.3 | 44.7 | 6.9 | 9.9 | 3.4 | 0.9 | 0.5 | 0.3 | 1845 | 752 | 2476.36 |
| 1962/63 | REDUCTION | 0.0 | 39.3 | 13.3 | 18.2 | 22.0 | 3.6 | 3.0 | 0.5 | 0.1 | 0.1 | 3415 | 433 | 4788.66 |
| 1963/64 | REDUCTION | 0.0 | 3.7 | 64.9 | 10.1 | 10.9 | 8.9 | 0.7 | 0.6 | 0.1 | 0.0 | 3400 | 1914 | 3555.87 |
| 1964/65 | REDUCTION | 0.0 | 6.0 | 13.6 | 51.0 | 8.5 | 11.0 | 8.5 | 1.0 | 0.3 | 0.1 | 3360 | 459 | 3649.12 |
| 1965/66 | REDUCTION | 0.0 | 0.0 | 5.3 | 21.4 | 23.4 | 16.3 | 19.1 | 9.7 | 3.2 | 1.6 | 435 | 59 | 1071.96 |
| 1966/67 | REDUCTION | 0.9 | 56.7 | 31.9 | 5.3 | 1.9 | 2.7 | 0.4 | 0.2 | 0.0 | 0.0 | 0 ^a | 25 | 1225.88 |
| 1967/68 | REDUCTION | 3.2 | 33.7 | 38.5 | 18.8 | 4.4 | 0.7 | 0.3 | 0.1 | 0.3 | 0.0 | 0 ^a | 25 | 281.72 |
| 1968/69 | OTHER | 1.3 | 29.7 | 44.5 | 20.3 | 3.8 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 69.79 |
| 1969/70 | OTHER | 0.7 | 18.5 | 62.4 | 15.0 | 3.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0 ^a | 25 | 184.71 |
| 1970/71 | OTHER | 0.0 | 6.5 | 50.4 | 29.3 | 8.0 | 4.3 | 0.8 | 0.5 | 0.2 | 0.0 | 601 | 38 | 413.67 |
| 1971/72 | ROE-SN | 0.0 | 0.0 | 5.3 | 17.9 | 64.4 | 5.9 | 3.8 | 2.4 | 0.1 | 0.1 | 714 | 209 | 278.66 ^{ce} |
| 1972/73 | OTHER | 0.0 | 22.9 | 47.7 | 7.8 | 13.1 | 4.6 | 2.6 | 1.3 | 0.0 | 0.0 | 153 | 14 | 35.70 |
| | ROE-SN | 0.0 | 0.3 | 33.0 | 4.4 | 30.4 | 26.6 | 3.4 | 1.3 | 0.8 | 0.0 | 797 | 662 | 94.37 |
| 1973/74 | ROE-SN | 0.0 | 0.2 | 17.9 | 53.2 | 7.4 | 16.5 | 4.4 | 0.3 | 0.2 | 0.0 | 632 | 121 | 174.36 ^c |
| | ROE-GN | 0.0 | 0.0 | 1.0 | 39.4 | 21.2 | 34.6 | 2.9 | 1.0 | 0.0 | 0.0 | 104 | 83 | 90.07 |
| 1974/75 | OTHER | 0.0 | 1.2 | 10.5 | 15.1 | 43.0 | 14.0 | 11.6 | 2.3 | 2.3 | 0.0 | 86 | 86 | 14.18 |
| | ROE-SN | 0.3 | 1.3 | 9.4 | 22.1 | 43.0 | 11.1 | 9.6 | 2.5 | 0.6 | 0.2 | 3084 | 769 | 116.58 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 31.9 | 59.6 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 47 | 47 | 0.76 |
| 1975/76 | OTHER | 0.0 | 0.0 | 4.9 | 6.8 | 9.9 | 16.7 | 17.9 | 35.2 | 8.6 | 0.0 | 162 | 1661 | 30.99 |
| | ROE-SN | 0.0 | 0.0 | 0.8 | 6.9 | 31.7 | 50.1 | 7.3 | 2.4 | 0.8 | 0.0 | 713 | 654 | 204.01 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 15.8 | 57.9 | 22.8 | 3.5 | 0.0 | 0.0 | 0.0 | 57 | 57 | 17.93 |
| 1976/77 | OTHER | 0.0 | 0.4 | 23.5 | 15.7 | 22.9 | 16.6 | 10.8 | 7.4 | 2.3 | 0.4 | 511 | 276 | 61.55 |
| | ROE-SN | 0.0 | 0.1 | 16.0 | 3.7 | 22.7 | 37.8 | 15.0 | 3.3 | 0.9 | 0.5 | 1310 | 1344 | 370.40 |
| | ROE-GN | 0.0 | 0.0 | 1.1 | 2.1 | 19.9 | 54.1 | 14.6 | 6.8 | 1.4 | 0.0 | 281 | 1104 | 89.48 |
| 1977/78 | OTHER | 0.0 | 1.3 | 9.6 | 27.8 | 18.2 | 18.1 | 14.6 | 6.9 | 2.4 | 1.0 | 982 | 124 | 238.36 |
| | ROE-SN | 0.0 | 1.1 | 11.7 | 32.8 | 9.6 | 21.1 | 20.4 | 2.4 | 0.6 | 0.3 | 795 | 131 | 136.94 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 20.5 | 6.0 | 32.5 | 33.1 | 6.6 | 1.3 | 0.0 | 151 | 37 | 181.42 |
| 1978/79 | OTHER | 0.0 | 1.8 | 9.3 | 9.8 | 25.9 | 17.8 | 16.2 | 9.5 | 5.7 | 4.0 | 1435 | 856 | 118.66 |
| | ROE-SN | 0.0 | 2.7 | 18.2 | 11.5 | 29.2 | 11.5 | 18.3 | 6.5 | 1.4 | 0.8 | 958 | 1475 | 84.40 |

Appendix Table 1.2 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1979/80 | ROE-GN | 0.0 | 1.1 | 1.1 | 8.0 | 41.4 | 15.7 | 22.2 | 8.0 | 1.9 | 0.4 | 261 | 255 | 74.00 |
| | OTHER | 0.0 | 1.1 | 61.2 | 6.5 | 7.9 | 8.2 | 6.5 | 4.9 | 2.1 | 1.6 | 1161 | 560 | 66.18 |
| 1980/81 | ROE-SN | 0.0 | 0.6 | 77.9 | 7.3 | 5.1 | 3.8 | 3.5 | 1.3 | 0.4 | 0.1 | 2811 | 535 | 171.81 |
| | ROE-GN | 0.0 | 0.0 | 3.4 | 8.7 | 31.2 | 22.3 | 21.1 | 9.1 | 3.4 | 0.6 | 493 | 915 | 63.73 |
| | OTHER | 0.0 | 1.0 | 7.4 | 54.6 | 9.3 | 10.2 | 9.3 | 4.3 | 2.3 | 1.5 | 6524 | 1129 | 137.14 |
| | ROE-SN | 0.0 | 0.5 | 11.2 | 81.2 | 3.3 | 1.7 | 1.5 | 0.4 | 0.2 | 0.1 | 3238 | 1059 | 106.00 |
| 1981/82 | ROE-GN | 0.0 | 0.0 | 0.5 | 38.9 | 15.5 | 23.0 | 14.8 | 5.6 | 1.9 | 0.0 | 427 | 557 | 23.77 |
| | OTHER | 0.0 | 1.5 | 11.5 | 20.5 | 41.1 | 10.5 | 6.6 | 5.0 | 2.1 | 1.1 | 2669 | 555 | 138.82 |
| 1982/83 | ROE-SN | 0.0 | 2.7 | 18.8 | 7.4 | 66.3 | 2.8 | 1.4 | 0.4 | 0.2 | 0.0 | 1544 | 576 | 16.50 |
| | ROE-GN | 0.0 | 1.4 | 20.8 | 17.7 | 5.3 | 49.2 | 3.7 | 1.1 | 0.6 | 0.2 | 4583 | 1448 | 1.00 ^b |
| 1983/84 | OTHER | 0.0 | 2.8 | 36.2 | 15.7 | 13.9 | 9.8 | 16.4 | 2.8 | 1.1 | 1.4 | 654 | 303 | 23.68 |
| | ROE-SN | 0.0 | 0.5 | 35.5 | 14.4 | 10.3 | 14.4 | 23.6 | 1.0 | 0.2 | 0.1 | 2837 | 618 | 159.00 |
| 1984/85 | ROE-GN | 0.0 | 0.0 | 1.0 | 2.0 | 12.9 | 21.4 | 57.4 | 3.4 | 1.2 | 0.8 | 505 | 961 | 127.31 |
| | OTHER | 0.0 | 15.4 | 8.2 | 25.8 | 28.2 | 11.7 | 5.4 | 4.1 | 0.8 | 0.3 | 631 | 45 | 28.24 |
| | ROE-SN | 0.0 | 0.2 | 7.8 | 54.7 | 11.9 | 6.4 | 10.6 | 8.2 | 0.1 | 0.1 | 3664 | 969 | 278.16 |
| | ROE-GN | 0.0 | 0.0 | 0.4 | 16.4 | 14.9 | 15.8 | 21.8 | 29.8 | 0.4 | 0.5 | 550 | 543 | 235.00 |
| 1985/86 | ROE-SN | 0.0 | 1.8 | 13.8 | 9.4 | 46.3 | 10.8 | 5.3 | 7.1 | 5.5 | 0.1 | 5655 | 4566 | 256.04 |
| | ROE-GN | 0.0 | 0.0 | 0.4 | 4.3 | 53.8 | 19.0 | 8.7 | 7.8 | 5.7 | 0.2 | 1274 | 558 | 333.56 |
| 1986/87 | ROE-SN | 0.0 | 0.9 | 38.6 | 10.2 | 6.9 | 29.9 | 5.9 | 3.5 | 2.9 | 1.2 | 4731 | 4068 | 129.04 |
| | ROE-GN | 0.0 | 0.0 | 0.6 | 3.0 | 6.9 | 55.3 | 16.1 | 8.8 | 6.0 | 3.4 | 1761 | 819 | 268.62 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | FISHERY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 21.8 | 43.9 | 79.3 | 107.9 | 128.2 | 146.1 | 163.1 | 173.5 | 188.7 | 206.8 | | | |
| | ROE-SN | 8.6 | 53.2 | 85.0 | 116.1 | 141.0 | 159.9 | 174.2 | 188.3 | 197.6 | 208.4 | | | |
| | ROE-GN | 0.0 | 90.3 | 114.0 | 136.6 | 148.8 | 164.3 | 171.6 | 179.5 | 191.8 | 197.4 | | | |
| | OTHER | 17.4 | 46.5 | 81.1 | 110.9 | 133.9 | 152.0 | 167.4 | 179.7 | 189.8 | 205.3 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.3. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the Central Coast stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|------|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.0 | 2.4 | 28.5 | 50.6 | 12.0 | 5.1 | 1.2 | 0.1 | 0.0 | 0.0 | 5318 | 2484 | 3853.75 |
| 1951/52 | REDUCTION | 1.1 | 5.1 | 19.9 | 29.7 | 37.7 | 4.4 | 1.5 | 0.4 | 0.0 | 0.0 | 5214 | 1352 | 2895.10 |
| 1952/53 | REDUCTION | 0.4 | 9.3 | 28.0 | 23.9 | 26.5 | 10.1 | 1.3 | 0.4 | 0.0 | 0.0 | 2939 | 537 | 73.85 |
| 1953/54 | REDUCTION | 0.0 | 1.7 | 70.6 | 21.4 | 4.7 | 1.3 | 0.1 | 0.0 | 0.1 | 0.0 | 2999 | 541 | 3304.89 |
| 1954/55 | REDUCTION | 0.0 | 4.2 | 7.3 | 77.2 | 9.3 | 1.6 | 0.4 | 0.0 | 0.0 | 0.0 | 2254 | 310 | 1197.84 |
| 1955/56 | REDUCTION | 0.0 | 15.6 | 12.8 | 9.3 | 58.9 | 3.0 | 0.3 | 0.0 | 0.0 | 0.0 | 4876 | 1308 | 4023.84 |
| 1956/57 | REDUCTION | 0.0 | 16.9 | 50.9 | 10.8 | 6.1 | 14.7 | 0.7 | 0.0 | 0.0 | 0.0 | 4641 | 1668 | 2643.75 |
| 1957/58 | REDUCTION | 0.0 | 23.5 | 61.4 | 12.7 | 1.3 | 0.6 | 0.6 | 0.0 | 0.0 | 0.0 | 3743 | 847 | 1445.86 |
| 1958/59 | REDUCTION | 0.4 | 3.8 | 49.3 | 36.7 | 8.1 | 0.8 | 0.4 | 0.4 | 0.0 | 0.0 | 4996 | 1337 | 3305.21 |
| 1959/60 | REDUCTION | 0.0 | 50.9 | 19.4 | 24.3 | 4.5 | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 | 1078 | 103 | 584.89 |
| 1960/61 | REDUCTION | 0.0 | 19.6 | 31.3 | 9.6 | 30.2 | 8.6 | 0.7 | 0.1 | 0.0 | 0.0 | 2198 | 833 | 2394.63 |
| 1961/62 | REDUCTION | 0.0 | 8.9 | 48.7 | 22.6 | 3.3 | 13.3 | 3.0 | 0.2 | 0.0 | 0.0 | 571 | 99 | 922.28 |
| 1962/63 | REDUCTION | 0.0 | 0.4 | 30.3 | 58.4 | 5.0 | 2.7 | 3.1 | 0.2 | 0.0 | 0.0 | 1038 | 860 | 3557.49 |
| 1963/64 | REDUCTION | 0.0 | 11.4 | 47.1 | 29.3 | 10.5 | 1.6 | 0.1 | 0.0 | 0.0 | 0.0 | 1064 | 180 | 3207.79 |
| 1964/65 | REDUCTION | 0.0 | 7.7 | 36.3 | 34.1 | 15.8 | 5.6 | 0.4 | 0.1 | 0.0 | 0.0 | 1512 | 580 | 1309.71 |
| 1965/66 | REDUCTION | 8.7 | 61.5 | 18.7 | 6.7 | 3.3 | 1.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 5290.63 |
| 1966/67 | REDUCTION | 1.2 | 37.0 | 45.6 | 12.9 | 2.0 | 1.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0 ^a | 25 | 2444.48 |
| 1967/68 | REDUCTION | 1.8 | 32.0 | 47.2 | 16.7 | 2.1 | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0 ^a | 25 | 164.60 |
| 1968/69 | OTHER | 16.1 | 27.0 | 23.2 | 22.4 | 9.5 | 1.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 11.56 |
| 1969/70 | OTHER | 39.5 | 32.7 | 26.9 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 39.77 |
| 1970/71 | OTHER | 0.1 | 14.4 | 39.6 | 36.8 | 3.8 | 4.2 | 0.9 | 0.1 | 0.1 | 0.0 | 953 | 135 | 339.63 |
| 1971/72 | ROE-SN | 0.0 | 4.4 | 29.8 | 27.7 | 25.7 | 6.9 | 4.4 | 1.1 | 0.1 | 0.0 | 1837 | 598 | 675.33 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.9 | 14.9 | 65.0 | 10.6 | 7.9 | 0.6 | 0.0 | 0.0 | 329 | 503 | 8.47 |
| 1972/73 | ROE-SN | 0.0 | 1.2 | 50.5 | 18.6 | 15.5 | 11.7 | 1.9 | 0.5 | 0.2 | 0.0 | 1328 | 593 | 537.76 ^c |
| | ROE-GN | 0.0 | 0.0 | 2.5 | 25.3 | 44.9 | 20.9 | 4.4 | 1.3 | 0.6 | 0.0 | 158 | 114 | 71.26 |
| 1973/74 | ROE-SN | 0.0 | 2.8 | 17.7 | 38.6 | 19.7 | 13.4 | 6.6 | 0.9 | 0.3 | 0.0 | 1587 | 202 | 273.68 |
| | ROE-GN | 0.0 | 0.0 | 0.4 | 22.4 | 38.8 | 24.5 | 12.2 | 1.7 | 0.0 | 0.0 | 474 | 83 | 332.30 |
| 1974/75 | ROE-SN | 0.3 | 0.9 | 32.8 | 25.5 | 28.1 | 8.5 | 3.2 | 0.7 | 0.1 | 0.0 | 8651 | 3262 | 276.96 |
| | ROE-GN | 0.0 | 0.0 | 3.3 | 25.6 | 46.2 | 16.4 | 6.4 | 2.1 | 0.0 | 0.0 | 519 | 117 | 347.32 |
| 1975/76 | ROE-SN | 0.0 | 2.4 | 11.5 | 41.3 | 21.2 | 17.2 | 4.7 | 1.5 | 0.2 | 0.0 | 5243 | 978 | 477.80 |
| | ROE-GN | 0.0 | 0.0 | 0.8 | 18.8 | 29.8 | 35.3 | 11.8 | 3.0 | 0.4 | 0.1 | 1222 | 253 | 383.45 |
| 1976/77 | OTHER | 0.0 | 1.0 | 32.8 | 18.7 | 29.8 | 8.1 | 6.6 | 3.0 | 0.0 | 0.0 | 198 | 144 | 32.75 |
| | ROE-SN | 0.0 | 0.7 | 17.4 | 22.6 | 31.8 | 16.6 | 8.5 | 1.9 | 0.4 | 0.0 | 2496 | 925 | 284.27 |
| | ROE-GN | 0.0 | 0.0 | 1.1 | 13.0 | 35.5 | 31.6 | 13.5 | 4.0 | 1.3 | 0.0 | 453 | 169 | 411.71 |
| 1977/78 | ROE-SN | 0.0 | 0.2 | 25.7 | 15.2 | 19.9 | 23.1 | 10.9 | 3.5 | 1.1 | 0.4 | 1396 | 589 | 354.31 |
| | ROE-GN | 0.0 | 0.0 | 1.3 | 8.9 | 29.6 | 38.1 | 17.7 | 3.8 | 0.5 | 0.1 | 1075 | 474 | 576.00 |
| 1979/80 | ROE-SN | 0.0 | 3.6 | 73.5 | 6.3 | 8.8 | 3.9 | 2.6 | 0.7 | 0.4 | 0.1 | 2504 | 1337 | 1.12 ^c |
| | ROE-GN | 0.0 | 0.0 | 3.3 | 2.6 | 24.8 | 23.7 | 26.3 | 11.3 | 6.6 | 1.5 | 274 | 210 | 32.46 |
| 1980/81 | ROE-SN | 0.0 | 2.0 | 12.3 | 66.6 | 8.4 | 7.0 | 2.6 | 0.6 | 0.3 | 0.1 | 2952 | 492 | 25.75 ^c |
| | ROE-GN | 0.0 | 0.3 | 1.5 | 50.7 | 13.6 | 15.4 | 10.6 | 5.5 | 1.8 | 0.7 | 1536 | 276 | 163.04 |

