Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S | **S C C S**

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Research Document 2004/081 | **Document de recherche 2004/081**

Not to be cited without
Permission of the authors *

Ne pas citer sans
autorisation des auteurs *

Stock Assessment For British Columbia Herring In 2004 and Forecasts Of The Potential Catch In 2005

Évaluation de 2004 des stocks de hareng de la Colombie-Britannique et prévisions des prises en 2005

J. Schweigert

Fisheries and Oceans, Canada
Pacific Biological Station
Nanaimo, B.C. V9T 6N7

* This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

* La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au Secrétariat.

This document is available on the Internet at:

Ce document est disponible sur l'Internet à:

http://www.dfo-mpo.gc.ca/csas/

ISSN 1499-3848 (Printed / Imprimé)

Canada

Abstract

Herring stock abundance in British Columbia waters was assessed for 2004 and forecasts were made for 2005 using an age structured assessment model for the major stock assessment regions and an escapement model for the minor stocks in Areas 2W and 27. These models have been applied to assess herring abundance since 1984. As in recent assessments a fixed spawn conversion or catchability factor was applied for the dive survey era beginning in 1988 and a free fitted parameter was estimated for the earlier surface survey period. In addition, a year specific logistic function was applied to model the availability of fish on the spawning grounds. Penalty weights adopted for the preceding assessment were again used this year. All available biological data on total harvest, spawn deposition, and age and size composition of the spawning runs were used to determine current abundance levels. No significant problems were evident in the extent and comprehensiveness of the data collections. However, fewer samples were aged in 2004 due to constraints imposed on the ageing laboratory. All available data were included in and summarized from an Access database. Coastwide, the estimated pre-fishery stock biomass for all assessment regions in 2004 was 221,000 tonnes based on the age-structured model which represents a 2% decrease from the 2003 abundance level. This reflects stable or minor increases in all stocks except the Strait of Georgia where biomass decreased slightly. Recruitment of the 2001 year-class was very poor in the north and poor to average in the southern stocks.

The estimated harvestable surplus in 2005 (20% of the 2005 forecast herring run) based on forecast abundance to the five assessment regions is 37,540 tonnes for the B.C. coast assuming average recruitment to all areas except the Queen Charlotte Islands where the stock remains at depressed levels and no surplus is available.

Résumé

On utilise un modèle d'évaluation structuré par âge pour déterminer l'abondance du hareng chez les principaux stocks de la Colombie-Britannique en 2004 et faire des prévisions des prises en 2005, et un modèle d'échappement pour les petits stocks des zones 2W et 27. Ces modèles sont utilisés à cette fin depuis 1984. Comme pour les dernières évaluations, un facteur fixe de conversion de l'indice de frai ou de capturabilité est appliqué à la série de données recueillies en plongée depuis 1988 et un paramètre librement ajusté est estimé pour la période précédente de relevés en surface. On introduit aussi une fonction logistique par année pour modéliser la disponibilité du poisson dans les frayères. Les poids de pénalité utilisés dans la dernière évaluation sont encore utilisés cette année. Toutes les données biologiques disponibles sur les prises totales, la ponte et la composition par âge et par taille des reproducteurs ont été utilisées pour déterminer les niveaux d'abondance actuels. Aucun problème important n'est évident dans l'étendue et la représentativité des séries de données. Par contre, moins d'échantillons ont été soumis à une détermination de l'âge en 2004 à cause de contraintes imposées sur le laboratoire concerné. Toutes les données ont été saisies dans une base de données Access, puis résumées. À l'échelle de la côte, la biomasse estimative des stocks dans toutes les zones évaluées avant qu'ils soient pêchés en 2004 s'élevait à 221 000 t d'après le modèle structuré par âge, ce qui représente une baisse de 2 % par rapport à 2003. Cette baisse reflète une augmentation stable ou faible de l'abondance chez tous les stocks, sauf dans le détroit de Georgia, où la biomasse a quelque peu diminué. Le recrutement de la classe d'âge de 2001 était médiocre chez les stocks du nord et de faible à moyen chez les stocks du sud.

Pour l'ensemble de la côte de la Colombie-Britannique, l'excédent pêchable en 2005 (20 % du nombre prévu de reproducteurs en 2005) estimé d'après l'abondance prévue dans les cinq zones évaluées se chiffre à 37 540 t dans l'hypothèse d'un recrutement moyen dans toutes les zones, sauf dans le cas des îles de la Reine-Charlotte; le stock y demeurant à un niveau faible, aucun excédent n'est disponible.

TABLE OF CONTENTS

1. INTRODUCTION

Herring have been one of the most important components of the British Columbia commercial fishery over the past century with catch records dating from 1877. The fishery evolved from a dry salted product in the early 1900s, to a reduction fishery in the 1930s that collapsed in the late 1960s as a result of environmental change and excessive harvesting. After a four year closure the current roe fishery began in 1972. Roe fisheries occur just prior to spawning when the fish are highly aggregated and very vulnerable to exploitation. Since 1983, herring roe fisheries have been managed with a fixed harvest rate policy and a quota system. Under this system, harvest levels are determined prior to the season based on a fixed percentage (20%) of forecast stock size. In addition, threshold biomass or Cutoff levels were introduced in 1986 to restrict harvest during periods of reduced abundance.

In previous reports, stock assessments were presented for two analytical models developed explicitly for British Columbia herring populations: (1) a modification of the escapement model described by Schweigert and Stocker (1988); and (2) a modification of the age-structured model described by Fournier and Archibald (1982). In 2002, the age-structured model was adopted as the primary assessment tool and escapement model estimates are provided only for minor stocks in Areas 2W and 27. Stock abundance estimates are developed for the period 1951-2004 and forecast pre-spawning abundance for the 2005 season are presented. Forecasts of upcoming run size are based on the combination of estimates of surviving repeat spawners and newly recruiting spawners which are presented as poor, average, and good, based on historic recruitment levels.

1.1. STOCK CONSIDERATIONS

The stock concept used for managing the British Columbia herring resource is based on current knowledge of stock structure that is necessarily incomplete. Given incomplete knowledge of population structure, it is prudent to manage fisheries to ensure maintenance of the greatest potential biological diversity in all regions. Additionally, stock forecasts for smaller geographic regions than those used in the current assessments are not accurate enough for fisheries management. Therefore, fisheries should continue to focus on the major aggregations within each assessment region to minimize the potential over-exploitation of any smaller, spatially discrete spawning groups. In the 2004 spawning season, a research study that uses a combination of coded wire tagging and micro-satellite DNA analysis to further investigate stock structure of British Columbia herring was continued. Preliminary results of these studies are presented in separate reports (Schweigert and Flostrand 2000, Flostrand and Schweigert 2002, 2003, 2004, Beacham et al. 2001, 2002).

The stock groupings used for the current assessments are identical to those used since 1993 (Fig. 1.). The Queen Charlotte Islands stock assessment region includes most of Statistical Area 2E, spanning from Cumshewa Inlet in the north to Louscoone Inlet in the south. The Prince Rupert District stock assessment region encompasses Statistical Areas 3 to 5. The Central Coast assessment region separates the major migratory stocks from the minor spawning populations in the mainland inlets. The Central Coast assessment region includes Statistical Area 7 plus Kitasu Bay in Area 6 and Kwakshua Channel in Area 8. The Strait of Georgia stock assessment region includes all of Statistical Areas 14 to 19, 28, 29, and Deepwater Bay and

Okisollo Channel in Area 13. The west coast of Vancouver Island assessment region encompasses Statistical Areas 23 to 25. Haist and Rosenfeld (1988) outline current geographical stock boundaries.

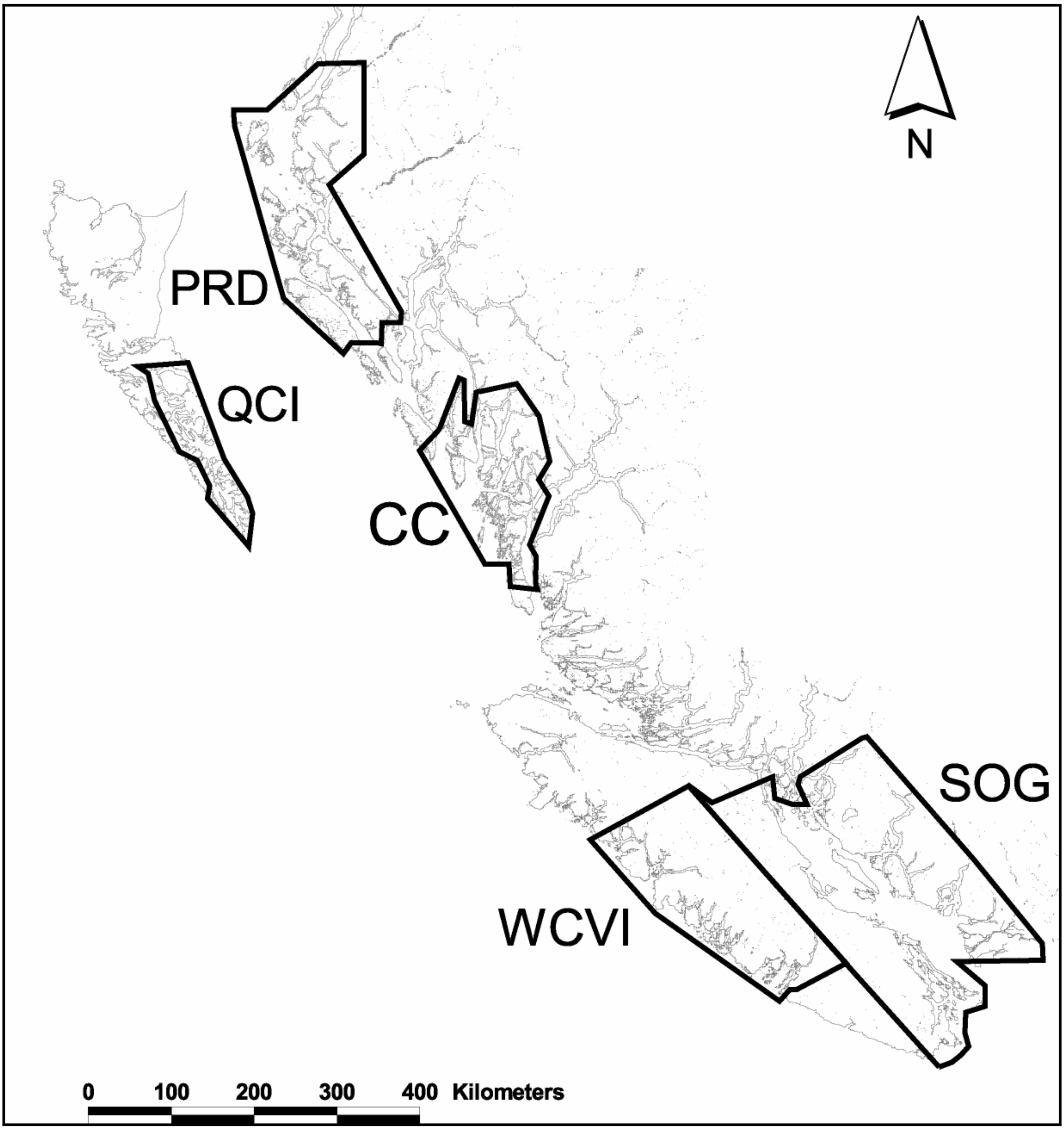


Figure 1.1. The five major British Columbia herring stock assessment regions: Prince Rupert District (PRD), Queen Charlotte Islands (QCI), Central Coast (CC), west coast Vancouver Island (WCVI) and the Strait of Georgia (SOG).

Abundance estimates are not presented for other areas outside of the major assessment regions that may support additional small herring runs, because both the spawn survey and catch data are incomplete for many of these areas. Therefore, presentation of stock estimates could lead to erroneous conclusions regarding either absolute abundance or stock trends. Recent attempts to conduct a complete age-structured assessment for Areas 2W and 27 have been unsuccessful because of incomplete data. An escapement model estimate of current stock abundance is available for these areas but no reliable forecast of abundance in the coming year is possible.

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 in an Access database for the period 1951 to 2004. This time span includes the reduction fishery period to 1968 and the subsequent roe fishery period that began in 1972.

Of the three data sets, the spawn data contain the largest measurement errors. While the quality of spawn surveys has generally improved over the 54 year span of these data, due to increased effort and better quality control of the surveys, there are occasional problems with equipment and weather which may hamper data completeness or accuracy in some years. The consistent observations made during all years of surveys are the total length, the average width, and a measure of egg density for each spawning site. Since 1987 an increasing number of egg beds have been assessed using SCUBA rather than traditional surface survey methods. We believe that the SCUBA data provide a relatively more accurate estimate of spawn bed length, width, and egg density than earlier surface surveys. These data have been used in developing the spawn index where available. All major herring spawning beds were surveyed in 2004 by SCUBA. Many of the minor spawning beds outside the main assessment areas were also surveyed by SCUBA in 2004.

Catch information was obtained from landing slips or monitoring of plant offload data. Historically, landing slip data were summed by fishery season (seasons run from July 1 to June 30). Beginning in 1997/98 season, roe catch figures are based on verified plant offload weights, a result of the introduction of the individual vessel quota (‘pool fishery’) system for all fisheries except the Strait of Georgia and Prince Rupert gillnet fisheries. Since the 1998/99 season, verified plant offload weights are available for all food and roe fisheries coast-wide. The spawn-on-kelp (SOK) fishery includes a total of 46 licensed operators that were allocated 3000 tons (2722 tonnes) of herring in 2004, similar to recent years, for use in open and closed pond operations. For assessment purposes, it is assumed that the 100 tons (91 tonnes) of herring allocated to each closed pond operator are removed from the population as egg production or mortality (Shields et al. 1985). A similar assumption of 35 tons (32 tonnes) is made for open pond operations. These data are treated as an additional seine removal. Allocations to all SOK fisheries since its inception in 1975 have been tabulated and are included in the current analysis. Historical catches taken in all non-SOK fisheries are presented for each assessment region in Figure 1.2.

Age structure data are used in both assessment models. The information from catch samples is used for years when there were commercial fisheries. Pre-fishery charters began in 1975 and these samples are used in addition to samples taken from the catch, particularly in areas with no fisheries, or when catch samples are few in number or not representative of the entire catch. Additional data used in both models are annual estimates of the mean weight-at-age. During the 2003/04 season a total of 301 herring samples (64 roe, 11 food, 199 test fishery and 27 miscellaneous others) were collected and processed compared to 407 in the previous year. Of the roe and test fishery samples, 13 were taken in the Queen Charlotte Islands assessment area (another 9 from Area 2W), 40 in the Prince Rupert area, 47 in the Central Coast, 81 in the Strait of Georgia, and 73 on the west coast of Vancouver Island. The reduced level of sampling coverage is a function of limited capacity and competing demands in the ageing laboratory that have limited annual ageing output for each species group. It is unclear whether the reduction in total ageing will negatively impact the stock assessment and resulting management advice. The age composition estimates for each assessment region for 1951-2004 are presented in Figure 1.3.

In the current assessment we continue to use the year of life convention for ageing adopted in the 1991 assessment. Fish which were previously named age 3 are now referred to as the 2^{+} age class. In a few instances the text refers to age class 2^{++} which indicates all fish that are age 2^{+} and older.

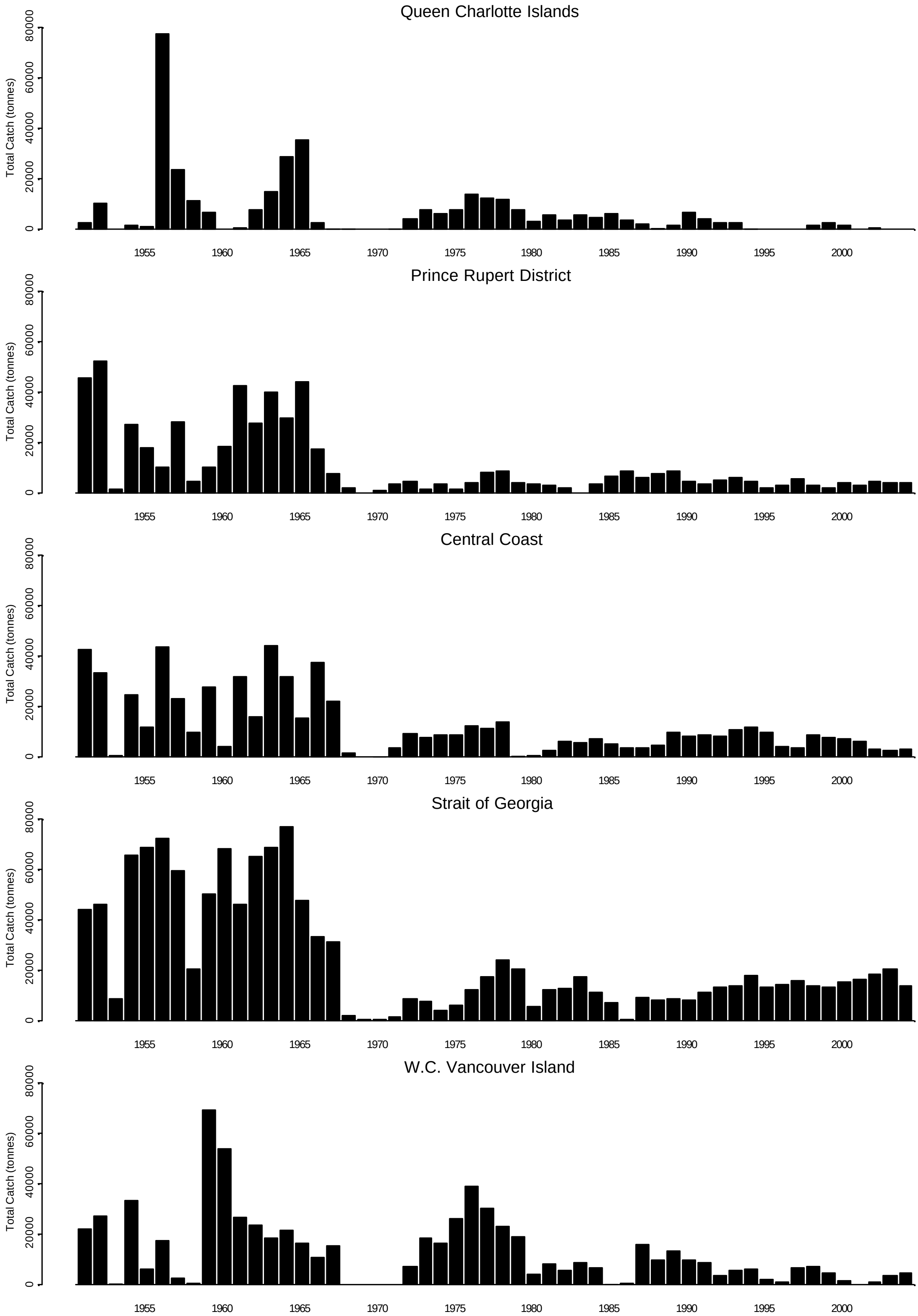


Figure 1.2. Estimated total catch from all fisheries except spawn-on-kelp for each assessment region from 1951-2004.

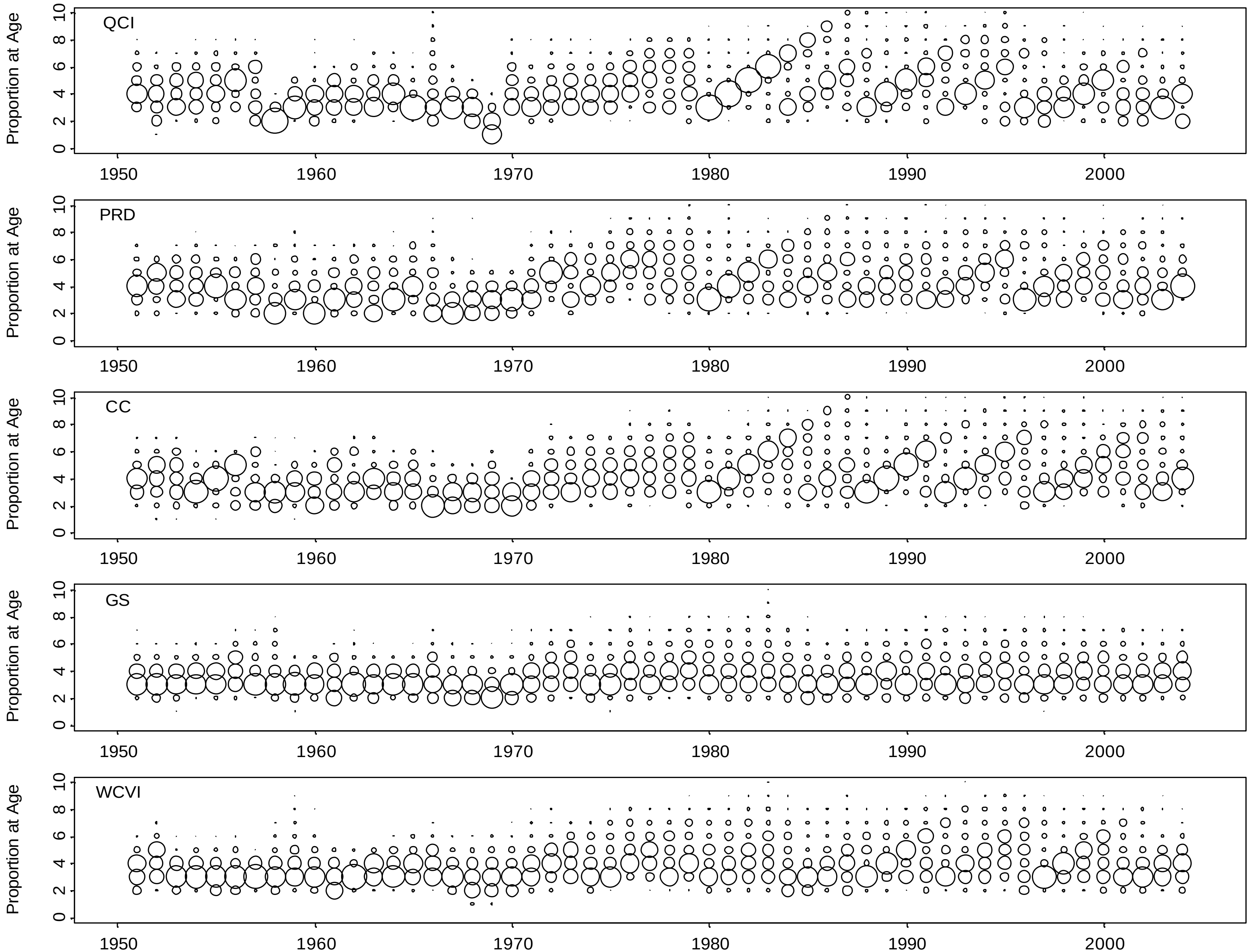


Figure 1.3. Age composition estimates for five major assessment regions from 1951-2004.

2. SPAWN INDEX

2.1 INTRODUCTION

The spawn index estimation was referred to as the escapement model in previous assessments. It provides the auxiliary information for tuning the age-structured model. It was first developed for the 1984 assessments (Haist et al. 1985; Schweigert and Stocker 1988), and provides an empirical estimate of the escapement from the fishery based on egg deposition information. For most stock assessment regions, recent estimates of escapement are based primarily on SCUBA survey data. SCUBA surveys have been used routinely on the south coast since 1987 and coast-wide the following year. SCUBA surveys have been found to be superior to surface surveys for spawn assessment because they provide more accurate estimates of both spawn bed width and the intensity of egg deposition. A summary of the recent spawn survey coverage for the British Columbia coast is presented below. As a result of reductions in DFO resources and the consequent contracting of diving surveys to industry, there was again virtually no DFO effort directed to surface surveys in 2004, particularly outside of the assessment regions. Limited surface surveys were conducted in Johnstone Strait using HCRS funded contractors. All areas did receive good SCUBA survey coverage. Coast-wide, the total spawn length was up marginally over 2003. The difference is attributable to increases in spawn bed length in the Queen Charlotte Islands, primarily Area 2W and the other areas outside the major assessment regions. Spawn decreased slightly in most of the major assessment regions.

Summary of the kilometres of herring spawning beds surveyed by SCUBA and surface methods for major and minor stocks on the British Columbia coast in recent years, 2001-2004.

	2001			2002			2003			2004		
Assessment Region	SCUBA	Surface	Total	SCUBA	Surface	Total	SCUBA	Surface	Total	SCUBA	Surface	Total
Queen Charlotte Is.	40.2	0.0	40.2	14.8	0.0	14.8	14.6	14.5	29.1	48.3	0.6	48.9
Prince Rupert District	98.9	0.0	98.9	63.5	0.0	63.5	70.2	0.0	70.2	61.7	0.9	62.6
Central Coast	99.3	0.0	99.3	107.2	16.3	123.5	94.9	0.0	94.9	104.7	0.0	104.7
Strait of Georgia	173.5	0.0	173.5	143.7	5.3	149.0	231.3	3.1	234.4	195.3	4.6	199.9
W.C. Vancouver Is.	35.0	0.0	35.0	41.3	0.0	41.3	50.9	0.0	50.9	43.9	0.0	43.9
Other Areas	18.3	37.6	55.9	44.0	32.7	66.7	23.8	60.5	84.3	71.4	46.5	117.9
Coastwide Total	465.2	37.6	502.8	414.5	42.1	456.6	485.7	78.1	563.8	525.3	52.6	577.9

2.2 METHODS

The spawn index provides an estimate of the total egg deposition in each assessment region. The total egg deposition is an amalgamation of estimates of total number of eggs based on surface surveys, dive surveys of the algal and bottom substrate, and surveys of the giant kelp, *Macrocystis* sp., and attached eggs. The methods adopted for deriving total egg deposition are detailed below.

Surface Surveys

Since the late 1920s, there have been organized efforts to assess the amount of herring eggs deposited throughout the British Columbia coast as an indicator of stock abundance. The parameters which have been monitored consistently are total length of each spawning bed measured parallel to the shoreline, the average width of each spawning bed, and an estimate of intensity of the spawn deposition. Prior to 1981, intensity was estimated subjectively on either a 1-5 or 1-9 scale of light to heavy (Hay and Kronlund 1987). Subsequently, intensity of egg deposition was recorded as the number of egg layers observed on each of several types of algal substrate. Beginning in 1987 an increasing proportion of the spawning beds have been surveyed using SCUBA techniques as outlined below.

To provide a consistent coastwide assessment of total egg deposition throughout the time period from 1951-2003, it was necessary to intercalibrate the surface and SCUBA surveys of egg deposition. Initially, the intercalibration took the form of linear equations that converted the surface survey estimates of spawning bed width and egg layers to comparable SCUBA estimates (Schweigert and Stocker 1988). However, the data available for this intercalibration were limited in time and space to particular spawning beds over the course of a few years. As SCUBA surveys of the spawning beds became widespread, an extensive database of estimates of the dimensions of herring spawning beds in most areas of the coast became available and a new procedure for calibrating the width of herring spawning beds estimated by surface surveys was proposed (Schweigert et al. 1993). The methodology consisted of defining spawn pools that were a grouping of herring spawning locations which were geographically adjacent and probably geomorphologically similar. Hence, diver width estimates developed for such a 'pool' were felt to be characteristic of all herring locations within that pool. For the small number of locations which could not be assigned to a pool, the median width for the herring section (Haist and Rosenfeld 1988) was used to adjust width estimates for the herring location. The median width was preferable to the mean because of the non-normal distribution of the spawn width estimates. Any pools for which fewer than 25 observations of width existed were also adjusted using the section median. For the rare instances where no median estimate was available at the section level, the median width for the assessment region was applied to calculate spawn area. The long term median spawn width for each pool, was then applied to each surface survey record to estimate a ‘diver’ width and combined with the estimated surface length, to determine the total area of egg deposition for each spawning bed.

To estimate egg density, it was assumed that surface and SCUBA survey estimates of the number of egg layers in a spawning bed were equivalent. The database of 5111 observations of egg density per square meter from laboratory egg counts of SCUBA surveyed quadrat samples was used to develop a predictive model of egg density from egg layers:

$$Eggs / m^2 = 14.698 + 212.218\ Layers$$

The relationship is statistically significant ($P<0.001$). Total egg deposition for each egg bed is then estimated from the product of total spawning bed area, and egg density predicted from the average surface egg layer estimate.

At present no methods exist for adjusting surface survey data in most areas outside the major assessment regions except in a few locations such as Johnstone Strait (Statistical Areas 9-13) where some dive surveys have been conducted. These surveys indicated that no adjustments are required for the spawn widths in Johnstone Strait because widths are very narrow and appear to be accurately assessed from the surface in this area (Schweigert and Haegele 1988a, b).

SCUBA Surveys

For SCUBA surveys, spawning bed lengths are determined by exploratory grabs with a spawn drag, rake or snorkelling to define the limits of the areas of egg deposition. A systematic sampling regime is employed whereby transects are set across the egg bed perpendicular to shore at 350 m intervals. Corresponding spawning bed widths are estimated as the mean of all transect lengths within the spawning bed. Estimates of mean egg density are based on a two-stage sampling design (Schweigert et al. 1985, 1990). Average egg density for each spawning bed is estimated, as the weighted mean of the means of a series of quadrats located along each transect, where the weighting is based on the length of each transect. For each quadrat, observations are made on several variables: type of algal substrate; proportion of the quadrat covered by each algal type; number of layers of eggs on each algal type; proportion of the bottom substrate covered by eggs; and an estimate of the number of egg layers on the bottom substrate. In some areas, assessments are also made of the egg deposition on the giant kelp as described in a following section.

Egg deposition for each sampling quadrat is estimated from the predictive equation described in the 1989 assessment (Haist and Schweigert 1990, Schweigert 1993). Egg density for each vegetation subfraction is estimated as follows using non-linear regression ($P<0.0001$):

$$Eggs_{ij} = 1033.6694\ L_{ij}^{0.7137}\ P_{ij}^{1.5076}\ V_{ij}\ Q_j.$$

where

$Eggs_{ij}$ = estimated number of eggs in thousands per m^2 on vegetation type i in quadrat j

L_{ij} = number of layers of eggs on algal substrate i in quadrat j,
P_{ij} = proportion of quadrat covered by algal substrate i in quadrat j,

V_{1j} = 0.9948 parameter for sea grasses in quadrat *j*,
V_{2j} = 1.2305 parameter for rockweed in quadrat *j*,
V_{3j} = 0.8378 parameter for flat kelp in quadrat *j*,
V_{4j} = 1.1583 parameter for other brown algae in quadrat *j*,
V_{5j} = 0.9824 parameter for leafy red and green algae in quadrat *j*,
V_{6j} = 1.0000 parameter for stringy red algae in quadrat *j*,
Q_1 = 0.5668 parameter for 1.00 m^2 quadrats,
Q_2 = 0.5020 parameter for 0.50 m^2 quadrats,
Q_3 = 1.0000 parameter for 0.25 m^2 quadrats.

Total egg density (thousands of eggs per m^2) for each quadrat is then estimated by summing the egg density estimates over the vegetation types,

$$Eggs_j = \sum_i eggs_{ij}.$$

Beginning in 1988, samples of algae and the attached eggs from entire quadrats were collected and processed to evaluate model predictions of egg density relative to sample egg counts. Due to funding shortfalls, no samples have been collected since 1997 and model predictions of egg numbers per sample quadrat are assumed to be unbiased for use in the assessment of egg density.

<u>Eggs on Bottom and *Macrocystis*</u>

Eggs on rock are estimated from the product of the proportion of the quadrat covered by eggs, number of egg layers, and 340,000 eggs/m^2 (Haegele *et al*. 1979). Eggs on rock also includes eggs on other inorganic substrata as well as egg deposition on very short (1-2 cm) red algae, calcareous encrusting algae, worm tubes, logs, etc. Total egg density for each quadrat is the sum of eggs on vegetation plus eggs on rock.

In some northerly areas such as the Queen Charlotte Islands and the Prince Rupert District, a significant proportion of the total egg deposition can occur on the giant kelp, *Macrocystis* sp., with smaller amounts in some localities on the Central Coast and west coast of Vancouver Island. The approach we have adopted for routine SCUBA surveys follows that outlined by Haegele and Schweigert (1985). The SCUBA transects which are used to assess egg density on understory vegetation are also used to enumerate *Macrocystis* plants and fronds within 1 m on either side of the transect line. An egg prediction equation has been developed (Haegele and Schweigert 1990) to estimate egg numbers for an individual plant ($P<0.0001$, $r^2=78.0$):

$$Eggs/Plant = 0.073\ Layers^{0.673}\ Height^{0.932}\ Fronds^{0.703}$$

where

Eggs/Plant = total number of eggs on the *Macrocystis* plant in millions,

Layers = average number of egg layers on each *Macrocystis* plant,
Height = total height of the *Macrocystis* plant in metres,
Fronds = total number of fronds per *Macrocystis* plant.

This equation estimates the number of eggs occurring on a plant of a specific height with a certain number of fronds and egg layers. In practice, the synoptic SCUBA survey estimates only the average number of egg layers per plant, the average plant height, and the average number of fronds per plant along each transect. These quantities are used in the above equation to estimate the total egg numbers per plant for each transect. These estimates are averaged across transects to obtain an average number of eggs per plant for the entire *Macrocystis* bed.

This information may then be combined with the estimate of the density of plants and the estimated area of the *Macrocystis* bed to obtain an estimate of the total number of eggs deposited on the kelp:

$$\textit{Total Eggs on Macrocystis} = \textit{Eggs Plant}^{-1} \cdot \textit{Plants m}^{-2} \cdot \textit{Bed Area}$$

This egg deposition is then added to the estimated eggs on the understory vegetation to determine a total egg deposition for that spawn pool.

Biomass Estimates for Minor Stocks

Biological sampling data and spawn surveys for the minor stocks in Areas 2W and 27 have been intermittent, making age-structured analysis difficult. Alternatively, escapement from the fishery from egg deposition surveys, plus total catch can be used to provide an estimate of the pre-fishery spawning stock biomass for these areas. A harvest rule of 10% of the estimated biomass in the previous year has been in place for several years for these minor stock areas. The following relationship may be used to estimate pre-fishery biomass for each area (Schweigert 1993), if all pertinent data are available:

$$B_j = C_j + Eggs_j \bullet \left(\frac{\sum_{3}^{10} P_{ij} W_{ij}}{\sum_{3}^{10} P_{ij} F_{ij} SR_{ij}} \right)$$

where

B_j = total pre-fishery mature biomass in tonnes in year *j*,
C_j = total catch in tonnes in year *j*,
$Eggs_j$ = total egg deposition in billions in year *j*,
P_{ij} = proportion of fish at age *i* in year *j* in the spawning run,
F_{ij} = fecundity of females of age *i* in year *j*,
SR_{ij} = sex ratio or proportion of females at age *i* in year *j*,
W_{ij} = mean weight of fish at age *i* in year *j* in tonnes.

However, estimates of fecundity, age composition, and mean weight at age are not available each year so a simpler method is used to estimate biomass from the estimate of total egg deposition. Total egg deposition estimates for all spawning beds from all three types of survey (surface, dive, and kelp) are summed within each area and the total egg deposition is converted to tonnes of spawning fish based on an estimate of 100 eggs per gram of herring on average (Hay 1985). The total catch is obtained from sales slip information or verified plant landed weight data and added to the escapement to determine current biomass. Estimates of mature biomass for Areas 2W and 27 based on this analysis are presented in Table 2.1.

Table 2.1. Estimates of spawning stock biomass, catch, and pre-fishery stock abundance (tonnes) for the minor stock in area 27 for 1951-2004.

	Spawn (mt)				Catch (mt)				Total
Season	Surface	Macro	Dive	Total	Seine	Gillnet	Other	Total	Stock
19501	1,955.24			1,955.24					1,955.24
19512	484.38			484.38					484.38
19523	4,618.03			4,618.03					4,618.03
19534	2,646.44			2,646.44	1,919.89			1,919.89	4,566.33
19545	574.87			574.87	5,938.70			5,938.70	6,513.58
19556	1.47			1.47					1.47
19567	184.03			184.03					184.03
19578	38.62			38.62					38.62
19589	60.47			60.47	407.22			407.22	467.69
19590	223.95			223.95					223.95
19601	168.99			168.99	1,149.06			1,149.06	1,318.05
19612	101.62			101.62	173.05			173.05	274.67
19623	407.30			407.30	30.75			30.75	438.05
19634	0.00			0.00	322.55			322.55	322.55
19645	2,516.54			2,516.54	769.08			769.08	3,285.62
19656	81.73			81.73	951.48			951.48	1,033.21
19667	46.24			46.24	51.42			51.42	97.66
19678	141.68			141.68					141.68
19689T	2,198.42			2,198.42					2,198.42
19690	2,433.72			2,433.72					2,433.72
19701	290.00			290.00					290.00
19712	250.29			250.29					250.29
19723	2,578.17			2,578.17					2,578.17
19734	0.00			0.00	507.91	18.33		526.25	526.25
19745	1,606.18			1,606.18					1,606.18
19756	210.44			210.44		78.62		78.62	289.06
19767	638.19		0.00	638.19					638.19
19778	3,595.03			3,595.03	74.98	75.12	0.00	150.10	3,745.13
19789	6,908.61			6,908.61	422.13	270.40	0.00	692.53	7,601.13
19790	14,419.06			14,419.06		519.26	0.00	519.26	14,938.32
19801	1,828.32			1,828.32		670.95	0.00	670.95	2,499.27
19812	4,136.53			4,136.53	238.49	332.09	0.00	570.58	4,707.11
19823	2,500.47			2,500.47		162.93	91.00	253.93	2,754.41
19834	3,004.22			3,004.22		170.71	182.00	352.71	3,356.93
19845	370.26		887.62	1,257.88			182.00	182.00	1,439.88
19856	47.10	284.64	2,865.78	3,197.52			96.00	96.00	3,293.52
19867	952.33			952.33			364.00	364.00	1,316.33
19878	1,612.23			1,612.23			364.00	364.00	1,976.23
19889	1,684.74	122.10	2,560.22	4,367.06			364.00	364.00	4,731.06
19890	3,565.45	37.96	1,450.65	5,054.06			246.00	246.00	5,300.06
19901	2,011.68	11.15	1,107.60	3,130.43	0.09		246.00	246.09	3,376.53
19912	55.30	613.94	1,938.09	2,607.33	335.43		364.00	699.43	3,306.76
19923	1,394.34	2,536.51	1,468.55	5,399.40		366.85	364.00	730.85	6,130.25
19934		1,967.85	3,052.01	5,019.86		344.55	246.00	590.55	5,610.41
19945		559.20	1,654.22	2,213.42	87.57		455.01	542.58	2,756.00
19956		14.41	1,244.48	1,258.88			364.02	364.02	1,622.90
19967		61.77	1,657.36	1,719.13			96.00	96.00	1,815.13
19978		214.65	1,791.13	2,005.78			273.00	273.00	2,278.78
19989		153.05	425.32	578.37			96.00	96.00	674.37
19990			1,118.60	1,118.60			96.00	96.00	1,214.60
20001			178.40	178.40			96.00	96.00	274.40
20012		100.68	719.62	820.31			32.00	32.00	852.31
20023		140.56	652.23	792.79			64.00	64.00	856.79
20034		230.06	817.21	1,047.27			96.00	96.00	1,143.27

Table 2.2. Estimates of spawning stock biomass, catch, and pre-fishery stock abundance (tonnes) for the minor stock in area 2W for 1951 to 2004.

	Spawn (mt)				Catch (mt)				Total
Season	Surface	Macro	Dive	Total	Seine	Gillnet	Other	Total	Stock
19523	202.90			202.90					202.90
19567	3.82			3.82	105.83			105.83	109.65
19578	156.88			156.88					156.88
19589	1,915.96			1,915.96					1,915.96
19590	1,569.27			1,569.27					1,569.27
19601	558.49			558.49					558.49
19612	1,715.31			1,715.31					1,715.31
19623	1,436.26			1,436.26					1,436.26
19634	968.87			968.87	312.49			312.49	1,281.35
19645	439.48			439.48	1,251.27			1,251.27	1,690.75
19656	23.51			23.51	172.37			172.37	195.87
19667	261.65			261.65					261.65
19678	72.62			72.62					72.62
19689	593.04			593.04					593.04
19690	576.86			576.86					576.86
19701	603.53			603.53					603.53
19712	1,010.77			1,010.77					1,010.77
19723	1,603.60			1,603.60	705.73			705.73	2,309.33
19734	1,674.84			1,674.84	403.25			403.25	2,078.09
19745	1,153.98			1,153.98	449.34			449.34	1,603.31
19756	826.10			826.10			68.00	68.00	894.10
19767	1,174.40			1,174.40				0.00	1,174.40
19778	831.97			831.97	574.68			574.68	1,406.66
19789	494.02			494.02	690.59			690.59	1,184.61
19790	2,114.38			2,114.38					2,114.38
19801	1,811.18			1,811.18	770.26		91.00	861.26	2,672.44
19812	4,781.24			4,781.24	1,225.32			1,225.32	6,006.56
19823	4,869.26			4,869.26	2,518.17			2,518.17	7,387.44
19834	2,522.18			2,522.18					2,522.18
19845	1,719.33			1,719.33	199.47			199.47	1,918.80
19856	683.72			683.72					683.72
19867	988.92			988.92					988.92
19878	3,380.16			3,380.16					3,380.16
19889	2,718.92			2,718.92					2,718.92
19890	2,787.76		7,570.52	10,358.28	2,271.92			2,271.92	12,630.21
19901	355.53	170.74	2,309.67	2,835.94	2,558.29			2,558.29	5,394.23
19912		169.14	3,374.66	3,543.81	1,283.54			1,283.54	4,827.35
19923	0.61	12.54	61.56	74.72	1,305.66			1,305.66	1,380.39
19934		17.13	192.45	209.58					209.58
19978		13.70	376.19	389.89	179.63			179.63	569.52
19990		145.60	119.01	264.61					264.61
20001			30.97	30.97					30.97
20012		13.39	120.73	134.12	0.00				134.12
20023	1,461.95			1,461.95					1,461.95
20034	10.94	345.16	2,385.80	2,741.90					2,741.90

3. AGE-STRUCTURED MODEL

3.1. INTRODUCTION

An age-structured model, based on the error structure proposed by Fournier and Archibald (1982), has been used to assess B.C. herring stocks since 1982. Ongoing revisions to the model have made it more consistent with the life history of herring and the associated fisheries that are analyzed. The current version uses auxiliary information in the form of spawning escapement data, separates catch and age composition data by gear type, and includes availability parameters to estimate partial recruitment to the spawning stock. Model parameters are estimated simultaneously using a maximum likelihood method. The model has used estimates of spawning stock biomass as the abundance or 'spawn index' for parameter estimation beginning in 1994 (Schweigert and Fort 1994). The model is implemented in the C^{++} programming language using AD model builder software (Otter Research Ltd, 2001).

3.2. METHODS

Data Sources

The input data for the age-structured analysis are stored in and summarized from an Access database that is updated annually with new catch, spawn, and biosampling information. The data are summarized by fishing season, gear, for three periods for each assessment region and presented in Appendix 1.

The Population Model

Purse seines and gillnets are the two types of fishing gear commonly used in B.C. herring fisheries. Seine nets are assumed to be non-selective for herring while gillnets are selective for larger, older fish. Herring fisheries have concentrated primarily on fish which are on, or migrating to the spawning grounds. Therefore, the relative availability of age-classes to non-selective gear should be equivalent to the partial recruitment of age-classes to the spawning stock. The age-structured model explicitly separates availability (partial recruitment) and gear selectivity. Seine and gillnet fisheries are usually temporally separate so catch and age-composition are partitioned into fishing periods, separating data for the different gears. Three fishing periods are modelled as follows. The first period encompasses all catch prior to the spring roe herring fisheries. This included reduction fishery catches prior to 1968 and the winter food and bait fisheries since 1970. Most of this catch was taken by seine gear although small amounts were caught with trawl nets (which are also assumed to be non-size selective). The second fishing period includes all seine roe herring catch and the third period includes all gillnet roe herring catch. Beginning with the 2002 assessment, the Access database summarizes catch-at-age data by periods (May-Sept., Oct.-Dec., Jan.-April) that differ slightly from the previous approach. However, the catch-at-age data are still tabulated into reduction and roe fishery periods consistent with the earlier methodology for further analysis.

In the population model for each assessment region, let T_{ij} be the total number of fish in age class *j* at the beginning of season *i*, where season is equivalent to year, and l_{ij} be the proportion of age *j* fish which are available to the fishery. Then N_{ij1}, the total number of age class *j* fish which are available at the start of period 1 in season *i* is given by

$$N_{ij1} = l_{ij} T_{ij} \text{ , where } 0 \langle l_{ij} \langle 1 \qquad 3.1$$

To model the fishing process, a form of the catch equations that models fishing and natural mortality as continuous processes over time period *r*, is used:

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

and, for *r* < *p*

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

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*,
i	is the number of seasons (*i*=54),
j	is the number of fishing periods (*j*=3),
k	is the number of age classes (*k*=9).

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

$$T_{i+1,j+1} = N_{ijp} \exp\left(-F_{ijp} - M_p\right) + T_{ij}\left(1 - l_{ij}\right) \exp \sum_r -M_r \qquad 3.2$$

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

$$T_{i+1,k} = N_{i,k-1,p} \exp\left(-F_{i,k-1,p} - M_p\right) + T_{i,k-1}\left(1 - l_{i,k-1}\right) \exp\left(\sum_r -M_r\right)$$
$$+ N_{ikp} \exp\left(-F_{ikp} - M_p\right) + T_{ik}\left(1 - l_{ik}\right) \exp\left(\sum_r -M_r\right).$$

To reduce the number of parameters to be estimated, assumptions are made about the form of the availabilities and mortalities. In previous assessments, the availabilities were formulated to increase with age and were set to 1 for age 6^+ and older. For age 3^+ to 5^+ the availabilities were constant between years, that is,

$$l_{ij} = l_{\bullet j},$$

The proportion of age 2^+ fish which are mature appears to vary among years (Haist and Stocker 1985) and some reduction fisheries targeted on immature 1^+ fish. Therefore, the availability for these two age classes was estimated separately for each year for which there is age-composition data, with the exception of the final year. In the final year, the availability for age 1^+ and 2^+ fish was set equal to the average over all years in the time series.
Beginning with the 2003 assessment, a modified logistic equation is fit for each year over all age classes (2^+-7^{++}) to reduce the large number of availability parameters that were estimated in previous assessments:

$$l_{ij} = \frac{1}{1+\exp(-d(j-g_i))}$$

For the selective gillnet fishery (i.e. fishing period 3), fishing mortality is separated into age selectivity and fishing intensity components. Following Doubleday (1976),

$$\ln\left(F_{ij3}\right) = a_{i3} + b_j \qquad 3.2a$$

where a_{i3} represents the general level of fishing mortality due to the gillnet fishery in season *i*, and b_j represents the relative selectivity of the gear for age-class *j*. The b_j are parameterized such that age selectivity is modelled as a function of annual average weights-at-age. A modified logistic equation is used to describe the level of selectivity as a function of weight-at-age,

$$b_{ij} = \frac{1}{1+\exp(r - t\, g_{ij}^{w})}$$

where g_{ij} is $\log_e$ of the geometric mean weight-at-age *j* in year *i*. The b_{ij} replace the b_j in equation 3.2a.

For non-selective fisheries (i.e. fishing periods 1 and 2) only fishing intensity parameters are estimated, that is

$$\ln\left(F_{ijr}\right) = a_{ir}.$$

As in recent assessments, an average natural mortality parameter, $M_\bullet$, is estimated. It is assumed that most of the natural mortality occurs following spawning and over the course of the summer and early winter prior to the first fishery (period 1). Little or no natural mortality is assumed during the course of the roe fisheries (periods 2 and 3) which occur over a roughly 2 week period at the end of the year. Hence, various proportions of the annual natural mortality for the three fishing periods is modelled as,

$M_1 = 0.95M_{\bullet}$
$M_2 = M_3 = 0.025M_{\bullet}$

Additional structure is built into the model through the inclusion of annual spawn data (spawn index, I_i). Spawning occurs at the end of the season so the number of spawners at age *j* in season *i* (G_{ij}) is estimated by

$$G_{ij} = N_{ijp} \exp\left(-F_{ijp} - M_r\right) \qquad \text{where } j>1$$

and the spawning stock biomass, which is assumed to be proportional to egg production, in season *i*, (R_i) is

$$R_i = \sum_j w_{ij} G_{ij},$$

where w_{ij} is the average weight-at-age *j* in season *i*. The errors in the spawn index observations (I_i) are assumed to be multiplicative so that

$$I_i = q\, R_i \exp(x_i), \qquad 3.3$$

where *q* is a spawn conversion factor and x_i is a normally distributed random variable with mean 0 and variance s_1^2. For the model described above the parameters to be estimated are:

T_{i1} , for all seasons *i*,
T_{ij} , for age classes 1^+ to *k* in the first year,
l_{ij} , from the logistic equation for ages 1^+ to 8^+, for seasons 1 to n-1,
a_{ir} , for all fisheries *i,r*,
$d, g_i, r, t, w, M_{\bullet}$ and *q***.**

The l_{ij} are parameterized to constrain their values between 0 and 1. The parameter s_1^2 is not estimated in the reconstructions, but is fixed 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*,
I_i, the estimated escapement biomass or spawn index in season *i*,
w_{ij} , the mean weight-at-age *j* in season *i*,

g_{ij} , the log$_e$ of the geometric mean weight-at-age *j* in season *i*.

The error structure suggested by Fournier and Archibald (1982) for the observations S_{ijr} and O_{ir} is used:

1) the S_{ijr} are obtained from ageing random samples of fish from the catch (and there are no ageing errors, i.e. a multinominal sampling distribution).

2) the error structure for the estimated number of fish caught (O_{ir}) is log-normal. That is,

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

where C_{ir} is the actual number of fish caught in period *r* in season *i* ($C_{ir} = \sum_j C_{ijr}$)

and the x_i are independent normally distributed random variables with mean 0 and variance s_3^2.

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

Given these stochastic assumptions, the log-likelihood function (ignoring the constant term), for the parameters P_{ijr} $\left(P_{ijr} = C_{ijr} / C_{ir}\right), C_{ir}$, and s_3^2 is

$$\sum_{ijr} S_{ijr} \ln(P_{ijr}) - \sum_{ir} \frac{\left(\ln(O_{ir}) - \ln(C_{ir})\right)^2}{2 s_3^2} \qquad 3.5$$

The assumption of log-normal measurement error in the observed spawn-actual spawn relationship introduces the following contribution to the log-likelihood function:

$$- \sum_{i} \frac{\left(\ln(I_i) - \ln(q R_i)\right)^2}{2 s_1^2} \qquad 3.6$$

The w_{ij} and g_{ij} are assumed to be estimated without error.

The objective function described above (eqn. 3.5 & 3.6) incorporates measurement error in the proportion at age data, the total catch data and the spawn index data, with the relative magnitude of the errors related through the variance terms s_1^2 , s_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 these observations, the variance terms are not estimated but are held at fixed values. In previous assessments, the following variances were assumed:

s_1^2 = 0.025,

s_3^2 = 0.0025,

These correspond to approximately a 5% average error in estimates of the total number of fish caught and a 16% average error in spawn index observations. However, it is not possible to estimate the variance directly. Analyses presented in the 2003 assessment indicated that the model was relatively insensitive to the variance assumption and as a result a variance of 0.005 was assumed for both s_1^2 and s_3^2. The same variances have been assumed in the current assessment.

The contribution to the objective function from the lack of fit for the age composition data for a fishery in period *r* in season *i* is:

$$V_{ir} = \sum_r S_{ijr} \ln P_{ijr} - \sum_r S_{ijr} \ln\left(\frac{S_{ijr}}{\sum_r S_{ijr}} \right)$$

The second term in this equation is a constant. Inclusion of this term allows comparison of the contribution to the lack of fit for the age composition data for each fishery. If the predicted and observed proportion at age data were identical, the V_{ir} would be zero.

To facilitate an assessment of the lack of model fit to the age composition data the standard deviates of the observed versus predicted proportions-at-age (Z_{ijr}) are also calculated:

$$Z_{ijr} = \frac{S_{ijr} - \left(\sum_r S_{ijr} \right) P_{ijr}}{\sqrt{S_{ijr} \left(1 - \frac{S_{ijr}}{\sum_r S_{ijr}} \right)}}$$

4. STOCK TRENDS AND ABUNDANCE FORECASTS

4.1 STOCK TRENDS

Estimates of pre-fishery spawning stock biomass over the period 1951 to 2004 from the age-structured model assuming 2q's and the observed and estimated spawn index are presented in Figures 4.1 and 4.2 for the five major coastal regions. The 2q model assumes that the spawn 'catchability' parameter, q, is equal to 1 for the dive survey era and q is estimated for the surface era prior to 1988. The indication is that abundance based on the spawn index has declined in 2004 in all areas except the Central Coast where there was a slight increase. In addition, there has been good agreement between abundance levels and trends in all areas since the inception of dive surveys in 1988.

Residual and Retrospective Analysis

The model estimate of the population egg production from equation 3.3 can be compared to the observed egg deposition and residuals reviewed for lack of model fit. The results of this comparison are shown in Figures 4.3 and 4.4 for the five major stocks. It is evident that the residuals have decreased over time in all areas except the west coast of Vancouver Island since the inception of diving surveys in 1988. The spawn residuals were minimal for 2004 in all areas except the west coast of Vancouver Island where it appears that substantially less spawn was observed than was expected from the model estimate.

A comparison between the observed age composition and that determined by the model is presented for the three fishing periods and the five major stocks in Figures 4.5 to 4.9. There are a number of large residuals but no clear patterns that occur across all areas. A number of large residuals occur in the fall food fisheries in the northern regions and these are generally poorly sampled with relatively small sample sizes. Similarly, large residuals are evident for the gillnet fisheries in the early 1970s and again these are likely the result of limited and largely ad hoc sample collection. The seine roe fishery also appears to have been affected by poorer sampling in the early 1970s relative to the recent years.

The estimated availability of the age 1^+ and 2^+ herring to the fisheries is estimated in the model with a modified logistic equation and the parameters are plotted in Figure 4.10. It is evident that availabilities were quite variable during the 1950s and 1960s when the reduction fishery targeted on larger aggregations of fish that included maturing and possibly immature age 1^+ and 2^+ herring. In some instances, it appears that the fishery was heavily impacting these year-classes. Such an effect is particularly evident in the late 1960s as the stocks collapsed most of the older age classes had already been removed from the population and the fishery targeted the remaining younger age-classes. Since the inception of the roe fishery in the early 1970s, estimated availability has been quite stable in all areas except the Queen Charlotte Islands where it has been increasing for age 1^+ fish and to a lesser extent also for age 2^+ fish.

A retrospective analysis for the age-structured model is presented for each of the major herring stocks in Figures 4.11 and 4.12. The plots show the stock trajectory determined for each of the past ten years beginning in 1995 demonstrating the impact of additional data on model performance relative to the current assessment of stock trajectory. In general, the retrospective pattern is very stable with the exception of some estimates for the Queen Charlotte Islands in the 1970s and early 1980s. All areas show a very slight tendency to over estimate abundance in the most recent years. A comparison of the abundance forecasts for 2004 from 2003 is also presented in Table 4.1 together with the assessment of current abundance.

4.2 STOCK FORECASTS

Forecasts of pre-fishery spawning stock abundance for 2005 are calculated in two ways. First, the numbers of fish at age prior to the fisheries are the numbers estimated at the beginning of the 2004/05 season multiplied by survival for the first period and the estimated availability at age. Recruitment is based on the survival and availability of the age 1^+ fish estimated for the previous season. This recruitment is added to the estimated returning adults to project total abundance. Markov Chain Monte Carlo (MCMC) simulations were also used to determine likelihood profiles for the 2004 biomass and for the predicted total biomass and are presented in Figures 4.13 and 4.14. Secondly, as in previous assessments, recruitment is calculated for three scenarios based on estimated numbers-at-age 2^+ for the 1951-2004 time series. Poor, average, and good recruitment levels are calculated as the mean of the lowest 33%, the mid 33%, and the highest 33% of the estimates of historic age 2^+ abundance. These three recruitment estimates are then added to the projected adult biomass in 2005 to provide abundance forecasts. The point estimates for these three levels of recruitment are plotted with the likelihood profiles in Figures 4.13 and 4.14 for each stock.

4.3. POTENTIAL HARVESTABLE

Management Considerations

The Pacific Science Advice Review Committee (PSARC) has reviewed the biological basis for target exploitation rate, considering both the priority of assuring conservation of the resource and allowing sustainable harvesting opportunities (Schweigert and Ware 1995). The review concluded that 20% is an appropriate exploitation rate for those stocks that are well above Cutoff or minimum spawning biomass threshold levels (PSARC 1995). 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 (Hall et al. 1988, Zheng et al. 1993). A fixed escapement policy would theoretically produce higher yields and spawning stock stability but is not readily attainable at the operational level. In addition to the 20% harvest rate, a Cutoff level set at 25% of the estimated unfished biomass level is used to ensure that adequate spawning biomass to sustain each population during natural reductions in abundant stock productivity occur, is maintained for each stock. To increase the probability that spawning biomass will be maintained above the Cutoff level, for those stocks which are marginally above Cutoff the following reduced catch level is recommended:

Catch = Forecast Run - Cutoff.

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

Cutoff levels have been established through a stock-recruitment curve or bootstrapping of the observed recruitment time series. Changes in model structure have historically resulted in a parallel change in Cutoff level. To minimize confusion, in 1995 the Subcommittee recommended that a fixed Cutoff level should be established for each stock based on the long-term production characteristics in relation to current environmental conditions and that this Cutoff level need not be re-evaluated on an ongoing basis. The Cutoff levels for the five major stocks are:

	1992/93 Cutoff[a]	1994/95 Cutoff	1996/97 Cutoff	**2004/05 Cutoff[c]**
Queen Charlotte Islands	11700	10700	10700	**10700**
Prince Rupert District[b]	12100	12100	12100	**12100**
Central Coast	10600	18800	17600	**17600**
Strait of Georgia	22100	21200	21200	**21200**
W.C. Vancouver Island	20300	18800	18800	**18800**

[a] - Cutoff level based on simulation model with stock-recruitment relationship, and two assessment areas on the WCVI.

[b] - Because of the poor performance of the age-structured model in this region in the past the Cutoff has not been recalculated using the bootstrap approach but is based on a stock-recruitment relationship.

[c] – A Cutoff of 14,000 tonnes was proposed for the Central Coast in 1998. Uncertainty about ASM performance in 1998 resulted in retention of the existing Cutoff.

The chronology of catch forecasts, recommended quotas, and actual harvests since the introduction of the Cutoff in 1986 is presented in Table 4.2.

Table 4.1. The abundance forecast from 2003 of 2004 run size (tonnes) showing the observed abundance and recruitment from the assessment model. Recruitment categories are in parentheses and are defined in Section 4.2.

Management Region	2003 Forecast of 2004 Biomass	2004 Observed Biomass	2004 Validated Roe Catch*	2004 Escapement
Queen Charlotte Islands	12,700 (average)	8,200 (poor)	0	7,300
Prince Rupert	40,700 (average)	29,900 (poor)	4,100	24,900
Central Coast	36,600 (average)	34,400 (poor-average)	3,000	30,200
Strait of Georgia	156,400 (good)	118,600 (average-good)	12,200	105,000
West Coast Vancouver Island	33,700 (poor)	30,200 (poor-average)	4,500	25,400
Total Coast	280,100	221,300	23,800	192,800

*includes test fish catch

Table 4.2. Stock biomass forecast, recommended yield, actual roe fishery quota, and roe catches (tonnes x 1000) since 1986.

		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[d]	2000[d]	2001[d]	2002[d]	2003[d]	2004[d]
QCI [e]	Forecast[a]		15.3	12.1	13.7	35.3	23.2	18.1	17.7	12.4	7.7	6.7	11.0	19.8	28.2	15.1	8.7	14.0	7.2	12.7
	Rec. Yield[b]		2.2	0.0	2.7	7.1	4.6	3.6	3.5	1.0	0.0	0.0	0.3	4.0	5.6	3.0	0.0	2.8	0.0	2.0
	Roe Quota	3.8	1.4	0.0	0.9	5.5	4.7	3.3	3.0	0.0	0.0	0.0	0.0	1.6	3.0	1.4	0.0	0.4	0.0	0.0
	Roe Catch[c]	3.6	2.0	0.3	1.4	9.0	7.0	3.8	4.0	0.3	0.0	0.0	0.0	1.4	3.0	1.8	0.0	0.7	0.0	0.0
PRD	Forecast[a]		32.1	43.8	42.6	23.3	19.4	30.5	55.1	34.1	21.9	21.2	36.1	34.0	24.4	37.0	23.2	34.1	31.7	40.7
	Rec. Yield[b]		6.4	8.7	8.5	4.7	3.9	6.1	11	6.8	4.4	4.2	7.2	6.8	4.9	7.4	4.6	6.8	6.3	8.1
	Roe Quota	6.4	5.4	7.5	7.3	3.5	2.6	4.2	5.4	4.9	2.3	2.4	5.5	5.5	2.0	4.1	2.5	4.2	3.5	4.1
	Roe Catch[c]	8.3	6.1	7.9	8.5	4.9	3.5	5.0	6.3	4.7	2.1	3.1	5.5	3.2	2.1	4.3	2.9	4.5	3.7	4.1
CC	Forecast[a]		23.0	23.8	48.5	43.2	38.2	37.7	70.1	69.8	54.4	25.8	20.7	44.5	43.4	47.0	36.8	25.4	25.3	36.6
	Rec. Yield[b]		4.6	4.8	9.7	8.6	7.6	7.5	14.0	14.0	10.9	5.2	3.1	8.9	8.7	9.4	7.4	5.1	5.0	7.3
	Roe Quota	2.3	3.3	3.7	7.8	7.4	6.2	5.3	7.8	10.3	8.5	3.2	1.4	7.8	6.9	6.3	5.2	2.8	2.1	2.3
	Roe Catch[c]	3.3	3.6	4.5	9.5	8.4	8.9	8.3	10.5	11.9	9.6	4.3	3.6	8.6	7.5	7.4	6.1	3.3	2.2	3.0
SG	Forecast[a]		53.0	46.7	49.4	55.2	69.8	59.2	91.8	97.4	69.5	63.4	77.2	72.7	78.9	84.7	82.6	103.1	130.0	156.4
	Rec. Yield[b]		10.6	9.3	9.9	11.0	14.0	11.8	18.3	19.5	13.9	12.7	15.5	14.5	15.8	16.9	16.5	20.6	26.0	31.3
	Roe Quota	0.0	8.0	6.4	7.4	7.1	9.1	9.7	11.0	14.4	11.9	10.8	13.2	13.0	11.5	13.2	13.9	16.2	16.8	16.1
	Roe Catch[c]	0.2	9.1	7.5	7.4	7.9	10.6	12.5	13.1	16.7	12.5	13.6	15.4	12.7	11.8	14.0	15.0	17.3	17.8	12.2
WCVI [f]	Forecast[a]		48.3	39.6	52.6	35.9	33.9	29.1	NA[g]	36.3	20.8	21.4	24.1	40.1	39.6	21.5	14.6	22.4	30.0	33.7
	Rec. Yield[b]		9.7	7.9	10.5	7.2	6.8	5.8	3.4[g]	7.3	2.0	2.0	4.8	8.0	7.9	2.7	0.0	3.6	6.0	6.7
	Roe Quota	0.0	9.4	8.1	10.3	7.2	6.7	2.9	2.7	5.0	1.3	0.9	3.7	7.5	5.1	1.1	0.0	0.4	2.9	4.3
	Roe Catch[c]	0.2	15.9	9.7	13.4	9.9	8.6	3.7	5.6	6.0	2.0	0.8	6.7	7.0	4.4	1.6	0.0	0.8	3.0	4.5
Coast	Forecast		171.7	166.0	206.8	192.9	184.5	174.6	234.7	250.0	174.3	138.5	169.1	211.1	214.5	205.3	165.9	199.0	224.2	280.1
	Rec. Yield		33.5	30.7	41.3	38.6	36.9	34.8	50.2	48.6	31.2	24.1	30.9	42.2	42.9	39.4	28.5	38.9	43.3	55.4
	Roe Quota	12.5	27.5	25.7	33.7	30.7	29.3	25.4	29.9	34.6	24.0	17.3	23.8	35.4	28.5	26.1	21.6	24.0	25.3	26.8
	Roe Catch	15.6	36.7	29.9	40.2	40.1	38.6	33.3	39.5	39.6	26.1	21.8	31.1	32.9	28.8	29.1	24.0	26.6	26.7	23.8

[a] PSARC stock forecast used to derive recommended yield;
[b] PSARC recommended yield, includes allocations to non-roe fisheries;
[c] Roe catch includes all test fishery catches;
[d] Catch in 1999 through 2004 are the dockside validated catch;
[e] In 1990 to 1993 catch for QCI included both areas 2E and 2W;
[f] Includes Area 27 catch in 1983 & 1984 but excludes it in 1992, 1993, 1994, 1995 following removal from assessment region; [g] No consensus on stock status, recommended that catch not exceed 1992 level.

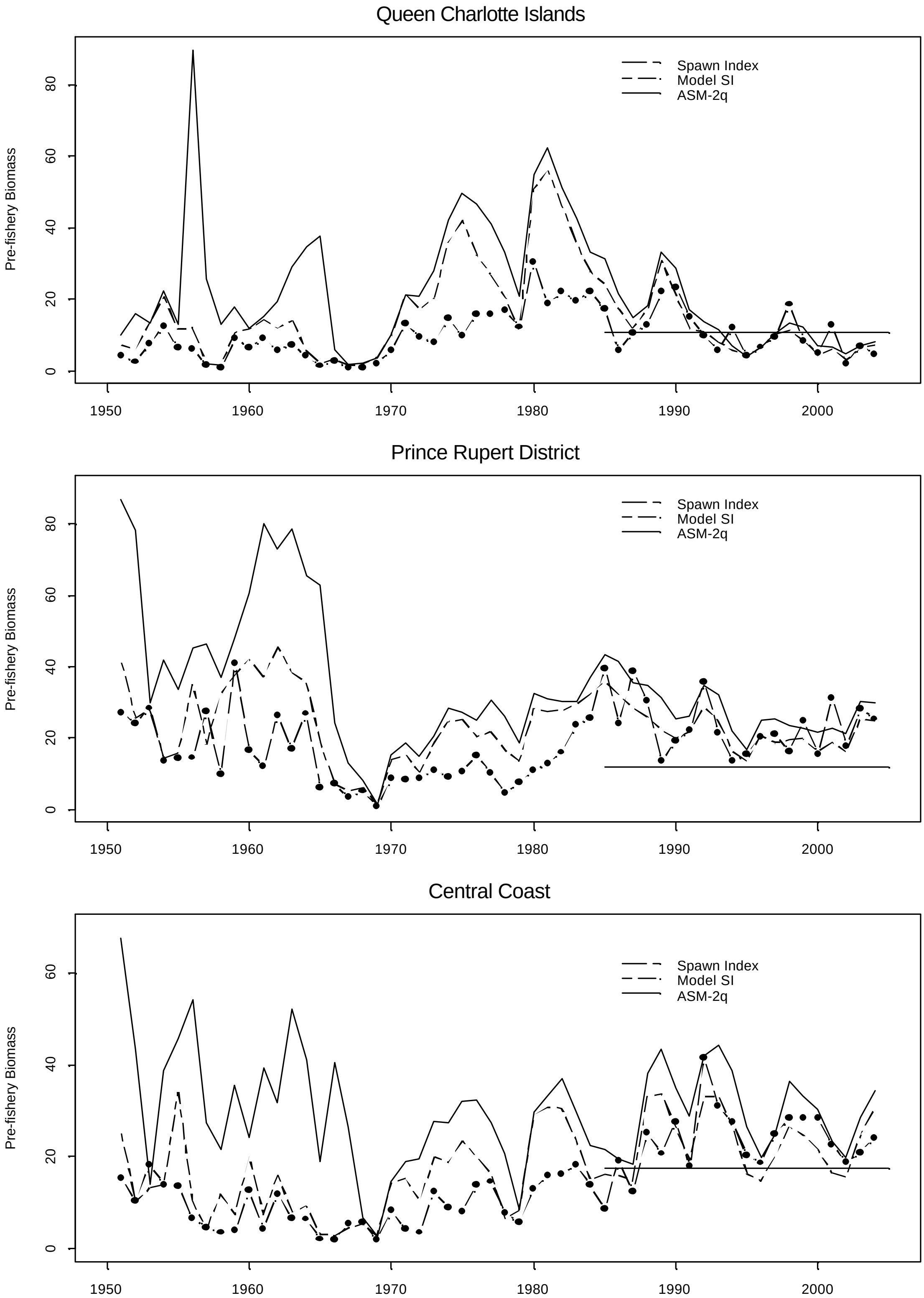
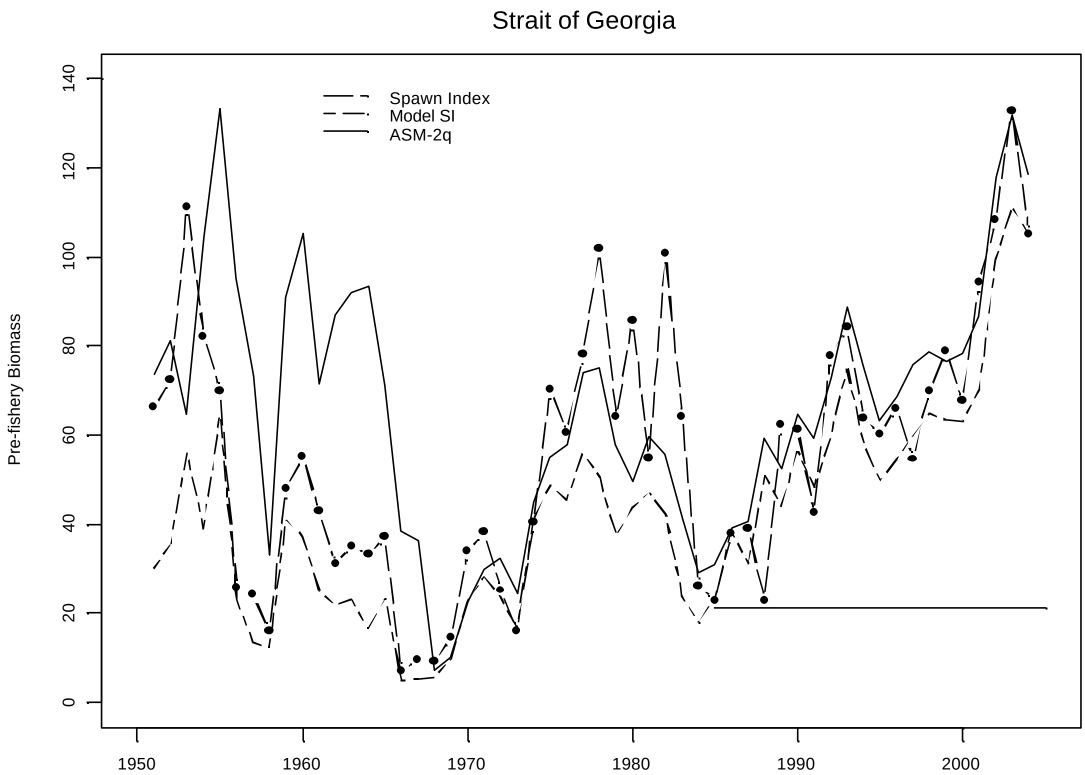


Figure 4.1. Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for northern B.C. herring stock assessment regions, 1951-2004, based on the 2-q model assuming annual selectivity curves. Horizontal line indicates the Cutoff level.



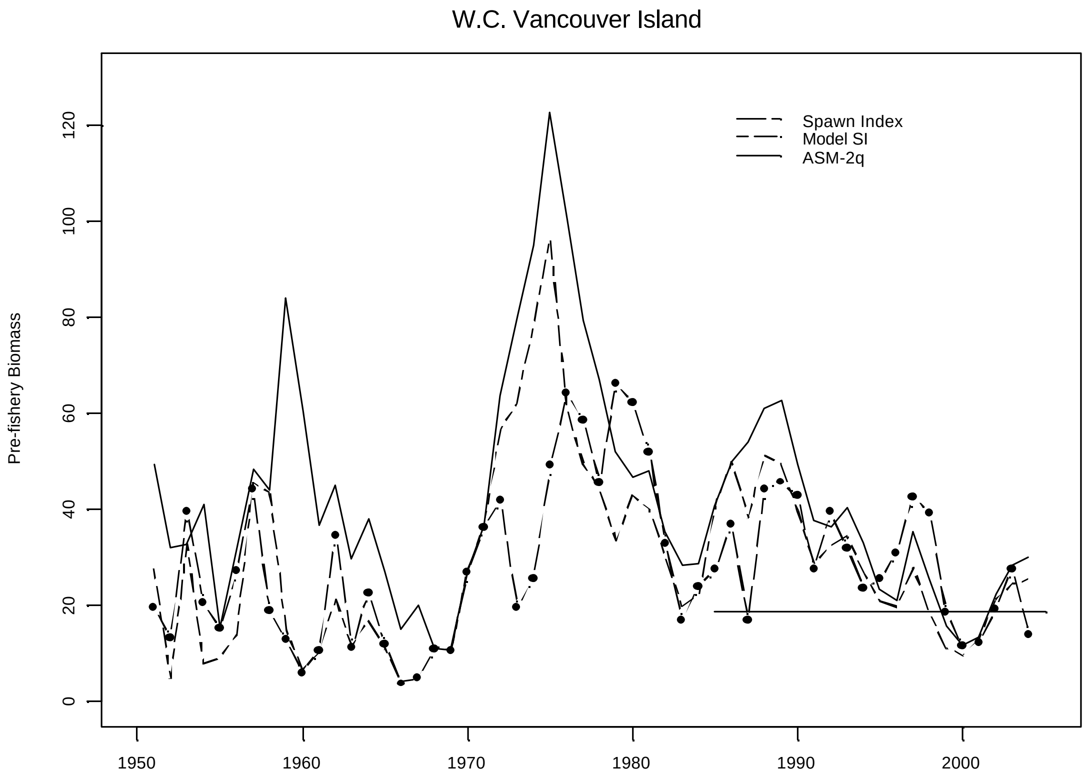


Figure 4.2. Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for southern B.C. herring stock assessment regions, 1951-2004, based on the 2-q model assuming annual selectivity curves. Horizontal line indicates the Cutoff level.

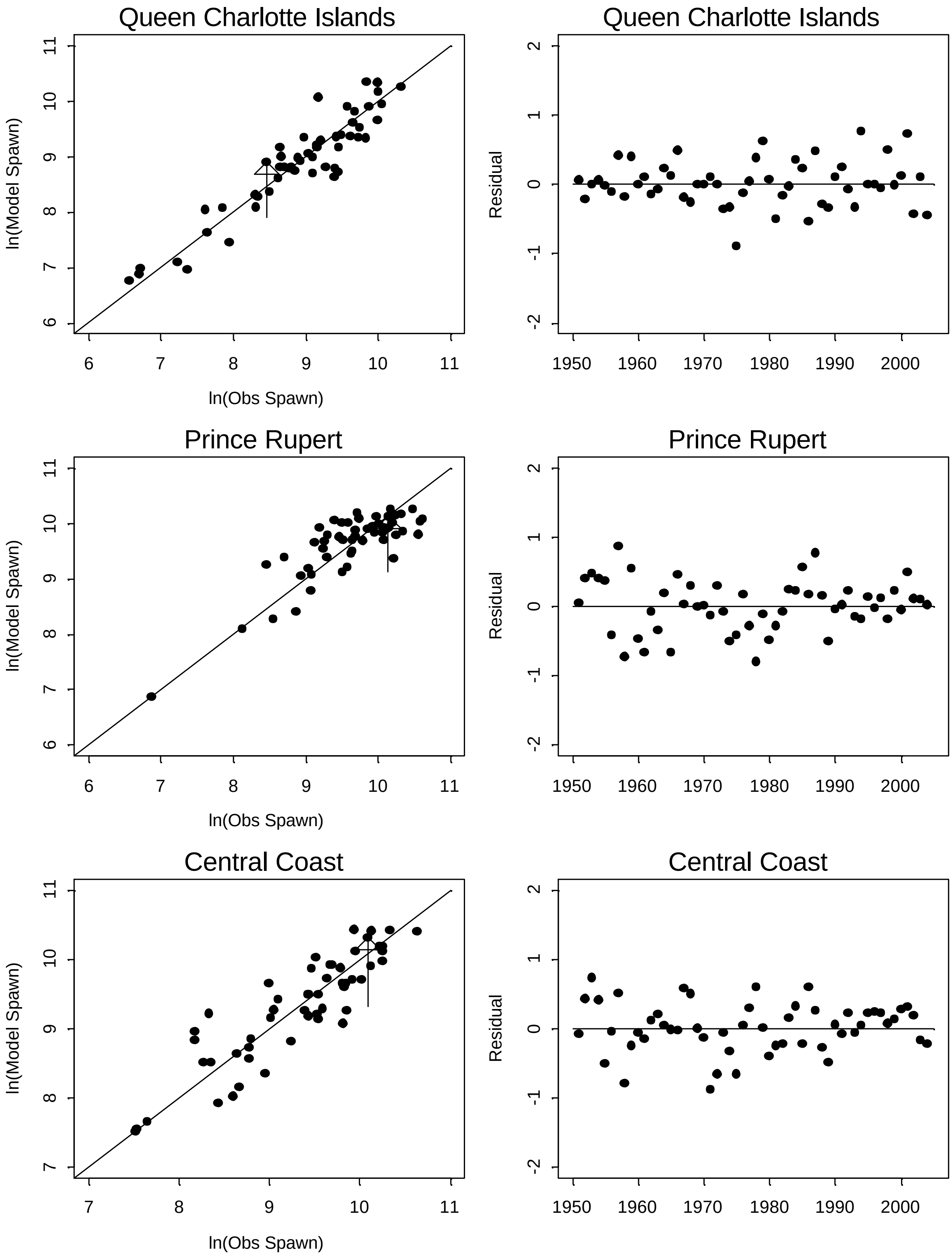


Figure 4.3. The residuals from the observed spawn - true spawn relationship for the northern assessment regions for the period 1951-2004. The arrow indicates the most recent data point.