Appendix Table 1.3 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1981/82 | ROE-SN | 0.0 | 1.7 | 14.9 | 10.7 | 60.9 | 5.3 | 4.5 | 1.5 | 0.5 | 0.0 | 3414 | 2184 | 187.25 ^c |
| | ROE-GN | 0.0 | 0.0 | 2.4 | 5.9 | 76.0 | 6.7 | 5.9 | 2.3 | 0.7 | 0.1 | 1337 | 301 | 287.08 |
| 1982/83 | ROE-SN | 0.0 | 0.5 | 7.0 | 15.4 | 10.8 | 57.1 | 5.0 | 3.1 | 0.7 | 0.3 | 5445 | 1082 | 154.75 |
| | ROE-GN | 0.0 | 0.0 | 0.5 | 7.2 | 13.1 | 69.4 | 5.0 | 3.9 | 0.6 | 0.3 | 1793 | 994 | 244.49 |
| 1983/84 | ROE-SN | 0.0 | 4.4 | 7.3 | 10.1 | 18.2 | 16.1 | 40.7 | 2.3 | 0.8 | 0.1 | 6294 | 2209 | 284.16 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.3 | 2.9 | 13.1 | 17.3 | 60.1 | 4.7 | 1.1 | 0.5 | 1159 | 338 | 242.25 |
| 1984/85 | ROE-SN | 0.0 | 2.7 | 37.5 | 7.5 | 8.6 | 13.1 | 11.9 | 18.2 | 0.4 | 0.1 | 5157 | 5529 | 222.13 |
| | ROE-GN | 0.0 | 0.0 | 3.2 | 5.4 | 9.4 | 19.5 | 22.5 | 38.2 | 1.0 | 0.8 | 1288 | 1407 | 143.53 |
| 1985/86 | ROE-SN | 0.0 | 3.9 | 16.3 | 40.1 | 8.7 | 6.2 | 6.8 | 6.1 | 11.4 | 0.6 | 5729 | 2032 | 126.20 |
| | ROE-GN | 0.0 | 0.0 | 1.8 | 23.9 | 12.0 | 10.0 | 16.0 | 13.2 | 22.3 | 0.8 | 1069 | 262 | 68.15 |
| 1986/87 | ROE-SN | 0.0 | 4.1 | 22.6 | 14.6 | 32.2 | 5.7 | 4.5 | 5.8 | 4.7 | 5.8 | 5038 | 2319 | 168.41 |
| | ROE-GN | 0.0 | 0.0 | 0.8 | 7.7 | 44.9 | 11.7 | 7.8 | 9.9 | 8.2 | 9.0 | 981 | 1199 | 53.76 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | FISHERY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 17.6 | 44.8 | 80.7 | 105.1 | 126.2 | 138.7 | 150.9 | 157.3 | 143.8 | 164.0 | | | |
| | ROE-SN | 16.0 | 54.9 | 89.3 | 115.5 | 136.9 | 154.8 | 169.3 | 183.6 | 196.7 | 209.9 | | | |
| | ROE-GN | 0.0 | 39.3 | 112.9 | 137.6 | 150.3 | 162.1 | 171.6 | 182.8 | 190.4 | 187.3 | | | |
| | OTHER | 17.3 | 49.3 | 85.3 | 110.5 | 131.9 | 146.8 | 160.6 | 172.0 | 183.4 | 203.3 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.4. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the northern Strait of Georgia stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|-----|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.1 | 3.5 | 45.5 | 38.5 | 9.5 | 2.1 | 0.6 | 0.2 | 0.0 | 0.0 | 3554 | 526 | 1733.55 |
| 1951/52 | REDUCTION | 0.1 | 13.0 | 52.2 | 26.4 | 6.8 | 1.5 | 0.1 | 0.0 | 0.0 | 0.0 | 4533 | 570 | 1857.54 |
| 1952/53 | REDUCTION | 0.4 | 12.9 | 49.7 | 30.3 | 4.8 | 1.6 | 0.3 | 0.1 | 0.0 | 0.0 | 5343 | 707 | 545.54 |
| 1953/54 | REDUCTION | 0.0 | 2.3 | 34.0 | 39.2 | 16.7 | 5.7 | 1.7 | 0.4 | 0.0 | 0.0 | 6856 | 2388 | 1906.18 |
| 1954/55 | REDUCTION | 0.0 | 5.5 | 40.9 | 44.2 | 7.7 | 1.6 | 0.1 | 0.0 | 0.0 | 0.0 | 2657 | 360 | 2903.78 |
| 1955/56 | REDUCTION | 0.0 | 9.5 | 16.4 | 28.1 | 36.9 | 7.4 | 1.2 | 0.4 | 0.1 | 0.0 | 4919 | 925 | 2587.73 |
| 1956/57 | REDUCTION | 0.0 | 0.9 | 36.8 | 25.1 | 24.3 | 11.5 | 1.3 | 0.1 | 0.0 | 0.0 | 2420 | 497 | 1848.17 |
| 1957/58 | REDUCTION | 0.0 | 6.4 | 44.3 | 23.4 | 9.5 | 9.6 | 5.8 | 0.8 | 0.1 | 0.0 | 3473 | 617 | 890.18 |
| 1958/59 | REDUCTION | 0.8 | 16.8 | 62.4 | 16.3 | 2.8 | 0.5 | 0.3 | 0.1 | 0.0 | 0.0 | 4454 | 1799 | 4185.81 |
| 1959/60 | REDUCTION | 0.0 | 14.1 | 39.7 | 39.2 | 5.8 | 0.8 | 0.3 | 0.1 | 0.0 | 0.1 | 1252 | 231 | 2365.00 |
| 1960/61 | REDUCTION | 0.0 | 21.7 | 22.8 | 30.0 | 22.0 | 3.1 | 0.4 | 0.0 | 0.0 | 0.0 | 1302 | 222 | 1759.31 |
| 1961/62 | REDUCTION | 0.0 | 13.3 | 63.4 | 12.7 | 7.2 | 2.8 | 0.6 | 0.0 | 0.0 | 0.0 | 1506 | 584 | 3439.28 |
| 1962/63 | REDUCTION | 0.0 | 20.8 | 48.3 | 24.5 | 3.4 | 1.8 | 0.9 | 0.2 | 0.0 | 0.0 | 1161 | 144 | 4278.29 |
| 1963/64 | REDUCTION | 0.0 | 5.8 | 64.7 | 26.5 | 2.3 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 2224 | 639 | 3713.96 |
| 1964/65 | REDUCTION | 0.2 | 14.1 | 53.3 | 28.3 | 2.7 | 1.1 | 0.3 | 0.1 | 0.0 | 0.0 | 2095 | 529 | 2601.85 |
| 1965/66 | REDUCTION | 0.0 | 19.5 | 36.8 | 23.0 | 15.9 | 3.2 | 1.6 | 0.0 | 0.0 | 0.0 | 435 | 77 | 1848.84 |
| 1966/67 | REDUCTION | 8.1 | 28.4 | 47.7 | 10.5 | 3.0 | 1.9 | 0.3 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 1196.04 |
| 1967/68 | REDUCTION | 13.0 | 20.0 | 50.6 | 13.0 | 2.5 | 0.6 | 0.2 | 0.1 | 0.0 | 0.0 | 0 ^a | 25 | 102.02 |
| 1968/69 | OTHER | 18.2 | 59.4 | 19.6 | 2.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 51.02 |
| 1969/70 | OTHER | 0.6 | 23.6 | 62.9 | 11.1 | 1.4 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 51.64 |
| 1970/71 | OTHER | 0.5 | 12.9 | 42.3 | 34.4 | 6.6 | 2.8 | 0.5 | 0.0 | 0.0 | 0.0 | 1060 | 239 | 82.55 |
| 1971/72 | OTHER | 0.0 | 1.5 | 27.6 | 36.8 | 26.1 | 5.4 | 2.3 | 0.3 | 0.0 | 0.0 | 1039 | 3596 | 55.97 |
| | ROE-SN | 0.0 | 4.2 | 39.3 | 31.5 | 19.5 | 4.3 | 1.1 | 0.0 | 0.0 | 0.0 | 2586 | 265 | 469.55 |
| | ROE-GN | 0.0 | 1.1 | 12.5 | 50.2 | 28.0 | 6.5 | 1.1 | 0.4 | 0.4 | 0.0 | 279 | 214 | 0.12 |
| 1972/73 | OTHER | 0.1 | 0.5 | 23.5 | 33.0 | 26.8 | 13.9 | 1.9 | 0.3 | 0.0 | 0.0 | 3915 | 1785 | 264.85 |
| | ROE-SN | 0.0 | 4.2 | 54.9 | 21.4 | 12.9 | 6.1 | 0.5 | 0.0 | 0.0 | 0.0 | 379 | 615 | 137.00 |
| | ROE-GN | 0.0 | 0.0 | 5.5 | 27.3 | 52.7 | 10.9 | 3.6 | 0.0 | 0.0 | 0.0 | 55 | 55 | 87.20 |
| 1973/74 | ROE-GN | 0.0 | 0.0 | 3.6 | 43.1 | 33.1 | 16.9 | 2.9 | 0.3 | 0.0 | 0.0 | 661 | 320 | 204.02 ^{cd} |
| 1974/75 | OTHER | 1.1 | 22.1 | 60.4 | 12.3 | 2.1 | 1.4 | 0.5 | 0.0 | 0.2 | 0.0 | 439 | 15 | 65.64 |
| | ROE-SN | 1.7 | 3.5 | 57.3 | 27.0 | 7.1 | 2.6 | 0.5 | 0.2 | 0.1 | 0.0 | 3092 | 662 | 50.23 |
| | ROE-GN | 0.0 | 0.0 | 6.7 | 31.9 | 43.7 | 13.4 | 3.4 | 0.8 | 0.0 | 0.0 | 119 | 26 | 283.37 |
| 1975/76 | OTHER | 0.1 | 7.9 | 17.6 | 34.9 | 25.5 | 8.6 | 3.7 | 1.3 | 0.2 | 0.1 | 1380 | 553 | 150.55 |
| | ROE-SN | 0.0 | 13.3 | 26.3 | 43.3 | 14.1 | 2.2 | 0.3 | 0.4 | 0.0 | 0.0 | 729 | 97 | 20.92 |
| | ROE-GN | 0.0 | 0.0 | 0.5 | 39.1 | 44.0 | 12.9 | 3.0 | 0.4 | 0.1 | 0.0 | 737 | 269 | 405.21 |
| 1976/77 | OTHER | 0.0 | 3.2 | 19.7 | 24.8 | 36.9 | 14.6 | 0.6 | 0.0 | 0.0 | 0.0 | 157 | 254 | 46.34 |
| | ROE-SN | 0.1 | 3.3 | 57.8 | 20.8 | 14.4 | 3.0 | 0.4 | 0.2 | 0.0 | 0.0 | 2234 | 1269 | 370.86 |
| | ROE-GN | 0.0 | 0.0 | 3.2 | 26.1 | 48.7 | 17.2 | 4.1 | 0.6 | 0.1 | 0.0 | 1423 | 162 | 466.14 |
| 1977/78 | OTHER | 0.1 | 4.7 | 38.0 | 28.4 | 9.6 | 11.6 | 5.7 | 1.2 | 0.5 | 0.1 | 758 | 205 | 364.13 |
| | ROE-SN | 0.0 | 0.8 | 34.8 | 42.8 | 11.9 | 7.7 | 1.5 | 0.3 | 0.0 | 0.1 | 3146 | 2299 | 353.53 |
| | ROE-GN | 0.0 | 0.0 | 0.4 | 19.7 | 31.4 | 35.1 | 11.3 | 1.7 | 0.4 | 0.0 | 462 | 690 | 426.90 |