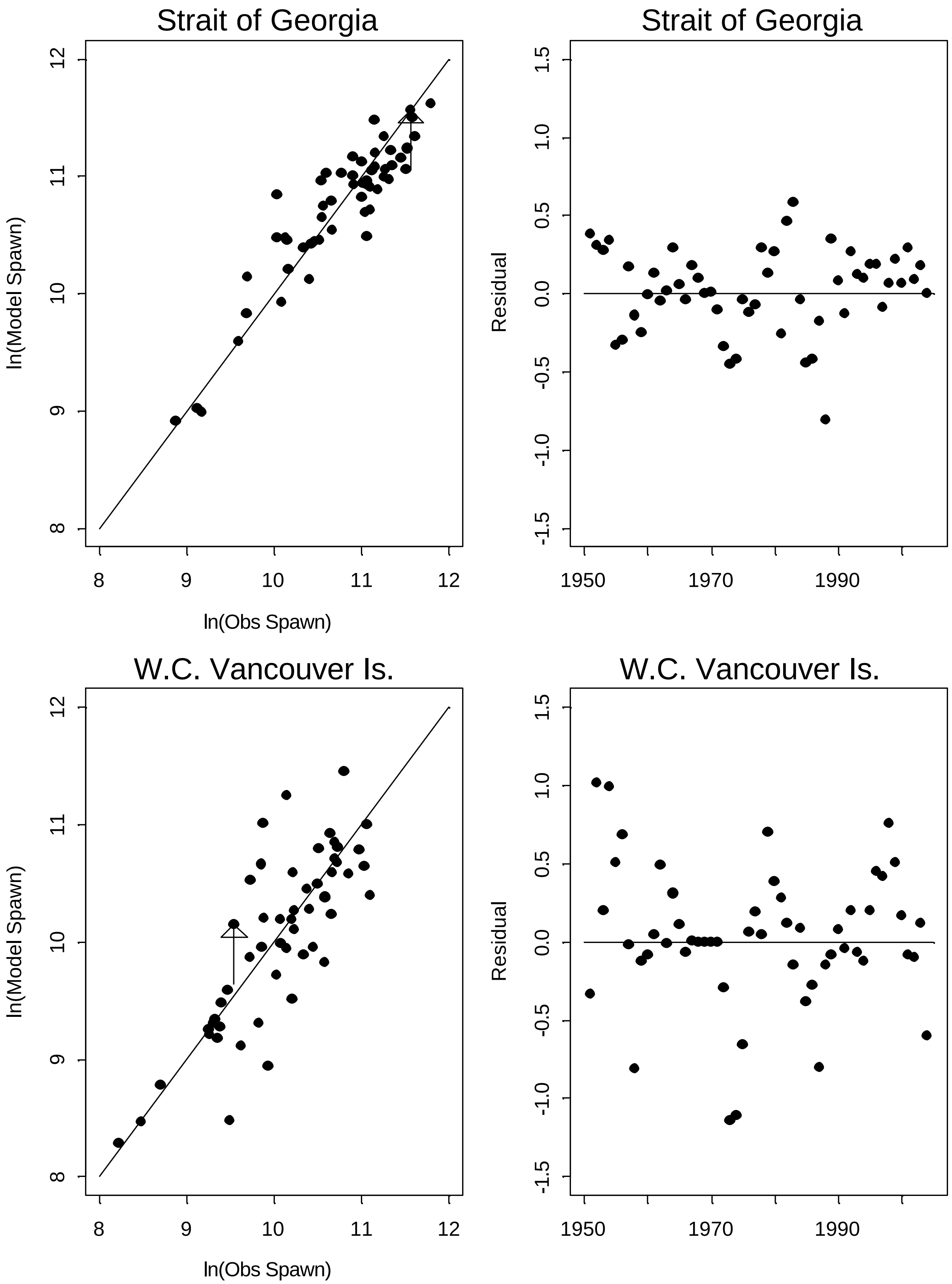


Figure 4.4. The residuals from the observed spawn - true spawn relationship for the southern assessment regions for the period 1951-2004. The arrow indicates the most recent data point.

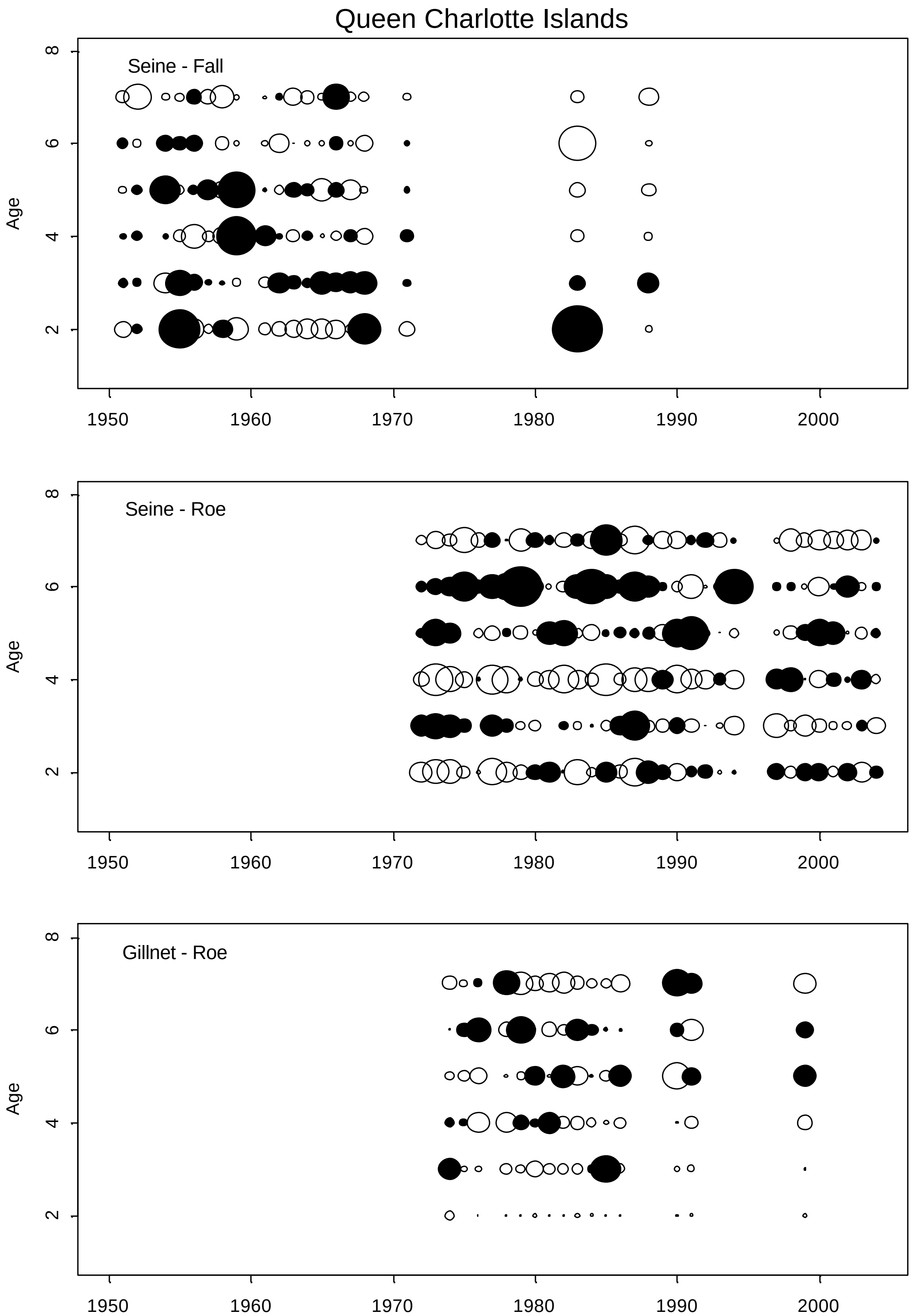


Figure 4.5. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Queen Charlotte Islands, 1951-2004. Filled circles are positive residuals and open circles are negative residuals.

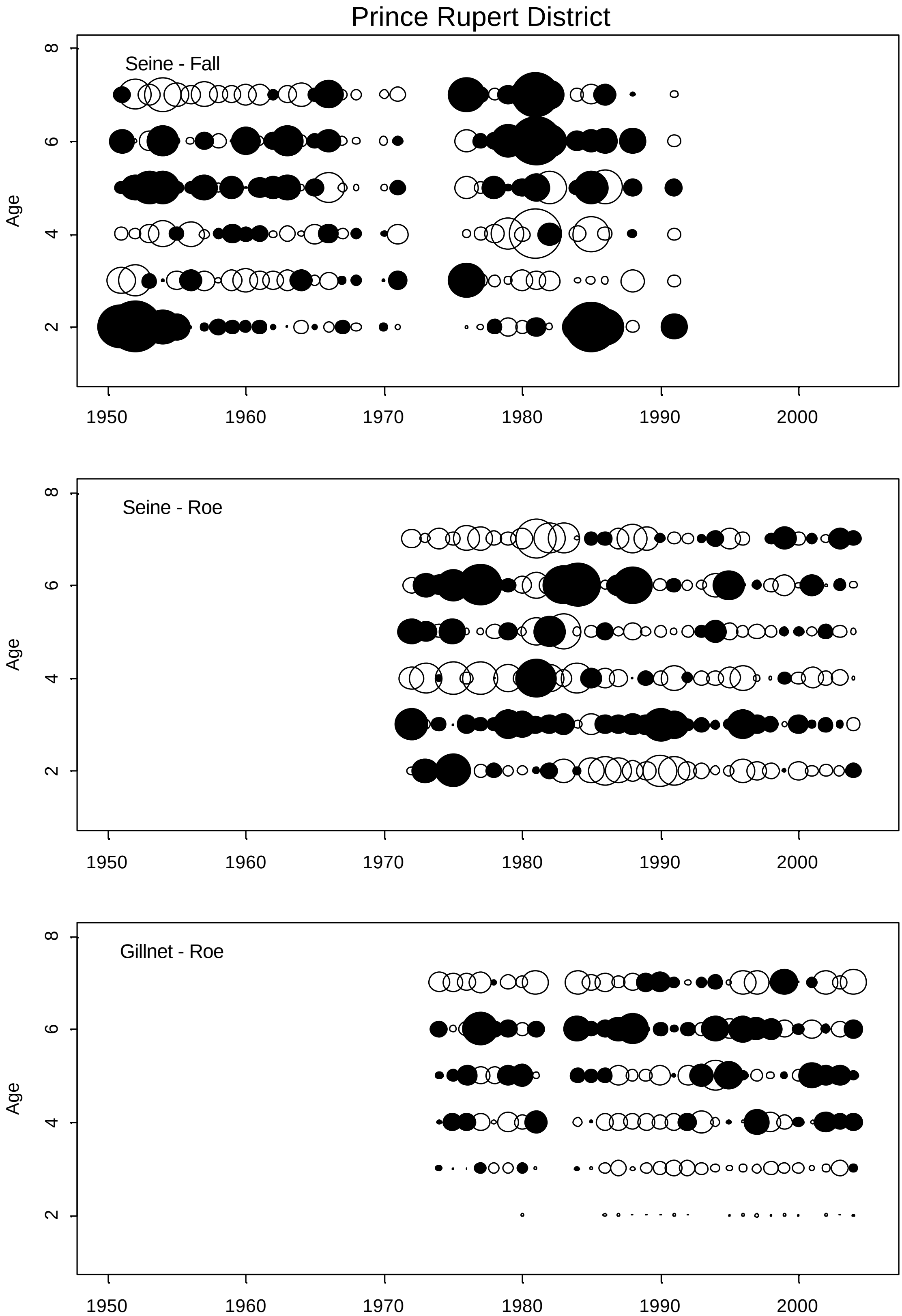


Figure 4.6. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Prince Rupert District for 1951-2004. Filled circles are positive residuals and open circles are negative residuals.

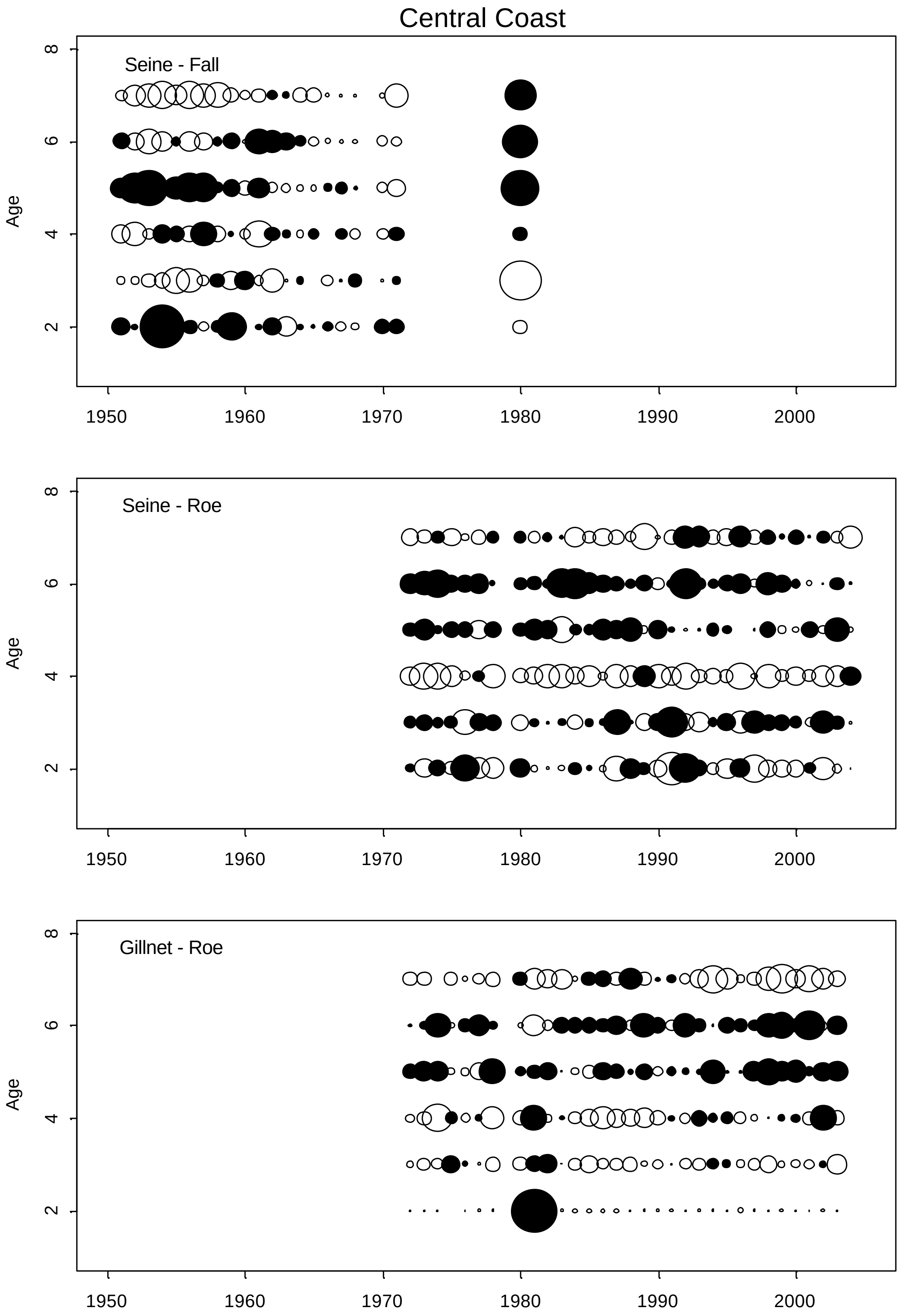


Figure 4.7. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Central Coast for 1951-2004. Filled circles indicate positive residuals and open circles are negative residuals.

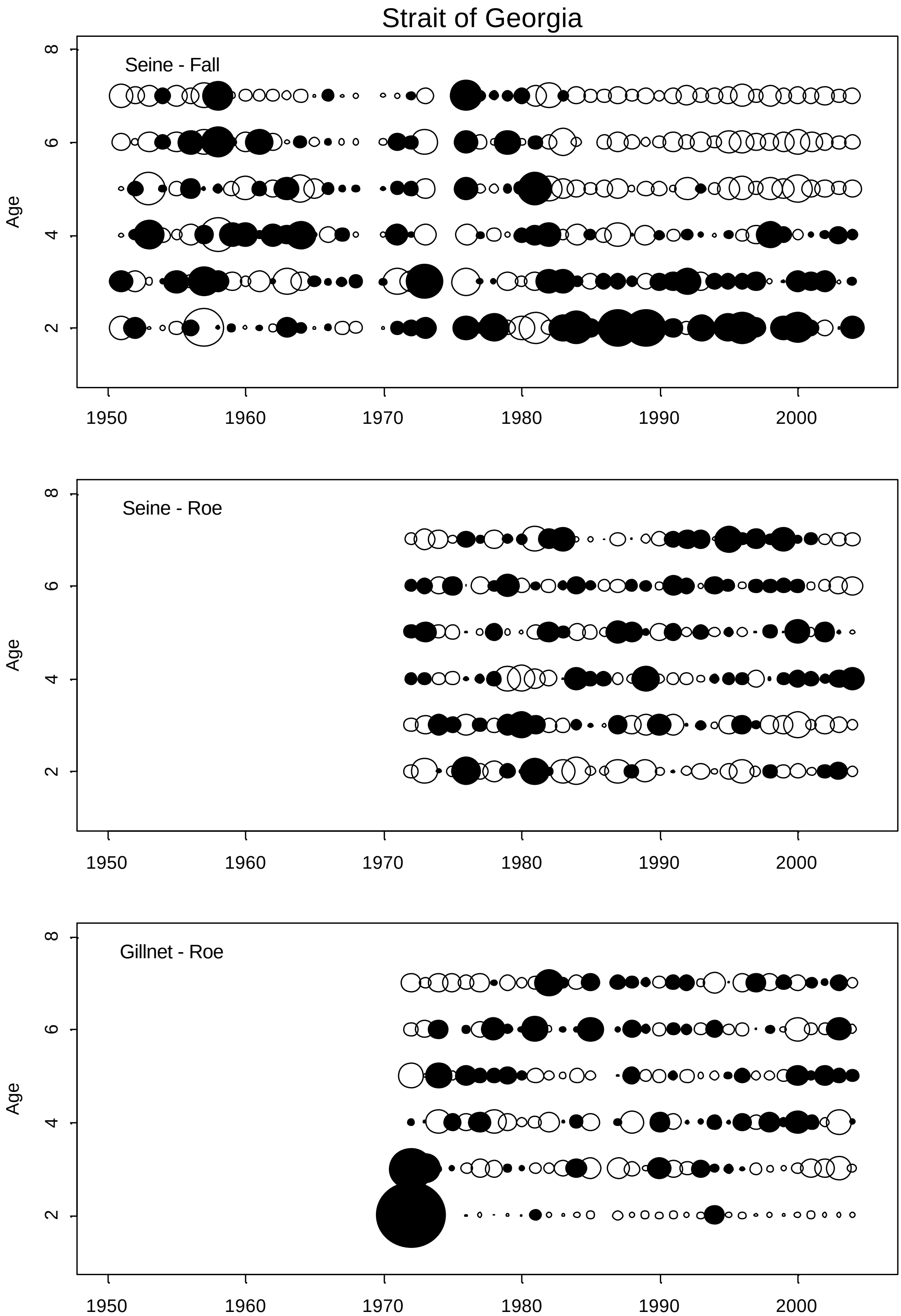


Figure 4.8. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Strait of Georgia for 1951-2004. Filled circles indicate positive residuals and open circles are negative residuals.

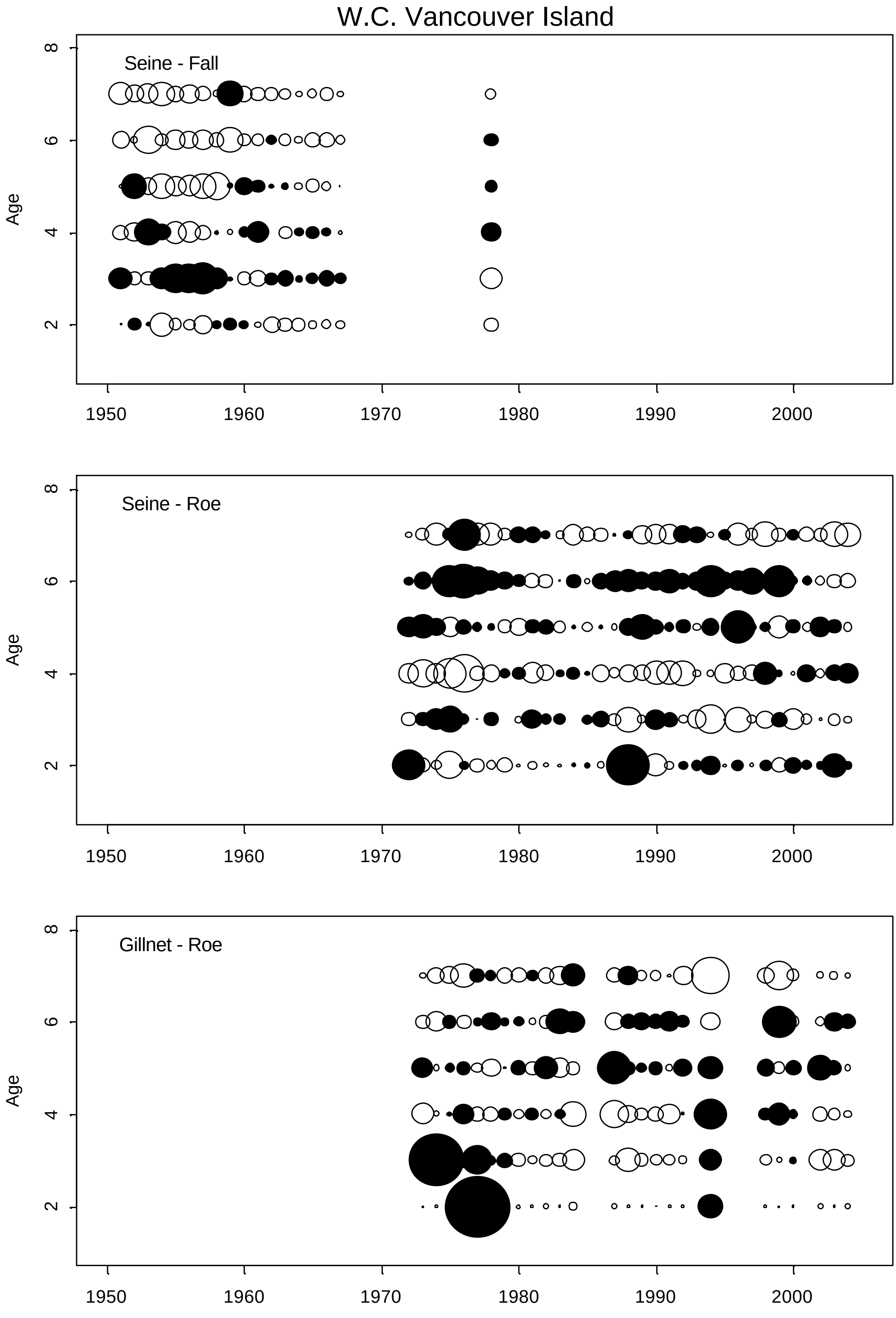


Figure 4.9. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the west coast of Vancouver Island for 1951-2004. Filled circles represent positive residuals and open circles are negative residuals.

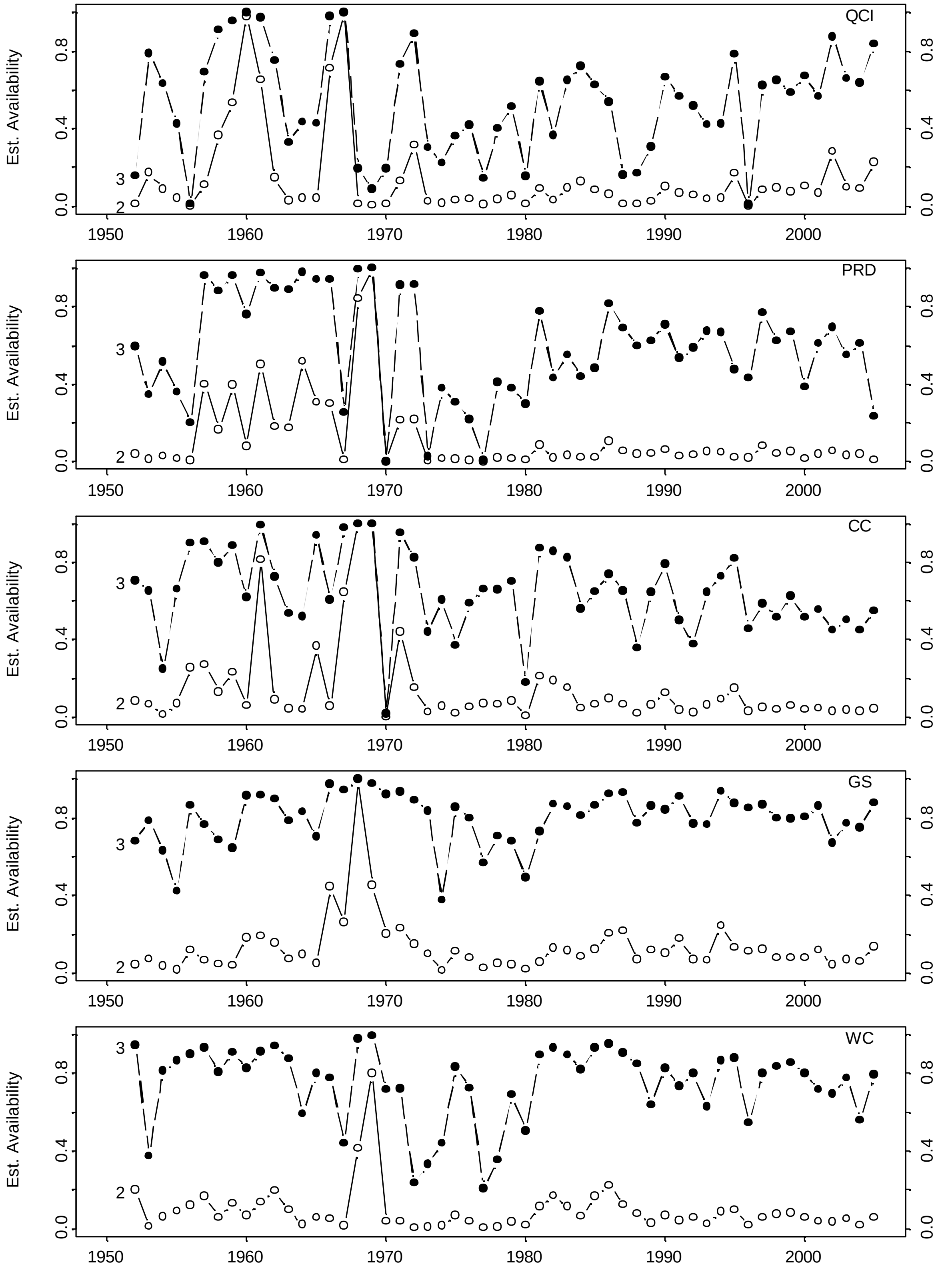


Figure 4.10. Estimated availability of age 2 (1^+) and 3 (2^+) herring by year and assessment region for the period 1951-2004.

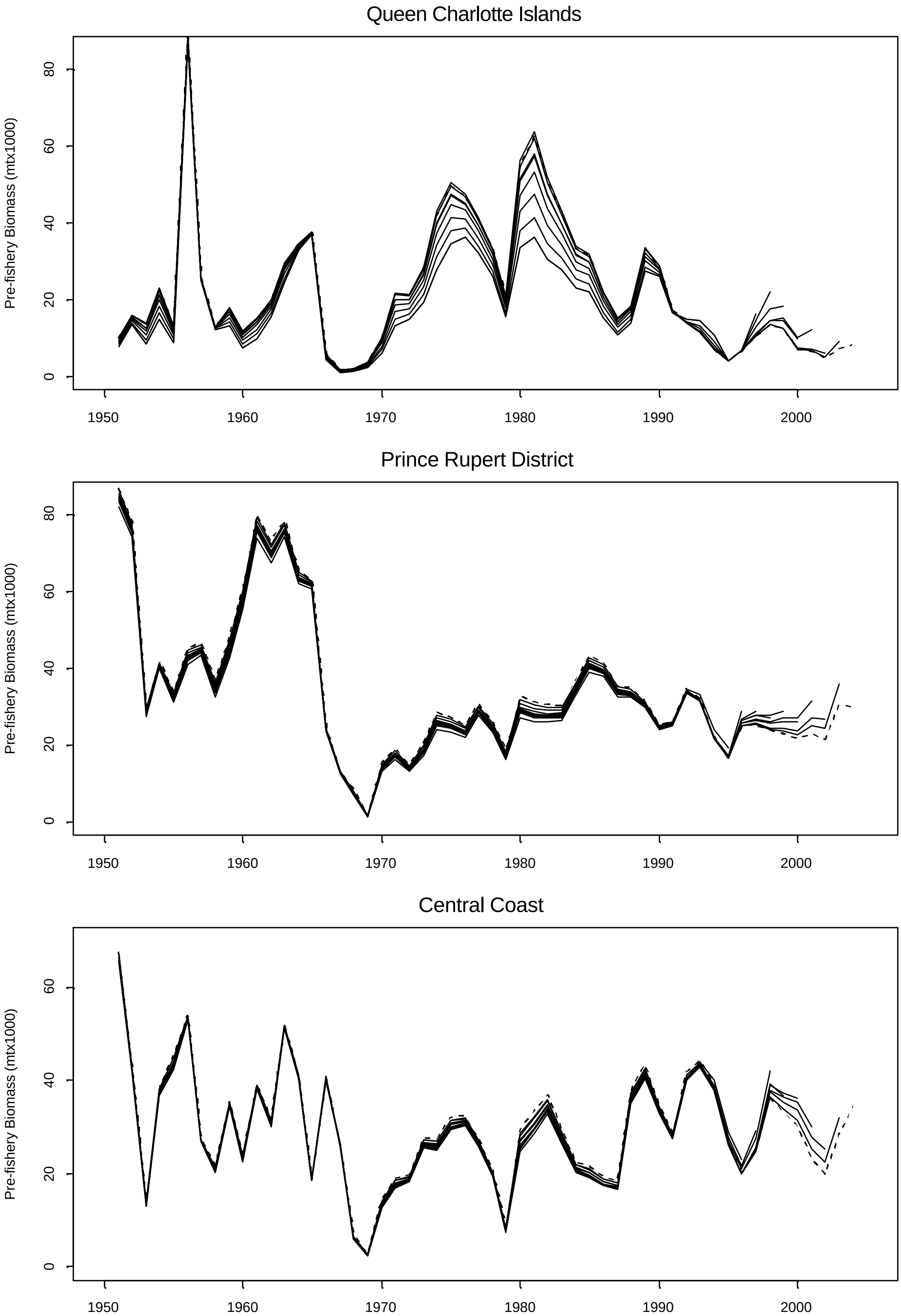


Figure 4.11. Retrospective analysis of estimated spawning biomass (tonnes x 1000) for northern B.C. herring stocks from 1951-2004. Dashed line indicates the most recent assessment.

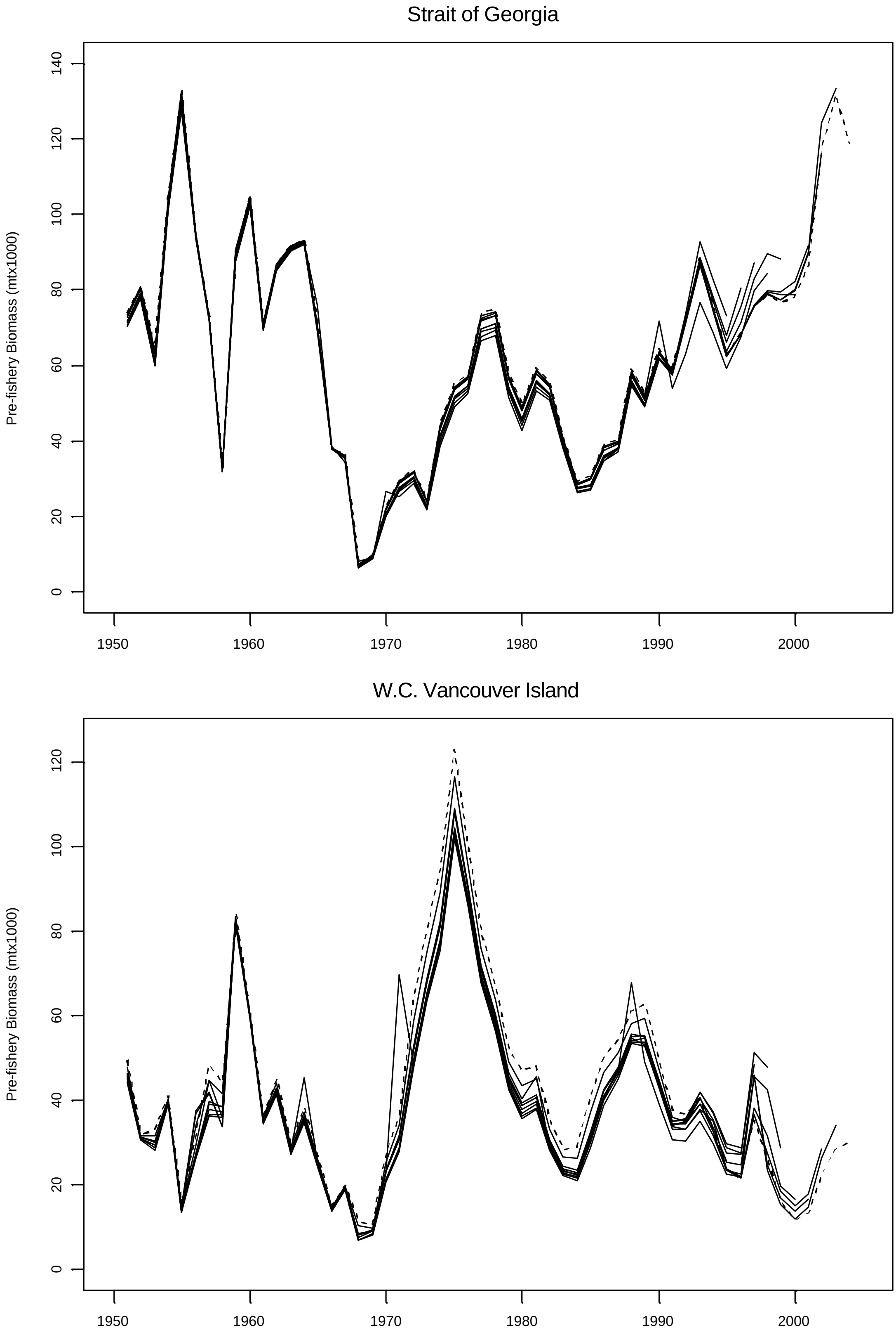


Figure 4.12. Retrospective analysis of estimated spawning biomass (tonnes x 1000) for southern B.C. herring stocks from 1951-2004. Dashed line indicates the most recent assessment.

Queen Charlotte Islands

The stock reconstruction for the Queen Charlotte Islands region indicates peaks in abundance during the mid-1950s, 1970s, and 1980s followed by a recent protracted decline (Fig. 4.1). Residuals from the spawn and age composition data do not indicate any major lack of fit to the model in recent years (Fig. 4.3, 4.5). The retrospective analysis for this stock suggests considerable uncertainty about abundance levels during the 1970s and 1980s with a general tendency to under estimate abundance relative to the current assessment. However, in recent years there is an indication that the revised model has a small tendency for optimistic forecasts of abundance (Fig. 4.11)

The profile likelihood indicates that abundance in 2004 was between 7,000 and 9,000 tonnes and projections for 2005 are similar ranging between 6,000 and 10,000 tonnes, well below the Cutoff level (Fig. 4.13). Recruitment to this stock has been generally poor for the past decade (Fig. 4.15) with only one good year-class in 1995. The recruitment of the 2001 year-class in 2004 appears to be one of the poorest in the time series. The spawning run was composed primarily of age 3^+ fish from the 2000 year-class constituting 51% of the spawners while age 2^+ recruits contributed another 2% of the run (Appendix 1.1). The recruitment to the Queen Charlotte Islands in 2005 is expected to be slightly above average (Fig. 4.17). The forecast with a poor recruitment is 5,400 tonnes and 6,900 tonnes with an average recruitment (Table 4.3).

Prince Rupert District

The stock reconstruction for the Prince Rupert District indicates minor fluctuations in abundance since the rebuilding of the stock in the early 1970s with a relatively stable level since the early 1980s (Fig. 4.1). Residuals from the spawn data indicate a good fit to the model (Fig. 4.3). The age composition data does not indicate any major lack of fit to the model in recent years although there are some large residuals from the fall food fishery samples in the early 1980s (Fig. 4.6). The retrospective analysis for this stock indicates some minor variations in estimated abundance during the early 1980s but it is much improved over recent assessments. In recent years the model abundance forecasts have been slightly higher than suggested by the current assessment (Fig. 4.11).

The profile likelihood indicates that abundance in 2004 was between 25,000 and 35,000 tonnes and projections for 2005 are anticipated to be marginally lower (Fig. 4.13). The stock remains well above the Cutoff of 12,100 tonnes for this assessment region. Recruitment to this stock has been consistent, with good year-classes occurring roughly ever 4 years since 1980 and indications are that the recruitment of the 2000 year-class in 2003 was very good while the 2001 year-class is quite poor (Fig. 4.15). The spawning run consisted of about 70% age 3^+ fish and only 2% age 2^+ recruits (Appendix 1.2). The recruitment to the Prince Rupert District in 2005 is expected to be about average (Fig. 4.17). The forecast run size to the Prince Rupert District in 2005 with average recruitment is 27,400 tonnes (Table 4.3).

Central Coast

The stock reconstruction for the Central Coast indicates moderate fluctuations in abundance since the rebuilding of the stock in the early 1970s with a slightly increasing trend to the mid-1990s (Fig. 4.1). The fluctuations appear to be associated with the recruitment of strong year-classes. Residuals from the spawn data indicate a good fit to the model (Fig. 4.3). The age composition data also do not indicate any major lack of fit to the model in recent years although there are some larger residuals for the gillnet fishery early in the time series (Fig. 4.7). The retrospective analysis for this stock indicates little or no variation in estimated abundance during the entire time series. There are only slight indications of over forecasting in the most recent years relative to the current assessment (Fig. 4.11).

The profile likelihood indicates that abundance in 2004 was between 25,000 and 35,000 tonnes and projections for 2005 are anticipated to be marginally lower (Fig. 4.13). The projected abundance remains well above the Cutoff of 17,600 tonnes for this assessment region. Recruitment to this stock has been characterized by intermittent strong year-classes with the most recent one being the 2000 that recruited in 2003 (Fig. 4.15). The 2000 year-class was very strong, accounting for 66% of the spawning run while the recruiting 2001 year-class constituted only 7% (Appendix 1.1). The recruitment to the Central Coast in 2005 is expected to be between poor and average (Fig. 4.17). The resulting forecast run size to the Central Coast in 2004 with poor recruitment is 31,300 tonnes and 33,900 tonnes with an average recruitment (Table 4.3).

Strait of Georgia

The Strait of Georgia herring stock remains the most productive on the coast. Stock reconstruction for the Strait of Georgia indicates that abundance has increased steadily since the fishery closure of the mid-1980s but declined slightly in 2004 (Fig. 4.2). Residuals from the spawn data indicate a good fit to the model particularly since the early 1990s (Fig. 4.4). The age composition data indicates some minor lack of fit to the model over the time series, particularly two very large gillnet residuals at the beginning of the time series in the 1970s and some large residuals for the fall food fishery since the mid-1970s (Fig. 4.8).The retrospective analysis for this stock indicates some variation in estimated abundance during the mid-1970s and a slight tendency to over forecast in the most recent years relative to the current assessment (Fig. 4.12).