Appendix Table 1.4 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|-----------|---------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1978/79 | OTHER | 0.0 | 1.2 | 16.2 | 36.6 | 25.3 | 10.9 | 7.7 | 1.6 | 0.4 | 0.1 | 764 | 201 | 164.24 |
| | ROE-SN | 0.0 | 1.0 | 17.7 | 31.0 | 32.5 | 10.2 | 5.8 | 1.5 | 0.2 | 0.0 | 889 | 311 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 1.2 | 23.2 | 54.7 | 13.5 | 5.8 | 1.5 | 0.0 | 0.2 | 607 | 290 | 441.80 |
| 1979/80 | OTHER | 1.4 | 5.0 | 40.4 | 21.9 | 18.6 | 8.1 | 2.8 | 1.5 | 0.3 | 0.0 | 2101 | 1071 | 126.23 |
| | ROE-SN | 0.0 | 2.4 | 48.5 | 16.2 | 18.1 | 10.5 | 2.6 | 1.3 | 0.3 | 0.1 | 3461 | 1451 | 16.86 |
| | ROE-GN | 0.0 | 0.0 | 2.0 | 9.2 | 44.6 | 33.4 | 8.8 | 1.9 | 0.3 | 0.0 | 754 | 1139 | 215.21 |
| 1980/81 | OTHER | 0.0 | 1.8 | 40.6 | 36.5 | 13.3 | 4.7 | 2.1 | 0.5 | 0.5 | 0.0 | 655 | 212 | 23.02 |
| | ROE-SN | 0.0 | 6.9 | 37.0 | 30.1 | 11.4 | 9.6 | 3.9 | 0.6 | 0.3 | 0.0 | 6893 | 2295 | 201.50 |
| | ROE-GN | 0.0 | 0.1 | 2.2 | 18.2 | 23.0 | 37.4 | 16.1 | 2.8 | 0.3 | 0.1 | 1140 | 338 | 333.10 |
| 1981/82 | OTHER | 0.0 | 0.0 | 25.8 | 35.2 | 28.3 | 4.4 | 2.5 | 2.5 | 0.0 | 1.3 | 159 | 123 | 10.00 |
| | ROE-SN | 0.0 | 6.9 | 31.4 | 24.8 | 21.1 | 5.6 | 6.3 | 3.0 | 0.9 | 0.1 | 2244 | 1051 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 4.4 | 15.4 | 28.5 | 14.8 | 20.8 | 14.2 | 1.7 | 0.4 | 833 | 543 | 367.36 |
| 1982/83 | OTHER | 0.0 | 27.2 | 47.2 | 13.9 | 7.8 | 2.8 | 0.0 | 1.1 | 0.0 | 0.0 | 180 | 523 | 10.56 |
| | ROE-SN | 0.0 | 2.4 | 31.6 | 28.4 | 17.8 | 12.1 | 3.3 | 2.9 | 1.2 | 0.2 | 9747 | 6013 | 675.25 |
| | ROE-GN | 0.0 | 0.0 | 0.5 | 27.8 | 29.5 | 23.6 | 9.3 | 7.4 | 1.7 | 0.2 | 407 | 305 | 563.81 |
| 1983/84 | OTHER | 0.0 | 8.7 | 39.4 | 28.5 | 11.0 | 7.3 | 3.7 | 1.4 | 0.0 | 0.0 | 355 | 66 | 19.33 |
| | ROE-SN | 0.0 | 4.7 | 39.3 | 31.4 | 12.8 | 6.6 | 3.5 | 1.0 | 0.5 | 0.1 | 5747 | 1917 | 351.51 |
| | ROE-GN | 0.0 | 0.0 | 7.0 | 30.2 | 31.1 | 19.2 | 9.3 | 1.7 | 0.7 | 0.9 | 766 | 759 | 421.50 |
| 1984/85 | OTHER | 0.0 | 13.1 | 50.8 | 20.3 | 10.2 | 4.0 | 1.3 | 0.3 | 0.0 | 0.0 | 679 | 380 | 10.32 |
| | ROE-SN | 0.0 | 22.0 | 45.1 | 19.4 | 8.6 | 3.1 | 1.3 | 0.5 | 0.1 | 0.0 | 5580 | 2423 | 287.19 |
| | ROE-GN | 0.0 | 0.1 | 3.1 | 26.1 | 32.5 | 23.6 | 9.2 | 3.7 | 0.8 | 0.8 | 1096 | 650 | 237.16 |
| 1985/86 | ROE-SN | 0.1 | 9.1 | 54.2 | 26.0 | 7.3 | 2.3 | 0.9 | 0.2 | 0.0 | 0.0 | 4105 | 1391 | 1.00 ^b |
| 1986/87 | ROE-SN | 0.0 | 6.0 | 31.3 | 39.6 | 17.3 | 4.0 | 1.2 | 0.4 | 0.2 | 0.1 | 5965 | 2571 | 310.39 |
| | ROE-GN | 0.0 | 0.0 | 2.0 | 32.7 | 34.5 | 17.6 | 9.7 | 2.7 | 0.5 | 0.3 | 1277 | 652 | 151.76 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| FISHERY | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| REDUCTION | | 14.9 | 45.6 | 83.9 | 110.5 | 133.2 | 149.7 | 168.6 | 174.4 | 194.0 | 188.3 | | | |
| ROE-SN | | 16.5 | 56.4 | 82.8 | 111.2 | 132.4 | 151.3 | 168.5 | 178.7 | 175.3 | 185.7 | | | |
| ROE-GN | | 0.0 | 67.2 | 118.8 | 137.4 | 149.9 | 161.9 | 170.5 | 183.4 | 181.5 | 182.8 | | | |
| OTHER | | 16.4 | 51.2 | 84.6 | 111.2 | 133.6 | 151.8 | 169.9 | 171.6 | 176.8 | 181.0 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.5. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the southern Strait of Georgia stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|------|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.0 | 4.7 | 65.6 | 23.5 | 5.1 | 0.9 | 0.1 | 0.0 | 0.0 | 0.0 | 4262 | 1605 | 2688.26 |
| 1951/52 | REDUCTION | 0.1 | 9.3 | 58.5 | 23.7 | 6.7 | 1.2 | 0.4 | 0.1 | 0.0 | 0.0 | 4499 | 1222 | 2966.21 |
| 1952/53 | REDUCTION | 0.1 | 3.9 | 65.9 | 26.6 | 3.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 3320 | 1258 | 493.14 |
| 1953/54 | REDUCTION | 0.0 | 0.7 | 58.4 | 34.2 | 5.9 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 6306 | 2318 | 4668.76 |
| 1954/55 | REDUCTION | 0.0 | 3.3 | 56.4 | 33.8 | 5.7 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 2634 | 714 | 4115.48 |
| 1955/56 | REDUCTION | 0.0 | 4.5 | 53.8 | 29.5 | 10.4 | 1.5 | 0.2 | 0.0 | 0.0 | 0.0 | 4913 | 2414 | 4726.81 |
| 1956/57 | REDUCTION | 0.0 | 1.6 | 70.8 | 21.0 | 4.2 | 2.0 | 0.3 | 0.1 | 0.0 | 0.0 | 5059 | 2139 | 4146.45 |
| 1957/58 | REDUCTION | 0.0 | 11.3 | 63.5 | 21.0 | 2.9 | 1.0 | 0.3 | 0.1 | 0.0 | 0.0 | 3924 | 1050 | 1379.36 |
| 1958/59 | REDUCTION | 0.8 | 17.1 | 64.2 | 14.6 | 2.4 | 0.6 | 0.2 | 0.1 | 0.0 | 0.0 | 5586 | 2067 | 1946.50 |
| 1959/60 | REDUCTION | 0.0 | 4.5 | 57.2 | 35.2 | 2.5 | 0.4 | 0.1 | 0.1 | 0.0 | 0.0 | 2490 | 1351 | 4499.74 |
| 1960/61 | REDUCTION | 0.0 | 35.7 | 29.1 | 25.5 | 8.8 | 0.8 | 0.1 | 0.0 | 0.0 | 0.0 | 3049 | 620 | 3469.79 |
| 1961/62 | REDUCTION | 0.0 | 5.2 | 76.0 | 13.6 | 3.6 | 1.4 | 0.2 | 0.1 | 0.0 | 0.0 | 1697 | 412 | 3696.98 |
| 1962/63 | REDUCTION | 0.0 | 14.4 | 53.6 | 29.2 | 2.6 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 1148 | 308 | 3870.31 |
| 1963/64 | REDUCTION | 0.1 | 6.2 | 56.3 | 34.0 | 2.9 | 0.4 | 0.1 | 0.1 | 0.0 | 0.0 | 1804 | 625 | 3796.46 |
| 1964/65 | REDUCTION | 0.0 | 16.2 | 58.1 | 22.6 | 2.3 | 0.7 | 0.0 | 0.2 | 0.0 | 0.0 | 1259 | 451 | 1965.81 |
| 1965/66 | REDUCTION | 0.0 | 31.0 | 32.7 | 23.8 | 11.1 | 1.0 | 0.5 | 0.0 | 0.0 | 0.0 | 416 | 36 | 1332.91 |
| 1966/67 | REDUCTION | 13.6 | 37.4 | 33.8 | 11.2 | 2.7 | 1.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0 ^a | 25 | 2516.94 |
| 1967/68 | REDUCTION | 69.3 | 15.8 | 9.0 | 4.3 | 1.0 | 0.4 | 0.0 | 0.2 | 0.0 | 0.0 | 0 ^a | 25 | 245.19 |
| 1968/69 | OTHER | 24.6 | 38.1 | 23.0 | 10.4 | 2.8 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 60.68 |
| 1969/70 | OTHER | 0.4 | 27.4 | 57.2 | 7.8 | 5.1 | 1.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 38.15 |
| 1970/71 | OTHER | 0.0 | 10.6 | 33.4 | 42.1 | 8.6 | 2.8 | 2.2 | 0.3 | 0.0 | 0.0 | 359 | 162 | 64.38 |
| 1971/72 | OTHER | 0.0 | 13.8 | 33.5 | 33.8 | 15.1 | 2.7 | 1.0 | 0.1 | 0.0 | 0.0 | 2625 | 807 | 154.95 |
| | ROE-SN | 0.0 | 14.0 | 28.6 | 36.0 | 17.4 | 2.8 | 1.0 | 0.2 | 0.0 | 0.0 | 2263 | 597 | 38.49 |
| | ROE-GN | 0.0 | 5.7 | 11.1 | 45.1 | 29.4 | 7.0 | 1.6 | 0.1 | 0.0 | 0.0 | 756 | 151 | 9.59 |
| 1972/73 | OTHER | 0.0 | 3.4 | 49.6 | 21.2 | 18.6 | 5.5 | 1.1 | 0.5 | 0.1 | 0.0 | 797 | 203 | 27.12 |
| | ROE-GN | 0.0 | 0.0 | 21.3 | 31.4 | 32.5 | 11.2 | 3.0 | 0.6 | 0.0 | 0.0 | 169 | 56 | 43.63 |
| 1973/74 | OTHER | 0.0 | 17.4 | 73.3 | 8.1 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 86 | 86 | 39.04 |
| | ROE-GN | 0.0 | 0.0 | 7.3 | 40.4 | 27.7 | 16.1 | 6.4 | 2.1 | 0.0 | 0.0 | 329 | 268 | 30.21 |
| 1974/75 | ROE-SN | 0.0 | 3.9 | 50.1 | 28.6 | 8.7 | 4.3 | 3.1 | 0.9 | 0.3 | 0.0 | 2154 | 597 | 2.49 ^c |
| | ROE-GN | 0.0 | 0.0 | 1.6 | 64.5 | 21.0 | 9.7 | 3.2 | 0.0 | 0.0 | 0.0 | 62 | 62 | 68.22 |
| 1975/76 | OTHER | 0.0 | 5.5 | 21.7 | 44.3 | 19.7 | 5.2 | 2.3 | 0.8 | 0.5 | 0.0 | 3023 | 965 | 249.87 |
| | ROE-SN | 0.0 | 9.6 | 22.1 | 35.5 | 16.0 | 5.6 | 6.1 | 3.6 | 1.3 | 0.3 | 394 | 108 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 0.7 | 41.5 | 41.5 | 11.6 | 2.7 | 2.0 | 0.0 | 0.0 | 147 | 126 | 63.84 |
| 1976/77 | OTHER | 0.6 | 4.2 | 52.5 | 21.7 | 15.2 | 3.8 | 1.3 | 0.5 | 0.2 | 0.1 | 2512 | 788 | 472.92 |
| | ROE-SN | 0.0 | 4.8 | 18.4 | 8.0 | 15.2 | 19.2 | 16.0 | 11.2 | 4.8 | 2.4 | 125 | 136 | 23.00 |
| | ROE-GN | 0.0 | 0.0 | 4.6 | 48.6 | 35.4 | 10.3 | 1.1 | 0.0 | 0.0 | 0.0 | 175 | 5 | 48.06 |
| 1977/78 | OTHER | 0.0 | 1.2 | 35.1 | 45.8 | 10.6 | 5.6 | 1.3 | 0.1 | 0.2 | 0.1 | 1709 | 391 | 819.26 |
| | ROE-SN | 0.0 | 1.1 | 40.5 | 46.2 | 7.5 | 4.3 | 0.4 | 0.0 | 0.0 | 0.0 | 279 | 132 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 1.9 | 23.1 | 24.0 | 38.5 | 12.5 | 0.0 | 0.0 | 0.0 | 104 | 433 | 57.85 |
| 1978/79 | OTHER | 0.0 | 1.9 | 18.6 | 37.8 | 29.0 | 8.0 | 3.3 | 1.0 | 0.3 | 0.1 | 4699 | 1796 | 922.01 |