The profile likelihood indicates that abundance in 2004 was between 105,000 and 135,000 tonnes and projections for 2005 are anticipated to be slightly lower (Fig. 4.14). The projected abundance remains well above the Cutoff of 21,200 tonnes for this assessment region. Recruitment to this stock has been characterized by consistent strong year-classes every second or third year since the mid-1980s (Fig. 4.16). The recent 1999 and 2000 year-classes appear to be among the largest ever observed in this assessment region accounting for 22% and 42% of the spawning run in 2004, respectively (Appendix 1.1). The recruiting 2001 year-class accounted for another 25% of the run. The recruitment to the stock in 2005 is expected to be between poor and average (Fig. 4.18). The resulting forecast run size to the Strait of Georgia in 2005 with poor recruitment is 85,500 tonnes and with an average recruitment is 97,400 tonnes (Table 4.3).

West Coast Vancouver Island

Abundance in the west coast of Vancouver Island assessment region has fluctuated dramatically from the historic high of the mid-1970s to the recent depressed levels (Fig. 4.2). Residuals from the spawn data indicate a reasonable fit to the model with larger residuals than most of the other areas and 2004 appears to be an outlier (Fig. 4.4). The age composition residuals indicate a good fit throughout the time series with a couple of large residuals during the first years of the gillnet fishery in the early-1970s (Fig. 4.9). The retrospective analysis for this stock indicates substantial variation in estimated abundance beginning in the 1970s with a slight tendency to overestimate abundance relative to the most recent assessment in the last few years (Fig. 4.12).

The profile likelihood indicates that abundance in 2004 was between 25,000 and 35,000 tonnes and projections for 2005 are more variable ranging between 25,000 and 50,000 tonnes (Fig. 4.14). The projected abundance is well above the Cutoff of 18,800 tonnes for this assessment region, and suggests that the rebuilding trend observed the past few years is continuing. Recruitment to this stock has been characterized by periods of good and bad recruitment prior to 1980. Subsequently, average or better year-classes have been intermittent occurring about every 4-5 years (Fig. 4.16). The best recent year-class was the 2000 which was average-good accounting for 52% of the spawning run in 2004 while the recruiting 2001 year-class constituted another 14% (Appendix 1.1). The recruitment to the stock in 2005 is expected to be slightly above average. The resulting forecast run size to the west coast of Vancouver Island in 2005 with average recruitment is 29,000 tonnes.

Minor Stocks

A forecast of run size is not available for the minor stocks in Area 27. However, based on recent harvesting policy for this area, a quota of no more than 10% of the estimated 2004 biomass is recommended. The estimated spawning biomass of 1143 tonnes in 2004 (Table 2.1), yields a maximum potential harvest of 114 tonnes for the area.

Similarly, the spawn assessment in Area 2W indicated a biomass of 2742 tonnes in 2004, resulting in a potential harvest of 274 tonnes for 2005 (Table 2.2).

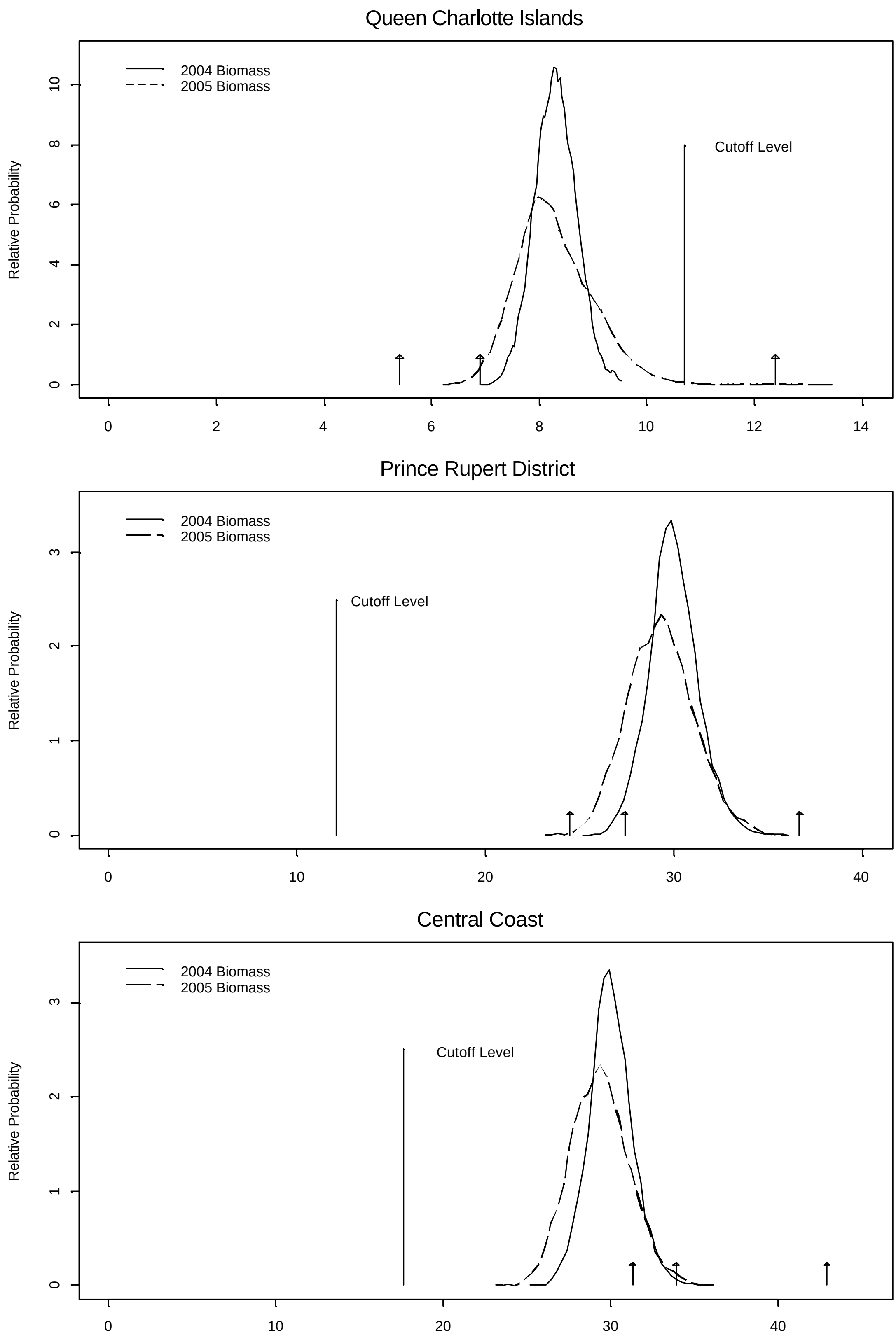
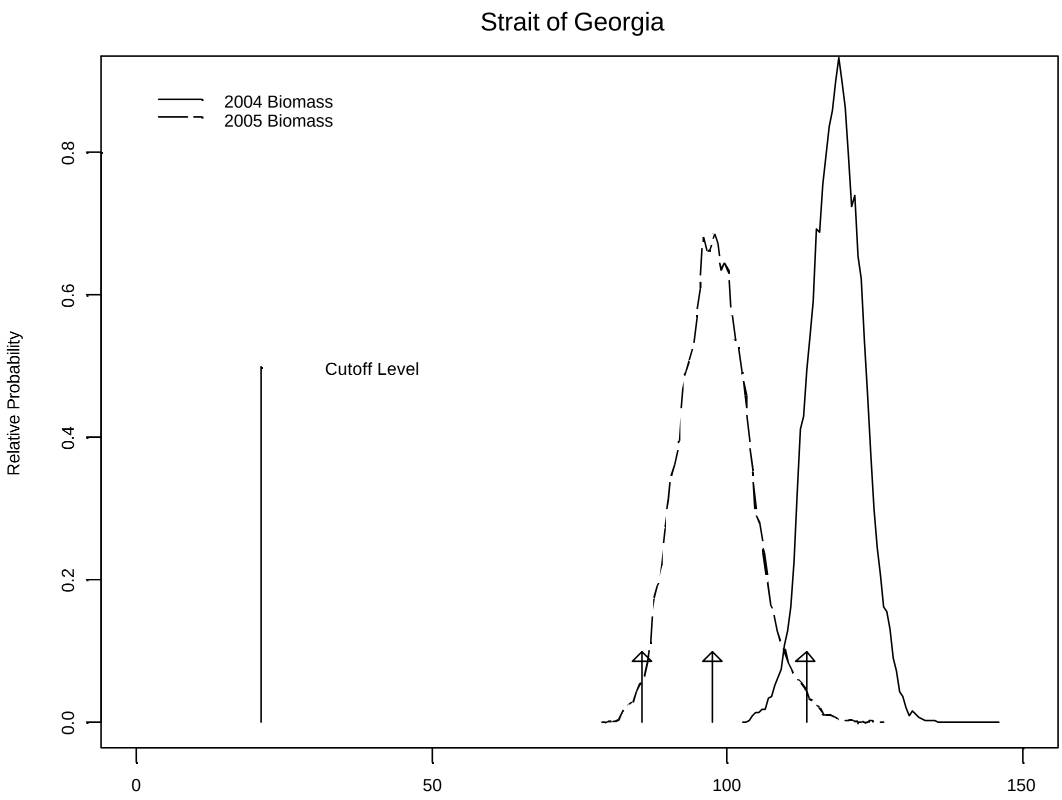


Figure 4.13. Estimated Markov chain Monte Carlo (MCMC) Bayesian profile likelihood distributions for current and forecast pre-fishery biomass for the northern stock assessment regions. Arrows indicate point forecasts assuming poor, average, or good recruitment.



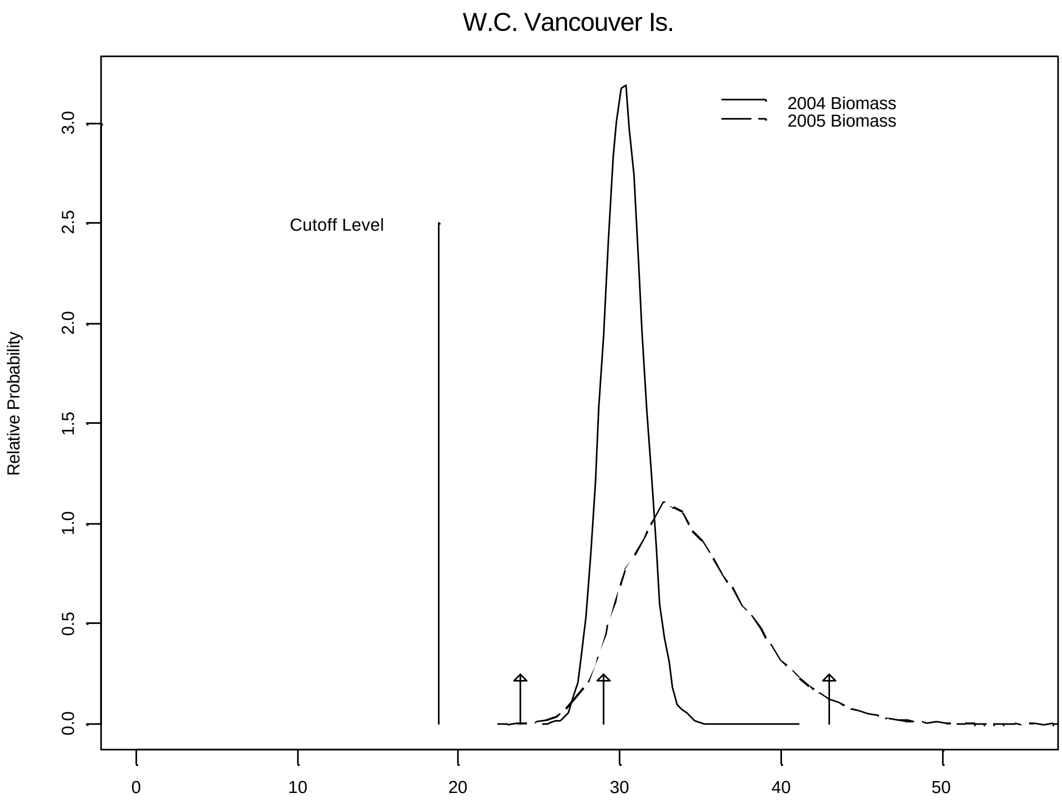


Figure 4.14. Estimated Markov chain Monte Carlo (MCMC) Bayesian profile likelihood distributions for current and forecast pre-fishery biomass for the southern stock assessment regions. Arrows represent point forecasts assuming poor, average and good recruitment.

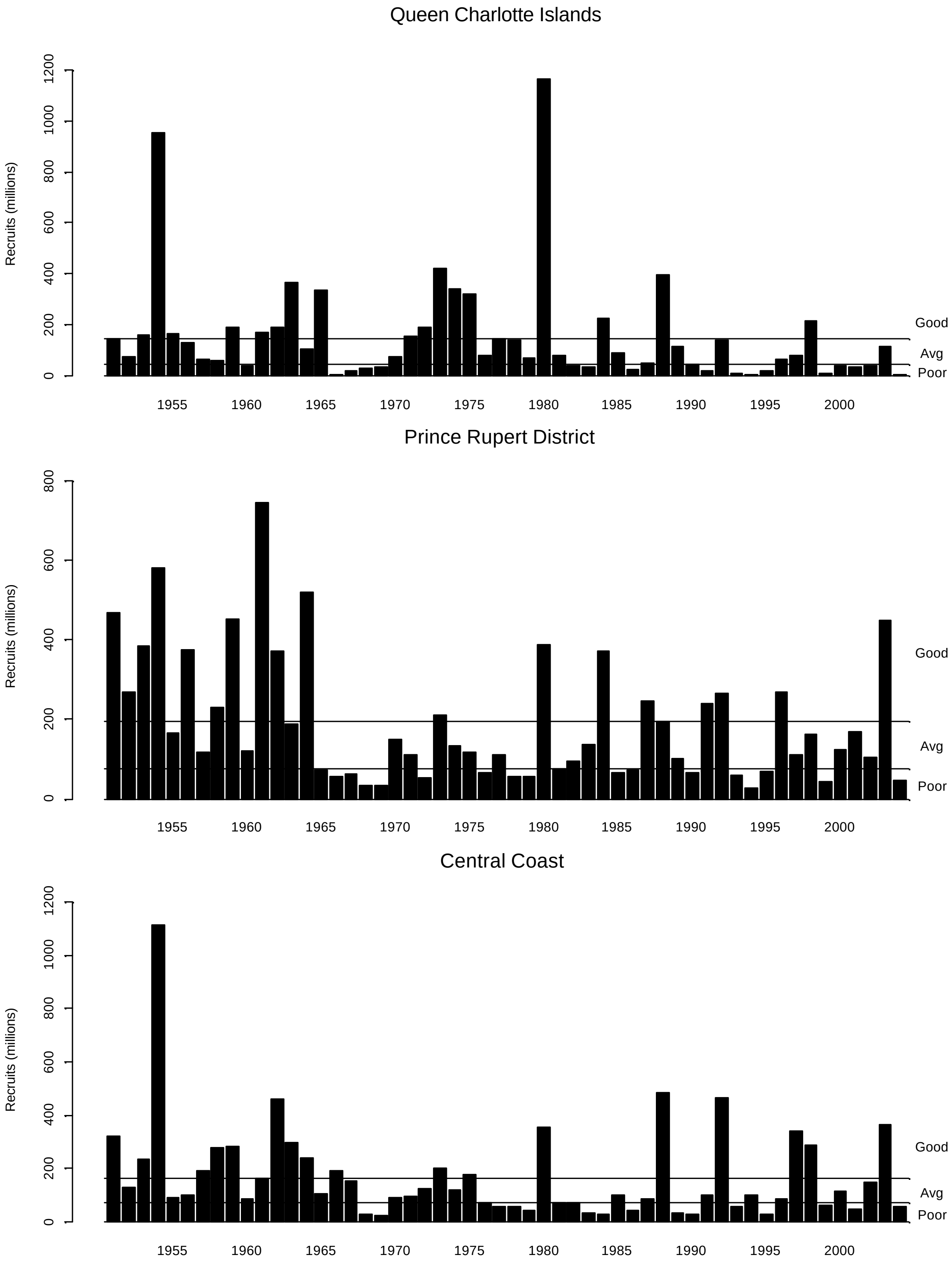


Figure 4.15. Estimates of abundance of recruiting age 2^+ year-classes from age-structured analysis for northern B.C. herring stock assessment regions, 1951-2004. The horizontal lines delimit poor, average, and good recruitment categories and are the 33 and 66 percentiles of the cumulative frequency distribution.

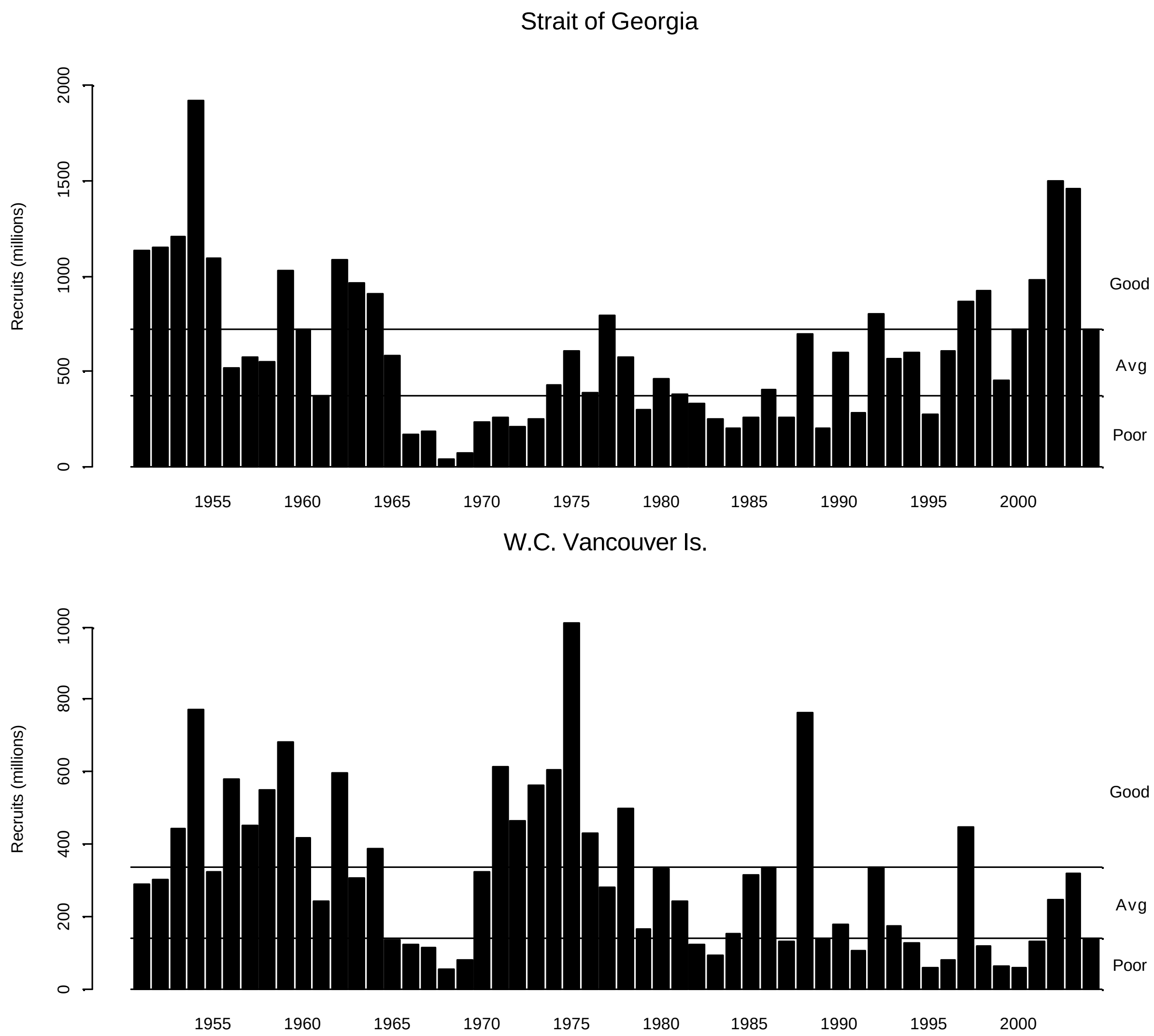


Figure 4.16. Estimates of abundance of recruiting age 2^+ year-classes from age-structured analysis for southern B.C. herring stock assessment regions, 1951-2004. The horizontal lines delimit poor, average, and good recruitment categories and are the 33 and 66 percentiles of the cumulative frequency distribution.

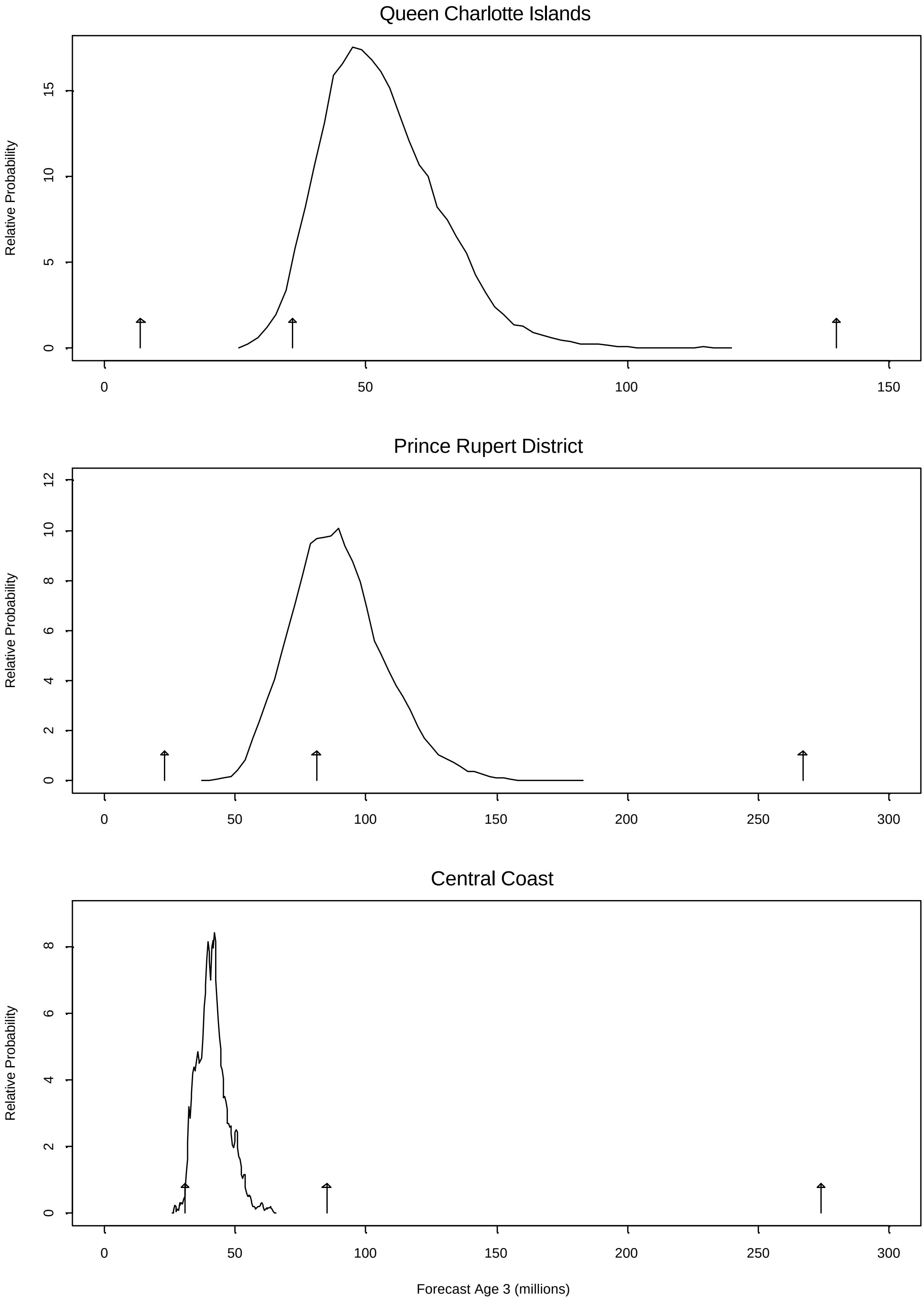


Figure 4.17. Markov chain Monte Carlo (MCMC) Bayesian estimate of the profile likelihood of forecast recruitment to northern assessment regions. Arrows represent point estimates of poor, average, and good recruitment.

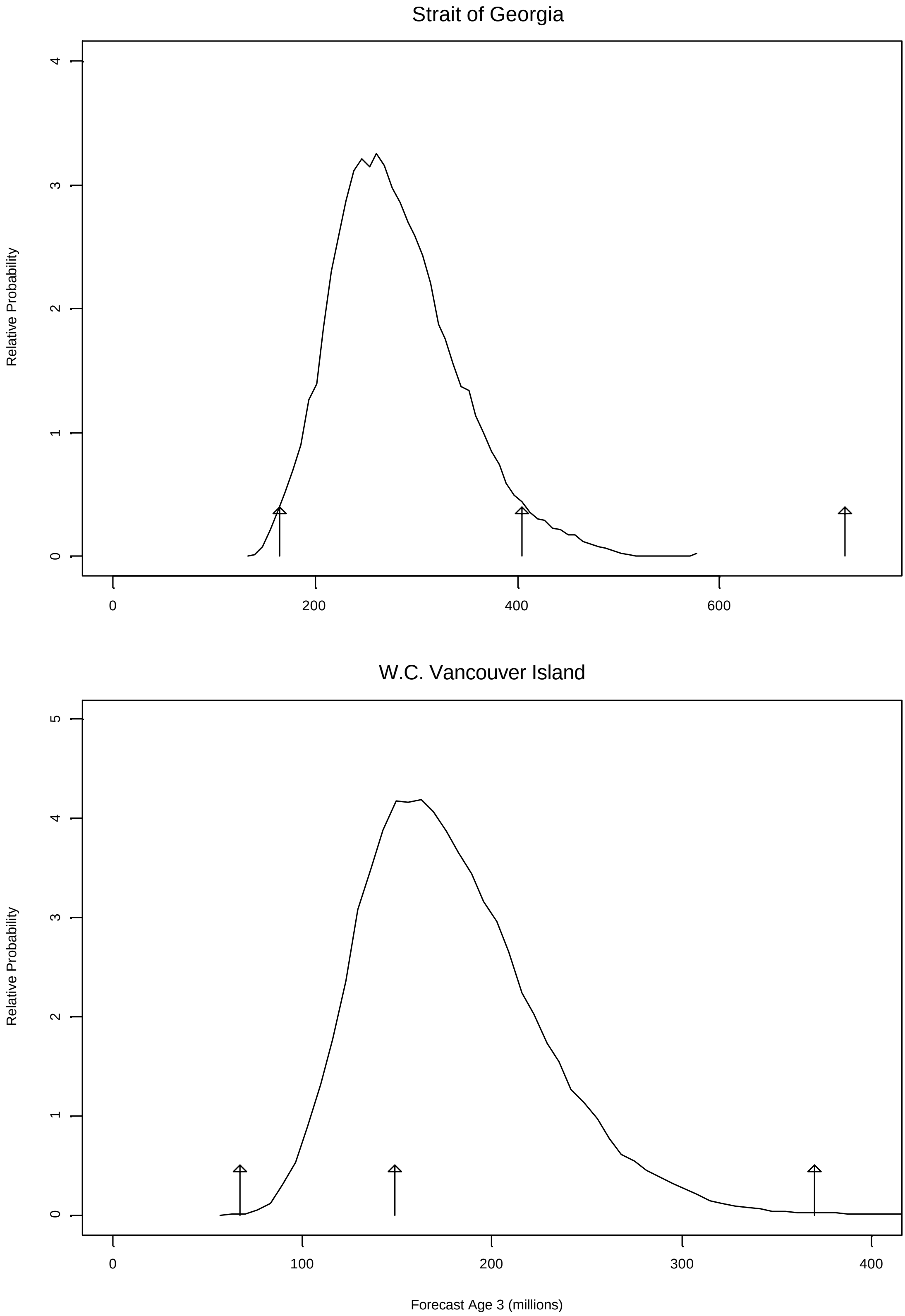


Figure 4.18. Markov chain Monte Carlo (MCMC) Bayesian estimate of the profile likelihood of forecast recruitment to southern assessment regions. Arrows represent point estimates of poor, average, and good recruitment.

Table 4.3. Summary of 2005 abundance forecasts, Cutoff levels, and potential harvest assuming poor, average, or good recruitment for each of the major assessment regions.

Assessment	Abundance Forecast			Cutoff	Potential Harvest		
Region	Poor	Avg	Good	Level	Poor	Avg	Good
Queen Charlotte Is.	5.40	6.93	12.44	10.7	0.00	0.00	1.74*
Prince Rupert	24.49	27.39	36.68	12.1	4.90	5.48	7.34
Central Coast	31.31	33.88	42.92	17.6	6.26	6.78	8.58
Georgia Strait	85.48	97.42	113.30	21.2	17.10	19.48	22.66
W.C. Vancouver Is.	23.81	28.98	43.02	18.8	4.76	5.80	8.60

* Available harvest is the forecast – Cutoff to maintain stock biomass at or above the Cutoff level

5. SIZE AT AGE TRENDS

Inter-annual changes in growth rate of herring can have significant impacts on the size at age and consequently on the estimates of stock productivity and availability to the harvesting sectors. Recent concerns about declining size of herring in the late 1990s ameliorated slightly in the northern areas since 2000 but has continued to decline in the south. In 2004, size-at-age again declined in all areas relative to recent years for most age classes (Fig. 5.1). Size at age trends continue to be of interest and since 1999 have been incorporated into the management decision making process to adjust the potential harvest based on the proportion of the stock estimated to be available to the gillnet sector.

ACKNOWLEDGEMENTS

Chuck Fort and Peter Midgley updated the catch, biological sampling and spawn survey data bases and reviewed all 2003 assessment data. Howard Stiff provided programming support for the Access databases used to summarize the assessment data series. Database upgrades and ongoing maintenance has been funded by the Herring Conservation and Research Society (HCRS). The HCRS through the test fishing program also funded the collection of spawn survey information and test fishery biological samples coastwide.

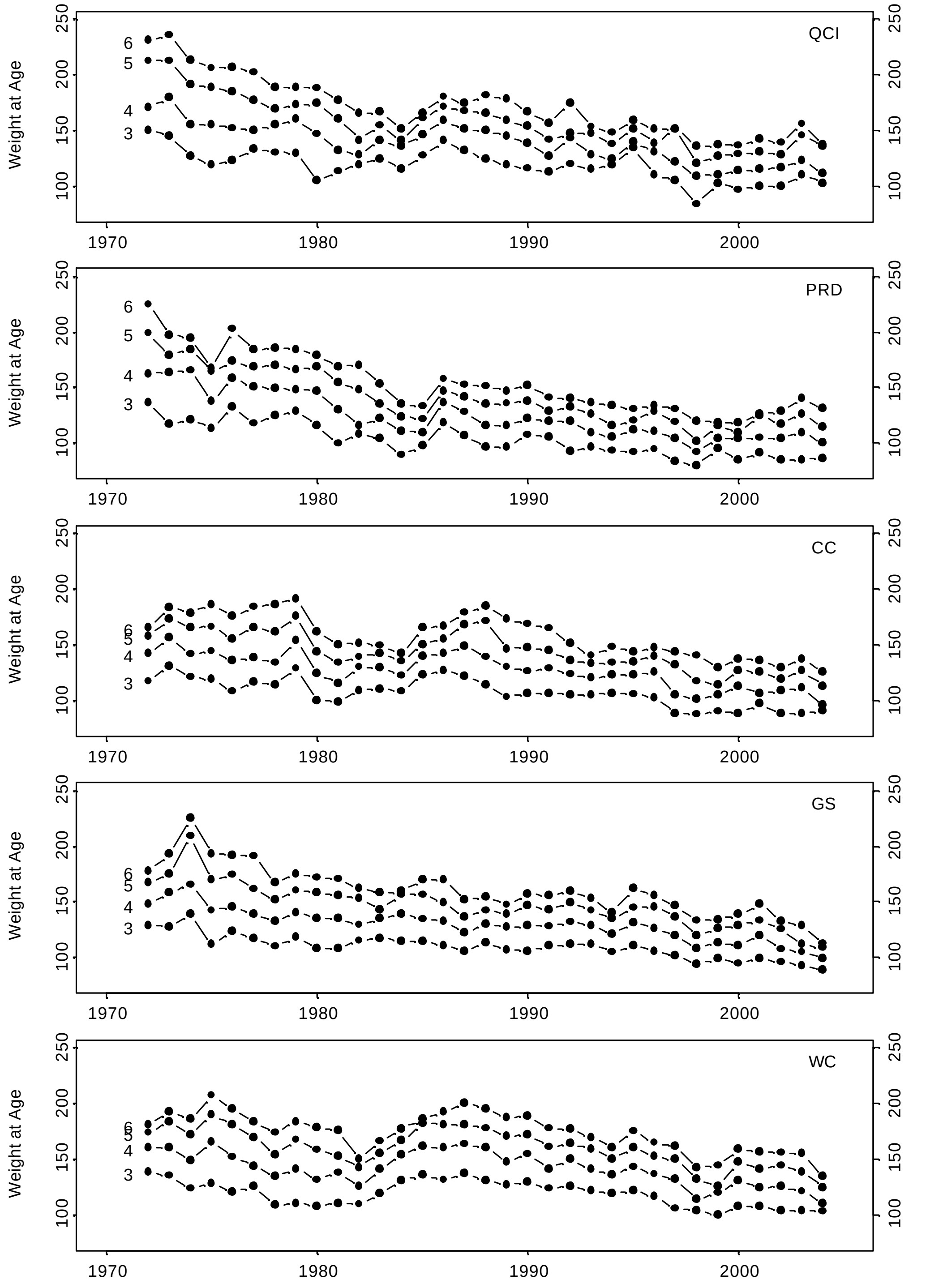


Figure 5.1. Estimates of weight-at-age (g) for 3-6 year old herring from 1951-2004 for the five major assessment regions.

6. REFERENCES

Beacham, T.D., Schweigert, J.F., MacConnachie, C., Le, K.D., Labaree, K., Miller, K.M. 2001. Population structure of herring (*Clupea pallasi*) in British Columbia: an analysis using microsatellite data. Can. Sci. Adv. Secr. 2001/128: 26p.

Beacham, T.D., Schweigert, J.F., MacConnachie, C., Le, K.D., Labaree, K., Miller, K.M. 2002. Population structure of herring (*Clupea pallasi*) in British Columbia: determined by microsatellites, with comparisons to southeast Alaska and California. Can. Sci. Adv. Secr. 2002/109: 37p.

Doubleday, W. G. 1976. A least squares approach to analyzing catch at age data. Res. Bull. Int. Comm. Northw. Atl. Fish. 12: 69-81.

Flostrand, L., and J.F. Schweigert. 2002. Pacific herring coded wire tagging study: releases, recoveries, 1999-2001. Can. Tech. Rep. Fish. Aquat. Sci. 2428: 34p.

Flostrand, L., and J.F. Schweigert. 2003. Pacific herring coded wire tagging study: releases, recoveries, 1999-2002. Can. Tech. Rep. Fish. Aquat. Sci. 2483: 38p.

Fournier, D., and C. P. Archibald. 1982. A general theory for analyzing catch at age data. Can. J. Fish. Aquat. Sci. 39: 1195-1207.

Haegele, C. W., A. S. Hourston, R. D. Humphreys, and D. C. Miller. 1979. Eggs per unit area in British Columbia herring spawn depositions. Fish. Mar. Serv. Tech. Rep. 894: 30p.

Haegele, C. W. and J. F. Schweigert. 1985. Estimation of egg numbers in Pacific herring spawns on giant kelp. N. Am. J. Fish. Manag. 5: 65-71.

Haegele, C. W. and J. F. Schweigert. 1990. A model which predicts Pacific herring (*Clupea harengus pallasi*) egg deposition on giant kelp (*Macrocystis* sp.) plants from underwater observations. Can. MS Rep. Fish. Aquat. Sci. 2056: 17p.

Haist, V., and L. Rosenfeld. 1988. Definitions and codings of localities, sections and assessment regions for British Columbia herring data. Can. MS Rep. Fish. Aquat. Sci. 1994: 123p.

Haist, V., and J.F. Schweigert. 1990. Stock assessments for British Columbia herring in 1989 and forecasts of the potential catch in 1990. Can. Tech. Rep. Fish. Aquat. Sci. 2049: 62p.

Haist, V., and M. Stocker. 1985. Growth and maturation of Pacific herring (*Clupea harengus pallasi*) in the Strait of Georgia. Can. J. Fish. Aquat. Sci. 42 (Suppl. 1): 138-146.

Haist, V., M. Stocker, and J. F. Schweigert. 1985. Stock assessments for British Columbia herring in 1984 and forecasts of the potential catch in 1985. Can. Tech. Rep. Fish. Aquat. Sci. 1365: 53p.

Hall, D. L., R. Hilborn, M. Stocker, and C. J. Walters. 1988. Alternative harvest strategies for Pacific herring (*Clupea harengus pallasi*). Can. J. Fish. Aquat. Sci. 45: 888-897.

Hay, D. E. 1985. Reproductive biology of Pacific herring (*Clupea harengus pallasi*). Can. J. Fish. Aquat. Sci. 42 (Suppl. 1): 111-126.

Hay, D. E., and A. R. Kronlund. 1987. Factors affecting the distribution, abundance, and measurement of Pacific herring *(Clupea harengus pallasi)* spawn. Can. J. Fish. Aquat. Sci. 44: 1181-1194.

Otter Research Ltd.. 2001. An introduction to AD Model Builder Version 6.0.2 for use in nonlinear modeling and statistics. Otter Research Ltd., Sydney, B.C.

Schweigert, J. 2001. Stock assessment for British Columbia herring in 2001 and forecasts of the potential catch in 2002. Can. Sci. Adv. Secr. 2001/140: 84p.

Schweigert, J. F. 1993. A review and evaluation of methodology for estimating Pacific herring egg deposition. Bull. Mar. Sci. 53: 818-841.

Schweigert, J., and L. Flostrand. 2000. Pacific herring coded wire tagging study: 1999 releases recovered in 2000. Can. Tech. Rep. Fish. Aquat. Sci. 2335: 33p.

Schweigert, J. F., and C. W. Haegele. 1988a. Herring stock estimates from diving surveys of spawn for Georgia and Johnstone Straits in 1985. Can. MS Rep. Fish. Aquat. Sci. 1972: 63p.

Schweigert, J. F., and C. W. Haegele. 1988b. Herring stock estimates from diving surveys of spawn in Georgia Strait in 1986. Can. MS Rep. Fish. Aquat. Sci. 1971: 65p.

Schweigert, J. F., C. W. Haegele, and M. Stocker. 1985. Optimizing sampling design for herring spawn surveys in the Strait of Georgia, B.C. Can. J. Fish. Aquat. Sci. 42: 1806-1814.