Appendix Table 1.5 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1979/80 | ROE-SN | 0.0 | 2.7 | 24.0 | 35.6 | 20.2 | 7.9 | 4.0 | 3.1 | 1.3 | 1.2 | 520 | 98 | 1.00 ^b |
| | OTHER | 0.0 | 1.4 | 45.4 | 24.0 | 17.7 | 8.4 | 1.7 | 1.1 | 0.3 | 0.1 | 2842 | 1954 | 109.21 |
| 1980/81 | ROE-SN | 0.0 | 3.0 | 57.9 | 12.0 | 15.9 | 6.8 | 2.9 | 0.8 | 0.2 | 0.5 | 591 | 189 | 1.00 ^b |
| | OTHER | 0.0 | 3.9 | 33.3 | 33.9 | 15.9 | 9.1 | 3.2 | 0.5 | 0.1 | 0.0 | 4505 | 2225 | 390.60 |
| 1981/82 | ROE-SN | 0.0 | 8.6 | 38.4 | 29.9 | 10.6 | 8.8 | 2.8 | 0.6 | 0.2 | 0.0 | 648 | 255 | 1.00 ^b |
| | OTHER | 0.0 | 3.6 | 39.0 | 31.5 | 15.3 | 5.8 | 3.9 | 0.8 | 0.1 | 0.0 | 2369 | 1384 | 303.92 |
| 1982/83 | ROE-SN | 0.0 | 8.7 | 39.7 | 23.1 | 17.4 | 3.8 | 4.5 | 2.2 | 0.5 | 0.0 | 2096 | 1168 | 302.55 |
| | OTHER | 0.0 | 0.8 | 16.6 | 32.0 | 23.2 | 13.2 | 4.9 | 5.7 | 3.0 | 0.6 | 1910 | 1526 | 47.33 |
| 1983/84 | ROE-SN | 0.0 | 5.8 | 29.8 | 28.7 | 18.3 | 8.7 | 2.8 | 3.8 | 1.6 | 0.5 | 2126 | 975 | 22.47 |
| | OTHER | 0.0 | 16.2 | 30.0 | 21.9 | 18.5 | 8.3 | 3.3 | 0.9 | 0.5 | 0.4 | 1527 | 555 | 52.95 |
| 1984/85 | ROE-SN | 0.0 | 21.9 | 31.4 | 18.8 | 13.4 | 9.3 | 2.6 | 1.5 | 0.6 | 0.3 | 1406 | 790 | 43.55 |
| | OTHER | 0.0 | 33.4 | 37.1 | 18.7 | 6.7 | 2.8 | 0.9 | 0.4 | 0.1 | 0.0 | 1843 | 288 | 64.51 |
| 1985/86 | ROE-SN | 0.0 | 29.3 | 39.1 | 18.5 | 6.3 | 4.2 | 1.5 | 0.9 | 0.1 | 0.0 | 2155 | 693 | 12.24 |
| | ROE-SN | 0.0 | 20.8 | 59.2 | 13.8 | 4.1 | 1.3 | 0.7 | 0.1 | 0.1 | 0.0 | 1961 | 542 | 1.00 ^b |
| 1986/87 | ROE-SN | 0.0 | 27.6 | 35.8 | 28.0 | 6.4 | 1.4 | 0.6 | 0.2 | 0.0 | 0.1 | 1257 | 246 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 3.6 | 41.4 | 31.4 | 14.3 | 6.1 | 2.5 | 0.6 | 0.2 | 643 | 926 | 261.76 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | FISHERY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 13.7 | 57.7 | 93.4 | 118.5 | 142.9 | 160.3 | 175.2 | 188.5 | 193.8 | 222.2 | | | |
| | ROE-SN | 0.0 | 59.5 | 87.2 | 113.4 | 136.2 | 161.6 | 172.8 | 192.7 | 201.4 | 211.9 | | | |
| | ROE-GN | 0.0 | 59.4 | 112.0 | 140.0 | 154.0 | 167.8 | 178.1 | 176.7 | 199.0 | 213.0 | | | |
| | OTHER | 15.2 | 55.8 | 88.9 | 112.6 | 135.2 | 159.1 | 168.9 | 181.5 | 197.1 | 210.4 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.6. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the southern west coast Vancouver Island stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|------|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.1 | 13.1 | 38.1 | 40.6 | 6.4 | 1.3 | 0.3 | 0.0 | 0.0 | 0.0 | 3843 | 551 | 1630.59 |
| 1951/52 | REDUCTION | 0.1 | 5.3 | 65.5 | 20.1 | 7.9 | 0.8 | 0.2 | 0.0 | 0.0 | 0.0 | 1686 | 593 | 1105.57 |
| 1952/53 | REDUCTION | 0.1 | 8.9 | 55.7 | 32.8 | 2.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 2777 | 1417 | 2.36 |
| 1953/54 | REDUCTION | 0.0 | 2.8 | 64.3 | 26.5 | 5.5 | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 | 5730 | 2473 | 3086.25 |
| 1954/55 | REDUCTION | 0.0 | 16.8 | 59.4 | 19.7 | 3.4 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 2510 | 699 | 706.20 |
| 1955/56 | REDUCTION | 0.0 | 12.4 | 64.3 | 16.0 | 6.1 | 1.1 | 0.2 | 0.0 | 0.0 | 0.0 | 4653 | 2257 | 1931.15 |
| 1956/57 | REDUCTION | 0.0 | 2.7 | 71.9 | 24.8 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 588 | 497 | 312.93 |
| 1957/58 | REDUCTION | 0.0 | 15.6 | 55.3 | 25.0 | 4.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 707 | 432 | 68.62 |
| 1958/59 | REDUCTION | 0.0 | 6.4 | 61.0 | 25.1 | 6.0 | 1.0 | 0.1 | 0.2 | 0.1 | 0.0 | 2066 | 1383 | 4315.70 |
| 1959/60 | REDUCTION | 0.0 | 26.9 | 48.2 | 19.7 | 4.1 | 0.6 | 0.4 | 0.2 | 0.0 | 0.0 | 539 | 189 | 1988.85 |
| 1960/61 | REDUCTION | 0.0 | 52.7 | 33.9 | 10.0 | 3.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 419 | 54 | 1719.68 |
| 1961/62 | REDUCTION | 0.0 | 5.1 | 78.2 | 12.1 | 3.7 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 751 | 386 | 1659.51 |
| 1962/63 | REDUCTION | 0.0 | 3.5 | 44.4 | 45.5 | 5.6 | 0.8 | 0.2 | 0.0 | 0.0 | 0.0 | 886 | 316 | 404.28 |
| 1963/64 | REDUCTION | 0.0 | 2.6 | 60.8 | 25.5 | 10.1 | 0.8 | 0.3 | 0.0 | 0.0 | 0.0 | 1134 | 1003 | 1989.83 |
| 1964/65 | REDUCTION | 0.0 | 2.3 | 34.7 | 49.3 | 9.8 | 3.5 | 0.4 | 0.0 | 0.0 | 0.0 | 775 | 344 | 1141.93 |
| 1965/66 | REDUCTION | 0.0 | 0.3 | 41.3 | 33.3 | 21.3 | 2.7 | 1.0 | 0.0 | 0.0 | 0.0 | 300 | 403 | 636.21 |
| 1966/67 | REDUCTION | 2.4 | 20.7 | 55.5 | 16.7 | 3.4 | 0.8 | 0.3 | 0.2 | 0.0 | 0.0 | 0 ^a | 25 | 859.81 |
| 1971/72 | ROE-SN | 0.0 | 4.1 | 19.9 | 50.8 | 20.0 | 3.3 | 1.1 | 0.8 | 0.0 | 0.0 | 1222 | 843 | 319.50 |
| 1972/73 | ROE-SN | 0.0 | 0.9 | 32.3 | 24.1 | 31.0 | 10.1 | 1.3 | 0.3 | 0.1 | 0.0 | 1967 | 1330 | 678.19 |
| | ROE-GN | 0.0 | 0.0 | 7.9 | 22.9 | 51.8 | 13.5 | 2.9 | 1.0 | 0.2 | 0.0 | 624 | 526 | 63.80 |
| 1973/74 | ROE-SN | 0.0 | 12.1 | 45.1 | 25.7 | 11.0 | 5.0 | 1.0 | 0.1 | 0.0 | 0.0 | 3022 | 1434 | 341.88 |
| | ROE-GN | 0.0 | 0.0 | 26.1 | 30.7 | 26.1 | 13.6 | 3.4 | 0.0 | 0.0 | 0.0 | 176 | 30 | 207.72 |
| 1974/75 | ROE-SN | 0.0 | 0.7 | 46.5 | 21.9 | 14.2 | 9.4 | 5.7 | 1.4 | 0.2 | 0.0 | 6191 | 3025 | 901.22 ^c |
| | ROE-GN | 0.0 | 0.0 | 3.0 | 30.5 | 37.9 | 21.2 | 7.1 | 0.4 | 0.0 | 0.0 | 269 | 145 | 407.98 |
| 1975/76 | ROE-SN | 0.0 | 0.1 | 7.6 | 45.5 | 20.8 | 14.4 | 8.3 | 2.8 | 0.5 | 0.0 | 7026 | 1218 | 1358.83 |
| | ROE-GN | 0.0 | 0.0 | 0.7 | 41.8 | 33.6 | 15.3 | 5.9 | 2.3 | 0.3 | 0.1 | 1238 | 125 | 932.28 |
| 1976/77 | ROE-SN | 0.0 | 0.5 | 11.8 | 32.1 | 37.5 | 12.5 | 4.1 | 1.5 | 0.2 | 0.0 | 6171 | 1298 | 1226.50 ^c |
| | ROE-GN | 0.0 | 1.0 | 6.1 | 23.0 | 45.4 | 16.8 | 6.1 | 1.5 | 0.0 | 0.0 | 196 | 26 | 669.58 |
| 1977/78 | OTHER | 0.0 | 1.3 | 41.9 | 26.2 | 13.7 | 13.5 | 2.0 | 0.9 | 0.3 | 0.3 | 1727 | 416 | 183.29 |
| | ROE-SN | 0.0 | 0.5 | 35.1 | 18.7 | 18.6 | 20.8 | 4.8 | 1.3 | 0.2 | 0.1 | 5067 | 2353 | 381.15 |
| | ROE-GN | 0.0 | 0.0 | 1.2 | 5.3 | 20.1 | 49.6 | 17.3 | 5.8 | 0.5 | 0.2 | 417 | 84 | 730.95 |
| 1978/79 | ROE-SN | 0.0 | 0.5 | 9.9 | 39.2 | 18.5 | 16.4 | 11.9 | 2.6 | 0.8 | 0.2 | 2165 | 1149 | 411.88 ^c |
| | ROE-GN | 0.0 | 0.0 | 1.0 | 25.1 | 27.2 | 26.3 | 18.0 | 2.1 | 0.4 | 0.0 | 518 | 214 | 263.70 |
| 1979/80 | ROE-SN | 0.0 | 3.5 | 45.0 | 11.4 | 18.2 | 9.2 | 8.4 | 3.5 | 0.7 | 0.1 | 2037 | 1241 | 146.54 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 4.4 | 40.7 | 25.6 | 16.8 | 11.4 | 0.8 | 0.3 | 386 | 717 | 36.65 |
| 1980/81 | ROE-SN | 0.0 | 4.0 | 37.7 | 26.4 | 10.6 | 11.5 | 6.4 | 2.8 | 0.6 | 0.0 | 3162 | 1247 | 251.13 ^c |
| | ROE-GN | 0.0 | 0.0 | 1.8 | 21.0 | 14.9 | 36.3 | 18.9 | 7.1 | 0.0 | 0.0 | 281 | 81 | 136.27 |
| 1981/82 | ROE-SN | 0.0 | 4.0 | 24.8 | 28.7 | 23.5 | 5.3 | 8.5 | 3.1 | 1.7 | 0.4 | 3930 | 2036 | 201.06 ^c |
| | ROE-GN | 0.0 | 0.0 | 0.3 | 17.3 | 39.5 | 11.4 | 23.3 | 5.4 | 2.6 | 0.3 | 352 | 216 | 49.47 |
| 1982/83 | ROE-SN | 0.0 | 4.5 | 23.3 | 22.8 | 21.7 | 16.2 | 4.0 | 5.3 | 1.2 | 1.1 | 2761 | 1911 | 476.41 |

Appendix Table 1.6 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1983/84 | ROE-SN | 0.0 | 20.5 | 36.8 | 14.1 | 9.6 | 10.5 | 6.1 | 1.1 | 1.1 | 0.2 | 2903 | 1266 | 485.38 |
| 1984/85 | ROE-SN | 0.0 | 21.1 | 50.2 | 16.1 | 4.1 | 2.9 | 3.4 | 1.8 | 0.1 | 0.3 | 2341 | 603 | 15.98 ^c |
| 1985/86 | ROE-SN | 0.0 | 4.2 | 48.8 | 27.2 | 10.3 | 3.9 | 2.7 | 2.1 | 0.7 | 0.1 | 3127 | 1073 | 1.00 ^b |
| 1986/87 | ROE-SN | 0.0 | 15.1 | 16.0 | 35.7 | 19.0 | 8.1 | 2.9 | 1.6 | 1.2 | 0.4 | 4050 | 2121 | 987.46 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | FISHERY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 22.9 | 57.2 | 89.9 | 112.9 | 132.2 | 149.3 | 156.4 | 166.8 | 173.2 | 237.6 | | | |
| | ROE-SN | 21.0 | 63.6 | 93.4 | 124.0 | 149.2 | 170.1 | 184.0 | 194.2 | 204.0 | 206.2 | | | |
| | ROE-GN | 0.0 | 45.5 | 104.3 | 135.4 | 154.0 | 168.4 | 179.4 | 184.5 | 184.6 | 188.5 | | | |
| | OTHER | 22.6 | 60.1 | 91.7 | 118.8 | 140.7 | 159.4 | 170.3 | 187.5 | 196.2 | 206.2 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.7 (cont'd).

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1985/86 | ROE-SN | 0.0 | 2.4 | 47.2 | 44.1 | 2.5 | 1.1 | 1.2 | 0.9 | 0.6 | 0.0 | 1389 | 85 | 1.00 ^b |
| 1986/87 | ROE-SN | 0.0 | 14.1 | 22.6 | 23.1 | 36.4 | 2.1 | 0.3 | 0.5 | 0.4 | 0.4 | 940 | 289 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 1.8 | 24.5 | 61.8 | 5.5 | 2.2 | 2.9 | 0.9 | 0.4 | 550 | 408 | 142.95 |
| | | Average weight at age (g) | | | | | | | | | | | | |
| | FISHERY | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | REDUCTION | 9.8 | 57.3 | 89.2 | 111.2 | 131.7 | 145.4 | 157.3 | 175.4 | 190.2 | 156.6 | | | |
| | ROE-SN | 0.0 | 60.9 | 91.0 | 119.3 | 142.9 | 163.9 | 175.9 | 185.5 | 197.0 | 203.9 | | | |
| | ROE-GN | 0.0 | 0.0 | 117.2 | 131.7 | 147.3 | 156.9 | 162.4 | 170.3 | 163.7 | 182.0 | | | |
| | OTHER | 9.8 | 59.4 | 90.3 | 115.8 | 137.5 | 154.7 | 167.7 | 181.2 | 193.8 | 190.4 | | | |

^aAge composition from published reports.

^bNo seine roe fishery in this season. Age composition from pre-fishery charter samples only.

^cincludes catch from "other" fisheries

^dincludes catch from seine roe fisheries

^eincludes catch from gillnet fisheries

Appendix Table 1.7. Age composition and catch in numbers by fishery and season and weight at age averaged over all seasons for the northern west coast Vancouver Island stock assessment region.

| Season | Fishery | Percent at age | | | | | | | | | | Number aged | Sample weight | Catch (x 10 ⁻⁵) |
|---------|-----------|----------------|------|------|------|------|------|------|------|-----|-----|----------------|---------------|-----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | REDUCTION | 0.0 | 1.5 | 27.0 | 54.1 | 12.8 | 3.6 | 1.0 | 0.0 | 0.0 | 0.0 | 196 | 190 | 566.14 |
| 1951/52 | REDUCTION | 0.0 | 0.2 | 10.2 | 27.5 | 52.2 | 7.1 | 2.1 | 0.5 | 0.1 | 0.0 | 3236 | 3206 | 1266.30 |
| 1953/54 | REDUCTION | 0.0 | 0.0 | 45.8 | 42.6 | 8.8 | 2.0 | 0.8 | 0.0 | 0.0 | 0.0 | 712 | 96 | 960.00 |
| 1954/55 | REDUCTION | 0.0 | 6.7 | 34.5 | 50.1 | 6.7 | 1.6 | 0.3 | 0.1 | 0.0 | 0.0 | 1486 | 558 | 628.76 |
| 1955/56 | REDUCTION | 0.0 | 10.0 | 58.1 | 9.5 | 19.0 | 2.6 | 0.5 | 0.2 | 0.1 | 0.0 | 0 ^a | 25 | 52.03 |
| 1956/57 | REDUCTION | 0.0 | 0.0 | 51.5 | 28.9 | 15.5 | 4.1 | 0.0 | 0.0 | 0.0 | 0.0 | 97 | 81 | 48.52 |
| 1957/58 | REDUCTION | 0.0 | 9.1 | 38.9 | 30.0 | 9.7 | 6.8 | 4.1 | 1.0 | 0.2 | 0.0 | 483 | 80 | 4.98 |
| 1958/59 | REDUCTION | 0.0 | 1.4 | 24.4 | 30.3 | 25.3 | 7.6 | 5.3 | 4.3 | 1.2 | 0.3 | 1599 | 1014 | 3194.28 |
| 1959/60 | REDUCTION | 0.0 | 5.0 | 56.8 | 23.8 | 9.6 | 3.2 | 1.0 | 0.4 | 0.2 | 0.1 | 2435 | 2242 | 3941.18 |
| 1960/61 | REDUCTION | 0.0 | 19.3 | 42.4 | 31.9 | 6.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 295 | 82 | 1840.47 |
| 1961/62 | REDUCTION | 0.0 | 7.1 | 78.7 | 9.4 | 3.1 | 1.1 | 0.6 | 0.0 | 0.0 | 0.0 | 1090 | 574 | 1362.97 |
| 1962/63 | REDUCTION | 0.0 | 0.5 | 47.3 | 47.4 | 3.7 | 0.9 | 0.1 | 0.0 | 0.0 | 0.0 | 1718 | 553 | 1658.16 |
| 1963/64 | REDUCTION | 0.0 | 1.0 | 53.8 | 28.2 | 15.9 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 195 | 239 | 182.93 |
| 1964/65 | REDUCTION | 0.0 | 0.9 | 22.2 | 43.6 | 26.5 | 4.7 | 0.4 | 0.9 | 0.9 | 0.0 | 234 | 93 | 352.62 |
| 1965/66 | REDUCTION | 0.0 | 13.6 | 26.8 | 26.1 | 23.2 | 9.1 | 1.2 | 0.0 | 0.0 | 0.0 | 0 ^a | 25 | 307.10 |
| 1966/67 | REDUCTION | 0.0 | 4.7 | 63.6 | 23.9 | 6.1 | 1.5 | 0.1 | 0.1 | 0.0 | 0.0 | 0 ^a | 25 | 506.07 |
| 1971/72 | ROE-SN | 0.0 | 0.3 | 13.8 | 38.7 | 40.7 | 4.3 | 1.4 | 0.6 | 0.3 | 0.0 | 349 | 99 | 177.82 |
| 1972/73 | ROE-SN | 0.0 | 0.2 | 24.5 | 24.8 | 35.0 | 13.0 | 2.3 | 0.2 | 0.2 | 0.0 | 609 | 358 | 557.43 ^e |
| 1973/74 | ROE-SN | 0.0 | 3.0 | 40.4 | 21.7 | 16.9 | 13.8 | 3.7 | 0.4 | 0.1 | 0.0 | 2398 | 2045 | 862.72 ^e |
| 1974/75 | ROE-SN | 0.0 | 0.5 | 66.3 | 16.3 | 6.6 | 5.4 | 3.7 | 1.1 | 0.1 | 0.0 | 4185 | 2248 | 685.51 ^{ce} |
| 1975/76 | ROE-SN | 0.0 | 0.5 | 12.8 | 51.5 | 16.7 | 8.2 | 7.5 | 2.5 | 0.3 | 0.0 | 2204 | 492 | 259.12 |
| | ROE-GN | 0.0 | 0.0 | 2.7 | 33.8 | 30.4 | 18.6 | 9.9 | 4.6 | 0.0 | 0.0 | 263 | 24 | 139.02 |
| 1976/77 | ROE-SN | 0.0 | 0.9 | 19.5 | 20.3 | 33.9 | 11.3 | 8.9 | 3.7 | 1.6 | 0.0 | 575 | 1613 | 52.30 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 8.6 | 39.5 | 18.5 | 19.8 | 9.9 | 3.1 | 0.6 | 162 | 92 | 180.00 |
| 1977/78 | OTHER | 0.0 | 1.3 | 49.6 | 15.0 | 14.4 | 16.3 | 2.6 | 0.6 | 0.3 | 0.0 | 701 | 259 | 81.77 |
| | ROE-SN | 0.0 | 1.7 | 69.0 | 13.3 | 6.4 | 5.8 | 2.2 | 1.5 | 0.1 | 0.1 | 896 | 650 | 78.36 |
| | ROE-GN | 0.0 | 0.0 | 1.1 | 2.7 | 21.8 | 41.0 | 23.4 | 8.5 | 1.1 | 0.5 | 188 | 65 | 209.21 |
| 1978/79 | ROE-SN | 0.0 | 1.2 | 18.1 | 65.2 | 9.1 | 3.3 | 2.7 | 0.3 | 0.1 | 0.1 | 1800 | 724 | 495.07 |
| | ROE-GN | 0.0 | 0.0 | 2.0 | 43.5 | 18.4 | 17.7 | 17.7 | 0.7 | 0.0 | 0.0 | 147 | 126 | 299.06 |
| 1979/80 | ROE-SN | 0.0 | 1.6 | 41.5 | 22.5 | 30.1 | 3.2 | 1.0 | 0.1 | 0.0 | 0.0 | 966 | 84 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 2.1 | 9.9 | 77.3 | 8.5 | 1.4 | 0.7 | 0.0 | 0.0 | 141 | 123 | 159.85 |
| 1980/81 | ROE-SN | 0.0 | 1.3 | 15.2 | 54.5 | 10.5 | 16.5 | 1.9 | 0.1 | 0.0 | 0.0 | 1346 | 386 | 185.26 |
| | ROE-GN | 0.0 | 0.0 | 0.0 | 98.1 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 53 | 53 | 154.75 |
| 1981/82 | ROE-SN | 0.0 | 0.5 | 27.8 | 17.5 | 38.2 | 5.0 | 9.9 | 0.9 | 0.2 | 0.0 | 2173 | 499 | 21.25 |
| | ROE-GN | 0.0 | 0.0 | 0.8 | 7.9 | 47.6 | 11.5 | 29.0 | 3.1 | 0.2 | 0.0 | 620 | 564 | 197.84 |
| 1982/83 | ROE-SN | 0.0 | 2.8 | 18.3 | 19.1 | 20.9 | 27.2 | 5.7 | 5.9 | 0.2 | 0.0 | 545 | 132 | 1.00 ^b |
| | ROE-GN | 0.0 | 0.0 | 0.3 | 13.5 | 22.7 | 47.0 | 6.0 | 10.0 | 0.3 | 0.2 | 651 | 191 | 188.25 |
| 1983/84 | ROE-SN | 0.0 | 42.0 | 44.9 | 4.5 | 1.1 | 2.3 | 3.4 | 0.6 | 1.1 | 0.0 | 176 | 369 | 0.29 ^c |
| | ROE-GN | 0.0 | 0.0 | 1.0 | 5.6 | 28.1 | 25.9 | 32.5 | 4.2 | 2.4 | 0.2 | 1027 | 626 | 66.55 |
| 1984/85 | ROE-SN | 0.0 | 18.2 | 65.7 | 7.5 | 2.4 | 2.3 | 2.4 | 1.2 | 0.2 | 0.0 | 654 | 215 | 1.00 ^b |

Appendix Table 2.1. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Queen Charlotte Islands stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|-------|------|------|-----|-----|-----|----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 6377 | 2752 | 1714 | 1029 | 208 | 139 | 0 | 0 | 0 | 59 | 171 | 142 | 4465 |
| 1951/52 | 32536 | 4066 | 1755 | 1055 | 526 | 95 | 61 | 0 | 0 | 26 | 112 | 115 | 4377 |
| 1952/53 | 4035 | 20745 | 2449 | 936 | 400 | 140 | 22 | 14 | 0 | 6 | 262 | 529 | 19113 |
| 1953/54 | 5331 | 2573 | 13227 | 1562 | 597 | 255 | 89 | 14 | 9 | 4 | 486 | 416 | 12210 |
| 1954/55 | 1765 | 3399 | 1635 | 8376 | 935 | 347 | 147 | 51 | 8 | 7 | 247 | 1217 | 42276 |
| 1955/56 | 2680 | 1125 | 2162 | 1035 | 5269 | 585 | 217 | 92 | 32 | 9 | 370 | 192 | 7890 |
| 1956/57 | 6455 | 1709 | 710 | 634 | 301 | 733 | 51 | 19 | 8 | 4 | 63 | 36 | 1554 |
| 1957/58 | 2207 | 4116 | 752 | 70 | 171 | 33 | 40 | 3 | 1 | 1 | 37 | 65 | 2355 |
| 1958/59 | 5105 | 1407 | 1310 | 219 | 22 | 29 | 4 | 5 | 0 | 0 | 351 | 207 | 7685 |
| 1959/60 | 6237 | 3255 | 615 | 573 | 112 | 10 | 13 | 2 | 2 | 0 | 129 | 147 | 4995 |
| 1960/61 | 11868 | 3977 | 2076 | 392 | 365 | 71 | 6 | 8 | 1 | 2 | 316 | 186 | 7668 |
| 1961/62 | 2648 | 7567 | 2533 | 1300 | 240 | 220 | 43 | 4 | 5 | 2 | 206 | 200 | 9365 |
| 1962/63 | 6855 | 1688 | 4809 | 1417 | 624 | 99 | 85 | 17 | 1 | 3 | 213 | 235 | 11174 |
| 1963/64 | 703 | 4371 | 1073 | 2549 | 613 | 214 | 31 | 27 | 5 | 1 | 116 | 67 | 2972 |
| 1964/65 | 521 | 448 | 2770 | 406 | 741 | 85 | 19 | 3 | 2 | 1 | 59 | 33 | 1751 |
| 1965/66 | 388 | 332 | 232 | 115 | 106 | 72 | 4 | 1 | 0 | 0 | 133 | 47 | 2579 |
| 1966/67 | 373 | 247 | 176 | 84 | 53 | 41 | 26 | 1 | 0 | 0 | 22 | 45 | 2540 |
| 1967/68 | 786 | 238 | 158 | 108 | 51 | 32 | 25 | 16 | 1 | 0 | 33 | 60 | 3329 |
| 1968/69 | 2531 | 501 | 150 | 98 | 68 | 32 | 20 | 15 | 10 | 1 | 53 | 52 | 2874 |
| 1969/70 | 1715 | 1614 | 320 | 96 | 63 | 43 | 20 | 13 | 10 | 7 | 79 | 73 | 3976 |
| 1970/71 | 4029 | 1093 | 1029 | 204 | 61 | 40 | 27 | 13 | 8 | 10 | 107 | 117 | 6535 |
| 1971/72 | 10545 | 2569 | 697 | 656 | 130 | 39 | 25 | 18 | 8 | 12 | 125 | 139 | 8390 |
| 1972/73 | 14012 | 6723 | 1634 | 412 | 384 | 73 | 22 | 14 | 10 | 11 | 123 | 150 | 8738 |
| 1973/74 | 3406 | 8934 | 4287 | 987 | 230 | 201 | 37 | 11 | 7 | 11 | 416 | 340 | 17691 |
| 1974/75 | 3695 | 2172 | 5696 | 2617 | 585 | 131 | 112 | 21 | 6 | 10 | 209 | 477 | 22814 |
| 1975/76 | 4295 | 2356 | 1384 | 3512 | 1501 | 317 | 69 | 60 | 11 | 9 | 457 | 557 | 27142 |
| 1976/77 | 1630 | 2738 | 1501 | 863 | 1881 | 737 | 151 | 33 | 28 | 9 | 590 | 512 | 25734 |
| 1977/78 | 38842 | 1039 | 1746 | 839 | 455 | 901 | 341 | 70 | 15 | 18 | 496 | 360 | 18235 |
| 1978/79 | 2508 | 24766 | 662 | 952 | 422 | 202 | 382 | 145 | 30 | 14 | 407 | 212 | 11194 |
| 1979/80 | 1113 | 1599 | 15770 | 405 | 473 | 163 | 67 | 133 | 50 | 15 | 963 | 888 | 42303 |