Schweigert, J. F., C. W. Haegele, and M. Stocker. 1990. Evaluation of sampling strategies for SCUBA surveys to assess spawn deposition by Pacific herring. N. Am. J. Fish. Manag. 10: 185-195.

Schweigert, J., D. Hay, and C. Fort. 1993. Herring spawn index analysis. PSARC Working Paper H93-2.

Schweigert, J. F., and M. Stocker. 1988. A new method for estimating Pacific herring stock size from spawn survey data and its management implications. N. Amer. J. Fish. Mgmt. 8: 63-74.

Schweigert, J., and D. Ware. 1995. Review of the biological basis for B.C. herring stock harvest rates and conservation levels. PSARC Working Paper H95: 2.

Shields, T.L., Jamieson, G.S., and P.E. Sprout. 1985. Spawn-on-kelp fisheries in the Queen Charlotte Islands and the northern British Columbia coast – 1982 and 1983l. Can. Tech. Rep. Fish. Aquat. Sci. 1372: 53p.

Zheng, J., F. C. Funk, G. H. Kruse, and R. Fagen. 1993. Threshold management strategies for Pacific herring in Alaska. In: Proc. Int. Symp. on Management Strategies for Exploited Fish Populations. Alaska Sea Grant Report 93-02. Univ. Alaska Fairbanks.

7. APPENDICES

Appendix 1.1. Age composition and catch by season, fishery and gear type for the Queen Charlotte Islands stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19501	Seine	Jan-Apr	0.00	0.07	15.31	52.91	15.31	11.52	4.20	0.61	0.07	0.00	89.7	1,476	2,847	31.744
19512	Seine	Jan-Apr	1.92	24.77	20.96	29.67	17.98	3.71	0.93	0.07	0.00	0.00	78.4	2,251	10,147	122.347
19534	Seine	Jan-Apr	0.06	2.90	29.02	21.28	33.66	10.19	1.93	0.71	0.19	0.06	77.1	0 *	1,786	23.168
19545	Seine	Oct-Dec	0.00	8.74	14.08	39.42	18.06	14.85	4.37	0.29	0.10	0.10	94.1	0 *	99	1.047
	Seine	Jan-Apr	0.00	8.74	14.08	39.42	18.06	14.85	4.37	0.29	0.10	0.10	94.1	0 *	1,136	12.066
19556	Seine	Jan-Apr	0.00	0.15	16.02	9.64	62.17	8.38	2.74	0.74	0.00	0.15	118.2	1,348	77,681	657.044
19567	Seine	Jan-Apr	0.07	20.71	24.66	15.96	9.38	26.29	2.37	0.44	0.11	0.00	103.3	4,423	23,711	227.806
19578	Seine	Oct-Dec	0.00	81.58	16.68	1.26	0.18	0.14	0.14	0.00	0.00	0.00	52.1	2,769 +	721	13.844
	Seine	Jan-Apr	0.00	81.98	16.24	1.29	0.20	0.16	0.12	0.00	0.00	0.00	51.8	2,475	10,426	201.343
	Seine	May-Sep	0.00	81.58	16.68	1.26	0.18	0.14	0.14	0.00	0.00	0.00	52.1	2,769 +	19	0.357
19589	Seine	Oct-Dec	0.00	1.05	63.16	28.42	7.37	0.00	0.00	0.00	0.00	0.00	92.8	95 +	199	2.140
	Seine	Jan-Apr	0.00	1.05	63.16	28.42	7.37	0.00	0.00	0.00	0.00	0.00	92.8	95 +	6,828	73.560
19601	Seine	Jan-Apr	0.00	4.21	32.63	36.00	24.84	1.26	0.42	0.21	0.42	0.00	97.7	0 *	576	5.901
	Seine	May-Sep	0.00	4.21	32.63	36.00	24.84	1.26	0.42	0.21	0.42	0.00	97.7	0 *	77	0.789
19612	Seine	Jan-Apr	0.00	2.57	38.97	44.12	5.88	7.35	0.74	0.37	0.00	0.00	114.0	272 +	7,632	66.952
19623	Seine	Jan-Apr	0.00	0.37	50.00	27.11	18.16	2.11	1.99	0.00	0.12	0.12	109.5	804	14,705	134.232
	Seine	May-Sep	0.00	0.37	50.00	27.11	18.16	2.11	1.99	0.00	0.12	0.12	109.5	804 +	275	2.508
19634	Seine	Jan-Apr	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490	28,600	251.046
	Seine	May-Sep	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490 +	131	1.154
	Trawl	Jan-Apr	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490 +	46	0.401
19645	Seine	Jan-Apr	0.00	1.71	82.31	10.25	3.63	1.34	0.55	0.20	0.00	0.00	101.5	1,019	35,304	348.556
	Seine	May-Sep	0.00	1.67	81.75	10.30	4.02	1.47	0.59	0.20	0.00	0.00	102.0	1,019 +	145	1.419
19656	Seine	Jan-Apr	0.00	18.36	32.77	16.38	10.40	7.45	5.89	4.92	2.07	1.75	130.7	0 *	2,746	21.016
19667	Seine	Jan-Apr	0.00	0.88	67.25	26.49	2.65	2.72	0.00	0.00	0.00	0.00	113.0	0 *	213	1.883
19678	Seine	Jan-Apr	0.00	29.95	50.57	17.23	2.25	0.00	0.00	0.00	0.00	0.00	94.9	0 *	80	0.843
19701	Seine	Jan-Apr	0.00	6.50	50.40	29.30	8.00	4.30	0.80	0.50	0.20	0.00	118.1	0 *	102	0.861
19712	Seine	Jan-Apr	0.00	3.59	34.24	40.98	12.30	5.57	2.14	0.77	0.35	0.06	142.1	1,184	3,972	27.954
19723	Seine	Jan-Apr	0.00	0.20	32.91	18.91	32.99	11.77	2.10	1.13	0.00	0.00	140.7	1,726	7,520	49.735
19734	Seine	Jan-Apr	0.00	0.12	27.40	41.39	17.67	10.64	2.32	0.40	0.06	0.00	126.8	1,215	6,191	47.881
	Gillnet	Jan-Apr	0.00	0.00	5.73	48.41	25.48	16.56	3.18	0.00	0.00	0.64	153.8	157 +	127	0.824
19745	Seine	Jan-Apr	0.00	0.62	27.82	36.04	24.53	8.53	1.94	0.40	0.12	0.00	132.8	6,010	7,602	60.181
	Seine	May-Sep	0.00	0.13	33.28	45.41	13.55	5.29	1.72	0.46	0.17	0.00	116.3	3,026 +	17	0.147
	Gillnet	Jan-Apr	0.00	0.00	0.00	22.50	40.00	30.00	5.00	2.50	0.00	0.00	169.3	40 +	105	0.619
19756	Seine	Jan-Apr	0.00	0.30	2.98	44.51	31.53	15.24	4.61	0.76	0.06	0.00	155.4	4,055	11,939	82.499
	Seine	May-Sep	0.00	0.44	2.81	36.87	29.25	23.18	6.41	0.96	0.07	0.00	151.8	4,055 +	374	2.466
	Other	Jan-Apr	0.00	0.44	2.81	36.87	29.25	23.18	6.41	0.96	0.07	0.00	151.8	4,055 +	341	2.247
	Gillnet	Jan-Apr	0.00	0.00	0.00	0.75	21.80	60.90	14.29	2.26	0.00	0.00	196.2	133 +	1,802	9.186
19767	Seine	Jan-Apr	0.00	0.05	18.42	9.26	36.66	22.74	9.92	2.64	0.31	0.00	159.1	3,178	11,125	73.628
	Seine	May-Sep	0.00	0.09	19.67	8.12	29.70	22.91	14.66	4.44	0.41	0.00	157.1	3,178 +	21	0.132
	Other	Jan-Apr	0.00	0.09	19.67	8.12	29.70	22.91	14.66	4.44	0.41	0.00	157.1	3,178 +	1,365	8.687
	Gillnet	Jan-Apr	0.00	0.00	0.00	2.53	16.61	39.71	27.08	11.55	2.17	0.36	196.6	277 +	1,489	7.575
19778	Seine	Jan-Apr	0.00	0.16	22.75	17.10	11.34	33.12	13.29	2.03	0.17	0.05	146.4	1,172	9,172	62.947
	Other	Jan-Apr	0.00	0.17	26.28	17.24	9.56	26.54	14.08	4.95	0.94	0.26	147.5	1,172 +	819	5.554
	Gillnet	Jan-Apr	0.00	0.00	0.00	4.17	11.81	20.14	38.89	20.14	4.17	0.69	196.9	144 +	2,553	12.967
19789	Seine	Oct-Dec	0.00	6.22	4.91	32.53	18.23	20.31	14.19	3.06	0.44	0.11	149.9	916 +	50	0.336
	Seine	Jan-Apr	0.00	7.06	5.39	32.35	18.23	20.80	12.45	3.08	0.51	0.13	148.9	779	5,817	39.078
	Other	Jan-Apr	0.00	6.22	4.91	32.53	18.23	20.31	14.19	3.06	0.44	0.11	149.9	916 +	1,001	6.679
	Gillnet	Jan-Apr	0.00	0.00	0.00	28.24	25.88	27.06	15.29	3.53	0.00	0.00	160.1	170 +	2,086	13.028
19790	Seine	Jan-Apr	0.00	0.69	83.10	4.49	5.44	2.58	1.79	1.22	0.60	0.09	97.1	2,986	2,106	22.050
	Other	Jan-Apr	0.00	1.74	83.71	4.18	4.46	2.49	1.54	1.15	0.65	0.07	93.5	4,015 +	1,001	10.704
	Gillnet	Jan-Apr	0.00	0.00	6.50	4.56	44.47	19.36	19.58	4.20	1.34	0.00	157.6	518	1,210	7.739
19801	Seine	Jan-Apr	0.00	0.42	3.05	85.37	5.13	3.08	1.92	0.68	0.21	0.14	116.3	5,551	3,888	32.912
	Seine	May-Sep	0.00	1.33	3.92	88.65	2.94	1.73	0.69	0.35	0.23	0.17	112.7	1,735 +	39	0.342
	Other	Jan-Apr	0.00	0.54	3.69	84.91	5.08	2.79	1.75	0.71	0.28	0.24	117.0	6,336 +	910	7.778
	Gillnet	Jan-Apr	0.00	0.00	0.30	72.00	8.55	9.84	5.88	2.84	0.60	0.00	141.9	790	1,705	11.930
19812	Seine	Jan-Apr	0.00	0.45	3.26	3.50	87.61	2.19	1.34	0.95	0.57	0.12	127.2	3,526	2,353	18.420
	Seine	May-Sep	0.00	0.85	4.68	4.48	84.32	2.47	1.53	0.99	0.54	0.14	128.0	3,526 +	18	0.138
	Other	Jan-Apr	0.00	0.85	4.68	4.48	84.32	2.47	1.53	0.99	0.54	0.14	128.0	3,526 +	1,001	7.821
	Gillnet	Jan-Apr	0.00	0.00	0.21	3.35	89.10	3.35	2.31	1.05	0.42	0.21	141.9	477	1,407	9.918
19823	Seine	Jan-Apr	0.00	4.14	4.21	3.02	5.75	77.05	3.65	1.33	0.70	0.14	148.7	1,425	4,601	30.942
	Seine	May-Sep	0.00	4.88	5.23	3.51	6.86	72.87	3.91	1.58	0.91	0.25	146.9	1,968 +	67	0.457
	Other	Jan-Apr	0.00	4.88	5.23	3.51	6.86	72.87	3.91	1.58	0.91	0.25	146.9	1,968 +	1,001	6.815
	Gillnet	Jan-Apr	0.00	0.00	0.00	1.19	2.38	90.32	2.72	2.38	0.51	0.51	158.5	589	929	5.860

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.1. Age composition and catch by season, fishery and gear type for the Queen Charlotte Islands stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	**Gear**	**Fishery**	**0+**	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9++**	**Weight**	**Aged**	**(tonnes)**	**(millions)**
19834	Seine	Jan-Apr	0.00	2.09	36.57	4.17	2.64	9.56	43.33	1.11	0.35	0.17	126.1	3,484	4,054	31.997
	Seine	May-Sep	0.00	2.70	36.39	4.54	2.87	10.10	41.76	1.12	0.34	0.17	125.5	3,484 +	58	0.459
	Other	Jan-Apr	0.00	2.70	36.39	4.54	2.87	10.10	41.76	1.12	0.34	0.17	125.5	3,484 +	1,001	7.976
	Gillnet	Jan-Apr	0.00	0.00	2.81	1.28	4.60	8.95	80.05	1.79	0.26	0.26	154.6	391 +	535	3.459
19845	Seine	Jan-Apr	0.00	0.12	8.63	25.14	3.52	3.93	12.79	45.24	0.53	0.10	146.4	3,099	4,581	27.888
	Seine	May-Sep	0.00	0.10	8.15	24.49	3.51	3.95	12.94	46.22	0.54	0.10	165.5	2,025 +	35	0.209
	Other	Jan-Apr	0.00	1.32	14.93	31.83	4.05	4.50	11.36	31.47	0.45	0.08	148.1	3,556 +	1,001	6.758
	Gillnet	Jan-Apr	0.00	0.00	8.30	24.48	2.90	4.56	12.45	46.89	0.41	0.00	155.0	241 +	1,493	9.632
19856	Seine	Jan-Apr	0.00	0.16	2.00	21.05	37.46	3.69	3.28	8.88	23.03	0.43	165.5	4,462	2,613	15.278
	Trawl	Jan-Apr	0.00	0.31	2.80	10.56	37.58	8.70	9.63	11.18	17.70	1.55	163.5	322	0	0.000 ~
	Other	Jan-Apr	0.00	0.22	2.83	21.27	40.02	4.33	3.68	8.23	19.03	0.40	165.5	5,055 +	1,001	6.048
	Gillnet	Jan-Apr	0.00	0.00	0.00	12.73	53.42	4.04	5.28	9.01	15.22	0.31	159.7	322 +	890	5.576
19867	Seine	Jan-Apr	0.00	1.78	9.60	4.90	24.93	38.44	3.88	4.36	5.86	6.24	158.6	2,916	2,028	12.787
	Seine	May-Sep	0.00	1.74	10.42	5.85	24.35	37.76	3.84	4.33	5.79	5.91	157.2	3,281 +	33	0.210
	Other	Jan-Apr	0.00	1.74	10.42	5.85	24.35	37.76	3.84	4.33	5.79	5.91	157.2	3,281 +	1,001	6.366
19878	Seine	Jan-Apr	0.00	3.64	51.01	7.52	4.77	11.75	14.86	1.37	1.67	3.40	123.6	1,676	0	0.000 ~
	Seine	May-Sep	0.00	1.34	41.98	5.34	3.24	14.50	22.71	1.91	1.72	7.25	136.5	524 +	32	0.232
	Trawl	Jan-Apr	0.00	1.33	68.11	11.63	1.66	6.98	6.64	1.33	1.66	0.66	105.4	301	0	0.000 ~
	Other	Jan-Apr	0.00	3.29	53.62	8.14	4.30	11.03	13.61	1.37	1.67	2.98	120.8	1,977 +	1,000	8.277
19889	Seine	Jan-Apr	0.00	3.43	5.12	85.99	3.74	0.18	0.77	0.47	0.08	0.22	119.2	2,996	1,449	11.972
	Seine	May-Sep	0.00	1.27	31.75	45.90	4.03	2.55	7.00	4.81	1.06	1.63	117.4	1,414 +	13	0.108
	Other	Jan-Apr	0.00	2.27	17.46	66.35	4.01	1.57	3.90	2.78	0.62	1.04	120.5	3,563 +	824	6.839
19890	Seine	Jan-Apr	0.00	0.14	10.61	6.53	78.55	2.43	0.33	0.85	0.34	0.23	133.9	4,769	5,542	39.649
	Other	Jan-Apr	0.00	0.22	9.64	18.17	60.02	3.94	1.84	3.82	1.70	0.65	134.8	5,053 +	915	6.789
	Gillnet	Jan-Apr	0.00	0.00	0.51	8.18	44.50	9.97	8.44	17.39	8.44	2.56	149.6	391 +	1,170	7.821
19901	Seine	Jan-Apr	0.00	5.60	4.25	10.74	33.21	33.99	3.68	2.00	4.70	1.84	127.8	2,448	3,899	30.506
	Trawl	Jan-Apr	0.00	1.06	4.26	8.51	21.28	46.81	4.26	6.38	4.26	3.19	143.0	94	0	0.000 ~
	Other	Jan-Apr	0.00	6.55	4.14	10.60	28.50	38.70	3.71	1.92	3.99	1.90	130.3	3,481 +	1,001	7.684
	Gillnet	Jan-Apr	0.00	0.00	0.00	2.27	22.44	43.47	9.66	7.10	10.23	4.83	151.9	352 +	543	3.576
19912	Seine	Jan-Apr	0.00	1.05	30.50	4.25	8.27	4.46	48.40	2.42	0.14	0.52	143.2	3,228	2,524	16.695
	Trawl	Jan-Apr	0.00	1.08	54.84	9.68	2.15	15.05	11.83	3.23	2.15	0.00	115.6	93	0	0.000 ~
	Other	Jan-Apr	0.00	0.72	38.96	5.06	8.19	12.53	30.20	2.41	0.63	1.29	134.2	3,321 +	583	4.343
19923	Seine	Jan-Apr	0.00	0.04	2.79	67.33	4.25	4.68	9.73	9.95	0.87	0.36	124.2	2,755	2,699	21.742
	Trawl	Jan-Apr	0.00	1.75	4.68	59.65	5.85	6.43	11.70	7.02	2.34	0.58	125.9	171	0	0.000 ~
	Other	Jan-Apr	0.00	0.39	3.50	60.31	4.51	6.08	12.05	11.54	1.21	0.41	128.3	3,883 +	883	6.883
	Gillnet	Jan-Apr	0.00	0.00	0.00	2.27	22.44	43.47	9.66	7.10	10.23	4.83	151.9	352 +	0	0.002
19934	Seine	Jan-Apr	0.00	5.50	5.50	5.63	40.75	12.87	14.48	11.13	3.49	0.67	130.5	746	299	2.291
	Trawl	Jan-Apr	0.00	7.08	2.36	5.42	53.30	8.49	6.60	8.49	7.31	0.94	133.0	424	0	0.000 ~
	Other	Jan-Apr	0.00	6.39	3.77	5.11	49.67	10.04	9.80	10.23	4.26	0.73	129.0	1,643 +	1,092	8.467
19945	Seine	Jan-Apr	0.00	14.35	15.82	2.32	4.43	37.55	9.70	8.02	5.27	2.53	134.8	474	0	0.000 ~
19956	Seine	Jan-Apr	0.10	10.76	53.81	9.30	3.24	3.34	15.57	2.40	1.15	0.31	102.8	957	0	0.000 ~
19967	Seine	Jan-Apr	0.00	22.64	26.17	33.41	5.23	1.52	4.44	5.36	0.85	0.37	97.5	1,643	0	0.000 ~
	Other	Jan-Apr	0.00	22.64	26.17	33.41	5.23	1.52	4.44	5.36	0.85	0.37	97.5	1,643 +	214	2.194
19978	Seine	Jan-Apr	0.00	0.16	58.12	27.55	9.74	2.53	0.48	0.40	0.63	0.40	87.9	1,263	1,372	15.597
	Other	Jan-Apr	0.00	0.37	54.12	27.91	11.60	2.69	0.66	1.22	1.10	0.33	87.8	2,716 +	818	9.322
19989	Seine	Jan-Apr	0.00	3.71	2.16	65.00	16.83	8.03	2.78	0.67	0.41	0.41	105.9	1,943	2,500	23.604
	Other	Jan-Apr	0.00	4.29	2.31	63.99	17.21	8.11	2.54	0.64	0.40	0.52	105.8	2,516 +	819	7.742
	Gillnet	Jan-Apr	0.00	0.00	0.67	30.78	22.80	29.12	9.98	2.66	1.33	2.66	131.4	601	473	3.596
19990	Seine	Jan-Apr	0.00	3.63	17.30	3.71	60.69	8.26	5.25	0.39	0.62	0.15	106.9	1,295	1,764	16.500
	Other	Jan-Apr	0.00	4.98	18.51	3.91	59.07	7.95	4.51	0.42	0.47	0.19	107.5	2,150 +	910	8.468
20001	Seine	Jan-Apr	0.00	15.26	31.65	22.32	5.06	20.92	3.05	1.39	0.26	0.09	97.0	1,147	0	0.000 ~
	Other	Jan-Apr	0.00	15.26	31.65	22.32	5.06	20.92	3.05	1.39	0.26	0.09	97.0	1,147 +	408	4.207
20012	Seine	Jan-Apr	0.00	20.84	22.90	25.47	12.99	3.11	12.83	1.36	0.43	0.08	93.6	2,572	706	7.543
	Other	Jan-Apr	0.00	20.46	25.49	24.00	12.54	2.92	12.61	1.43	0.44	0.10	94.7	2,942 +	910	9.608
20023	Seine	Jan-Apr	0.00	0.08	68.16	18.33	6.43	3.24	1.13	2.10	0.40	0.12	96.7	2,472	0	0.000 ~
20023	Other	Jan-Apr	0.00	0.08	68.16	18.33	6.43	3.24	1.13	2.10	0.40	0.12	96.7	2,472 +	910	9.408
20034	Seine	Jan-Apr	0.00	29.35	2.37	50.65	8.76	4.02	2.60	1.42	0.59	0.24	91.5	845	0	0.000 ~
	Other	Jan-Apr	0.00	29.35	2.37	50.65	8.76	4.02	2.60	1.42	0.59	0.24	91.5	845 +	910	9.945

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	**Gear**	**Fishery**	**0+**	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9++**	**Weight**	**Aged**	**(tonnes)**	**(millions)**
19501	Seine	Oct-Dec	0.03	5.19	18.96	57.83	10.05	5.42	2.27	0.20	0.06	0.00	91.5	3,524	27,192	297.109
	Seine	Jan-Apr	0.09	1.72	15.86	60.43	11.38	6.21	3.79	0.43	0.00	0.09	95.8	1,160	18,674	195.022
19512	Seine	Oct-Dec	0.09	5.32	9.32	33.19	45.08	5.66	0.91	0.40	0.03	0.00	121.7	3,498	42,613	350.112
	Seine	Jan-Apr	0.00	3.96	8.08	34.32	45.41	6.84	1.19	0.16	0.04	0.00	115.7	2,427	9,650	83.415
	Seine	May-Sep	0.05	4.76	8.81	33.65	45.22	6.14	1.03	0.30	0.03	0.00	119.2	5,925 +	116	0.976
19523	Seine	Oct-Dec	0.00	1.46	38.05	28.90	26.40	4.99	0.21	0.00	0.00	0.00	114.7	481	401	3.491
	Seine	Jan-Apr	0.00	1.07	38.17	20.04	24.95	14.29	1.39	0.11	0.00	0.00	107.7	938	1,465	13.601
19534	Seine	Oct-Dec	0.00	0.38	22.98	31.95	27.13	14.48	2.52	0.56	0.01	0.00	114.3	2,138	26,692	232.215
	Seine	Jan-Apr	0.00	8.88	47.88	19.11	13.51	6.76	3.28	0.58	0.00	0.00	83.9	518	584	6.969
19545	Seine	Jan-Apr	0.00	2.25	4.08	70.30	15.80	6.01	1.34	0.22	0.00	0.00	105.2	1,131	17,806	167.544
19556	Seine	Oct-Dec	0.00	10.04	58.11	9.51	18.95	2.55	0.53	0.18	0.12	0.00	83.6	1,683 +	1,602	19.164
	Seine	Jan-Apr	0.00	8.99	59.62	9.14	18.79	2.65	0.66	0.07	0.07	0.00	84.6	1,357	8,580	101.455
19567	Seine	Oct-Dec	0.00	18.02	19.80	35.57	12.24	13.25	0.90	0.22	0.00	0.00	93.8	3,172 +	820	9.056
	Seine	Jan-Apr	0.00	3.83	19.26	42.33	13.46	19.05	1.61	0.41	0.05	0.00	104.8	2,784	19,753	182.450
	Seine	May-Sep	0.00	0.00	7.11	44.95	37.16	9.17	1.38	0.23	0.00	0.00	106.7	436	7,461	69.921
	Trawl	Jan-Apr	0.00	4.08	21.43	52.04	12.24	10.20	0.00	0.00	0.00	0.00	88.3	98	0	0.000 ~
19578	Seine	Oct-Dec	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497 +	1,270	20.260
	Seine	Jan-Apr	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497 +	667	10.640
	Seine	May-Sep	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497 +	2,586	41.259
19589	Seine	Oct-Dec	0.00	1.64	62.11	19.52	5.96	7.16	2.05	1.54	0.01	0.00	98.0	1,592 +	1,629	16.406
	Seine	Jan-Apr	0.00	2.88	61.03	19.34	5.06	7.96	1.81	1.85	0.06	0.00	97.5	1,454	5,629	57.722
	Seine	May-Sep	0.00	1.17	62.96	19.29	6.19	6.74	2.21	1.44	0.56	0.00	98.7	1,592 +	2,899	29.047
	Trawl	Jan-Apr	0.00	3.39	58.98	20.35	5.15	8.73	1.44	1.88	0.06	0.00	97.5	1,592 +	66	0.674
19590	Seine	Oct-Dec	0.00	62.74	8.21	20.55	5.57	1.63	1.10	0.08	0.12	0.00	64.7	1,549	3,125	49.715
	Seine	Jan-Apr	0.00	66.74	7.43	18.52	4.46	1.48	0.94	0.22	0.22	0.00	61.5	1,617	12,513	218.740
	Seine	May-Sep	0.00	5.00	3.26	51.30	20.22	10.65	7.39	1.96	0.22	0.00	115.5	460	2,297	19.897
	Trawl	Oct-Dec	0.00	59.38	7.49	23.25	6.10	2.21	1.17	0.22	0.19	0.00	64.7	3,166 +	72	1.110
	Trawl	Jan-Apr	0.00	59.38	7.49	23.25	6.10	2.21	1.17	0.22	0.19	0.00	64.7	3,166 +	468	7.238
19601	Seine	Oct-Dec	0.00	13.33	69.22	4.76	9.50	2.44	0.44	0.25	0.06	0.00	80.6	1,729	14,879	183.842
	Seine	Jan-Apr	0.00	8.10	60.17	6.91	18.06	4.38	1.74	0.43	0.20	0.00	93.8	2,174	24,244	278.906
	Seine	May-Sep	0.00	10.08	59.51	7.23	17.13	4.07	1.43	0.42	0.13	0.00	93.9	3,903 +	350	4.012
	Trawl	Jan-Apr	0.00	10.25	60.16	7.07	16.63	3.97	1.38	0.41	0.13	0.00	86.7	3,903 +	3,273	37.756
19612	Seine	Oct-Dec	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403 +	633	5.938
	Seine	Jan-Apr	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403 +	25,352	237.877
	Seine	May-Sep	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403 +	346	3.243
	Trawl	Oct-Dec	0.00	6.05	30.85	38.31	7.66	11.69	3.43	0.60	1.01	0.40	109.0	496 +	296	2.714
	Trawl	Jan-Apr	0.00	6.05	30.85	38.31	7.66	11.69	3.43	0.60	1.01	0.40	109.0	496 +	1,033	9.474
19623	Seine	Oct-Dec	0.00	76.33	15.42	4.46	3.10	0.28	0.35	0.06	0.00	0.00	55.5	1,267	9,769	199.178
	Seine	Jan-Apr	0.00	38.55	15.20	21.58	17.43	3.27	3.61	0.21	0.06	0.10	96.9	1,921	29,142	350.900
	Seine	May-Sep	0.00	60.74	16.33	12.62	7.12	1.42	1.69	0.01	0.00	0.07	74.6	3,188 +	736	11.819
	Trawl	Oct-Dec	0.00	41.59	13.61	17.25	21.11	3.14	2.79	0.41	0.06	0.03	80.9	3,188 +	123	1.526
	Trawl	Jan-Apr	0.00	41.59	13.61	17.25	21.11	3.14	2.79	0.41	0.06	0.03	80.9	3,188 +	457	5.653
19634	Seine	Oct-Dec	0.00	2.51	71.43	11.94	7.88	5.04	0.85	0.35	0.00	0.00	84.2	1,644	14,887	170.573
	Seine	Jan-Apr	0.00	1.29	48.47	10.21	19.65	17.00	1.48	1.38	0.40	0.11	89.9	1,697	13,180	135.777
	Seine	May-Sep	0.00	2.89	67.52	11.86	10.20	6.38	0.60	0.43	0.11	0.02	80.8	3,341 +	1,282	14.960
	Trawl	Oct-Dec	0.00	3.26	65.07	10.15	11.10	8.98	0.69	0.60	0.12	0.03	85.8	3,341 +	44	0.519
	Trawl	Jan-Apr	0.00	3.26	65.07	10.15	11.10	8.98	0.69	0.60	0.12	0.03	85.8	3,341 +	537	6.254
19645	Seine	Oct-Dec	0.00	9.22	19.05	45.55	10.13	10.34	4.75	0.71	0.22	0.03	127.7	805	5,435	40.840
	Seine	Jan-Apr	0.00	4.99	13.41	53.55	9.70	9.66	7.23	1.03	0.37	0.06	118.0	2,088	12,851	99.593
	Seine	May-Sep	0.00	6.54	15.87	50.81	10.48	9.83	5.18	0.95	0.34	0.77	124.0	2,893 +	25,924	191.386
19656	Seine	Oct-Dec	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0 *	3,312	24.120
	Seine	Jan-Apr	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0 *	9,151	66.643
	Seine	May-Sep	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0 *	4,831	35.181
	Trawl	Jan-Apr	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0 *	1	0.007
19667	Seine	Oct-Dec	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0 *	4,379	66.650
	Seine	Jan-Apr	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0 *	2,338	35.588
	Seine	May-Sep	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0 *	1,280	19.484
19678	Seine	Oct-Dec	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0 *	53	0.678
	Seine	Jan-Apr	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0 *	1,084	13.902
19678	Seine	May-Sep	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0 *	932	11.953
19690	Seine	Jan-Apr	0.00	18.67	62.91	15.11	3.12	0.03	0.08	0.08	0.00	0.00	81.6	0 *	1,330	16.304
19701	Seine	Jan-Apr	0.00	5.79	45.91	31.35	9.51	5.05	1.63	0.59	0.15	0.00	92.2	673	3,418	37.076
	Seine	May-Sep	0.00	5.79	45.91	31.35	9.51	5.05	1.63	0.59	0.15	0.00	92.2	673 +	82	0.894
19712	Seine	Jan-Apr	0.00	0.00	5.32	17.93	64.43	5.88	3.78	2.38	0.14	0.14	161.3	714	4,490	27.842
	Gillnet	Jan-Apr	0.00	0.00	0.96	39.42	21.15	34.62	2.88	0.96	0.00	0.00	168.2	104 +	4	0.023
19723	Seine	Oct-Dec	0.00	3.89	35.37	4.95	27.58	23.05	3.26	1.26	0.63	0.00	133.3	950 +	16	0.123
	Seine	Jan-Apr	0.00	0.61	33.23	4.45	30.09	26.25	3.38	1.26	0.74	0.00	137.9	950	1,524	10.454
	Seine	May-Sep	0.00	3.89	35.37	4.95	27.58	23.05	3.26	1.26	0.63	0.00	133.3	950 +	67	0.499
19734	Seine	Jan-Apr	0.00	0.16	17.88	53.16	7.44	16.46	4.43	0.32	0.16	0.00	132.2	632	2,300	17.401
	Gillnet	Jan-Apr	0.00	0.00	0.96	39.42	21.15	34.62	2.88	0.96	0.00	0.00	168.2	104 +	1,519	9.034

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	CATCH (tonnes)	CATCH (millions)
			PERCENT AT AGE													
19745	Seine	Jan-Apr	0.20	0.35	4.42	26.83	51.39	9.06	6.31	1.26	0.18	0.00	124.1	1,704	1,691	12.357
	Other	Jan-Apr	0.32	1.29	9.40	21.92	42.97	11.20	9.65	2.46	0.63	0.16	131.2	3,170 +	204	1.555
	Gillnet	Jan-Apr	0.00	0.00	0.00	31.91	59.57	8.51	0.00	0.00	0.00	0.00	140.9	47 +	11	0.076
19756	Seine	Oct-Dec	0.00	0.00	1.60	6.86	27.66	43.89	9.26	8.46	2.29	0.00	172.2	875 +	564	3.278
	Seine	Jan-Apr	0.00	0.00	0.90	7.22	32.25	49.73	7.47	1.74	0.70	0.00	169.6	713	3,466	20.451
	Other	Jan-Apr	0.00	0.00	1.60	6.86	27.66	43.89	9.26	8.46	2.29	0.00	172.2	875 +	409	2.375
	Gillnet	Jan-Apr	0.00	0.00	0.00	15.79	57.89	22.81	3.51	0.00	0.00	0.00	154.0	57 +	276	1.793
19767	Seine	Oct-Dec	0.00	0.08	13.52	6.40	24.30	35.92	14.53	4.01	0.80	0.43	154.2	1,821 +	296	1.895
	Seine	Jan-Apr	0.00	0.13	21.43	3.97	20.78	34.28	14.49	3.18	1.29	0.45	151.9	1,765	6,309	41.462
	Seine	May-Sep	0.00	0.16	18.12	7.08	22.73	31.85	13.84	4.45	1.32	0.44	149.8	1,821 +	31	0.204
	Other	Jan-Apr	0.00	0.16	18.12	7.08	22.73	31.85	13.84	4.45	1.32	0.44	149.8	1,821 +	682	4.552
	Gillnet	Jan-Apr	0.00	0.00	1.07	2.14	19.93	54.09	14.59	6.76	1.42	0.00	166.9	281 +	1,494	8.948
	Gillnet	May-Sep	0.00	0.00	1.07	2.14	19.93	54.09	14.59	6.76	1.42	0.00	166.9	281 +	12	0.072
19778	Seine	Oct-Dec	0.00	1.66	7.66	32.30	17.60	16.98	13.46	6.21	2.48	1.66	151.1	483	2,263	14.977
	Seine	Jan-Apr	0.00	1.35	12.58	34.86	9.09	19.63	18.84	2.66	0.67	0.32	147.2	812	2,202	14.957
	Seine	May-Sep	0.00	1.73	12.50	38.39	9.35	18.12	15.88	2.73	0.92	0.38	147.1	1,295 +	68	0.469
	Trawl	Oct-Dec	0.00	1.36	10.03	31.95	13.18	19.41	17.48	4.37	1.43	0.79	150.3	1,396 +	1,024	6.814
	Trawl	Jan-Apr	0.00	0.99	2.97	20.79	19.80	25.74	20.79	7.92	0.99	0.00	167.6	101	0	0.000 ~
	Other	Jan-Apr	0.00	1.36	10.03	31.95	13.18	19.41	17.48	4.37	1.43	0.79	150.3	1,396 +	819	5.450
	Gillnet	Jan-Apr	0.00	0.00	0.00	20.53	5.96	32.45	33.11	6.62	1.32	0.00	167.1	151 +	3,031	18.142
19789	Seine	Oct-Dec	0.00	1.42	9.81	10.85	25.36	19.39	17.10	8.63	4.73	2.71	152.3	777	971	6.314
	Seine	Jan-Apr	0.00	2.91	9.88	12.21	32.17	13.57	21.32	5.81	1.74	0.39	158.5	516	1,411	8.905
	Seine	May-Sep	0.00	2.19	14.84	11.37	28.12	14.72	17.26	6.93	2.94	1.62	151.3	1,732 +	10	0.063
	Trawl	Oct-Dec	0.00	2.04	9.07	10.37	27.96	15.37	15.37	8.52	7.04	4.26	147.9	540	690	4.664
	Trawl	Jan-Apr	0.00	2.04	9.07	10.37	27.96	15.37	15.37	8.52	7.04	4.26	147.9	540	0	0.000 ~
	Other	Jan-Apr	0.00	2.16	13.47	11.14	28.08	14.88	16.81	7.31	3.92	2.24	150.5	2,272 +	910	6.048
	Gillnet	Jan-Apr	0.00	0.00	0.00	8.25	41.24	18.56	22.68	7.56	1.72	0.00	168.4	291 +	1,236	7.338
19790	Seine	Oct-Dec	0.00	1.82	62.62	6.88	6.93	7.57	5.81	5.21	2.12	1.04	108.2	1,049	460	4.238
	Seine	Jan-Apr	0.00	1.69	85.42	4.98	2.89	2.29	1.69	0.70	0.30	0.05	90.0	2,010	1,641	18.223
	Trawl	Oct-Dec	0.00	1.59	73.25	7.18	5.79	4.99	3.78	2.12	0.91	0.39	99.0	4,389 +	278	2.806
	Trawl	Jan-Apr	0.00	0.00	47.95	12.33	10.96	16.44	1.37	5.48	4.11	1.37	123.9	73	0	0.000 ~
	Other	Jan-Apr	0.00	1.59	73.25	7.18	5.79	4.99	3.78	2.12	0.91	0.39	99.0	4,389 +	910	9.190
	Gillnet	Jan-Apr	0.00	0.00	4.98	7.66	35.25	19.92	19.54	8.43	3.45	0.77	162.2	261 +	1,046	6.449
19801	Seine	Oct-Dec	0.00	1.13	7.37	53.52	10.15	10.64	8.82	4.51	2.45	1.40	124.7	3,068	733	5.870
	Seine	Jan-Apr	0.03	0.57	10.08	82.32	3.36	1.46	1.55	0.32	0.19	0.13	98.7	3,156	1,051	10.652
	Trawl	Oct-Dec	0.00	1.07	7.67	56.82	8.62	9.09	9.02	3.68	2.37	1.66	119.0	3,095	949	7.928
	Trawl	Jan-Apr	0.00	1.07	7.21	55.35	8.89	9.56	9.66	4.17	2.36	1.74	121.0	3,095	0	0.000 ~
	Other	Jan-Apr	0.01	0.96	8.75	66.19	6.94	6.27	5.79	2.63	1.42	1.03	112.3	10,887 +	728	6.484
	Gillnet	Jan-Apr	0.00	0.00	0.37	39.18	16.42	23.13	14.55	4.48	1.87	0.00	149.7	268 +	356	2.378
19812	Seine	Oct-Dec	0.00	0.83	14.25	24.70	45.73	6.01	3.80	3.07	1.13	0.49	128.5	1,143	794	6.481
	Seine	Jan-Apr	0.00	4.57	11.84	7.15	71.51	2.93	1.41	0.35	0.23	0.00	106.5	853	170	1.593
	Trawl	Oct-Dec	0.00	2.34	11.99	19.03	39.60	10.11	6.80	6.60	2.13	1.39	132.6	1,283	1,021	7.686
	Trawl	Jan-Apr	0.00	2.34	11.85	18.08	40.14	10.37	6.94	6.24	2.42	1.64	132.6	1,283	0	0.000 ~
	Other	Jan-Apr	0.00	1.99	14.56	15.09	51.11	7.30	4.58	3.27	1.39	0.71	119.6	3,970 +	728	6.086
19823	Seine	Jan-Apr	0.00	1.35	20.82	17.74	5.26	49.16	3.73	1.13	0.59	0.22	117.7	4,583	0	0.000 ~
	Other	Jan-Apr	0.00	1.35	20.82	17.74	5.26	49.16	3.73	1.13	0.59	0.22	117.7	4,583 +	773	6.565
19834	Seine	Oct-Dec	0.00	1.83	34.08	15.42	15.21	10.14	19.68	3.04	0.20	0.41	97.1	493	87	0.900
	Seine	Jan-Apr	0.00	0.43	32.79	11.18	9.48	17.31	27.38	0.95	0.33	0.14	106.6	3,118	1,679	15.337
19834	Seine	May-Sep	0.00	0.72	36.17	14.18	10.77	13.79	22.65	1.27	0.28	0.17	102.7	3,611 +	6	0.055
	Trawl	Oct-Dec	0.00	0.93	36.45	14.29	10.74	13.57	21.95	1.30	0.42	0.34	102.3	3,772 +	54	0.529
	Trawl	Jan-Apr	0.00	5.59	42.86	16.77	9.94	8.70	6.21	1.86	3.73	4.35	93.4	161	0	0.000 ~
	Other	Jan-Apr	0.00	0.93	36.45	14.29	10.74	13.57	21.95	1.30	0.42	0.34	102.3	3,772 +	728	7.116
	Gillnet	Jan-Apr	0.00	0.00	0.99	1.98	12.87	21.39	57.43	3.37	1.19	0.79	147.7	505	1,880	12.731
19845	Seine	Oct-Dec	0.00	17.10	8.92	20.45	30.67	12.83	4.46	4.28	0.93	0.37	86.0	538	48	0.556
	Seine	Jan-Apr	0.00	0.33	7.91	50.78	11.15	6.74	12.95	9.81	0.19	0.16	108.4	4,214	3,070	27.724
	Seine	May-Sep	0.00	2.15	7.95	50.48	14.31	7.07	10.01	7.61	0.27	0.17	108.3	4,752 +	70	0.662
	Trawl	Oct-Dec	0.00	2.31	7.95	50.46	14.58	7.09	9.74	7.41	0.27	0.17	105.8	4,752 +	83	0.787
	Other	Jan-Apr	0.00	2.31	7.95	50.46	14.58	7.09	9.74	7.41	0.27	0.17	105.8	4,752 +	728	6.884
	Gillnet	Jan-Apr	0.00	0.00	0.36	16.36	14.91	15.82	21.82	29.82	0.36	0.55	147.9	550	3,476	23.500
19856	Seine	Oct-Dec	0.00	1.77	12.72	10.13	44.29	9.00	5.23	8.78	7.96	0.11	139.2	3,554 +	130	0.937
	Seine	Jan-Apr	0.00	1.75	12.79	10.09	44.41	9.10	5.23	8.69	7.83	0.11	133.1	5,655	3,823	27.523
	Seine	May-Sep	0.00	1.69	13.34	9.55	46.09	10.53	5.26	7.46	5.98	0.10	137.1	5,655 +	105	0.778
	Trawl	Oct-Dec	0.00	12.11	11.13	9.48	27.58	16.27	9.30	5.81	5.02	3.30	137.9	1,635	47	0.343
	Trawl	Jan-Apr	0.00	12.11	11.13	9.48	27.58	16.27	9.30	5.81	5.02	3.30	137.9	1,635	0	0.000 ~
	Other	Jan-Apr	0.00	4.07	13.17	9.45	42.07	12.03	6.17	6.80	5.42	0.81	135.2	7,290 +	728	5.384
	Gillnet	Jan-Apr	0.00	0.00	0.38	4.09	54.02	18.86	8.71	7.65	6.06	0.23	147.0	1,320	4,573	31.100
19867	Seine	Oct-Dec	0.00	0.60	38.78	9.59	7.26	29.94	5.84	3.59	3.09	1.33	117.1	2,977 +	47	0.398
	Seine	Jan-Apr	0.00	0.45	39.37	9.51	7.32	29.04	5.78	3.72	3.34	1.47	117.1	4,049	2,100	17.695
	Seine	May-Sep	0.00	1.06	36.99	9.81	7.06	32.66	6.01	3.21	2.31	0.89	117.1	2,977 +	52	0.448
	Other	Jan-Apr	0.00	0.87	39.44	10.15	6.77	29.47	5.82	3.42	2.82	1.24	116.1	4,828 +	728	6.271
	Gillnet	Jan-Apr	0.00	0.00	0.50	2.67	6.37	55.23	16.65	9.37	6.07	3.14	150.4	1,855	4,071	27.067