Appendix Table 2.1 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 1170 | 710 | 1019 | 9932 | 249 | 270 | 89 | 37 | 74 | 36 | 981 | 1086 | 49371 |
| 1981/82 | 7700 | 746 | 452 | 640 | 5964 | 139 | 145 | 48 | 20 | 60 | 870 | 1167 | 49044 |
| 1982/83 | 3405 | 4910 | 475 | 282 | 394 | 3560 | 82 | 85 | 29 | 47 | 628 | 829 | 39318 |
| 1983/84 | 668 | 2171 | 3118 | 288 | 168 | 224 | 1986 | 46 | 48 | 43 | 695 | 666 | 31204 |
| 1984/85 | 937 | 426 | 1377 | 1871 | 169 | 94 | 123 | 1094 | 25 | 50 | 603 | 470 | 24508 |
| 1985/86 | 461 | 597 | 267 | 832 | 1065 | 87 | 46 | 61 | 543 | 37 | 209 | 390 | 21141 |
| 1986/87 | 295 | 294 | 381 | 166 | 489 | 588 | 47 | 25 | 33 | 313 | 543 | 311 | 16240 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.11 | 0.46 | 0.63 | 0.91 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.01 | 0.23 | 0.72 | 1.00 | 0.84 | 0.84 | 0.84 | 0.84 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 36.70$, $\beta = 0.2631E-02$. The estimated spawn index-escapement conversion factor is $0.955E-02$.

Appendix Table 2.2. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Prince Rupert District stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|-------|------|------|------|------|-----|-----|-----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 8646 | 5336 | 6302 | 7947 | 1099 | 404 | 0 | 0 | 0 | 214 | 1058 | 511 | 11761 |
| 1951/52 | 18864 | 5512 | 3246 | 3362 | 3030 | 279 | 68 | 0 | 0 | 36 | 641 | 177 | 4739 |
| 1952/53 | 5599 | 12027 | 3367 | 1796 | 1110 | 538 | 21 | 5 | 0 | 3 | 961 | 967 | 26053 |
| 1953/54 | 14979 | 3570 | 7667 | 2095 | 1112 | 677 | 325 | 12 | 3 | 2 | 835 | 306 | 8042 |
| 1954/55 | 5012 | 9550 | 2234 | 4319 | 797 | 281 | 112 | 54 | 2 | 1 | 869 | 447 | 11104 |
| 1955/56 | 9424 | 3196 | 6053 | 1360 | 1901 | 273 | 77 | 31 | 15 | 1 | 951 | 1400 | 34639 |
| 1956/57 | 18844 | 6009 | 1943 | 3315 | 776 | 1022 | 140 | 40 | 16 | 8 | 1279 | 479 | 11914 |
| 1957/58 | 6180 | 12014 | 3580 | 846 | 1368 | 234 | 230 | 32 | 9 | 5 | 507 | 1108 | 26931 |
| 1958/59 | 33584 | 3940 | 7457 | 2152 | 501 | 778 | 129 | 127 | 18 | 8 | 1285 | 1191 | 33208 |
| 1959/60 | 16323 | 21414 | 2487 | 4299 | 1224 | 268 | 398 | 66 | 65 | 13 | 1087 | 1298 | 29523 |
| 1960/61 | 9149 | 10407 | 12732 | 1468 | 2247 | 570 | 114 | 170 | 28 | 33 | 990 | 1124 | 29112 |
| 1961/62 | 27079 | 5833 | 6279 | 5989 | 666 | 813 | 171 | 34 | 51 | 18 | 1530 | 1105 | 31297 |
| 1962/63 | 3779 | 17265 | 3661 | 3423 | 2981 | 285 | 310 | 65 | 13 | 26 | 783 | 1030 | 24874 |
| 1963/64 | 1660 | 2410 | 9582 | 1851 | 1520 | 1037 | 81 | 88 | 18 | 11 | 1185 | 1518 | 37870 |
| 1964/65 | 2024 | 1059 | 1435 | 4348 | 936 | 669 | 410 | 32 | 35 | 12 | 501 | 368 | 10635 |
| 1965/66 | 2973 | 1291 | 501 | 536 | 1640 | 232 | 107 | 66 | 5 | 7 | 332 | 262 | 6928 |
| 1966/67 | 3994 | 1895 | 823 | 274 | 228 | 525 | 58 | 27 | 16 | 3 | 222 | 253 | 6565 |
| 1967/68 | 19002 | 2546 | 833 | 278 | 121 | 78 | 145 | 16 | 7 | 5 | 433 | 348 | 9209 |
| 1968/69 | 13549 | 12116 | 1544 | 444 | 161 | 67 | 42 | 77 | 9 | 7 | 74 | 230 | 6202 |
| 1969/70 | 6517 | 8639 | 7715 | 970 | 270 | 96 | 39 | 24 | 45 | 9 | 886 | 895 | 24604 |
| 1970/71 | 12339 | 4155 | 5482 | 4830 | 603 | 166 | 58 | 24 | 15 | 33 | 716 | 1325 | 32066 |
| 1971/72 | 10805 | 7868 | 2632 | 3368 | 2943 | 359 | 97 | 34 | 14 | 28 | 1000 | 1358 | 45525 |
| 1972/73 | 5117 | 6889 | 5017 | 1664 | 2047 | 1745 | 209 | 57 | 20 | 24 | 730 | 1843 | 61310 |
| 1973/74 | 3449 | 3263 | 4392 | 3159 | 1045 | 1276 | 1083 | 130 | 35 | 27 | 670 | 1685 | 54544 |
| 1974/75 | 5602 | 2199 | 2080 | 2771 | 1958 | 626 | 741 | 638 | 76 | 37 | 814 | 1707 | 49230 |
| 1975/76 | 3328 | 3572 | 1400 | 1315 | 1734 | 1214 | 385 | 457 | 393 | 70 | 1158 | 1431 | 48591 |
| 1976/77 | 3378 | 2122 | 2278 | 884 | 804 | 1034 | 710 | 226 | 268 | 272 | 1438 | 1118 | 37325 |
| 1977/78 | 29369 | 2154 | 1352 | 1379 | 517 | 436 | 529 | 370 | 118 | 281 | 750 | 772 | 25468 |
| 1978/79 | 5505 | 18726 | 1369 | 827 | 794 | 260 | 194 | 249 | 174 | 188 | 814 | 662 | 22045 |
| 1979/80 | 5667 | 3510 | 11936 | 846 | 493 | 438 | 134 | 103 | 133 | 193 | 1529 | 1267 | 38096 |

Appendix Table 2.2 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 6794 | 3614 | 2236 | 7456 | 519 | 286 | 242 | 76 | 58 | 184 | 1175 | 1512 | 38679 |
| 1981/82 | 21985 | 4332 | 2303 | 1406 | 4599 | 312 | 168 | 143 | 45 | 144 | 1305 | 1827 | 41317 |
| 1982/83 | 3746 | 14018 | 2760 | 1449 | 882 | 2860 | 193 | 104 | 88 | 117 | 1826 | 1836 | 47915 |
| 1983/84 | 4733 | 2389 | 8938 | 1759 | 924 | 562 | 1823 | 123 | 66 | 131 | 2032 | 1775 | 43737 |
| 1984/85 | 16100 | 3018 | 1521 | 5635 | 1090 | 547 | 319 | 1059 | 71 | 114 | 2056 | 1700 | 41820 |
| 1985/86 | 1033 | 10266 | 1922 | 948 | 3422 | 608 | 282 | 172 | 571 | 100 | 2084 | 1518 | 43544 |
| 1986/87 | 65 | 659 | 6541 | 1190 | 574 | 1882 | 306 | 149 | 91 | 355 | 2555 | 1544 | 43026 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.09 | 0.38 | 0.55 | 0.82 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.02 | 0.01 | 0.17 | 0.69 | 1.00 | 0.70 | 0.70 | 0.70 | 0.70 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 39.98$, $\beta = 0.1463E-02$. The estimated spawn index-escapement conversion factor is $0.154E-01$.

Appendix Table 2.3. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Central Coast stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|-------|------|------|-----|-----|-----|----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 6097 | 2350 | 3782 | 4660 | 822 | 329 | 0 | 0 | 81 | 3 | 834 | 531 | 13342 |
| 1951/52 | 32660 | 3885 | 1428 | 1588 | 1524 | 180 | 64 | 0 | 0 | 16 | 343 | 143 | 3561 |
| 1952/53 | 3508 | 20808 | 2368 | 488 | 397 | 175 | 15 | 5 | 0 | 1 | 629 | 379 | 9149 |
| 1953/54 | 3565 | 2237 | 13262 | 1494 | 298 | 238 | 104 | 9 | 3 | 1 | 487 | 367 | 7709 |
| 1954/55 | 8268 | 2271 | 1382 | 6664 | 473 | 61 | 43 | 19 | 2 | 1 | 542 | 1239 | 26737 |
| 1955/56 | 12878 | 5271 | 1411 | 816 | 3495 | 229 | 29 | 20 | 9 | 1 | 369 | 326 | 7646 |
| 1956/57 | 14048 | 8205 | 2893 | 511 | 226 | 528 | 28 | 4 | 2 | 1 | 213 | 131 | 3140 |
| 1957/58 | 2971 | 8950 | 4903 | 854 | 134 | 29 | 53 | 3 | 0 | 0 | 367 | 625 | 13572 |
| 1958/59 | 5510 | 1894 | 5445 | 2444 | 405 | 56 | 12 | 21 | 1 | 0 | 352 | 244 | 5465 |
| 1959/60 | 17367 | 3511 | 1116 | 2286 | 700 | 66 | 8 | 2 | 3 | 0 | 681 | 1230 | 23767 |
| 1960/61 | 9255 | 11073 | 2028 | 632 | 1343 | 399 | 38 | 4 | 1 | 2 | 314 | 394 | 8745 |
| 1961/62 | 8992 | 5898 | 6706 | 721 | 219 | 330 | 89 | 8 | 1 | 1 | 860 | 506 | 12682 |
| 1962/63 | 4583 | 5732 | 3691 | 3889 | 349 | 94 | 138 | 37 | 3 | 1 | 374 | 220 | 5275 |
| 1963/64 | 4780 | 2920 | 3645 | 1567 | 1039 | 48 | 10 | 15 | 4 | 0 | 430 | 282 | 7130 |
| 1964/65 | 9268 | 3046 | 1588 | 1193 | 461 | 182 | 7 | 2 | 2 | 1 | 171 | 247 | 7160 |
| 1965/66 | 4096 | 5906 | 1865 | 650 | 425 | 119 | 43 | 2 | 0 | 1 | 158 | 134 | 3479 |
| 1966/67 | 1801 | 2610 | 1435 | 271 | 155 | 42 | 8 | 3 | 0 | 0 | 322 | 232 | 6164 |
| 1967/68 | 7390 | 1147 | 627 | 278 | 88 | 34 | 8 | 2 | 1 | 0 | 370 | 269 | 7537 |
| 1968/69 | 6037 | 4712 | 684 | 347 | 161 | 49 | 19 | 5 | 1 | 0 | 162 | 213 | 5955 |
| 1969/70 | 7933 | 3849 | 3002 | 434 | 218 | 101 | 31 | 12 | 3 | 1 | 637 | 492 | 13677 |
| 1970/71 | 13390 | 5058 | 2442 | 1904 | 273 | 137 | 63 | 19 | 7 | 2 | 289 | 774 | 22019 |
| 1971/72 | 9152 | 8537 | 3190 | 1463 | 1114 | 155 | 77 | 35 | 11 | 5 | 435 | 691 | 18667 |
| 1972/73 | 12075 | 5834 | 5415 | 1842 | 737 | 507 | 68 | 34 | 16 | 7 | 961 | 1131 | 34211 |
| 1973/74 | 5987 | 7698 | 3714 | 3185 | 1032 | 379 | 249 | 34 | 17 | 11 | 890 | 1128 | 30526 |
| 1974/75 | 3681 | 3817 | 4901 | 2317 | 1806 | 491 | 159 | 103 | 14 | 12 | 784 | 1452 | 39382 |
| 1975/76 | 4338 | 2347 | 2432 | 3028 | 1345 | 911 | 224 | 72 | 47 | 11 | 1426 | 1243 | 31478 |
| 1976/77 | 3191 | 2766 | 1485 | 1494 | 1670 | 628 | 380 | 92 | 30 | 24 | 1187 | 1101 | 30377 |
| 1977/78 | 30124 | 2034 | 1761 | 883 | 840 | 790 | 262 | 157 | 38 | 22 | 732 | 649 | 17644 |
| 1978/79 | 5339 | 19205 | 1296 | 1025 | 455 | 309 | 226 | 74 | 44 | 17 | 694 | 1150 | 27095 |
| 1979/80 | 5158 | 3404 | 12246 | 827 | 654 | 290 | 197 | 144 | 47 | 39 | 1159 | 1802 | 45978 |

Appendix Table 2.3 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 2163 | 3289 | 2170 | 7805 | 524 | 409 | 180 | 122 | 89 | 53 | 1317 | 2232 | 51971 |
| 1981/82 | 1736 | 1379 | 2097 | 1380 | 4910 | 321 | 245 | 107 | 73 | 85 | 1302 | 2210 | 54359 |
| 1982/83 | 6450 | 1107 | 876 | 1307 | 840 | 2809 | 176 | 134 | 59 | 86 | 1600 | 1618 | 40111 |
| 1983/84 | 2256 | 4112 | 705 | 547 | 793 | 481 | 1544 | 96 | 73 | 79 | 1075 | 1042 | 24662 |
| 1984/85 | 2851 | 1438 | 2610 | 429 | 313 | 410 | 233 | 745 | 46 | 74 | 1155 | 858 | 24539 |
| 1985/86 | 1195 | 1818 | 911 | 1579 | 249 | 166 | 204 | 116 | 370 | 60 | 1262 | 766 | 21828 |
| 1986/87 | 112 | 762 | 1154 | 560 | 945 | 141 | 90 | 111 | 63 | 233 | 1138 | 691 | 19954 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.14 | 0.50 | 0.70 | 0.94 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.03 | 0.24 | 0.65 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 38.64$, $\beta = 0.1613E-02$. The estimated spawn index-escapement conversion factor is $0.168E-01$.

Appendix Table 2.4. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Northern Strait of Georgia stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|------|------|------|-----|-----|----|----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 8796 | 5451 | 2865 | 1383 | 325 | 65 | 0 | 0 | 0 | 26 | 2789 | 1258 | 9115 |
| 1951/52 | 18821 | 5606 | 3429 | 1211 | 388 | 84 | 17 | 0 | 0 | 7 | 2903 | 1976 | 14699 |
| 1952/53 | 10862 | 11996 | 3387 | 1429 | 417 | 127 | 28 | 6 | 0 | 2 | 3259 | 3707 | 23376 |
| 1953/54 | 4664 | 6925 | 7594 | 1948 | 799 | 231 | 71 | 15 | 3 | 1 | 1809 | 2215 | 14598 |
| 1954/55 | 4436 | 2973 | 4382 | 4339 | 651 | 253 | 73 | 22 | 5 | 1 | 2420 | 5197 | 33552 |
| 1955/56 | 6094 | 2827 | 1776 | 1906 | 1778 | 258 | 100 | 29 | 9 | 2 | 1231 | 2362 | 15451 |
| 1956/57 | 16273 | 3884 | 1617 | 815 | 563 | 490 | 71 | 28 | 8 | 3 | 1381 | 1076 | 7783 |
| 1957/58 | 8955 | 10370 | 2464 | 513 | 196 | 122 | 106 | 15 | 6 | 2 | 735 | 755 | 5266 |
| 1958/59 | 5545 | 5708 | 6569 | 1270 | 153 | 55 | 34 | 30 | 4 | 2 | 2039 | 1846 | 12983 |
| 1959/60 | 12354 | 3534 | 3118 | 2259 | 303 | 33 | 12 | 7 | 6 | 1 | 1871 | 2196 | 15298 |
| 1960/61 | 12574 | 7874 | 1990 | 1285 | 732 | 93 | 10 | 4 | 2 | 2 | 1460 | 1530 | 9549 |
| 1961/62 | 14114 | 8014 | 4730 | 945 | 393 | 210 | 27 | 3 | 1 | 1 | 1445 | 1757 | 12545 |
| 1962/63 | 6711 | 8995 | 4764 | 1377 | 234 | 89 | 47 | 6 | 1 | 1 | 1197 | 914 | 5762 |
| 1963/64 | 3284 | 4276 | 5053 | 1446 | 209 | 29 | 11 | 6 | 1 | 0 | 1279 | 962 | 7738 |
| 1964/65 | 2603 | 2093 | 2567 | 1430 | 240 | 29 | 4 | 2 | 1 | 0 | 1343 | 1412 | 11843 |
| 1965/66 | 1665 | 1659 | 1056 | 591 | 361 | 55 | 7 | 1 | 0 | 0 | 258 | 231 | 2030 |
| 1966/67 | 1073 | 1061 | 775 | 159 | 61 | 26 | 4 | 0 | 0 | 0 | 497 | 346 | 2873 |
| 1967/68 | 3574 | 684 | 248 | 130 | 31 | 10 | 4 | 1 | 0 | 0 | 551 | 348 | 3044 |
| 1968/69 | 3774 | 2279 | 414 | 124 | 66 | 15 | 5 | 2 | 0 | 0 | 815 | 714 | 5581 |
| 1969/70 | 3076 | 2406 | 1429 | 256 | 75 | 40 | 9 | 3 | 1 | 0 | 2437 | 1758 | 15607 |
| 1970/71 | 4488 | 1961 | 1523 | 888 | 159 | 47 | 25 | 6 | 2 | 1 | 2299 | 1982 | 17007 |
| 1971/72 | 6906 | 2862 | 1242 | 943 | 544 | 97 | 28 | 15 | 4 | 2 | 1519 | 1454 | 10833 |
| 1972/73 | 9392 | 4402 | 1815 | 641 | 397 | 222 | 40 | 12 | 6 | 2 | 1358 | 1213 | 9884 |
| 1973/74 | 6429 | 5987 | 2802 | 1047 | 281 | 149 | 73 | 13 | 4 | 3 | 2838 | 2313 | 17420 |
| 1974/75 | 11145 | 4099 | 3817 | 1778 | 593 | 126 | 53 | 25 | 4 | 2 | 3760 | 4785 | 34125 |
| 1975/76 | 9020 | 7107 | 2610 | 2354 | 1000 | 272 | 47 | 19 | 9 | 2 | 3734 | 3891 | 26273 |
| 1976/77 | 4314 | 5751 | 4519 | 1633 | 1289 | 440 | 96 | 16 | 7 | 4 | 5592 | 5348 | 39709 |
| 1977/78 | 7423 | 2750 | 3654 | 2653 | 864 | 553 | 153 | 33 | 6 | 4 | 4538 | 4500 | 31480 |
| 1978/79 | 5712 | 4732 | 1746 | 2100 | 1313 | 350 | 185 | 50 | 11 | 3 | 4511 | 3986 | 29701 |
| 1979/80 | 5333 | 3642 | 3016 | 1087 | 1169 | 605 | 134 | 69 | 19 | 5 | 4394 | 4949 | 33571 |

Appendix Table 2.4 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 5225 | 3400 | 2318 | 1865 | 645 | 639 | 304 | 67 | 34 | 12 | 3007 | 4908 | 34520 |
| 1981/82 | 4373 | 3332 | 2154 | 1389 | 1059 | 322 | 282 | 132 | 29 | 20 | 4869 | 4304 | 29547 |
| 1982/83 | 7312 | 2788 | 2124 | 1363 | 820 | 539 | 142 | 121 | 57 | 21 | 2828 | 2601 | 18545 |
| 1983/84 | 10879 | 4662 | 1748 | 1118 | 574 | 238 | 110 | 27 | 23 | 15 | 2202 | 2224 | 15754 |
| 1984/85 | 7323 | 6936 | 2955 | 951 | 502 | 173 | 48 | 21 | 5 | 7 | 1970 | 3148 | 22902 |
| 1985/86 | 4723 | 4669 | 4361 | 1737 | 489 | 201 | 54 | 15 | 6 | 4 | 4074 | 5464 | 40075 |
| 1986/87 | 1425 | 3011 | 2977 | 2780 | 1107 | 312 | 128 | 35 | 9 | 7 | 3588 | 5664 | 38189 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.13 | 0.70 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.02 | 0.20 | 0.57 | 0.95 | 1.00 | 1.00 | 1.00 | 1.00 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 8.623$, $\beta = 0.3982E-03$. The estimated spawn index-escapement conversion factor is $0.603E-01$

Appendix Table 2.5. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Southern Strait of Georgia stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|------|------|-----|-----|----|----|----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 11907 | 5619 | 3614 | 1124 | 230 | 46 | 0 | 1 | 8 | 0 | 285 | 733 | 8617 |
| 1951/52 | 18942 | 7588 | 3488 | 981 | 229 | 45 | 9 | 0 | 0 | 2 | 768 | 389 | 4479 |
| 1952/53 | 14497 | 12071 | 4635 | 944 | 125 | 27 | 5 | 1 | 0 | 0 | 2489 | 1582 | 15807 |
| 1953/54 | 11889 | 9243 | 7682 | 2699 | 504 | 67 | 14 | 3 | 1 | 0 | 1774 | 1192 | 13336 |
| 1954/55 | 10813 | 7577 | 5869 | 2790 | 499 | 88 | 12 | 2 | 0 | 0 | 1380 | 1724 | 20311 |
| 1955/56 | 5226 | 6892 | 4727 | 1999 | 713 | 123 | 22 | 3 | 1 | 0 | 890 | 761 | 8227 |
| 1956/57 | 13526 | 3331 | 4240 | 1153 | 279 | 91 | 16 | 3 | 0 | 0 | 409 | 381 | 4230 |
| 1957/58 | 13004 | 8619 | 2073 | 538 | 111 | 23 | 8 | 1 | 0 | 0 | 895 | 530 | 5596 |
| 1958/59 | 6569 | 8288 | 5376 | 644 | 137 | 27 | 6 | 2 | 0 | 0 | 1074 | 970 | 10412 |
| 1959/60 | 16008 | 4187 | 5031 | 2473 | 195 | 40 | 8 | 2 | 1 | 0 | 504 | 879 | 10488 |
| 1960/61 | 12494 | 10202 | 2518 | 1315 | 400 | 29 | 6 | 1 | 0 | 0 | 602 | 572 | 6281 |
| 1961/62 | 9449 | 7962 | 5585 | 832 | 200 | 56 | 4 | 1 | 0 | 0 | 324 | 437 | 5188 |
| 1962/63 | 5499 | 6021 | 4935 | 1525 | 99 | 21 | 6 | 0 | 0 | 0 | 489 | 448 | 5077 |
| 1963/64 | 3784 | 3504 | 3427 | 1616 | 180 | 10 | 2 | 1 | 0 | 0 | 513 | 310 | 3917 |
| 1964/65 | 3601 | 2411 | 2063 | 616 | 143 | 14 | 1 | 0 | 0 | 0 | 151 | 201 | 2591 |
| 1965/66 | 2358 | 2295 | 1304 | 485 | 65 | 13 | 1 | 0 | 0 | 0 | 193 | 163 | 2049 |
| 1966/67 | 639 | 1503 | 1134 | 473 | 61 | 7 | 2 | 0 | 0 | 0 | 138 | 128 | 1553 |
| 1967/68 | 1156 | 407 | 118 | 66 | 34 | 4 | 0 | 0 | 0 | 0 | 230 | 136 | 1557 |
| 1968/69 | 1387 | 737 | 142 | 39 | 22 | 11 | 1 | 0 | 0 | 0 | 346 | 197 | 2305 |
| 1969/70 | 1140 | 885 | 442 | 78 | 21 | 12 | 6 | 1 | 0 | 0 | 576 | 364 | 4647 |
| 1970/71 | 1513 | 727 | 554 | 266 | 47 | 13 | 7 | 4 | 0 | 0 | 491 | 304 | 3804 |
| 1971/72 | 2483 | 964 | 458 | 336 | 148 | 26 | 7 | 4 | 2 | 0 | 465 | 404 | 4864 |
| 1972/73 | 3358 | 1583 | 592 | 240 | 156 | 65 | 11 | 3 | 2 | 1 | 455 | 548 | 6723 |
| 1973/74 | 2464 | 2141 | 1009 | 364 | 137 | 79 | 29 | 5 | 2 | 1 | 699 | 952 | 11554 |
| 1974/75 | 5059 | 1571 | 1361 | 624 | 217 | 77 | 41 | 16 | 3 | 2 | 704 | 1113 | 13389 |
| 1975/76 | 3893 | 3226 | 1002 | 862 | 373 | 117 | 37 | 22 | 8 | 2 | 541 | 981 | 9606 |
| 1976/77 | 1849 | 2482 | 2045 | 596 | 442 | 176 | 51 | 17 | 10 | 5 | 315 | 1138 | 11883 |
| 1977/78 | 2087 | 1179 | 1566 | 1121 | 283 | 197 | 74 | 22 | 8 | 7 | 696 | 1007 | 10564 |
| 1978/79 | 1899 | 1331 | 744 | 776 | 442 | 102 | 65 | 26 | 8 | 5 | 1492 | 485 | 5124 |
| 1979/80 | 1442 | 1210 | 835 | 343 | 205 | 113 | 26 | 17 | 7 | 3 | 746 | 745 | 8078 |

Appendix Table 2.5 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|--|--|------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 650 | 919 | 770 | 492 | 197 | 117 | 65 | 15 | 10 | 6 | 551 | 607 | 6580 |
| 1981/82 | 915 | 414 | 573 | 388 | 212 | 84 | 50 | 28 | 6 | 7 | 206 | 337 | 3873 |
| 1982/83 | 1449 | 583 | 232 | 154 | 101 | 53 | 21 | 13 | 7 | 3 | 419 | 254 | 2811 |
| 1983/84 | 2717 | 924 | 370 | 135 | 79 | 51 | 27 | 11 | 6 | 5 | 466 | 296 | 3653 |
| 1984/85 | 2301 | 1732 | 573 | 210 | 68 | 40 | 26 | 14 | 5 | 6 | 465 | 552 | 6564 |
| 1985/86 | 5513 | 1467 | 1085 | 341 | 123 | 40 | 23 | 15 | 8 | 7 | 476 | 1048 | 12596 |
| 1986/87 | 263 | 3515 | 935 | 692 | 217 | 78 | 25 | 15 | 10 | 9 | 604 | 953 | 10545 |
| Estimated availability at age (λ_j) | | | | | | | | | | | | | |
| | 0.00 | 0.15 | 0.72 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.02 | 0.24 | 0.60 | 1.00 | 0.70 | 0.70 | 0.70 | 0.70 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 10.33$, $\beta = 0.6350E-03$. The estimated spawn index-escapement conversion factor is $0.393E-01$.