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19878	Seine	Oct-Dec	0.00	0.52	35.53	36.87	5.23	7.15	11.18	1.59	1.43	0.49	100.3	3,076 +	23	0.229
	Seine	Jan-Apr	0.00	0.52	35.53	36.87	5.23	7.15	11.18	1.59	1.43	0.49	100.3	3,076	3,550	35.399
	Seine	May-Sep	0.00	0.45	30.98	38.94	5.97	8.35	11.53	1.95	1.45	0.38	102.6	4,206 +	56	0.542
	Trawl	Jan-Apr	0.00	0.26	13.73	41.19	11.92	11.14	11.92	4.40	4.15	1.30	109.5	386	0	0.000 ~
	Other	Jan-Apr	0.00	0.44	29.53	39.13	6.47	8.58	11.56	2.16	1.68	0.46	103.2	4,592 +	728	7.056
	Gillnet	Jan-Apr	0.00	0.00	0.24	4.97	4.59	20.02	48.56	13.52	5.31	2.78	157.2	710	4,340	27.459
19889	Seine	Oct-Dec	0.00	0.21	25.24	29.11	30.29	4.94	4.83	4.40	0.64	0.32	105.0	931 +	42	0.403
	Seine	Jan-Apr	0.00	0.70	19.15	41.92	25.84	4.00	4.19	3.39	0.46	0.36	104.1	2,893	3,686	35.672
	Other	Jan-Apr	0.00	0.61	21.68	36.14	27.68	4.92	4.48	3.57	0.64	0.28	104.2	3,616 +	728	6.986
	Gillnet	Jan-Apr	0.00	0.00	0.00	5.11	30.02	13.98	22.91	21.87	3.66	2.46	149.3	476	4,745	31.739
19890	Seine	Jan-Apr	0.00	0.63	20.05	21.02	29.59	18.95	3.90	3.41	2.08	0.37	120.7	4,215	2,295	19.231
	Seine	May-Sep	0.00	0.14	14.00	25.59	26.19	24.51	3.85	3.58	1.99	0.14	120.9	5,068 +	32	0.263
	Other	Jan-Apr	0.00	0.65	18.15	22.55	28.24	20.52	4.01	3.31	2.15	0.41	119.7	5,068 +	728	6.080
	Gillnet	Jan-Apr	0.00	0.00	0.00	6.25	21.32	42.46	10.29	11.58	6.07	2.02	146.7	544	2,361	16.100
19901	Seine	Jan-Apr	0.00	1.07	51.92	9.89	11.11	15.82	7.04	1.23	0.91	1.03	98.8	2,529	1,348	13.642
	Seine	May-Sep	0.00	0.55	40.80	10.75	16.94	17.49	11.29	1.82	0.00	0.36	108.1	549 +	19	0.172
	Trawl	Jan-Apr	0.00	17.05	28.41	5.68	22.73	6.82	6.82	0.00	2.27	10.23	110.2	88	0	0.000 ~
	Other	Jan-Apr	0.00	1.28	47.62	9.41	12.81	15.57	9.43	1.62	0.90	1.35	102.1	4,208 +	819	8.020
	Gillnet	Jan-Apr	0.00	0.00	0.00	4.26	18.67	31.44	31.33	6.66	4.37	3.28	144.5	916	2,143	14.832
19912	Seine	Jan-Apr	0.00	0.19	45.84	29.44	6.36	5.42	7.73	3.60	0.74	0.67	96.6	4,265	1,377	14.161
	Seine	May-Sep	0.00	0.70	24.97	53.31	5.57	5.34	5.23	3.95	0.46	0.46	96.2	861 +	3	0.027
	Trawl	Jan-Apr	0.00	14.10	21.79	20.94	8.97	18.80	6.41	4.70	1.28	2.99	108.5	234	0	0.000 ~
	Other	Jan-Apr	0.00	1.07	38.90	36.36	6.05	6.05	6.71	3.49	0.64	0.73	96.9	4,499 +	819	8.456
	Gillnet	Jan-Apr	0.00	0.00	0.32	13.21	9.13	23.52	25.35	19.66	3.97	4.83	145.5	931	3,797	26.100
19923	Seine	Jan-Apr	0.00	0.04	6.28	56.22	21.93	4.18	4.46	4.86	1.59	0.44	103.4	3,262	2,204	20.895
	Seine	May-Sep	0.00	0.40	21.17	25.83	39.41	4.26	3.73	3.20	1.73	0.27	101.3	751 +	5	0.046
	Trawl	Jan-Apr	0.00	6.59	31.87	31.32	22.53	2.75	3.85	1.10	0.00	0.00	91.4	182	0	0.000 ~
	Other	Jan-Apr	0.00	0.40	11.64	43.72	29.86	3.97	4.37	4.21	1.50	0.33	103.6	4,209 +	819	7.906
	Gillnet	Jan-Apr	0.00	0.00	0.00	8.32	40.54	9.53	18.52	13.29	8.19	1.61	134.1	745	4,112	30.661
19934	Seine	Jan-Apr	0.00	0.47	3.34	10.44	54.82	20.19	4.55	4.05	1.50	0.64	108.9	6,643	2,364	21.475
	Trawl	Jan-Apr	0.00	3.61	4.64	27.84	38.66	20.10	2.58	1.55	1.03	0.00	106.1	194	0	0.000 ~
	Other	Jan-Apr	0.00	0.75	4.89	13.73	48.57	22.32	4.11	3.67	1.43	0.53	107.6	6,837 +	920	8.550
	Gillnet	Jan-Apr	0.00	0.00	0.00	3.15	18.85	48.99	11.78	11.14	4.86	1.24	132.6	899	2,324	17.614
19945	Seine	Jan-Apr	0.08	3.82	12.91	5.38	9.57	49.66	13.84	2.46	1.44	0.82	113.1	3,532	706	6.242
	Other	Jan-Apr	0.07	3.18	15.31	6.76	11.26	43.18	15.74	2.43	1.27	0.80	111.4	4,396 +	1,183	10.622
	Gillnet	Jan-Apr	0.00	0.00	0.12	1.18	16.98	34.79	39.39	4.13	1.89	1.53	131.4	848	1,355	10.311
19956	Seine	Jan-Apr	0.00	1.08	65.37	8.94	2.82	4.26	11.72	5.19	0.37	0.26	89.0	2,697	0	0.000 ~
	Other	Jan-Apr	0.00	1.08	65.37	8.94	2.82	4.26	11.72	5.19	0.37	0.26	89.0	2,697 +	1,092	12.264
	Gillnet	Jan-Apr	0.00	0.00	0.78	4.11	5.68	25.83	32.68	26.42	3.13	1.37	133.8	511	3,086	23.053
19967	Seine	Jan-Apr	0.00	1.30	22.79	53.63	8.01	2.52	4.93	4.74	1.85	0.22	88.5	2,698	0	0.000 ~
	Other	Jan-Apr	0.00	1.30	22.79	53.63	8.01	2.52	4.93	4.74	1.85	0.22	88.5	2,698 +	942	10.642
	Gillnet	Jan-Apr	0.00	0.00	0.16	19.49	11.57	13.95	20.29	20.60	11.09	2.85	133.4	631	5,541	41.550
19978	Seine	Jan-Apr	0.00	0.19	33.18	21.98	36.29	4.44	1.42	1.09	1.28	0.14	83.2	2,116	0	0.000 ~
	Other	Jan-Apr	0.00	0.19	33.18	21.98	36.29	4.44	1.42	1.09	1.28	0.14	83.2	2,116 +	910	10.943
	Gillnet	Jan-Apr	0.00	0.00	0.65	3.05	43.07	20.52	9.89	11.28	7.02	4.53	127.9	1,082	3,217	25.158
19989	Seine	Jan-Apr	0.00	0.93	3.39	51.17	20.68	17.76	2.92	0.47	1.17	1.52	105.5	856	256	2.426
	Other	Jan-Apr	0.00	0.99	5.52	41.05	20.35	24.71	4.42	1.05	0.87	1.05	103.4	1,720 +	1,001	9.684
	Gillnet	Jan-Apr	0.00	0.00	0.00	11.18	16.22	48.98	13.23	4.72	2.20	3.46	126.1	721	1,858	14.716
19990	Seine	Jan-Apr	0.00	1.71	24.71	8.27	36.25	14.34	11.83	1.99	0.41	0.49	95.9	3,685	1,314	12.980
	Other	Jan-Apr	0.00	1.94	27.97	9.59	28.50	12.54	16.26	2.24	0.50	0.45	95.5	3,972 +	1,001	10.482
	Gillnet	Jan-Apr	0.00	0.00	0.12	2.10	23.06	20.47	42.17	9.37	1.11	1.60	133.7	811	3,001	22.441
20001	Seine	Jan-Apr	0.00	0.53	28.84	25.30	5.65	23.85	9.15	5.34	1.14	0.22	103.9	2,285	1,012	9.743
	Other	Jan-Apr	0.00	1.81	42.75	20.99	5.42	15.40	6.71	5.92	0.89	0.12	89.8	5,188 +	1,001	11.146
	Gillnet	Jan-Apr	0.00	0.00	0.29	5.58	9.33	32.40	20.67	25.58	5.29	0.87	134.3	1,040	1,905	14.183
20012	Seine	Oct-Dec	0.00	5.18	19.99	36.74	18.99	3.93	9.56	3.51	1.79	0.30	90.3	5,577 +	1	0.009
	Seine	Jan-Apr	0.00	7.21	19.39	32.03	20.34	4.16	11.12	3.83	1.60	0.33	93.0	3,678	2,061	22.159
	Other	Jan-Apr	0.00	5.18	19.99	36.74	18.99	3.93	9.56	3.51	1.79	0.30	90.3	5,577 +	910	10.083
	Gillnet	Jan-Apr	0.00	0.00	0.11	7.05	20.25	11.72	27.42	15.81	15.36	2.28	143.2	879	2,432	16.982
20023	Seine	Oct-Dec	0.00	0.79	67.83	13.49	11.10	3.13	1.52	1.15	0.48	0.51	85.1	659 +	5	0.068
	Seine	Jan-Apr	0.00	0.07	53.06	13.44	14.53	9.54	2.97	4.24	1.47	0.68	95.3	2,925	1,446	15.169
	Other	Jan-Apr	0.00	0.31	57.87	13.18	14.37	7.44	2.19	3.00	1.06	0.59	87.5	5,108 +	910	10.401
	Gillnet	Jan-Apr	0.00	0.00	0.34	4.60	37.13	25.98	10.57	12.30	5.29	3.79	136.6	870	2,562	18.760
20034	Seine	Oct-Dec	0.00	0.91	1.98	69.32	11.20	10.06	4.20	0.91	1.27	0.16	93.7	2,526 +	11	0.116
	Seine	Jan-Apr	0.00	0.88	1.76	69.88	10.58	9.88	4.45	0.97	1.39	0.19	96.0	2,155	1,908	19.885
	Other	Jan-Apr	0.00	0.91	1.98	69.32	11.20	10.06	4.20	0.91	1.27	0.16	93.7	2,526 +	910	9.709
	Gillnet	Jan-Apr	0.00	0.00	0.09	21.84	13.52	36.88	15.40	4.92	4.74	2.60	134.5	1,117	2,192	16.304

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	CATCH (tonnes)	CATCH (millions)
						PERCENT AT AGE										
19501	Seine	Oct-Dec	0.00	2.68	28.09	50.52	12.28	5.17	1.20	0.06	0.00	0.00	109.2	3,175	15,508	141.986
	Seine	Jan-Apr	0.06	2.25	31.20	49.36	11.23	4.84	1.06	0.01	0.00	0.00	107.9	2,143	26,950	250.936
19512	Seine	Jan-Apr	0.25	4.61	20.10	29.98	38.50	4.56	1.55	0.40	0.04	0.02	112.7	5,214	33,072	290.690
	Seine	May-Sep	1.11	5.12	19.85	29.75	37.71	4.45	1.52	0.44	0.04	0.02	112.3	5,214 +	123	1.091
19523	Seine	Jan-Apr	0.43	7.65	28.02	24.49	27.28	10.25	1.40	0.48	0.00	0.00	104.9	2,939	768	7.304
19534	Seine	Oct-Dec	0.15	7.31	69.86	17.41	3.99	1.06	0.15	0.00	0.08	0.00	63.6	1,327	6,389	100.473
	Seine	Jan-Apr	0.00	1.72	72.02	21.04	3.91	1.10	0.15	0.00	0.06	0.00	76.2	1,739	18,119	243.703
	Seine	May-Sep	0.07	4.04	69.18	20.52	4.63	1.34	0.16	0.00	0.07	0.00	71.1	3,066 +	109	1.531
19545	Seine	Oct-Dec	0.29	9.94	6.32	77.40	5.10	0.48	0.48	0.00	0.00	0.00	85.4	826	2,559	28.033
	Seine	Jan-Apr	0.00	1.31	5.42	80.39	11.08	1.56	0.25	0.00	0.00	0.00	99.8	1,524	9,035	90.856
19556	Seine	Oct-Dec	0.10	13.79	13.63	11.05	58.24	2.85	0.25	0.10	0.00	0.00	91.4	2,408	22,335	208.767
	Seine	Jan-Apr	0.00	7.39	12.21	8.70	67.86	3.36	0.43	0.00	0.00	0.04	114.2	2,614	21,018	178.311
	Seine	May-Sep	0.04	16.97	13.60	9.12	56.99	2.89	0.34	0.04	0.00	0.02	105.4	5,022 +	275	2.606
19567	Seine	Oct-Dec	0.00	52.32	42.90	3.83	0.55	0.27	0.14	0.00	0.00	0.00	60.1	732	1,788	29.756
	Seine	Jan-Apr	0.00	3.59	52.30	13.98	8.33	20.79	0.98	0.03	0.00	0.00	93.9	3,890	21,002	211.756
	Seine	May-Sep	0.00	23.13	49.84	9.53	5.03	11.85	0.59	0.02	0.00	0.00	79.6	4,622 +	470	5.669
19578	Seine	Oct-Dec	0.00	40.38	49.69	8.01	1.33	0.17	0.42	0.00	0.00	0.00	61.5	2,106	4,928	79.258
	Seine	Jan-Apr	0.00	5.67	73.61	17.35	1.50	1.22	0.65	0.00	0.00	0.00	73.8	1,472	4,454	60.180
	Seine	May-Sep	0.00	47.57	42.11	7.27	2.01	0.42	0.62	0.00	0.00	0.00	64.8	3,578 +	467	8.141
19589	Seine	Oct-Dec	0.17	5.25	49.47	35.94	7.43	0.61	0.57	0.55	0.01	0.00	83.4	2,169	10,774	125.789
	Seine	Jan-Apr	0.00	0.74	47.39	40.66	9.62	0.72	0.52	0.35	0.00	0.00	88.2	2,594	17,096	192.788
19590	Seine	Oct-Dec	0.00	42.87	24.11	26.16	5.59	1.10	0.08	0.08	0.00	0.00	62.1	1,269	3,397	54.675
	Seine	Jan-Apr	0.00	41.51	23.53	27.72	5.86	1.22	0.08	0.08	0.00	0.00	63.7	1,313 +	640	10.054
19601	Seine	Oct-Dec	0.00	64.30	28.81	3.34	2.30	1.25	0.00	0.00	0.00	0.00	51.4	479	956	18.581
	Seine	Jan-Apr	0.00	4.30	32.64	12.80	36.63	12.48	0.94	0.16	0.05	0.00	100.6	2,302	30,641	302.709
	Seine	May-Sep	0.00	16.18	32.43	10.82	29.70	9.92	0.79	0.11	0.04	0.00	91.1	2,781 +	104	1.136
	Trawl	May-Sep	0.00	16.18	32.43	10.82	29.70	9.92	0.79	0.11	0.04	0.00	91.1	2,781 +	4	0.042
19612	Seine	Oct-Dec	0.00	7.65	54.80	20.82	2.85	11.39	2.31	0.18	0.00	0.00	94.1	562 +	677	7.197
	Seine	Jan-Apr	0.00	3.73	51.28	25.17	2.80	13.99	2.80	0.23	0.00	0.00	99.6	429	14,942	150.045
	Seine	May-Sep	0.00	7.65	54.80	20.82	2.85	11.39	2.31	0.18	0.00	0.00	94.1	562 +	90	0.954
19623	Seine	Oct-Dec	0.00	0.36	30.27	58.03	5.25	2.86	3.02	0.21	0.00	0.00	100.6	1,052 +	124	1.232
	Seine	Jan-Apr	0.00	0.35	30.14	58.19	5.18	2.86	3.07	0.21	0.00	0.00	100.6	1,052	43,930	436.570
19634	Seine	Oct-Dec	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169 +	3,214	35.288
	Seine	Jan-Apr	0.00	4.88	43.06	35.48	14.65	1.80	0.13	0.00	0.00	0.00	103.4	778	28,288	273.620
	Seine	May-Sep	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169 +	165	1.808
	Trawl	Jan-Apr	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169 +	228	2.507
19645	Seine	Oct-Dec	0.00	14.07	37.58	31.01	12.10	5.03	0.18	0.03	0.00	0.00	114.4	1,750 +	1,562	14.266
	Seine	Jan-Apr	0.00	3.62	35.16	37.44	17.59	5.77	0.39	0.03	0.00	0.00	122.3	1,652	12,630	101.310
	Seine	May-Sep	0.00	8.49	36.46	33.62	15.63	5.41	0.33	0.06	0.00	0.00	111.9	1,750 +	1,477	12.553
19656	Seine	Oct-Dec	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0 *	16,217	225.703
	Seine	Jan-Apr	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0 *	19,101	265.835
	Seine	May-Sep	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0 *	2,163	30.107
19667	Seine	Oct-Dec	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0 *	2,910	33.432
	Seine	Jan-Apr	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0 *	17,206	197.668
	Seine	May-Sep	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0 *	1,774	20.378
19678	Seine	Oct-Dec	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0 *	497	5.535
	Seine	Jan-Apr	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0 *	309	3.439
	Seine	May-Sep	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0 *	722	8.043
19690	Seine	Jan-Apr	0.00	54.02	44.42	1.16	0.40	0.00	0.00	0.00	0.00	0.00	73.9	0 *	209	2.832
19701	Seine	Jan-Apr	0.06	12.04	39.34	39.20	4.11	4.33	0.72	0.06	0.13	0.00	108.2	953	3,614	32.684
19712	Seine	Jan-Apr	0.00	3.54	28.25	27.13	27.01	7.57	5.17	1.26	0.08	0.00	120.5	1,763	9,143	74.425
	Gillnet	Jan-Apr	0.00	0.00	2.27	18.18	61.36	11.36	6.82	0.00	0.00	0.00	159.6	44 +	137	0.855
19723	Seine	Jan-Apr	0.00	0.97	48.51	18.90	16.23	12.72	2.02	0.47	0.19	0.00	125.2	1,239	6,664	52.842
	Seine	May-Sep	0.00	1.21	49.64	18.40	15.98	12.11	2.02	0.48	0.16	0.00	124.7	1,239 +	22	0.178
	Gillnet	Jan-Apr	0.00	0.00	4.04	28.28	43.43	21.21	2.02	1.01	0.00	0.00	152.8	99 +	1,113	7.288
19734	Seine	Jan-Apr	0.00	2.94	20.26	42.18	18.05	10.26	5.42	0.71	0.18	0.00	129.5	1,515	3,621	28.835
	Gillnet	Jan-Apr	0.00	0.00	0.42	22.36	38.82	24.47	12.24	1.69	0.00	0.00	158.5	474	5,267	33.230
19745	Seine	Jan-Apr	0.18	0.99	48.84	22.87	19.00	5.33	2.25	0.48	0.04	0.02	119.5	8,923	3,343	31.457
	Gillnet	Jan-Apr	0.00	0.00	4.27	26.40	45.60	15.73	5.60	2.40	0.00	0.00	152.8	375 +	5,395	35.308
19756	Seine	Jan-Apr	0.00	2.18	11.33	41.86	21.86	16.69	4.31	1.52	0.24	0.02	124.4	5,418	6,198	50.662
	Gillnet	Jan-Apr	0.00	0.00	0.86	18.72	30.18	35.12	11.56	3.02	0.44	0.09	162.0	1,222	6,213	38.357
19767	Seine	Jan-Apr	0.00	0.70	17.01	23.32	31.11	17.06	8.70	1.72	0.34	0.05	136.6	2,606	4,201	30.702
	Gillnet	Jan-Apr	0.00	0.00	1.10	13.02	35.54	31.57	13.47	3.97	1.32	0.00	167.7	453	6,904	41.171
19778	Seine	Jan-Apr	0.00	0.19	28.64	16.47	21.54	21.13	8.68	2.56	0.59	0.20	129.6	1,391	4,723	37.629
	Seine	May-Sep	0.00	0.18	29.21	16.70	21.83	20.76	8.28	2.38	0.50	0.17	124.6	1,391 +	46	0.369
	Other	Jan-Apr	0.00	0.22	25.59	15.24	19.99	23.15	10.86	3.52	1.08	0.36	134.7	1,391 +	182	1.352
	Gillnet	Jan-Apr	0.00	0.00	0.83	8.45	32.10	38.26	16.57	3.21	0.44	0.15	162.1	886	9,277	56.466
19789	Seine	Oct-Dec	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0 *	0	0.001
	Seine	May-Sep	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0 *	5	0.031
	Other	Jan-Apr	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0 *	91	0.600

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE												CATCH	
Season	**Gear**	**Fishery**	**0+**	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9++**	**Mean Weight**	**Number Aged**	**(tonnes)**	**(millions)**
19790	Seine	Oct-Dec	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345 +	10	0.111
	Seine	Jan-Apr	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345	0	0.000 ~
	Other	Jan-Apr	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345 +	91	0.995
	Gillnet	Jan-Apr	0.00	0.00	5.36	0.89	34.82	21.43	18.75	11.61	6.25	0.89	157.9	112 +	528	3.347
19801	Seine	Jan-Apr	0.00	1.88	14.92	68.45	7.06	4.98	1.95	0.44	0.29	0.04	101.3	5,210	263	2.570
	Seine	May-Sep	0.00	3.78	14.57	63.82	7.83	6.03	2.80	0.67	0.36	0.13	99.2	5,210 +	6	0.063
	Other	Jan-Apr	0.00	3.78	14.57	63.82	7.83	6.03	2.80	0.67	0.36	0.13	99.2	5,210 +	91	0.917
	Gillnet	Jan-Apr	0.00	0.28	1.47	47.46	12.43	15.35	12.78	6.94	2.48	0.82	142.5	1,418	2,304	15.892
19812	Seine	Jan-Apr	0.00	0.61	11.52	10.17	66.35	5.52	4.26	1.26	0.30	0.00	131.9	2,300	2,258	17.116
	Seine	May-Sep	0.00	0.61	11.52	10.17	66.35	5.52	4.26	1.26	0.30	0.00	131.9	2,300 +	0	0.003
	Other	Jan-Apr	0.00	1.68	15.62	10.72	60.21	5.19	4.56	1.45	0.48	0.09	122.2	3,508 +	91	0.745
	Gillnet	Jan-Apr	0.00	0.00	2.88	6.96	76.07	7.38	5.17	1.20	0.33	0.01	141.3	1,242	4,112	29.155
19823	Seine	Jan-Apr	0.00	0.58	7.06	13.65	11.15	58.16	5.32	3.13	0.64	0.31	134.7	5,445	2,061	15.154
	Other	Jan-Apr	0.00	0.53	7.00	15.43	10.82	57.10	5.03	3.10	0.73	0.26	133.2	5,445 +	273	2.050
	Gillnet	Jan-Apr	0.00	0.00	0.56	7.56	13.82	68.06	5.22	3.93	0.62	0.23	146.7	1,703	3,579	24.422
19834	Seine	Jan-Apr	0.00	2.29	5.47	7.67	17.73	17.04	47.03	1.93	0.69	0.14	128.0	6,294	3,589	28.383
	Other	Jan-Apr	0.02	4.35	7.31	10.12	18.16	16.14	40.72	2.26	0.83	0.10	127.1	6,294 +	273	2.148
	Gillnet	Jan-Apr	0.00	0.00	0.27	2.69	12.49	16.84	61.49	4.63	1.07	0.53	145.1	1,092	3,582	24.536
19845	Seine	Jan-Apr	0.00	0.61	28.72	8.11	9.89	17.28	14.48	20.15	0.49	0.26	136.5	3,690	2,915	20.337
	Other	Jan-Apr	0.00	2.75	37.85	7.56	8.43	12.87	11.77	18.20	0.44	0.13	130.2	5,422 +	273	2.097
	Gillnet	Jan-Apr	0.00	0.00	3.78	6.27	9.37	20.63	23.57	35.09	0.85	0.44	161.3	1,507	2,294	14.082
19856	Seine	Oct-Dec	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995 +	30	0.224
	Seine	Jan-Apr	0.00	0.94	14.64	41.12	10.95	5.12	6.40	6.55	13.85	0.43	138.7	3,983	2,173	16.047
	Trawl	Jan-Apr	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995 +	7	0.054
	Other	Jan-Apr	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995 +	214	1.585
	Gillnet	Jan-Apr	0.00	0.00	2.01	21.83	14.45	7.98	14.53	14.47	24.18	0.56	155.5	1,020	1,176	7.676
19867	Seine	Jan-Apr	0.00	4.13	20.03	13.26	32.77	5.60	5.06	6.71	5.11	7.33	143.9	3,614	2,695	18.225
	Other	Jan-Apr	0.00	4.99	22.77	14.49	31.67	5.63	4.48	5.73	4.58	5.67	137.6	5,134 +	214	1.555
	Gillnet	Jan-Apr	0.00	0.00	0.82	7.75	44.85	11.72	7.85	9.89	8.15	8.97	165.2	981	920	5.571
19878	Seine	Jan-Apr	0.00	0.82	65.84	12.35	6.16	8.30	1.73	1.71	1.68	1.40	107.5	4,159	3,539	31.909
	Seine	May-Sep	0.00	0.81	65.96	12.42	6.14	8.29	1.66	1.73	1.66	1.34	110.9	2,835 +	18	0.162
	Other	Jan-Apr	0.00	1.14	67.92	11.67	6.28	7.12	1.68	1.46	1.50	1.23	103.4	5,194 +	273	2.639
	Gillnet	Jan-Apr	0.00	0.00	4.39	10.69	15.27	27.48	13.74	7.06	9.73	11.64	162.2	524	970	5.978
19889	Seine	Jan-Apr	0.00	0.84	3.72	79.59	8.59	2.79	2.28	0.60	0.87	0.71	112.1	4,321	6,531	61.253
	Other	Jan-Apr	0.00	1.28	4.61	76.21	9.16	3.58	2.80	0.74	0.80	0.82	109.5	5,642 +	273	2.492
	Gillnet	Jan-Apr	0.00	0.00	0.32	29.13	25.73	17.31	14.72	5.34	3.72	3.72	147.9	618	2,911	19.680
19890	Seine	Jan-Apr	0.00	0.81	3.55	5.07	74.01	7.47	3.93	3.48	0.81	0.85	131.1	6,843	5,305	39.561
	Other	Jan-Apr	0.00	0.96	5.60	5.06	72.67	7.47	3.77	2.95	0.75	0.77	127.9	6,843 +	273	2.134
	Gillnet	Jan-Apr	0.00	0.00	0.00	1.03	68.15	16.46	5.46	6.48	1.10	1.32	144.7	806	3,046	20.978
19901	Seine	Jan-Apr	0.00	1.76	16.48	7.41	6.52	56.72	6.70	2.34	1.70	0.36	133.9	7,107	7,097	52.412
	Other	Jan-Apr	0.03	2.03	18.81	6.75	6.19	55.54	6.37	2.34	1.48	0.46	131.0	7,107 +	455	3.474
	Gillnet	Jan-Apr	0.00	0.00	0.56	2.41	6.30	69.81	9.44	7.04	3.52	0.93	154.7	540	1,806	11.673
19912	Seine	Jan-Apr	0.00	0.94	60.91	10.17	2.47	2.95	19.02	2.03	0.79	0.72	107.2	7,264	7,251	66.620
	Other	Jan-Apr	0.00	2.01	58.38	11.40	2.74	3.44	18.75	2.13	0.61	0.54	105.4	7,264 +	455	4.315
	Gillnet	Jan-Apr	0.00	0.00	6.87	6.96	4.42	6.98	60.93	9.67	2.99	1.19	155.5	1,119	1,111	6.991
19923	Seine	Jan-Apr	0.00	3.37	7.06	63.75	9.66	1.85	2.41	10.22	1.24	0.43	112.3	6,939	8,478	75.838
	Other	Jan-Apr	0.00	2.88	6.70	64.08	9.69	2.02	2.57	10.47	1.12	0.47	111.4	8,751 +	455	4.084
	Gillnet	Jan-Apr	0.00	0.00	0.20	45.74	14.12	5.43	5.88	25.47	2.48	0.67	138.9	781	2,038	14.682
19934	Seine	Jan-Apr	0.00	0.87	18.91	7.17	56.09	7.93	2.09	3.02	3.51	0.42	118.7	6,174	9,757	81.704
	Other	Jan-Apr	0.00	1.16	21.05	8.48	53.20	7.51	2.03	2.72	3.52	0.33	115.9	7,308 +	455	3.925
	Gillnet	Jan-Apr	0.00	0.00	1.73	5.09	66.34	12.30	3.27	4.00	6.51	0.77	133.8	1,951	2,122	15.809
19945	Seine	Jan-Apr	0.00	0.58	5.12	22.95	9.25	49.46	6.30	2.18	2.34	1.81	127.0	8,932	8,131	64.167
	Other	Jan-Apr	0.00	0.77	6.06	23.46	9.32	48.00	6.35	2.00	2.29	1.75	124.8	9,592 +	637	5.105
	Gillnet	Jan-Apr	0.00	0.00	0.23	8.93	8.00	64.84	10.67	1.79	2.23	3.31	137.4	1,267	1,451	10.565
19956	Seine	Jan-Apr	0.00	12.82	18.28	5.03	16.68	7.26	31.17	5.89	1.57	1.31	124.2	4,087	3,897	32.478
	Other	Jan-Apr	0.00	11.91	19.89	5.77	16.53	6.93	30.32	5.80	1.48	1.37	117.8	5,601 +	1,001	8.494
	Gillnet	Jan-Apr	0.00	0.00	0.39	1.55	18.33	11.88	53.07	10.48	1.97	2.33	146.4	566	402	2.743
19967	Seine	Jan-Apr	0.00	2.20	56.77	15.70	3.46	6.65	4.27	8.66	1.70	0.58	94.3	5,235	3,276	34.713
	Other	Jan-Apr	0.00	2.12	56.64	16.90	3.62	6.14	3.99	8.48	1.54	0.55	92.7	6,871 +	1,183	12.757
	Gillnet	Jan-Apr	0.00	0.00	1.36	2.92	6.23	22.76	19.26	38.33	7.20	1.95	143.5	514	344	2.401
19978	Seine	Jan-Apr	0.00	0.52	30.62	41.30	7.99	2.46	6.42	5.30	4.48	0.90	97.1	1,339	7,963	81.986
	Other	Jan-Apr	0.00	0.52	36.42	42.50	8.42	2.36	3.07	3.01	2.92	0.78	89.2	6,571 +	1,183	13.268
	Gillnet	Jan-Apr	0.00	0.00	0.44	13.09	12.55	8.50	18.31	16.51	22.13	8.46	140.4	1,031	639	4.483
19989	Seine	Jan-Apr	0.00	0.38	8.37	39.70	34.48	7.66	2.22	2.89	2.74	1.55	100.2	3,861	5,940	58.064
	Other	Jan-Apr	0.00	0.78	8.79	42.78	34.15	6.51	1.62	2.12	1.94	1.32	98.7	5,005 +	1,092	11.063
	Gillnet	Jan-Apr	0.00	0.00	0.13	15.27	45.02	17.80	6.24	5.31	5.44	4.78	128.8	753	1,524	11.833
19990	Seine	Jan-Apr	0.00	0.19	17.02	10.47	33.07	28.97	6.40	1.46	1.17	1.26	109.3	2,624	6,440	55.631
	Other	Jan-Apr	0.00	0.35	19.11	10.82	34.72	26.20	5.81	1.17	0.91	0.91	109.6	4,527 +	1,274	11.625
	Gillnet	Jan-Apr	0.00	0.00	0.44	2.04	40.44	41.61	10.36	1.61	0.88	2.63	133.0	685	926	6.963

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
20001	Seine	Jan-Apr	0.00	2.00	6.90	24.68	12.46	25.29	21.72	5.20	1.21	0.54	119.7	1,653		5,613	46.878
	Other	Jan-Apr	0.02	2.54	7.70	27.04	11.71	26.57	18.82	4.10	0.86	0.63	112.9	4,415	+	827	7.326
	Gillnet	Jan-Apr	0.00	0.00	0.00	4.87	5.75	52.75	28.13	7.12	1.13	0.25	135.3	800		517	3.822
20012	Seine	Jan-Apr	0.00	4.71	33.86	9.81	15.67	6.41	19.55	8.17	1.56	0.26	98.5	3,164		2,894	29.155
	Other	Jan-Apr	0.00	4.79	34.80	9.87	16.85	5.67	18.56	7.95	1.29	0.23	95.7	6,456	+	931	9.724
	Gillnet	Jan-Apr	0.00	0.00	0.60	5.95	20.83	7.54	47.02	16.47	1.39	0.20	128.6	504		399	3.099
20023	Seine	Jan-Apr	0.00	0.09	30.97	24.46	9.95	12.93	5.79	11.12	3.98	0.72	104.9	2,212		2,299	21.911
	Other	Jan-Apr	0.00	0.44	46.63	24.37	7.15	8.23	3.80	6.48	2.41	0.49	94.4	5,479	+	1,022	10.831
	Gillnet	Jan-Apr	0.00	0.00	0.43	3.57	11.14	25.73	11.24	33.08	12.32	2.49	143.2	925		289	2.021
20034	Seine	Jan-Apr	0.00	1.27	6.54	66.18	15.87	2.91	3.42	1.74	1.65	0.41	96.1	2,094		2,987	32.826
	Other	Jan-Apr	0.00	1.52	7.01	62.29	16.74	3.33	4.29	2.13	2.11	0.56	92.8	4,079	+	1,022	11.012

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.

+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.