Appendix Table 2.6. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Southern West Coast of Vancouver Island stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|-------|------|------|------|-----|-----|-----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 4586 | 2800 | 1235 | 993 | 146 | 30 | 0 | 6 | 0 | 0 | 475 | 173 | 3334 |
| 1951/52 | 7703 | 2924 | 1621 | 307 | 159 | 21 | 4 | 0 | 1 | 0 | 387 | 106 | 2140 |
| 1952/53 | 3282 | 4911 | 1818 | 463 | 46 | 21 | 3 | 1 | 0 | 0 | 660 | 450 | 7951 |
| 1953/54 | 5416 | 2092 | 3131 | 1158 | 295 | 29 | 13 | 2 | 0 | 0 | 453 | 175 | 3356 |
| 1954/55 | 3816 | 3453 | 1266 | 446 | 119 | 24 | 2 | 1 | 0 | 0 | 602 | 390 | 7369 |
| 1955/56 | 6378 | 2433 | 2108 | 487 | 176 | 46 | 9 | 1 | 0 | 0 | 597 | 193 | 3729 |
| 1956/57 | 10245 | 4067 | 1365 | 373 | 77 | 24 | 6 | 1 | 0 | 0 | 424 | 416 | 7435 |
| 1957/58 | 4739 | 6533 | 2586 | 695 | 188 | 38 | 12 | 3 | 1 | 0 | 857 | 896 | 14342 |
| 1958/59 | 4213 | 3022 | 4157 | 1619 | 431 | 116 | 24 | 8 | 2 | 0 | 387 | 368 | 6612 |
| 1959/60 | 8544 | 2686 | 1715 | 652 | 224 | 51 | 14 | 3 | 1 | 0 | 449 | 349 | 6936 |
| 1960/61 | 4459 | 5447 | 1303 | 369 | 151 | 48 | 11 | 3 | 1 | 0 | 396 | 370 | 7288 |
| 1961/62 | 8049 | 2843 | 2820 | 375 | 101 | 39 | 12 | 3 | 1 | 0 | 671 | 378 | 7885 |
| 1962/63 | 3143 | 5132 | 1748 | 791 | 101 | 26 | 10 | 3 | 1 | 0 | 371 | 403 | 7628 |
| 1963/64 | 1931 | 2004 | 3261 | 977 | 362 | 46 | 12 | 4 | 1 | 0 | 915 | 444 | 9066 |
| 1964/65 | 2650 | 1231 | 1238 | 1152 | 246 | 86 | 11 | 3 | 1 | 0 | 652 | 327 | 7205 |
| 1965/66 | 1229 | 1690 | 764 | 481 | 309 | 63 | 22 | 3 | 1 | 0 | 239 | 242 | 5515 |
| 1966/67 | 1475 | 784 | 1076 | 285 | 148 | 91 | 18 | 6 | 1 | 0 | 117 | 155 | 3667 |
| 1967/68 | 6083 | 940 | 370 | 389 | 63 | 30 | 19 | 4 | 1 | 0 | 364 | 292 | 6897 |
| 1968/69 | 13471 | 3879 | 600 | 236 | 248 | 40 | 19 | 12 | 2 | 1 | 429 | 431 | 9909 |
| 1969/70 | 10651 | 8590 | 2473 | 382 | 150 | 158 | 26 | 12 | 8 | 2 | 959 | 958 | 23066 |
| 1970/71 | 14515 | 6792 | 5477 | 1577 | 244 | 96 | 101 | 16 | 8 | 6 | 1256 | 2004 | 51883 |
| 1971/72 | 14527 | 9255 | 4331 | 3492 | 1006 | 155 | 61 | 64 | 10 | 9 | 1107 | 2110 | 47640 |
| 1972/73 | 25797 | 9263 | 5889 | 2699 | 2053 | 589 | 91 | 36 | 38 | 11 | 471 | 2657 | 61192 |
| 1973/74 | 11074 | 16449 | 5901 | 3529 | 1498 | 1113 | 315 | 49 | 19 | 26 | 678 | 4359 | 88343 |
| 1974/75 | 5966 | 7061 | 10448 | 3610 | 2122 | 860 | 618 | 177 | 28 | 26 | 1229 | 4120 | 94105 |
| 1975/76 | 6513 | 3804 | 4496 | 6240 | 1999 | 1078 | 411 | 303 | 87 | 26 | 1426 | 2958 | 61575 |
| 1976/77 | 2003 | 4153 | 2424 | 2763 | 2954 | 766 | 354 | 144 | 107 | 40 | 1558 | 2160 | 44871 |
| 1977/78 | 4779 | 1277 | 2642 | 1403 | 1275 | 1142 | 261 | 128 | 52 | 53 | 1355 | 1770 | 33796 |
| 1978/79 | 3874 | 3047 | 811 | 1478 | 703 | 501 | 375 | 93 | 45 | 37 | 1291 | 1052 | 21614 |
| 1979/80 | 2402 | 2470 | 1941 | 475 | 732 | 302 | 194 | 152 | 38 | 34 | 1264 | 1199 | 23957 |

Appendix Table 2.6 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 2056 | 1532 | 1570 | 1175 | 282 | 423 | 172 | 111 | 87 | 41 | 1272 | 1166 | 23078 |
| 1981/82 | 3417 | 1311 | 967 | 903 | 647 | 141 | 199 | 83 | 54 | 62 | 821 | 965 | 18672 |
| 1982/83 | 4722 | 2179 | 828 | 567 | 507 | 349 | 74 | 106 | 44 | 61 | 534 | 642 | 13259 |
| 1983/84 | 5450 | 3011 | 1368 | 419 | 253 | 222 | 153 | 33 | 46 | 46 | 799 | 658 | 14887 |
| 1984/85 | 2043 | 3475 | 1822 | 696 | 197 | 117 | 103 | 71 | 15 | 43 | 844 | 1169 | 27552 |
| 1985/86 | 9566 | 1303 | 2212 | 1154 | 441 | 125 | 74 | 65 | 45 | 37 | 944 | 1361 | 31607 |
| 1986/87 | 786 | 6100 | 831 | 1410 | 736 | 281 | 79 | 47 | 42 | 52 | 1214 | 841 | 19120 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.09 | 0.73 | 0.96 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.03 | 0.23 | 0.66 | 1.00 | 0.85 | 0.85 | 0.85 | 0.85 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 16.93$, $\beta = 0.7200E-03$
 The estimated spawn index-escapement conversion factor is $0.227E-01$.

Appendix Table 2.7. Estimates of numbers at age, spawn, and other parameters from age-structured model analysis for the Northern West Coast of Vancouver Island stock assessment region.

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|------|------|------|------|-----|-----|-----|----|----|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1950/51 | 3388 | 1082 | 1154 | 1995 | 289 | 85 | 0 | 0 | 0 | 24 | 792 | 899 | 15218 |
| 1951/52 | 8304 | 2160 | 683 | 617 | 1015 | 141 | 41 | 0 | 0 | 12 | 316 | 213 | 3753 |
| 1952/53 | 3448 | 5295 | 1376 | 339 | 135 | 159 | 21 | 6 | 0 | 2 | 1133 | 619 | 10105 |
| 1953/54 | 3631 | 2198 | 3376 | 877 | 216 | 86 | 101 | 14 | 4 | 1 | 839 | 404 | 6381 |
| 1954/55 | 7060 | 2315 | 1402 | 1796 | 307 | 66 | 26 | 31 | 4 | 2 | 724 | 963 | 17106 |
| 1955/56 | 7372 | 4502 | 1443 | 726 | 914 | 150 | 32 | 13 | 15 | 3 | 1098 | 1304 | 23043 |
| 1956/57 | 7650 | 4700 | 2867 | 904 | 456 | 573 | 94 | 20 | 8 | 11 | 1790 | 1531 | 25057 |
| 1957/58 | 8767 | 4878 | 2997 | 1808 | 569 | 286 | 360 | 59 | 13 | 12 | 625 | 1871 | 27207 |
| 1958/59 | 4166 | 5590 | 3110 | 1910 | 1151 | 362 | 182 | 229 | 38 | 16 | 529 | 492 | 7328 |
| 1959/60 | 9389 | 2657 | 3531 | 1403 | 416 | 179 | 55 | 27 | 34 | 8 | 253 | 243 | 4284 |
| 1960/61 | 4856 | 5987 | 1554 | 654 | 230 | 39 | 16 | 5 | 2 | 4 | 308 | 214 | 3824 |
| 1961/62 | 2786 | 3096 | 3525 | 336 | 142 | 36 | 6 | 2 | 1 | 1 | 639 | 491 | 9497 |
| 1962/63 | 1365 | 1776 | 1900 | 1422 | 120 | 45 | 11 | 2 | 1 | 1 | 449 | 274 | 4970 |
| 1963/64 | 1571 | 870 | 1126 | 618 | 343 | 22 | 8 | 2 | 0 | 0 | 612 | 640 | 11644 |
| 1964/65 | 2067 | 1002 | 553 | 642 | 356 | 194 | 12 | 5 | 1 | 0 | 809 | 448 | 9112 |
| 1965/66 | 860 | 1318 | 636 | 287 | 306 | 161 | 88 | 6 | 2 | 1 | 284 | 329 | 7237 |
| 1966/67 | 787 | 549 | 816 | 359 | 131 | 132 | 69 | 37 | 2 | 1 | 394 | 360 | 8303 |
| 1967/68 | 3279 | 502 | 325 | 318 | 152 | 52 | 52 | 27 | 15 | 1 | 272 | 342 | 7604 |
| 1968/69 | 6397 | 2091 | 320 | 207 | 203 | 97 | 33 | 33 | 17 | 10 | 485 | 368 | 8212 |
| 1969/70 | 4615 | 4079 | 1333 | 204 | 132 | 129 | 62 | 21 | 21 | 17 | 676 | 581 | 13616 |
| 1970/71 | 3827 | 2943 | 2601 | 850 | 130 | 84 | 83 | 39 | 13 | 25 | 495 | 1046 | 25203 |
| 1971/72 | 4434 | 2440 | 1876 | 1658 | 542 | 83 | 54 | 53 | 25 | 24 | 923 | 992 | 20621 |
| 1972/73 | 6567 | 2827 | 1555 | 1173 | 959 | 309 | 47 | 31 | 30 | 28 | 727 | 998 | 20303 |
| 1973/74 | 1754 | 4187 | 1802 | 859 | 572 | 446 | 143 | 22 | 14 | 27 | 301 | 847 | 16530 |
| 1974/75 | 1912 | 1118 | 2645 | 810 | 366 | 226 | 175 | 56 | 9 | 16 | 659 | 1136 | 22677 |
| 1975/76 | 8255 | 1219 | 710 | 1268 | 406 | 176 | 108 | 84 | 27 | 12 | 453 | 700 | 13188 |
| 1976/77 | 1754 | 5264 | 776 | 420 | 645 | 181 | 72 | 39 | 30 | 14 | 589 | 577 | 10194 |
| 1977/78 | 4681 | 1118 | 3356 | 484 | 235 | 308 | 76 | 25 | 14 | 16 | 1000 | 868 | 14547 |
| 1978/79 | 1431 | 2985 | 711 | 2043 | 254 | 97 | 103 | 20 | 7 | 8 | 1364 | 628 | 10324 |
| 1979/80 | 1017 | 912 | 1897 | 360 | 823 | 68 | 19 | 14 | 3 | 2 | 1516 | 807 | 13294 |

Appendix Table 2.7 (cont'd).

| Season | Estimated numbers at age ($\times 10^{-5}$) for period one | | | | | | | | | | Spawn Index | Estimated Spawn | Spawning Biomass (t) |
|---------|--|-------|------|------|------|------|------|------|------|------|-------------|-----------------|----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 1980/81 | 383 | 649 | 582 | 1206 | 209 | 410 | 30 | 7 | 5 | 2 | 728 | 644 | 10799 |
| 1981/82 | 1387 | 244 | 411 | 342 | 622 | 92 | 158 | 10 | 2 | 2 | 909 | 527 | 8704 |
| 1982/83 | 8371 | 884 | 156 | 255 | 192 | 288 | 36 | 50 | 3 | 1 | 669 | 287 | 4916 |
| 1983/84 | 4907 | 5338 | 564 | 98 | 138 | 79 | 93 | 8 | 12 | 1 | 482 | 478 | 9034 |
| 1984/85 | 3710 | 3129 | 3403 | 358 | 58 | 71 | 36 | 36 | 3 | 5 | 296 | 751 | 15355 |
| 1985/86 | 18839 | 2365 | 1995 | 2169 | 228 | 37 | 45 | 23 | 23 | 5 | 741 | 1485 | 31072 |
| 1986/87 | 3983 | 12012 | 1508 | 1271 | 1383 | 145 | 23 | 29 | 14 | 18 | 1013 | 1598 | 34874 |
| | Estimated availability at age (λ_j) | | | | | | | | | | | | |
| | 0.00 | 0.05 | 0.67 | 0.86 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | |
| | Estimated relative selectivity at age for gillnet gear | | | | | | | | | | | | |
| | 0.00 | 0.00 | 0.01 | 0.19 | 0.45 | 0.68 | 1.00 | 1.00 | 1.00 | 1.00 | | | |

The coefficients for the Ricker stock-recruitment curve are: $\alpha = 10.20$, $\beta = 0.9191E-03$. The estimated spawn index-escapement conversion factor is $0.248E-01$.