~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19501	Seine	Oct-Dec	0.03	4.32	58.19	28.93	6.71	1.40	0.30	0.10	0.02	0.00	99.6	7,816	42,180	424.795
	Seine	Jan-Apr	0.06	4.40	32.64	48.59	10.65	2.76	0.62	0.23	0.06	0.00	103.6	1,774 +	1,226	11.828
	Seine	May-Sep	0.04	3.46	61.00	26.57	7.12	1.25	0.43	0.12	0.00	0.00	99.5	7,816 +	393	3.923
19512	Seine	Oct-Dec	0.11	14.85	55.11	21.73	6.50	1.32	0.28	0.08	0.01	0.00	93.0	8,839	44,896	492.871
	Seine	Jan-Apr	0.16	21.32	49.53	21.11	6.19	1.52	0.11	0.05	0.00	0.00	91.8	8,839 +	423	4.847
	Seine	May-Sep	0.03	5.73	55.51	29.95	7.19	1.34	0.20	0.05	0.00	0.00	97.0	8,839 +	527	5.222
	Trawl	Jan-Apr	0.00	0.00	50.26	36.79	9.84	2.59	0.52	0.00	0.00	0.00	115.6	193	0	0.000 ~
19523	Seine	Oct-Dec	0.10	1.72	54.76	38.77	3.97	0.52	0.07	0.10	0.00	0.00	87.1	3,810	3,750	41.452
	Seine	Jan-Apr	0.14	3.79	65.35	27.05	2.97	0.62	0.07	0.00	0.00	0.00	81.0	5,220	3,966	48.795
	Seine	May-Sep	0.17	2.60	55.66	37.08	3.71	0.63	0.09	0.07	0.00	0.00	84.6	9,030 +	442	5.059
	Trawl	Oct-Dec	0.00	1.58	63.29	30.79	3.68	0.66	0.00	0.00	0.00	0.00	88.4	760	29	0.326
	Trawl	Jan-Apr	0.00	5.91	67.27	23.62	2.60	0.60	0.00	0.00	0.00	0.00	78.0	999	225	2.888
19534	Seine	Oct-Dec	0.00	1.12	53.97	36.36	6.83	1.38	0.27	0.06	0.01	0.00	96.0	9,693	57,443	595.913
	Seine	Jan-Apr	0.00	2.17	43.19	41.52	8.91	3.32	0.70	0.18	0.01	0.00	94.5	3,618 +	619	6.600
	Seine	May-Sep	0.00	1.78	22.05	37.29	26.45	8.79	2.98	0.60	0.07	0.00	119.9	3,374	7,692	62.447
	Trawl	Jan-Apr	0.00	1.36	52.67	36.83	7.07	1.66	0.33	0.08	0.01	0.00	95.7	9,788 +	14	0.142
19545	Seine	Oct-Dec	0.00	3.92	56.38	33.92	5.18	0.52	0.09	0.00	0.00	0.00	98.5	4,028	50,604	503.361
	Seine	Jan-Apr	0.00	3.50	22.26	60.88	11.00	2.22	0.15	0.00	0.00	0.00	85.6	896	13,825	161.566
	Seine	May-Sep	0.00	4.65	49.87	38.62	5.95	0.82	0.10	0.00	0.00	0.00	94.5	4,924 +	4,207	43.919
	Trawl	Oct-Dec	0.00	4.65	50.12	38.35	5.99	0.80	0.10	0.00	0.00	0.00	95.8	4,994 +	5	0.054
	Trawl	Jan-Apr	0.00	8.57	57.14	25.71	8.57	0.00	0.00	0.00	0.00	0.00	84.7	70	0	0.000 ~
19556	Seine	Oct-Dec	0.00	4.07	52.03	30.65	11.30	1.65	0.29	0.00	0.00	0.00	97.4	3,783	44,043	451.810
	Seine	Jan-Apr	0.00	4.10	14.20	29.99	41.94	7.87	1.37	0.43	0.09	0.02	109.1	4,816	26,375	243.982
	Seine	May-Sep	0.00	0.13	9.76	43.52	26.32	17.07	2.44	0.64	0.00	0.13	125.5	779	1,462	11.648
	Trawl	Oct-Dec	0.00	5.52	58.00	26.95	8.19	1.05	0.29	0.00	0.00	0.00	93.7	1,050	182	1.944
	Trawl	Jan-Apr	0.00	18.62	44.38	24.62	10.24	1.91	0.23	0.00	0.00	0.00	85.7	2,197	0	0.000 ~
19567	Seine	Oct-Dec	0.00	0.73	64.78	20.31	9.37	4.25	0.51	0.04	0.00	0.00	96.2	4,691	44,241	460.767
	Seine	Jan-Apr	0.00	1.42	64.96	21.83	7.50	3.97	0.31	0.00	0.00	0.00	95.7	826	8,202	84.577
	Seine	May-Sep	0.00	3.46	18.92	40.97	25.30	9.95	1.08	0.11	0.11	0.11	129.9	925	7,165	55.146
	Trawl	Jan-Apr	0.12	2.24	71.93	14.15	4.60	5.66	0.94	0.24	0.00	0.12	91.7	848	0	0.000 ~
19578	Seine	Oct-Dec	0.00	10.67	60.24	20.45	3.60	3.20	1.64	0.15	0.04	0.00	88.8	3,085	11,745	133.517
	Seine	Jan-Apr	0.00	9.97	61.67	16.52	4.36	3.66	3.24	0.49	0.09	0.00	90.1	1,850	6,982	84.814
	Seine	May-Sep	0.00	9.00	60.10	21.06	3.99	3.20	2.30	0.30	0.05	0.00	88.9	4,935 +	1,206	13.597
	Trawl	Jan-Apr	0.00	12.72	73.29	11.64	1.88	0.45	0.01	0.01	0.00	0.00	74.8	527	695	9.491
	Gillnet	Jan-Apr	0.00	24.49	53.06	18.37	0.00	2.04	0.00	2.04	0.00	0.00	76.1	49	0	0.000 ~
19589	Seine	Oct-Dec	0.74	13.95	66.31	15.95	2.34	0.39	0.21	0.10	0.01	0.00	83.5	7,169	47,601	575.751
	Seine	Jan-Apr	0.86	14.21	65.57	16.41	2.29	0.39	0.21	0.06	0.01	0.00	82.4	7,215 +	146	1.770
	Seine	May-Sep	0.00	25.55	57.59	10.98	3.72	1.52	0.27	0.29	0.09	0.00	79.4	1,506	1,897	23.636
	Trawl	Jan-Apr	1.52	19.81	59.43	18.10	1.14	0.00	0.00	0.00	0.00	0.00	70.9	525	0	0.000 ~
	Gillnet	Oct-Dec	0.00	24.49	53.06	18.37	0.00	2.04	0.00	2.04	0.00	0.00	76.1	49 +	381	5.002
19590	Seine	Oct-Dec	0.00	6.80	54.12	35.60	2.93	0.36	0.09	0.07	0.00	0.02	98.1	3,323	67,866	685.617
	Seine	Jan-Apr	0.00	23.34	50.24	24.15	2.11	0.00	0.16	0.00	0.00	0.00	79.8	617	149	1.863
	Trawl	Oct-Dec	0.00	10.10	51.47	34.80	3.07	0.36	0.10	0.08	0.00	0.03	95.7	3,940 +	23	0.237
19601	Seine	Oct-Dec	0.00	40.17	30.91	22.59	5.84	0.50	0.00	0.00	0.00	0.00	88.0	2,248	25,847	303.907
	Seine	Jan-Apr	0.00	31.62	24.51	25.79	16.10	1.87	0.11	0.00	0.00	0.00	80.6	1,145	9,335	115.270
	Seine	May-Sep	0.00	0.16	28.79	22.54	26.29	19.56	2.35	0.31	0.00	0.00	114.2	639	9,119	79.855
	Trawl	Oct-Dec	0.00	38.75	35.27	19.59	6.24	0.15	0.00	0.00	0.00	0.00	85.8	689	1,328	15.472
	Trawl	Jan-Apr	0.00	38.75	35.27	19.59	6.24	0.15	0.00	0.00	0.00	0.00	85.8	689 +	586	6.822
19612	Seine	Oct-Dec	0.00	9.92	71.21	12.79	4.02	1.72	0.33	0.00	0.00	0.00	88.8	2,824	53,725	602.612
	Seine	Jan-Apr	0.00	13.01	67.90	10.71	5.23	2.56	0.60	0.00	0.00	0.00	87.8	2,824 +	36	0.412
	Seine	May-Sep	0.00	9.42	71.71	13.00	3.96	1.57	0.32	0.02	0.00	0.00	88.8	2,824 +	10,747	120.280
	Trawl	Oct-Dec	0.00	9.56	71.49	12.85	4.11	1.59	0.35	0.04	0.00	0.00	89.0	2,824 +	785	8.818
	Trawl	Jan-Apr	0.00	9.56	71.49	12.85	4.11	1.59	0.35	0.04	0.00	0.00	89.0	2,824 +	9	0.106
19623	Seine	Oct-Dec	0.00	13.94	52.76	29.55	3.49	0.19	0.04	0.04	0.00	0.00	86.6	1,596	56,900	651.147
	Seine	Jan-Apr	0.00	31.58	47.44	15.39	2.88	1.78	0.72	0.35	0.00	0.00	82.2	1,874 +	5,014	71.016
	Seine	May-Sep	0.00	16.74	51.99	27.11	3.19	1.26	0.49	0.10	0.00	0.00	83.3	1,874 +	6,685	78.835
	Trawl	Oct-Dec	0.00	16.73	53.03	26.51	2.73	0.65	0.25	0.10	0.00	0.00	84.5	2,014 +	200	2.372
	Trawl	Jan-Apr	0.00	16.73	53.03	26.51	2.73	0.65	0.25	0.10	0.00	0.00	84.5	2,014 +	47	0.562
19634	Seine	Oct-Dec	0.00	4.30	63.37	29.55	2.20	0.47	0.05	0.07	0.00	0.00	103.4	3,255	65,538	626.573
	Seine	Jan-Apr	0.06	5.19	60.54	31.14	2.58	0.40	0.03	0.06	0.00	0.00	105.7	3,255 +	878	8.440
	Seine	May-Sep	0.00	3.41	49.27	36.83	6.34	3.17	0.73	0.24	0.00	0.00	99.2	410	10,153	102.385
	Trawl	Oct-Dec	0.06	5.41	60.55	30.91	2.58	0.40	0.03	0.06	0.00	0.00	103.4	3,255 +	105	1.016
	Trawl	Jan-Apr	0.06	5.41	60.55	30.91	2.58	0.40	0.03	0.06	0.00	0.00	103.4	3,255 +	208	2.011
19645	Seine	Oct-Dec	0.00	20.04	54.60	22.98	2.07	0.28	0.00	0.03	0.00	0.00	103.0	2,555	39,050	388.413
	Seine	Jan-Apr	0.00	20.49	50.36	25.51	2.46	1.14	0.23	0.00	0.00	0.00	104.3	2,939 +	5,453	54.899
	Seine	May-Sep	0.00	16.35	55.51	25.09	2.26	0.77	0.67	0.04	0.00	0.00	104.0	2,939 +	3,266	31.893
	Trawl	Oct-Dec	0.00	14.53	56.86	25.79	2.14	0.61	0.03	0.03	0.00	0.00	104.3	2,939 +	36	0.349
	Trawl	Jan-Apr	0.00	14.53	56.86	25.79	2.14	0.61	0.03	0.03	0.00	0.00	104.3	2,939 +	14	0.132

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19656	Seine	Oct-Dec	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529	27,909	231.771
	Seine	Jan-Apr	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529 +	4,216	35.012
	Seine	May-Sep	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529 +	1,165	9.673
	Trawl	Oct-Dec	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529 +	25	0.211
	Trawl	Jan-Apr	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529 +	18	0.146
19667	Seine	Oct-Dec	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0 *	28,090	306.795
	Seine	Jan-Apr	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0 *	1,694	18.499
	Seine	May-Sep	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0 *	1,193	13.031
	Trawl	Oct-Dec	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0 *	1	0.008
	Trawl	Jan-Apr	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0 *	65	0.707
19678	Seine	Oct-Dec	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0 *	1,031	10.881
	Seine	Jan-Apr	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0 *	58	0.616
	Seine	May-Sep	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0 *	700	7.390
	Trawl	Jan-Apr	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0 *	101	1.061
19690	Seine	Oct-Dec	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0 *	1	0.007
	Seine	Jan-Apr	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0 *	220	2.299
	Trawl	Jan-Apr	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0 *	0	0.004
	Gillnet	Jan-Apr	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0 *	22	0.230
19701	Seine	Oct-Dec	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419	588	5.118
	Seine	Jan-Apr	0.43	13.36	41.17	34.74	7.01	2.58	0.67	0.04	0.00	0.00	113.9	1,419 +	857	7.672
	Seine	May-Sep	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419 +	66	0.577
	Trawl	Oct-Dec	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419 +	95	0.828
	Trawl	Jan-Apr	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419 +	4	0.032
	Gillnet	Oct-Dec	0.00	4.58	11.75	46.61	28.49	6.77	1.49	0.20	0.10	0.00	140.1	1,004 +	40	0.286
	Gillnet	Jan-Apr	0.00	4.58	11.75	46.61	28.49	6.77	1.49	0.20	0.10	0.00	140.1	1,004 +	44	0.311
19712	Seine	Oct-Dec	0.06	12.78	32.57	33.30	16.53	3.36	1.21	0.12	0.06	0.00	126.0	2,340	1,017	8.277
	Seine	Jan-Apr	0.00	5.69	32.75	36.27	19.69	4.21	1.29	0.09	0.01	0.00	113.1	7,062	7,240	63.276
	Seine	May-Sep	0.01	4.41	29.73	34.98	23.32	6.08	1.39	0.09	0.01	0.00	117.3	9,402 +	98	0.815
	Trawl	Jan-Apr	0.01	8.60	34.61	33.23	18.40	3.79	1.17	0.17	0.02	0.00	114.9	9,402 +	0	0.002
	Gillnet	Jan-Apr	0.00	5.92	11.45	45.25	28.69	6.90	1.65	0.14	0.00	0.00	139.8	1,004	456	3.275
19723	Seine	Oct-Dec	0.00	3.37	50.48	20.94	18.35	5.39	0.91	0.45	0.11	0.00	120.6	1,071	256	2.082
	Seine	Jan-Apr	0.08	1.98	36.48	29.31	20.75	10.01	1.24	0.14	0.01	0.00	130.3	4,643	5,161	41.003
	Seine	May-Sep	0.09	3.35	39.83	27.62	19.68	7.90	1.15	0.33	0.05	0.00	124.1	5,714 +	167	1.351
	Trawl	Oct-Dec	0.10	1.89	31.61	30.52	23.07	11.01	1.51	0.26	0.03	0.00	130.6	5,777 +	1	0.008
	Trawl	Jan-Apr	0.10	1.89	31.61	30.52	23.07	11.01	1.51	0.26	0.03	0.00	130.6	5,777 +	0	0.000
	Gillnet	Oct-Dec	0.00	0.00	17.41	30.36	37.50	11.16	3.13	0.45	0.00	0.00	133.4	224 +	6	0.048
	Gillnet	Jan-Apr	0.00	0.00	17.41	30.36	37.50	11.16	3.13	0.45	0.00	0.00	133.4	224 +	2,057	15.421
19734	Seine	Jan-Apr	0.00	16.29	60.29	17.53	4.19	1.47	0.11	0.11	0.00	0.00	77.8	884 +	842	10.833
	Seine	May-Sep	0.00	16.29	60.29	17.53	4.19	1.47	0.11	0.11	0.00	0.00	77.8	884 +	62	0.795
	Trawl	Jan-Apr	0.00	16.83	61.15	17.24	3.42	1.23	0.14	0.00	0.00	0.00	72.2	731	5	0.064
	Gillnet	Jan-Apr	0.00	0.00	3.74	43.04	32.01	17.56	3.21	0.43	0.00	0.00	157.1	924	3,095	19.692
19745	Seine	Oct-Dec	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685 +	218	2.243
	Seine	Jan-Apr	0.36	3.87	57.31	27.80	7.04	2.49	0.77	0.23	0.13	0.00	98.1	5,685	575	5.995
	Seine	May-Sep	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685 +	55	0.564
	Trawl	Oct-Dec	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685 +	1	0.006
	Other	Jan-Apr	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685 +	204	2.102
	Gillnet	Jan-Apr	0.00	0.00	4.88	46.34	32.32	12.80	3.05	0.61	0.00	0.00	150.1	164 +	5,331	35.526
19756	Seine	Oct-Dec	0.06	7.34	23.01	40.08	20.31	5.57	2.38	0.79	0.43	0.04	122.7	3,494	4,313	35.358
	Seine	Jan-Apr	0.00	5.95	20.35	46.41	19.28	5.46	1.60	0.71	0.20	0.04	109.9	2,254	834	7.166
	Seine	May-Sep	0.03	7.45	21.69	41.20	20.01	5.53	2.57	1.04	0.40	0.07	119.8	5,748 +	28	0.238
	Trawl	Oct-Dec	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918 +	3	0.021
	Trawl	Jan-Apr	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918 +	86	0.711
	Other	Jan-Apr	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918 +	205	1.704
	Gillnet	Jan-Apr	0.00	0.00	0.54	42.00	43.88	10.28	2.70	0.40	0.20	0.00	148.8	786	6,975	46.818
19767	Seine	Oct-Dec	0.62	6.52	56.39	19.55	12.05	3.06	0.95	0.66	0.19	0.01	107.2	1,828	616	5.836
	Seine	Jan-Apr	0.06	3.39	52.68	22.31	16.46	3.70	0.86	0.42	0.03	0.09	105.5	3,200	8,257	78.397
	Seine	May-Sep	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	25	0.236
	Trawl	Oct-Dec	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	73	0.683
	Trawl	Jan-Apr	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	802	7.534
	Other	Jan-Apr	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	569	5.343
	Gillnet	Jan-Apr	0.00	0.00	3.50	27.75	47.32	16.68	4.08	0.54	0.15	0.00	150.3	1,658	7,736	51.507
19778	Seine	Oct-Dec	0.06	2.53	36.75	40.07	9.39	7.18	3.08	0.56	0.35	0.03	110.2	1,984	10,648	96.197
	Seine	Jan-Apr	0.00	0.42	34.65	42.60	13.62	7.09	1.22	0.32	0.00	0.08	105.6	3,516	3,919	36.641
	Seine	May-Sep	0.06	2.25	36.56	39.10	10.46	7.84	2.83	0.57	0.27	0.06	106.3	5,500 +	30	0.287
	Trawl	Oct-Dec	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	1,792	16.618
	Trawl	Jan-Apr	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	296	2.746
	Other	Jan-Apr	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	546	5.063
	Gillnet	Oct-Dec	0.00	0.00	0.37	20.33	30.50	36.04	10.91	1.48	0.37	0.00	148.9	541 +	63	0.425
	Gillnet	Jan-Apr	0.00	0.00	0.37	20.33	30.50	36.04	10.91	1.48	0.37	0.00	148.9	541	7,253	48.694

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

Season	Gear	Fishery	PERCENT AT AGE 0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	CATCH (tonnes)	CATCH (millions)
19789	Seine	Oct-Dec	0.00	1.62	17.91	38.42	27.23	8.82	4.77	1.01	0.15	0.08	126.5	2,433	10,046	79.075
	Seine	Jan-Apr	0.00	3.01	23.91	33.51	25.54	7.92	3.91	1.48	0.43	0.29	117.7	2,095	54	0.461
	Seine	May-Sep	0.00	2.25	20.19	36.76	25.68	8.39	4.95	1.27	0.31	0.20	120.8	4,528 +	71	0.587
	Trawl	Oct-Dec	0.00	1.04	17.08	39.67	29.98	8.28	2.76	1.04	0.07	0.07	125.5	1,341	2,734	21.790
	Trawl	Jan-Apr	0.00	2.34	21.31	33.82	29.30	8.39	3.55	0.56	0.48	0.24	121.0	1,239	607	5.018
	Other	Jan-Apr	0.00	2.11	19.98	36.69	27.50	8.16	3.95	1.11	0.31	0.18	123.2	7,108 +	364	2.954
	Gillnet	Oct-Dec	0.00	0.00	1.15	23.14	54.68	13.77	5.54	1.53	0.00	0.19	153.5	523 +	7	0.048
	Gillnet	Jan-Apr	0.00	0.00	1.25	22.00	55.02	14.11	5.74	1.66	0.00	0.21	153.8	523	6,818	44.171
19790	Seine	Oct-Dec	0.30	2.02	42.12	22.71	18.78	9.35	2.56	1.54	0.47	0.15	114.6	3,063	1,188	10.051
	Seine	Jan-Apr	0.00	4.54	41.60	20.45	20.27	9.00	2.55	1.29	0.25	0.05	100.2	7,664	903	9.224
	Seine	May-Sep	0.15	4.03	43.30	19.97	19.34	8.73	2.59	1.42	0.37	0.11	102.3	10,727 +	52	0.514
	Trawl	Oct-Dec	0.00	3.30	46.70	22.21	15.90	8.60	2.01	1.29	0.00	0.00	108.4	698	242	2.234
	Trawl	Jan-Apr	0.00	3.31	49.04	22.17	14.65	7.90	1.78	1.15	0.00	0.00	107.1	785 +	254	2.373
	Other	Jan-Apr	0.06	3.58	46.53	19.04	17.66	9.09	2.32	1.29	0.31	0.11	104.8	11,512 +	273	2.606
	Gillnet	Oct-Dec	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	0	0.001
	Gillnet	Jan-Apr	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	3,177	21.367
	Gillnet	May-Sep	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	2	0.017
19801	Seine	Oct-Dec	0.00	4.38	33.94	34.26	14.82	8.57	3.14	0.66	0.21	0.02	116.5	6,355	4,152	34.800
	Seine	Jan-Apr	0.00	6.17	34.93	30.73	11.93	10.58	4.58	0.67	0.37	0.04	99.9	12,461	2,133	19.819
	Seine	May-Sep	0.00	4.80	38.21	36.28	10.06	7.77	2.22	0.46	0.15	0.03	96.4	18,816 +	79	0.813
	Trawl	Oct-Dec	0.26	4.36	39.15	29.90	13.16	7.76	3.57	1.13	0.61	0.09	111.0	1,147	501	4.510
	Trawl	Jan-Apr	0.26	4.36	39.15	29.90	13.16	7.76	3.57	1.13	0.61	0.09	111.0	1,147 +	121	1.087
	Other	Jan-Apr	0.02	7.86	37.75	30.48	11.48	8.21	3.21	0.71	0.26	0.04	106.0	19,963 +	409	3.860
	Gillnet	Jan-Apr	0.00	0.09	2.19	18.16	22.98	37.37	16.05	2.81	0.26	0.09	152.1	1,140	5,067	33.319
19812	Seine	Oct-Dec	0.00	5.36	39.98	31.38	14.07	4.96	3.31	0.83	0.06	0.06	121.1	3,876	3,337	27.503
	Seine	Jan-Apr	0.00	7.65	37.90	23.33	19.46	4.51	4.57	2.11	0.40	0.06	104.8	5,332	3,324	30.103
	Seine	May-Sep	0.00	3.86	35.45	28.47	21.36	4.56	4.30	1.74	0.22	0.04	106.8	9,208 +	74	0.690
	Trawl	Oct-Dec	0.00	2.19	46.35	30.29	15.51	2.74	1.64	0.91	0.00	0.36	119.5	548	414	3.464
	Trawl	Jan-Apr	0.00	2.19	46.35	30.29	15.51	2.74	1.64	0.91	0.00	0.36	119.5	548 +	101	0.843
	Other	Jan-Apr	0.00	5.74	37.68	27.80	17.93	4.66	4.14	1.65	0.32	0.08	112.4	9,756 +	455	4.049
	Gillnet	Jan-Apr	0.00	0.00	4.60	15.77	30.37	15.82	20.42	11.58	1.03	0.41	150.9	589	5,583	37.004
	Gillnet	May-Sep	0.00	0.00	4.58	15.96	30.56	15.11	20.88	11.71	0.85	0.34	151.6	589 +	0	0.001
19823	Seine	Oct-Dec	0.00	3.37	34.06	30.39	16.43	8.12	2.93	3.00	1.43	0.26	116.0	5,296	632	4.809
	Seine	Jan-Apr	0.00	3.36	31.41	28.72	17.68	11.49	3.16	2.78	1.16	0.24	113.5	13,007	7,798	69.556
	Seine	May-Sep	0.00	10.91	42.05	22.39	12.44	7.63	1.95	1.76	0.72	0.14	109.6	18,303 +	57	0.568
	Trawl	Oct-Dec	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439	115	0.797
	Trawl	Jan-Apr	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439	0	0.000 ~
	Trawl	May-Sep	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439 +	2	0.017
	Other	Jan-Apr	0.00	4.41	33.16	28.53	16.64	9.91	2.97	2.85	1.27	0.26	115.3	18,742 +	272	2.359
	Gillnet	Jan-Apr	0.00	0.00	0.49	27.76	29.48	23.59	9.34	7.37	1.72	0.25	152.8	407	8,613	56.381
19834	Seine	Oct-Dec	0.21	19.24	36.34	21.19	13.02	6.01	2.80	0.64	0.34	0.22	108.4	3,634	444	3.882
	Seine	Jan-Apr	0.00	4.70	40.35	31.85	11.86	6.31	3.10	1.27	0.44	0.11	103.8	7,318	4,137	41.098
	Seine	May-Sep	0.15	10.57	39.21	27.00	12.16	6.30	3.13	0.95	0.39	0.14	105.9	10,952 +	88	0.843
	Trawl	Oct-Dec	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	113	1.056
	Trawl	Jan-Apr	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	214	2.011
	Other	Jan-Apr	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	182	1.708
	Gillnet	Jan-Apr	0.00	0.00	7.14	30.29	30.95	19.05	9.39	1.59	0.66	0.93	142.9	756	6,039	42.246
19845	Seine	Oct-Dec	0.00	32.93	37.34	18.72	6.75	2.89	0.91	0.34	0.11	0.00	101.9	2,528	409	3.904
	Seine	Jan-Apr	0.00	23.09	43.51	19.33	8.62	3.55	1.27	0.55	0.07	0.00	90.8	8,187	2,770	29.011
	Seine	May-Sep	0.00	24.05	45.04	18.72	7.69	2.83	1.19	0.42	0.05	0.01	90.3	10,715 +	88	0.975
	Trawl	Oct-Dec	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	20	0.218
	Trawl	Jan-Apr	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	246	2.630
	Other	Jan-Apr	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	182	1.943
	Gillnet	Oct-Dec	0.00	0.09	3.10	26.09	32.48	23.63	9.22	3.74	0.82	0.82	147.4	1,096 +	0	0.002
	Gillnet	Jan-Apr	0.00	0.09	3.10	26.09	32.48	23.63	9.22	3.74	0.82	0.82	147.4	1,096	3,495	23.718
19856	Seine	Oct-Dec	0.00	14.33	62.24	17.57	4.40	1.27	0.17	0.02	0.00	0.00	103.3	1,390	209	2.004
	Seine	Jan-Apr	0.01	9.76	55.76	24.98	6.45	2.06	0.80	0.12	0.08	0.00	94.7	6,773	178	1.844
	Seine	May-Sep	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	40	0.426
	Trawl	Oct-Dec	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	46	0.481
	Trawl	Jan-Apr	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	120	1.257
	Gillnet	Oct-Dec	0.00	0.00	2.50	35.62	33.44	16.51	8.49	2.60	0.57	0.26	145.1	1,920 +	0	0.000
19867	Seine	Oct-Dec	0.10	23.34	34.77	30.50	8.84	1.75	0.46	0.23	0.00	0.00	104.8	1,148	104	0.984
	Seine	Jan-Apr	0.03	2.73	32.98	38.23	19.76	4.32	1.22	0.45	0.19	0.10	97.6	7,957	3,133	32.258
	Seine	May-Sep	0.03	11.92	35.91	34.11	13.52	3.16	0.96	0.27	0.08	0.05	94.2	9,105 +	41	0.431
	Trawl	Jan-Apr	0.03	11.82	33.27	35.95	14.21	3.23	0.99	0.34	0.11	0.05	98.6	9,105 +	76	0.768
	Gillnet	Jan-Apr	0.00	0.00	3.01	38.33	32.48	15.47	7.35	2.55	0.60	0.21	145.3	1,920	5,998	41.166

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.

+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.

~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE												CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	(tonnes)	(millions)
19878	Seine	Oct-Dec	0.41	6.52	64.47	14.59	11.38	1.81	0.55	0.15	0.11	0.00	106.4	1,632	357	3.386
	Seine	Jan-Apr	0.00	2.35	52.89	17.58	20.29	5.27	1.31	0.21	0.10	0.00	104.0	6,338	1,475	13.516
	Seine	May-Sep	0.07	4.82	61.90	14.59	13.99	3.51	0.87	0.18	0.06	0.00	99.7	7,970 +	33	0.333
	Trawl	Oct-Dec	0.06	4.74	61.47	14.71	14.27	3.60	0.90	0.19	0.06	0.00	100.5	7,970 +	83	0.826
	Trawl	Jan-Apr	0.06	4.74	61.47	14.71	14.27	3.60	0.90	0.19	0.06	0.00	100.5	7,970 +	279	2.773
	Gillnet	Jan-Apr	0.00	0.00	9.20	14.81	47.81	20.09	5.27	2.24	0.34	0.22	144.4	891	5,988	41.461
19889	Seine	Oct-Dec	0.00	26.15	17.44	42.75	6.77	5.90	0.82	0.16	0.00	0.00	109.1	1,252	728	6.660
	Seine	Jan-Apr	0.00	12.31	15.17	51.91	10.87	7.93	1.48	0.27	0.04	0.03	104.6	6,517	1,446	13.339
	Seine	May-Sep	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	56	0.547
	Trawl	Oct-Dec	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	134	1.308
	Trawl	Jan-Apr	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	86	0.844
	Gillnet	Jan-Apr	0.00	0.00	1.60	40.43	21.42	26.02	7.99	2.26	0.28	0.00	140.3	823	5,919	42.236
19890	Seine	Oct-Dec	0.00	6.68	58.62	12.72	17.67	2.26	2.05	0.00	0.00	0.00	101.3	928	75	0.736
	Seine	Jan-Apr	0.00	10.09	57.87	8.23	17.43	3.59	2.27	0.40	0.07	0.06	100.2	5,915	96	0.936
	Seine	May-Sep	0.00	7.51	56.71	11.25	19.33	2.97	1.81	0.34	0.06	0.01	97.4	6,843 +	62	0.632
	Gillnet	Jan-Apr	0.00	0.00	8.93	11.71	56.04	12.10	9.44	1.41	0.30	0.06	141.6	1,371	7,886	55.630
19901	Seine	Oct-Dec	0.00	13.89	31.24	38.58	7.67	7.42	1.04	0.16	0.00	0.00	107.5	698	371	3.440
	Seine	Jan-Apr	0.00	3.82	21.09	44.52	10.27	16.08	2.48	1.47	0.24	0.03	109.4	5,291	1,141	10.217
	Seine	May-Sep	0.00	10.74	23.31	39.87	8.80	13.78	2.05	1.27	0.17	0.02	108.1	5,989 +	58	0.541
	Trawl	Oct-Dec	0.00	10.74	23.31	39.87	8.80	13.78	2.05	1.27	0.17	0.02	108.1	5,989 +	122	1.133
	Gillnet	Jan-Apr	0.00	0.00	1.29	28.15	17.20	40.11	7.27	4.69	1.20	0.09	146.0	1,087	9,410	64.461
19912	Seine	Oct-Dec	0.00	3.96	67.09	17.24	9.27	1.31	0.56	0.56	0.00	0.00	103.6	641	639	6.140
	Seine	Jan-Apr	0.00	3.62	53.63	14.96	17.44	4.04	5.34	0.59	0.38	0.00	105.6	5,036	3,725	34.318
	Seine	May-Sep	0.00	4.95	56.44	14.07	15.80	3.22	4.63	0.58	0.28	0.02	104.1	5,677 +	57	0.550
	Trawl	Oct-Dec	0.00	4.95	56.44	14.07	15.80	3.22	4.63	0.58	0.28	0.02	104.1	5,677 +	128	1.229
	Gillnet	Jan-Apr	0.00	0.00	6.33	14.88	43.63	11.72	18.91	2.65	1.45	0.43	147.6	1,169	8,870	60.081
19923	Seine	Oct-Dec	0.00	26.95	31.11	31.47	6.97	2.56	0.26	0.58	0.11	0.00	98.6	973	516	5.272
	Seine	Jan-Apr	0.00	11.22	39.18	33.15	7.57	5.77	1.37	1.63	0.06	0.06	101.3	5,445	4,396	42.070
	Seine	May-Sep	0.00	16.80	36.80	31.55	6.87	5.28	1.20	1.32	0.14	0.03	99.6	6,418 +	96	0.968
	Gillnet	Jan-Apr	0.00	0.00	11.47	40.02	16.98	21.61	4.08	5.40	0.22	0.22	137.9	907	8,733	63.326
19934	Seine	Oct-Dec	0.00	5.65	50.00	25.43	16.30	1.52	1.09	0.00	0.00	0.00	101.3	460	866	8.549
	Seine	Jan-Apr	0.02	3.72	42.96	26.98	19.34	3.70	2.65	0.53	0.13	0.00	97.2	5,969	5,138	52.868
	Seine	May-Sep	0.02	4.74	42.74	26.61	18.59	3.81	2.69	0.65	0.14	0.00	97.4	6,429 +	71	0.730
	Gillnet	Jan-Apr	0.00	0.07	3.65	25.26	44.78	15.21	7.83	2.42	0.62	0.16	133.7	1,201	11,572	86.661
19945	Seine	Oct-Dec	0.00	20.87	27.81	36.05	10.01	4.44	0.68	0.11	0.00	0.02	102.9	1,130	604	5.865
	Seine	Jan-Apr	0.00	7.09	21.21	37.04	18.67	11.51	2.92	1.13	0.35	0.08	110.4	5,754	4,362	38.990
	Seine	May-Sep	0.00	11.65	22.69	35.69	16.39	9.89	2.37	0.93	0.29	0.10	107.9	6,884 +	33	0.306
	Gillnet	Jan-Apr	0.00	0.00	2.10	27.82	38.15	24.14	5.10	2.10	0.30	0.30	139.6	927	8,190	58.655
19956	Seine	Oct-Dec	0.49	29.31	46.92	11.70	8.84	1.78	0.87	0.08	0.00	0.00	85.9	1,662	397	4.650
	Seine	Jan-Apr	0.06	9.29	47.72	15.20	15.88	6.74	3.87	0.86	0.27	0.11	98.2	8,243	7,434	73.620
	Seine	May-Sep	0.08	14.92	48.51	13.72	13.62	5.27	3.01	0.61	0.19	0.07	95.1	9,905 +	10	0.106
	Trawl	Oct-Dec	0.08	14.92	48.51	13.72	13.62	5.27	3.01	0.61	0.19	0.07	95.1	9,905 +	39	0.406
	Gillnet	Jan-Apr	0.00	0.00	4.05	15.87	44.53	22.08	10.30	2.11	0.84	0.21	138.2	544	6,233	45.214
19967	Seine	Oct-Dec	3.29	9.71	54.01	21.40	5.31	5.27	2.24	1.24	0.14	0.16	88.1	7,667 +	279	3.120
	Seine	Jan-Apr	0.00	5.52	51.35	24.45	6.54	7.43	2.84	1.70	0.12	0.04	88.8	7,297	9,390	96.287
	Seine	May-Sep	0.65	8.74	52.26	22.45	5.78	6.09	2.41	1.42	0.13	0.07	91.7	7,667 +	7	0.071
	Gillnet	Jan-Apr	0.00	0.00	4.74	17.85	16.43	31.91	17.06	8.53	2.53	0.95	136.7	633	6,148	44.974
19978	Seine	Oct-Dec	0.00	3.96	48.07	40.23	6.40	0.91	0.34	0.08	0.00	0.00	86.1	1,288	954	11.072
	Seine	Jan-Apr	0.02	2.93	47.03	31.80	12.25	2.90	2.14	0.70	0.21	0.03	86.8	5,837	5,755	66.260
	Trawl	Jan-Apr	0.00	7.01	45.19	37.03	8.16	1.14	0.98	0.16	0.33	0.00	74.3	613	0	0.000 ~
	Gillnet	Jan-Apr	0.00	0.00	1.54	26.20	28.32	15.61	18.69	7.13	1.54	0.96	130.4	519	6,895	52.858
19989	Seine	Oct-Dec	0.17	12.30	27.77	43.17	13.35	2.74	0.37	0.13	0.00	0.00	91.3	1,297	1,471	16.123
	Seine	Jan-Apr	0.00	4.23	22.78	45.02	18.55	6.58	1.88	0.78	0.13	0.06	100.0	3,192	4,976	49.748
	Trawl	Jan-Apr	0.00	5.49	31.87	30.77	21.98	7.69	1.10	0.00	1.10	0.00	92.3	91	0	0.000 ~
	Gillnet	Jan-Apr	0.00	0.00	2.15	29.31	36.72	21.05	6.70	3.35	0.60	0.12	130.8	836	6,837	52.248
19990	Seine	Oct-Dec	0.00	21.12	50.16	16.69	8.74	2.39	0.89	0.00	0.00	0.00	75.0	1,077	1,156	15.363
	Seine	Jan-Apr	0.10	9.62	35.44	19.34	23.92	8.81	2.12	0.36	0.28	0.02	92.2	5,042	6,454	69.966
	Gillnet	Jan-Apr	0.00	0.00	1.07	13.75	44.56	28.68	9.59	1.92	0.43	0.00	135.1	938	7,593	56.219
20001	Seine	Oct-Dec	0.00	9.66	51.94	27.98	5.52	3.51	1.25	0.00	0.13	0.00	95.6	797	1,423	14.897
	Seine	Jan-Apr	0.00	4.80	42.65	30.65	9.52	9.19	2.52	0.55	0.09	0.02	97.3	4,558	7,275	74.770
	Gillnet	Jan-Apr	0.00	0.00	3.55	17.75	25.59	35.06	15.09	2.37	0.30	0.30	133.4	676	7,682	57.589
20012	Seine	Oct-Dec	0.00	4.96	61.42	26.19	5.93	0.97	0.32	0.11	0.00	0.11	87.0	928	1,328	15.265
	Seine	Jan-Apr	0.00	6.59	49.18	27.04	12.45	2.35	1.99	0.40	0.00	0.00	87.7	4,475	9,299	106.015
	Gillnet	Jan-Apr	0.00	0.00	5.83	20.78	30.42	17.69	21.01	3.54	0.49	0.24	131.8	915	7,986	60.800
20023	Seine	Oct-Dec	0.00	2.80	44.16	42.29	8.41	2.10	0.23	0.00	0.00	0.00	91.9	428	1,696	18.466
	Seine	Jan-Apr	0.01	2.67	42.62	36.58	12.64	4.03	0.93	0.41	0.10	0.00	87.2	7,293	10,670	122.311
	Gillnet	Jan-Apr	0.00	0.00	2.29	22.38	31.05	23.83	9.87	7.34	2.65	0.60	131.6	831	8,010	60.889
20034	Seine	Oct-Dec	0.00	11.24	30.77	40.04	14.00	3.55	0.39	0.00	0.00	0.00	83.1	507	1,360	16.316
	Seine	Jan-Apr	0.00	2.90	25.39	41.55	22.29	5.65	1.54	0.43	0.25	0.00	83.1	1,707	7,019	79.437
	Gillnet	Jan-Apr	0.00	0.00	1.74	21.39	37.02	23.98	11.72	2.51	1.49	0.14	124.0	1,185	5,226	41.630

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.5. Age composition and catch by season, fishery and gear type for the West Coast Vancouver Island stock assessment region. These data are used for the age-structured model analysis.

Season	Gear	Fishery	PERCENT AT AGE 0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	CATCH (tonnes)	(millions)
19501	Seine	Oct-Dec	0.10	15.78	39.08	37.78	5.35	1.56	0.26	0.05	0.05	0.00	96.8	1,927	7,670	79.266
	Seine	Jan-Apr	0.00	10.19	36.69	43.89	7.69	1.25	0.30	0.00	0.00	0.00	99.3	2,112	14,151	143.353
19512	Seine	Oct-Dec	0.11	6.62	61.99	20.85	9.27	0.89	0.27	0.00	0.00	0.00	98.9	996	8,251	83.215
	Seine	Jan-Apr	0.00	0.33	12.08	27.32	50.77	6.88	2.08	0.48	0.06	0.00	123.8	3,897	18,757	146.019
19523	Seine	Jan-Apr	0.16	11.77	57.76	28.08	1.67	0.50	0.05	0.00	0.00	0.00	82.4	3,764	20	0.242
19534	Seine	Oct-Dec	0.05	1.61	61.40	29.42	6.70	0.59	0.12	0.12	0.00	0.00	95.6	3,655	23,534	245.938
	Seine	Jan-Apr	0.00	4.43	65.53	24.81	4.06	0.83	0.21	0.04	0.04	0.04	87.2	2,439	9,675	109.814
19545	Seine	Oct-Dec	0.06	19.64	57.81	18.59	3.27	0.64	0.00	0.00	0.00	0.00	87.6	1,723	4,650	53.117
	Seine	Jan-Apr	0.00	10.86	65.09	20.01	3.47	0.52	0.05	0.00	0.00	0.00	80.9	754	1,473	18.369
19556	Seine	Oct-Dec	0.00	13.43	67.98	14.82	3.09	0.50	0.16	0.02	0.00	0.00	87.4	3,730	15,310	175.972
	Seine	Jan-Apr	0.00	9.21	49.51	19.28	17.88	3.68	0.11	0.11	0.22	0.00	87.2	923	1,787	20.496
19567	Seine	Oct-Dec	0.00	2.86	71.84	24.69	0.41	0.20	0.00	0.00	0.00	0.00	86.4	490 +	1,690	19.549
	Seine	Jan-Apr	0.00	2.74	71.92	24.81	0.35	0.18	0.00	0.00	0.00	0.00	86.4	588 +	915	10.586
	Seine	May-Sep	0.00	2.72	71.94	24.83	0.34	0.17	0.00	0.00	0.00	0.00	86.4	588 +	8	0.088
19578	Seine	Jan-Apr	0.00	15.18	54.28	25.87	3.98	0.47	0.17	0.04	0.01	0.00	76.8	1,480	513	6.766
	Seine	May-Sep	0.00	13.04	52.03	25.41	5.47	2.30	1.35	0.34	0.07	0.00	78.3	1,480 +	43	0.551
19589	Seine	Oct-Dec	0.00	3.26	45.21	29.96	14.51	3.46	1.82	1.45	0.33	0.00	92.2	2,843	55,196	588.911
	Seine	Jan-Apr	0.00	3.28	19.68	23.88	26.94	9.15	7.94	6.52	1.99	0.62	99.6	751	13,845	136.204
	Gillnet	Jan-Apr	0.00	10.00	58.10	9.50	19.00	2.60	0.50	0.20	0.10	0.00	97.6	0 *	182	1.868
19590	Seine	Oct-Dec	0.00	8.92	54.85	23.26	8.64	2.81	0.95	0.35	0.14	0.07	95.7	2,846	53,911	563.328
	Seine	Jan-Apr	0.00	8.92	54.85	23.26	8.64	2.81	0.95	0.35	0.14	0.07	95.7	2,846	0	0.000 ~
19601	Seine	Oct-Dec	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590 +	16,711	195.384
	Seine	Jan-Apr	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590 +	9,679	113.162
	Seine	May-Sep	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590 +	44	0.520
19612	Seine	Oct-Dec	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163 +	5,951	63.821
	Seine	Jan-Apr	0.00	5.32	80.46	10.07	3.10	1.05	0.00	0.00	0.00	0.00	92.8	1,117	17,710	190.890
	Trawl	Jan-Apr	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163 +	24	0.253
19623	Seine	Oct-Dec	0.00	1.99	43.18	48.71	5.16	0.75	0.21	0.00	0.00	0.00	101.3	1,862 +	3,184	31.449
	Seine	Jan-Apr	0.00	2.47	41.39	49.75	5.41	0.71	0.27	0.00	0.00	0.00	101.0	1,633	15,022	148.723
19634	Seine	Oct-Dec	0.00	1.64	60.61	25.86	10.83	0.77	0.29	0.00	0.00	0.00	103.4	1,107 +	2,952	28.550
	Seine	Jan-Apr	0.00	0.95	65.05	22.91	10.00	0.85	0.25	0.00	0.00	0.00	101.0	769	18,313	182.208
19645	Seine	Oct-Dec	0.00	2.78	34.38	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576 +	68	0.553
	Seine	Jan-Apr	0.00	2.78	34.37	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576	10,397	84.858
	Seine	May-Sep	0.00	2.78	34.37	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576 +	5,582	45.559
19656	Seine	Oct-Dec	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0 *	4,299	31.377
	Seine	Jan-Apr	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0 *	6,471	47.228
	Seine	May-Sep	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0 *	73	0.535
19667	Seine	Oct-Dec	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0 *	2,965	25.811
	Seine	Jan-Apr	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0 *	9,794	85.253
	Seine	May-Sep	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0 *	2,385	20.760
19701	Seine	Jan-Apr	0.00	5.77	44.57	36.95	7.85	2.77	1.62	0.46	0.00	0.00	132.8	433	0	0.000 ~
19712	Seine	Jan-Apr	0.00	3.66	19.01	50.10	21.81	3.39	1.23	0.79	0.03	0.00	135.3	1,482	6,894	51.001
19723	Seine	Jan-Apr	0.00	0.21	25.15	23.05	35.64	13.81	1.89	0.17	0.08	0.00	139.1	2,556	16,766	117.326
	Gillnet	Jan-Apr	0.00	0.00	8.81	23.56	51.44	12.23	3.06	0.72	0.18	0.00	159.4	556	1,537	9.642
19734	Seine	Jan-Apr	0.00	5.71	43.66	22.09	15.14	10.96	2.32	0.12	0.00	0.00	114.9	5,221	12,394	109.083
	Gillnet	Jan-Apr	0.00	0.00	29.87	27.92	27.92	10.39	3.90	0.00	0.00	0.00	133.5	154 +	3,940	29.517
19745	Seine	Jan-Apr	0.02	0.44	51.61	19.95	12.00	8.70	5.71	1.38	0.18	0.00	124.6	10,038	17,798	142.327
	Trawl	Jan-Apr	0.02	0.60	53.85	19.75	11.36	8.01	4.96	1.28	0.17	0.01	122.5	10,038 +	0	0.004
	Other	Jan-Apr	0.02	0.60	53.85	19.75	11.36	8.01	4.96	1.28	0.17	0.01	122.5	10,038 +	136	1.111
	Gillnet	Jan-Apr	0.00	0.00	2.90	32.37	36.51	19.92	7.88	0.41	0.00	0.00	169.0	241 +	8,310	49.159
19756	Seine	Jan-Apr	0.00	0.20	8.31	48.06	19.79	12.97	7.65	2.57	0.43	0.00	140.0	9,230	22,820	162.893
	Trawl	Jan-Apr	0.00	0.47	14.55	54.46	18.78	6.10	5.16	0.47	0.00	0.00	131.6	213	0	0.000 ~
	Other	Jan-Apr	0.00	0.21	8.99	47.10	19.78	12.80	8.02	2.67	0.42	0.00	140.1	9,443 +	204	1.456
	Gillnet	Jan-Apr	0.00	0.00	0.68	41.72	34.00	14.77	5.92	2.50	0.33	0.08	150.2	1,199	16,005	106.418
19767	Seine	Jan-Apr	0.00	0.39	11.51	32.16	38.00	12.43	3.89	1.42	0.16	0.03	136.7	6,684	17,463	126.700
	Gillnet	Jan-Apr	0.00	0.60	3.61	17.47	43.37	16.87	11.14	5.12	1.51	0.30	154.2	332 +	12,556	81.452
	Gillnet	May-Sep	0.00	0.60	3.61	17.47	43.37	16.87	11.14	5.12	1.51	0.30	154.2	332 +	24	0.154
19778	Seine	Oct-Dec	0.00	0.00	31.00	23.75	15.00	22.50	4.25	1.50	1.00	1.00	127.3	400	303	2.379
	Seine	Jan-Apr	0.00	0.77	39.43	18.78	16.78	18.80	4.14	1.10	0.17	0.04	109.2	7,454	7,615	67.761
19778	Seine	May-Sep	0.00	0.80	41.49	19.07	15.66	17.60	3.85	1.18	0.23	0.11	111.9	7,854 +	7	0.066
	Trawl	Oct-Dec	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898 +	51	0.456
	Trawl	Jan-Apr	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898 +	3	0.023
	Trawl	May-Sep	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898 +	11	0.101
	Gillnet	Jan-Apr	0.00	0.00	1.42	5.45	21.33	49.05	17.54	4.74	0.24	0.24	157.6	422	14,755	93.615
19789	Seine	Oct-Dec	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689 +	70	0.563
	Seine	Jan-Apr	0.00	1.07	14.94	51.51	13.82	9.87	7.04	1.43	0.26	0.06	123.1	3,689	10,473	86.211
	Seine	May-Sep	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689 +	4	0.032
	Trawl	Oct-Dec	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689 +	9	0.073
	Gillnet	Jan-Apr	0.00	0.00	1.05	24.79	28.57	23.74	18.07	3.15	0.42	0.21	161.5	476	8,138	50.388

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.5. Age composition and catch by season, fishery and gear type for the West Coast Vancouver Island stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	**Gear**	**Fishery**	**0+**	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9++**	**Weight**	**Aged**	**(tonnes)**	**(millions)**
19790	Seine	Jan-Apr	0.00	7.13	37.93	13.75	20.24	8.99	8.11	3.14	0.48	0.23	110.8	3,735	1,682	14.641
	Seine	May-Sep	0.00	6.21	43.91	15.58	20.00	6.37	5.30	2.20	0.35	0.08	108.2	3,735 +	0	0.000
	Gillnet	Jan-Apr	0.00	0.00	0.00	5.31	52.51	22.35	12.01	7.26	0.28	0.28	163.6	358 +	2,300	14.061
19801	Seine	Jan-Apr	0.00	3.89	32.52	33.31	10.62	13.65	4.07	1.51	0.37	0.05	116.1	5,026	5,008	44.277
	Seine	May-Sep	0.00	2.83	27.39	22.26	14.13	17.84	8.83	4.77	1.41	0.53	133.6	566	2	0.015
	Other	Jan-Apr	0.00	4.62	37.17	28.31	9.93	12.00	5.19	2.05	0.58	0.16	114.1	5,026 +	46	0.403
	Gillnet	Jan-Apr	0.00	0.00	1.78	21.00	14.95	36.30	18.86	7.12	0.00	0.00	148.6	281 +	3,079	20.725
19812	Seine	Jan-Apr	0.00	4.32	24.84	28.55	22.53	5.50	7.92	3.73	2.04	0.58	120.4	4,775	2,370	19.713
	Seine	May-Sep	0.00	3.27	23.96	27.41	26.05	5.45	9.51	2.72	1.36	0.27	115.9	4,775 +	2	0.013
	Gillnet	Jan-Apr	0.00	0.00	0.70	12.02	44.25	11.67	27.53	3.31	0.35	0.17	137.0	574	3,115	22.741
19823	Seine	Jan-Apr	0.00	3.83	19.37	23.62	23.39	16.69	4.60	5.45	1.50	1.55	131.3	3,188	6,141	45.840
	Gillnet	Jan-Apr	0.00	0.00	0.35	14.19	23.82	44.83	6.48	9.81	0.35	0.18	137.8	571	2,434	17.662
19834	Seine	Jan-Apr	0.00	23.09	37.97	13.00	8.86	9.48	5.52	0.88	1.00	0.19	114.9	3,079	5,718	49.965
	Gillnet	Jan-Apr	0.00	0.00	1.68	6.72	17.98	32.61	31.93	5.38	3.36	0.34	154.9	595	858	5.540
19845	Seine	Jan-Apr	0.00	6.28	48.74	22.86	6.40	5.12	6.21	3.47	0.37	0.55	120.1	2,995	177	1.352
	Seine	May-Sep	0.00	20.47	53.62	14.22	3.71	2.74	3.17	1.70	0.13	0.23	109.0	2,995 +	1	0.008
19856	Seine	Oct-Dec	0.00	3.78	50.45	29.70	8.29	3.13	2.24	1.76	0.58	0.07	121.5	4,151 +	1	0.005
	Seine	Jan-Apr	0.00	3.86	48.16	27.50	10.68	3.83	2.92	2.21	0.74	0.11	124.3	2,847	203	1.633
19867	Seine	Jan-Apr	0.00	16.21	16.21	36.29	18.16	7.70	2.56	1.38	1.15	0.34	130.8	3,480	13,463	102.956
	Trawl	Jan-Apr	0.00	26.98	26.03	28.57	13.65	1.59	0.95	1.90	0.32	0.00	93.9	315	0	0.000 ~
	Gillnet	Jan-Apr	0.00	0.00	1.82	24.55	61.82	5.45	2.18	2.91	0.91	0.36	171.3	550	2,471	14.431
19878	Seine	Jan-Apr	0.00	1.60	63.80	7.41	14.70	8.38	2.75	0.65	0.48	0.23	127.5	4,883	8,276	67.129
	Trawl	Jan-Apr	0.00	3.03	59.09	19.70	15.15	3.03	0.00	0.00	0.00	0.00	92.9	66	0	0.000 ~
	Gillnet	Jan-Apr	0.00	0.00	5.38	7.10	41.29	28.60	12.90	3.01	1.29	0.43	166.9	465	1,448	8.674
19889	Seine	Jan-Apr	0.00	3.06	14.96	61.92	7.11	8.47	3.45	0.79	0.17	0.07	126.4	4,178	9,774	77.304
	Trawl	Jan-Apr	0.00	0.00	14.29	63.10	10.71	9.52	2.38	0.00	0.00	0.00	127.4	84	0	0.000 ~
	Gillnet	Jan-Apr	0.00	0.00	0.20	54.50	11.00	22.30	9.40	1.60	1.00	0.00	151.0	382 +	3,515	23.274
19890	Seine	Jan-Apr	0.00	0.46	26.32	11.72	48.79	4.89	5.99	1.53	0.27	0.03	139.4	3,720	7,890	56.611
	Gillnet	Jan-Apr	0.00	0.00	1.35	7.87	68.99	8.31	10.34	2.47	0.67	0.00	155.6	445	1,959	12.593
19901	Seine	Jan-Apr	0.00	6.15	19.13	22.02	10.60	35.06	2.99	3.39	0.64	0.02	130.8	5,715	6,299	47.096
	Other	Jan-Apr	0.00	6.59	21.41	21.11	10.67	33.10	3.01	3.43	0.66	0.03	132.0	7,311 +	273	2.069
	Gillnet	Jan-Apr	0.00	0.00	3.26	6.84	12.70	64.50	6.84	8.14	6.52	0.00	175.5	307 +	2,336	13.308
19912	Seine	Jan-Apr	0.00	1.47	43.29	10.77	14.97	6.62	18.95	2.42	1.26	0.26	132.2	4,290	3,086	23.337
	Trawl	Jan-Apr	0.00	3.45	31.03	20.69	26.44	2.30	10.34	2.30	2.30	1.15	105.6	87	0	0.000 ~
	Other	Jan-Apr	0.00	1.69	48.04	10.74	13.42	5.87	16.70	2.09	1.22	0.23	128.7	6,162 +	273	2.122
	Gillnet	Jan-Apr	0.00	0.00	6.29	13.49	30.76	13.85	29.86	2.88	2.52	0.36	154.2	556	627	4.066
19923	Seine	Jan-Apr	0.00	3.46	26.25	39.83	7.14	8.29	4.57	8.71	1.08	0.66	126.9	4,705	5,612	44.244
	Other	Jan-Apr	0.00	3.87	27.66	40.82	6.88	7.53	4.09	7.66	0.92	0.56	124.3	5,524 +	273	2.196
19934	Seine	Jan-Apr	0.00	3.85	18.47	22.30	31.82	8.69	6.19	6.58	1.84	0.27	125.3	6,196	5,332	42.481
	Trawl	Oct-Dec	0.00	3.00	22.74	24.13	30.04	8.00	5.00	5.26	1.58	0.24	124.7	6,274 +	0	0.001
	Trawl	Jan-Apr	0.00	6.41	25.64	37.18	12.82	12.82	3.85	0.00	1.28	0.00	92.4	78	0	0.000 ~
	Trawl	May-Sep	0.00	0.79	26.11	29.11	26.58	7.91	5.38	2.85	1.11	0.16	97.1	632	1	0.008
	Other	Jan-Apr	0.00	3.00	22.74	24.13	30.04	8.00	5.00	5.26	1.58	0.24	124.7	6,274 +	273	2.190
	Gillnet	Jan-Apr	0.00	0.16	5.65	32.10	54.84	5.32	1.13	0.65	0.16	0.00	131.1	620	706	5.381
19945	Seine	Jan-Apr	0.00	1.02	13.98	21.55	19.83	27.32	7.46	4.66	3.26	0.93	139.0	5,392	1,947	14.006
	Trawl	Oct-Dec	0.00	1.17	13.32	25.60	20.52	25.29	6.44	4.02	2.89	0.75	135.6	7,086 +	1	0.005
	Trawl	May-Sep	0.00	2.57	34.57	29.07	10.02	13.75	4.52	3.93	1.57	0.00	105.9	574	3	0.029
	Other	Jan-Apr	0.00	1.17	13.32	25.60	20.52	25.29	6.44	4.02	2.89	0.75	135.6	7,086 +	637	4.699
19956	Seine	Jan-Apr	0.00	17.06	22.43	12.83	15.22	12.76	14.03	3.39	1.42	0.86	119.3	5,394	790	6.607
	Trawl	Oct-Dec	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255 +	1	0.006
	Trawl	May-Sep	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255 +	0	0.000
	Other	Jan-Apr	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255 +	728	6.093
19967	Seine	Jan-Apr	0.00	3.65	70.44	8.47	4.17	5.11	4.02	3.18	0.63	0.32	98.6	6,539	6,656	67.506
	Other	Jan-Apr	0.01	3.23	69.98	8.14	4.10	6.01	4.44	3.22	0.56	0.32	100.4	8,540 +	728	7.249
19978	Seine	Jan-Apr	0.00	2.40	21.91	61.07	6.56	2.75	2.40	1.65	0.98	0.29	99.1	6,098	5,449	55.784
	Other	Jan-Apr	0.00	2.49	22.75	59.49	6.52	2.75	2.95	1.79	1.01	0.26	98.7	7,055 +	364	3.689
	Gillnet	Jan-Apr	0.00	0.00	0.86	41.37	10.51	10.55	14.67	12.41	6.33	3.29	138.6	899	1,550	11.177
19989	Seine	Jan-Apr	0.00	1.39	21.95	23.61	39.60	8.41	2.67	1.29	0.73	0.33	110.5	4,341	3,407	31.759
	Other	Jan-Apr	0.00	1.44	21.90	24.90	38.57	8.09	2.66	1.49	0.63	0.32	106.2	5,562 +	455	4.285
	Gillnet	Jan-Apr	0.00	0.00	0.82	9.98	60.36	18.46	5.32	3.35	1.48	0.24	135.7	1,043	963	7.098
19990	Seine	Jan-Apr	0.00	7.85	24.06	19.88	17.32	25.46	3.65	1.07	0.58	0.13	115.1	6,613	926	8.308
	Other	Jan-Apr	0.00	6.68	24.61	19.79	17.36	25.78	3.70	1.19	0.68	0.20	112.7	6,888 +	364	3.229
	Gillnet	Jan-Apr	0.00	0.00	1.28	7.52	27.04	52.80	6.24	2.56	2.24	0.32	145.2	625	700	4.823
20001	Seine	Jan-Apr	0.00	7.02	45.66	20.20	8.38	7.57	9.44	1.32	0.21	0.21	105.3	2,352	0	0.000 ~
	Other	Jan-Apr	0.00	7.02	45.66	20.20	8.38	7.57	9.44	1.32	0.21	0.21	105.3	2,352 +	364	3.456
20012	Seine	Jan-Apr	0.00	4.14	51.73	22.77	9.91	3.00	4.36	3.73	0.36	0.00	103.0	2,200	433	4.204
	Other	Jan-Apr	0.00	7.02	53.62	22.92	7.48	2.82	3.17	2.64	0.30	0.02	96.6	4,957 +	546	5.651
	Gillnet	Jan-Apr	0.00	0.00	0.00	10.28	28.79	15.33	20.56	22.43	2.24	0.37	152.3	535	388	2.550
20023	Seine	Jan-Apr	0.00	1.13	38.66	39.14	14.95	2.87	1.45	0.88	0.79	0.11	105.7	4,309	2,571	24.345
	Other	Jan-Apr	0.11	1.81	41.22	38.41	13.26	2.54	1.17	0.79	0.62	0.08	103.1	5,316 +	455	4.413
	Gillnet	Jan-Apr	0.00	0.00	2.61	17.43	31.86	19.84	9.82	12.83	5.01	0.60	146.7	499	945	6.444
20034	Seine	Jan-Apr	0.00	1.32	13.73	52.30	22.60	7.34	1.89	0.51	0.27	0.03	104.1	2,956	3,861	37.106
	Other	Jan-Apr	0.00	7.51	24.75	43.48	17.62	4.98	1.12	0.35	0.17	0.02	96.5	6,327 +	308	3.193
	Gillnet	Jan-Apr	0.00	0.00	0.79	28.37	24.41	25.04	14.58	3.80	2.22	0.79	137.2	631	593	4.324

Appendix 1.6. Age composition and catch by season, fishery and gear type for the Area 27 stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE												CATCH	
Season	**Gear**	**Fishery**	**0+**	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9++**	**Mean Weight**	**Number Aged**	**(tonnes)**	**(millions)**
19534	Seine	Jan-Apr	0.03	2.56	62.55	28.12	5.74	0.69	0.19	0.08	0.02	0.02	92.9	6,361 +	1,920	20.667
19545	Seine	Oct-Dec	0.00	2.77	35.29	52.50	7.55	1.48	0.33	0.08	0.00	0.00	99.0	1,412	5,939	58.757
	Seine	Jan-Apr	0.00	6.80	34.77	49.72	6.94	1.42	0.28	0.07	0.00	0.00	96.7	1,412	0	0.000 ~
19589	Seine	Jan-Apr	0.00	4.12	44.71	27.63	14.44	3.90	2.45	2.06	0.58	0.11	93.3	3,594 +	407	4.366
19601	Seine	Jan-Apr	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590 +	1,149	13.434
19612	Seine	Jan-Apr	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163 +	173	1.856
19623	Seine	Jan-Apr	0.00	1.99	43.18	48.71	5.16	0.75	0.21	0.00	0.00	0.00	101.3	1,862 +	31	0.304
19634	Seine	Jan-Apr	0.00	1.33	59.98	26.04	11.56	0.83	0.25	0.00	0.00	0.00	103.7	1,202 +	323	3.110
19645	Seine	Jan-Apr	0.00	2.51	31.20	46.10	14.62	4.60	0.42	0.28	0.28	0.00	125.8	718 +	769	6.113
19656	Seine	Oct-Dec	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0 *	125	0.913
	Seine	Jan-Apr	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0 *	826	6.032
19667	Seine	Jan-Apr	2.43	20.71	55.46	16.68	3.43	0.80	0.26	0.19	0.04	0.00	106.7	0 *	51	0.482
19701	Seine	Jan-Apr	0.00	19.86	30.14	40.41	4.79	2.05	1.37	0.68	0.68	0.00	131.8	146	0	0.000 ~
19734	Seine	Jan-Apr	0.00	8.03	43.12	23.94	13.56	8.83	2.23	0.22	0.04	0.02	111.3	5,389 +	508	4.562
	Gillnet	Jan-Apr	0.00	8.03	43.12	23.94	13.56	8.83	2.23	0.22	0.04	0.02	111.3	5,389 +	18	0.165
19756	Gillnet	Jan-Apr	0.00	0.00	1.03	41.48	32.92	15.35	6.05	2.80	0.30	0.07	149.7	1,355 +	79	0.525
19778	Seine	Jan-Apr	0.00	0.81	41.60	18.95	15.70	17.59	3.84	1.17	0.23	0.11	111.8	7,925 +	75	0.670
	Gillnet	Jan-Apr	0.00	0.00	1.42	5.45	21.33	49.05	17.54	4.74	0.24	0.24	157.6	422 +	75	0.477
19789	Seine	Jan-Apr	0.00	0.82	13.88	50.49	14.19	10.61	7.80	1.59	0.50	0.11	124.1	3,769 +	422	3.401
	Gillnet	Jan-Apr	0.00	0.00	0.93	27.43	27.61	23.32	17.35	2.80	0.37	0.19	159.6	536 +	270	1.695
19790	Seine	Jan-Apr	0.00	7.17	82.08	8.96	1.43	0.00	0.00	0.36	0.00	0.00	84.3	279	0	0.000 ~
	Gillnet	Jan-Apr	0.00	6.28	46.56	15.12	18.71	5.93	4.93	2.07	0.32	0.07	106.6	4,014 +	519	4.873
19801	Seine	Jan-Apr	0.00	2.08	13.73	60.33	8.74	13.59	1.53	0.00	0.00	0.00	113.6	721	0	0.000 ~
	Gillnet	Jan-Apr	0.00	4.30	34.23	32.33	9.78	12.20	4.73	1.79	0.50	0.14	114.0	5,747 +	671	5.884
19812	Seine	Jan-Apr	0.00	0.60	30.57	8.73	47.59	4.07	7.53	0.75	0.15	0.00	118.6	664	238	2.011
	Gillnet	Jan-Apr	0.00	0.00	0.63	11.62	44.58	11.77	27.63	3.30	0.31	0.16	137.7	637 +	332	2.411
19823	Seine	Jan-Apr	0.00	3.96	20.79	31.68	10.89	28.71	0.00	3.96	0.00	0.00	108.4	101	0	0.000 ~
	Other	Jan-Apr	0.00	4.23	22.50	22.13	21.59	17.97	4.32	5.35	1.03	0.88	127.9	3,289 +	91	0.712
	Gillnet	Jan-Apr	0.00	0.00	0.31	13.52	22.73	47.00	5.99	9.98	0.31	0.15	138.0	651 +	163	1.181
19834	Other	Jan-Apr	0.00	21.73	37.22	13.58	9.16	10.04	5.91	1.07	1.07	0.23	116.1	3,079 +	182	1.567
	Gillnet	Jan-Apr	0.00	0.00	0.00	4.17	42.13	16.67	33.33	2.55	1.16	0.00	154.2	432	171	1.107
19845	Other	Jan-Apr	0.00	20.47	53.62	14.22	3.71	2.74	3.17	1.70	0.13	0.23	109.0	2,995 +	182	1.670
19856	Seine	Jan-Apr	0.00	2.21	23.62	63.47	2.58	1.48	1.85	2.58	2.21	0.00	136.5	271	0	0.000 ~
	Other	Jan-Apr	0.00	3.69	48.80	31.77	7.94	3.03	2.22	1.81	0.68	0.07	122.4	4,422 +	96	0.784
19867	Seine	Jan-Apr	0.00	17.02	27.66	15.96	35.46	1.06	0.00	1.06	0.35	1.42	131.2	282	0	0.000 ~
	Other	Jan-Apr	0.00	15.66	17.74	33.06	21.73	6.67	2.32	1.39	1.00	0.41	131.1	5,305 +	364	2.776
19878	Seine	Jan-Apr	0.00	2.16	62.53	11.05	6.20	15.36	1.62	0.81	0.00	0.27	121.3	371	0	0.000 ~
	Other	Jan-Apr	0.00	2.55	61.03	7.92	14.35	10.07	2.72	0.73	0.42	0.22	123.7	7,896 +	364	2.943
19889	Seine	Jan-Apr	0.00	0.21	12.66	57.51	8.15	8.37	11.37	1.29	0.43	0.00	151.3	466	0	0.000 ~
	Other	Jan-Apr	0.00	0.21	12.66	57.51	8.15	8.37	11.37	1.29	0.43	0.00	151.3	466 +	364	2.406
19890	Seine	Jan-Apr	0.00	1.84	22.68	14.25	39.63	5.83	7.13	7.78	0.65	0.22	158.0	926	0	0.000 ~
	Other	Jan-Apr	0.00	1.84	22.68	14.25	39.63	5.83	7.13	7.78	0.65	0.22	158.0	926 +	246	1.557
19901	Seine	Oct-Dec	0.01	6.71	22.27	20.52	10.65	32.59	2.99	3.50	0.73	0.03	131.8	7,680 +	0	0.001
	Seine	Jan-Apr	0.27	8.94	39.30	8.94	10.30	22.49	2.71	4.88	2.17	0.00	128.4	369	0	0.000 ~
	Other	Jan-Apr	0.01	6.71	22.27	20.52	10.65	32.59	2.99	3.50	0.73	0.03	131.8	7,680 +	246	1.867
19912	Seine	Jan-Apr	0.00	1.30	66.59	13.39	4.27	3.20	7.11	1.42	1.90	0.83	130.0	844	335	2.580
	Other	Jan-Apr	0.00	3.48	71.21	11.21	3.40	2.91	5.04	0.99	1.28	0.50	116.9	1,410 +	364	3.115
19923	Seine	Jan-Apr	0.00	11.30	35.79	38.93	5.02	1.57	1.41	5.02	0.31	0.63	108.5	637	0	0.000 ~
	Other	Jan-Apr	0.00	11.30	35.79	38.93	5.02	1.57	1.41	5.02	0.31	0.63	108.5	637 +	364	3.356
	Gillnet	Jan-Apr	0.00	0.00	3.28	53.28	14.09	7.92	7.53	11.58	0.97	1.35	146.6	518	367	2.502
19934	Seine	Jan-Apr	0.00	1.48	31.75	24.55	30.90	5.50	2.12	2.86	0.53	0.32	119.5	945	0	0.000 ~
	Other	Jan-Apr	0.00	1.48	31.75	24.55	30.90	5.50	2.12	2.86	0.53	0.32	119.5	945 +	246	2.059
	Gillnet	Jan-Apr	0.00	0.00	1.28	19.40	61.19	9.81	3.41	3.84	0.43	0.64	140.4	469	345	2.455
19945	Seine	Jan-Apr	0.00	1.29	6.83	30.93	27.19	25.26	5.28	1.55	1.29	0.39	130.6	776	88	0.670
	Trawl	May-Sep	0.00	1.68	6.37	35.29	24.37	24.65	4.13	1.33	1.61	0.56	131.3	1,428 +	0	0.000
	Other	Jan-Apr	0.00	1.68	6.37	35.29	24.37	24.65	4.13	1.33	1.61	0.56	131.3	1,428 +	455	3.465
19956	Seine	Jan-Apr	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569	0	0.000 ~
	Trawl	May-Sep	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569 +	0	0.000
	Other	Jan-Apr	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569 +	364	3.011

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.6. Age composition and catch by season, fishery and gear type for the Area 27 stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19967	Seine	Jan-Apr	0.00	4.01	76.83	7.32	1.57	4.01	4.70	1.57	0.00	0.00	89.9	574	0	0.000 ~
	Other	Jan-Apr	0.00	4.01	76.83	7.32	1.57	4.01	4.70	1.57	0.00	0.00	89.9	574 +	96	1.068
19978	Seine	Jan-Apr	0.00	1.39	38.89	48.61	4.86	0.35	2.78	2.43	0.69	0.00	90.8	288	0	0.000 ~
	Other	Jan-Apr	0.00	2.45	23.38	59.06	6.46	2.66	2.94	1.81	0.99	0.25	98.4	7,343 +	273	2.775
19989	Seine	Jan-Apr	0.00	7.76	28.03	33.82	24.87	4.08	0.53	0.53	0.26	0.13	86.9	760	0	0.000 ~
	Other	Jan-Apr	0.00	7.76	28.03	33.82	24.87	4.08	0.53	0.53	0.26	0.13	86.9	760 +	96	1.104
19990	Seine	Jan-Apr	0.00	2.30	54.36	24.20	9.65	7.50	1.23	0.15	0.46	0.15	89.9	653	0	0.000 ~
	Other	Jan-Apr	0.00	2.30	54.36	24.20	9.65	7.50	1.23	0.15	0.46	0.15	89.9	653 +	96	1.068
20001	Seine	Jan-Apr	0.00	6.63	20.92	35.71	12.76	12.24	9.69	1.02	0.51	0.51	91.7	196	0	0.000 ~
	Other	Jan-Apr	0.00	6.99	43.76	21.39	8.71	7.93	9.46	1.30	0.24	0.24	104.3	2,548 +	96	0.921
20012	Seine	Jan-Apr	0.00	7.49	62.74	15.63	10.06	0.64	2.36	0.86	0.21	0.00	96.7	467	0	0.000 ~
	Other	Jan-Apr	0.00	7.49	62.74	15.63	10.06	0.64	2.36	0.86	0.21	0.00	96.7	467 +	32	0.331
20023	Seine	Jan-Apr	0.00	0.52	51.13	37.09	6.24	3.99	0.17	0.69	0.17	0.00	104.9	577	0	0.000 ~
	Other	Jan-Apr	0.00	0.52	51.13	37.09	6.24	3.99	0.17	0.69	0.17	0.00	104.9	577 +	64	0.610
20034	Seine	Jan-Apr	0.00	1.30	21.50	54.15	19.69	1.04	1.55	0.78	0.00	0.00	98.1	386	0	0.000 ~
	Other	Jan-Apr	0.00	7.15	24.56	44.09	17.74	4.75	1.15	0.37	0.16	0.01	96.5	6,713 +	96	1.088

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix 1.7. Age composition and catch by season, fishery and gear type for the Area 2W stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Gear	Fishery	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19567	Seine	Jan-Apr	0.07	20.00	25.34	16.22	9.41	25.92	2.46	0.47	0.11	0.00	104.2	4,506 +	106	1.016
19634	Seine	Jan-Apr	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490 +	312	2.743
19645	Seine	Jan-Apr	0.00	1.59	80.07	10.20	5.14	1.78	0.84	0.37	0.00	0.00	104.0	1,069 +	1,251	12.030
19656	Seine	Jan-Apr	1.67	18.05	32.22	16.11	10.23	7.33	5.79	4.84	2.04	1.72	128.8	0 *	172	1.338
19723	Seine	Jan-Apr	0.00	0.16	38.08	21.42	26.62	10.93	1.93	0.80	0.05	0.00	144.7	1,867 +	706	4.878
19734	Seine	Jan-Apr	0.00	0.61	31.47	38.54	17.89	8.36	2.58	0.49	0.06	0.00	126.9	1,627 +	403	3.178
	Gillnet	Jan-Apr	0.00	50.98	11.11	5.88	15.69	5.88	9.15	1.31	0.00	0.00	101.0	153	0	0.000 ~
19745	Seine	Jan-Apr	0.00	0.63	26.50	34.13	27.01	9.18	2.05	0.41	0.09	0.00	130.8	6,384 +	449	3.436
19756	Seine	Jan-Apr	0.00	23.71	6.70	41.24	23.71	4.64	0.00	0.00	0.00	0.00	139.8	194	0	0.000 ~
	Other	Jan-Apr	0.00	1.51	2.99	37.07	29.00	22.33	6.12	0.92	0.07	0.00	151.2	4,249 +	68	0.450
19778	Seine	Jan-Apr	0.00	0.15	23.63	18.15	9.48	28.96	13.11	5.04	1.26	0.22	150.5	1,350 +	575	3.819
19789	Seine	Jan-Apr	0.00	1.49	18.84	22.95	16.23	22.95	13.81	1.87	1.12	0.75	151.9	536	691	4.546
19790	Seine	Jan-Apr	0.00	0.37	76.03	13.11	4.49	3.37	1.87	0.00	0.75	0.00	108.8	267	0	0.000 ~
19801	Seine	Jan-Apr	0.00	4.98	1.87	66.92	11.97	6.35	5.02	1.79	0.84	0.26	132.9	1,232	770	5.808
	Other	Jan-Apr	0.00	4.51	3.77	67.99	11.90	5.72	3.90	1.41	0.67	0.13	133.0	1,487 +	91	0.684
19812	Seine	Jan-Apr	0.00	0.02	53.90	2.31	34.93	3.91	2.55	2.02	0.23	0.13	139.5	1,654	1,225	9.099
19823	Seine	Jan-Apr	0.00	0.50	1.52	68.64	3.59	20.49	2.37	1.43	0.83	0.64	151.9	3,356	2,518	16.808
19834	Seine	Jan-Apr	0.00	6.45	1.61	0.60	35.28	2.42	51.01	1.81	0.60	0.20	166.2	496	0	0.000 ~
19845	Seine	Jan-Apr	0.00	0.40	0.67	5.80	2.56	13.75	1.62	74.39	0.67	0.13	212.3	742	199	0.940
19856	Seine	Jan-Apr	0.00	0.82	0.27	11.48	11.75	5.46	20.77	7.38	41.53	0.55	205.2	366	0	0.000 ~
19867	Seine	Jan-Apr	0.00	22.14	61.32	0.25	1.27	1.27	1.27	8.14	1.02	3.31	112.0	393	0	0.000 ~
19878	Seine	Jan-Apr	0.00	1.79	74.01	19.31	0.26	0.53	0.66	0.79	1.65	0.99	114.1	1,512	0	0.000 ~
19889	Seine	Jan-Apr	0.00	0.49	3.42	76.06	15.88	0.49	0.49	0.98	0.81	1.38	137.6	1,228	0	0.000 ~
19890	Seine	Jan-Apr	0.00	0.19	1.71	2.28	80.41	13.18	0.46	0.18	0.70	0.90	168.1	2,353	2,272	13.608
19901	Seine	Jan-Apr	0.00	0.50	6.46	0.89	1.84	68.91	19.83	0.72	0.45	0.39	173.3	1,795	2,558	14.762
19912	Seine	Jan-Apr	0.00	1.48	6.34	13.44	1.37	2.79	60.55	12.46	0.55	1.04	183.5	1,830	1,284	6.994
19923	Seine	Jan-Apr	0.00	0.76	11.71	16.46	13.53	1.91	4.57	44.54	5.67	0.84	156.7	2,574	1,306	7.985
19934	Seine	Jan-Apr	0.00	5.32	12.23	43.62	14.89	9.57	2.13	5.85	5.32	1.06	145.6	188	0	0.000 ~
19978	Seine	Jan-Apr	0.00	18.50	34.75	23.10	18.68	2.62	0.63	1.53	0.18	0.00	120.8	1,108	180	1.487
19989	Seine	Jan-Apr	0.00	15.60	32.38	28.09	14.30	7.28	1.56	0.52	0.26	0.00	116.8	769	0	0.000 ~
19990	Seine	Jan-Apr	0.00	14.77	63.64	18.18	0.00	2.27	0.00	1.14	0.00	0.00	85.0	88	0	0.000 ~
20001	Seine	Jan-Apr	0.00	4.37	8.48	40.62	24.42	12.08	6.94	2.06	0.51	0.51	153.2	389	0	0.000 ~
20012	Seine	Jan-Apr	0.00	28.69	23.83	4.77	21.64	9.72	6.86	2.67	1.53	0.29	130.5	1,049	0	0.000 ~
20023	Seine	Jan-Apr	0.00	1.03	73.49	15.31	3.39	3.69	1.15	1.33	0.36	0.24	111.3	1,652	0	0.000 ~
20034	Seine	Jan-Apr	0.00	7.24	9.74	71.71	7.50	1.71	1.58	0.26	0.00	0.26	124.5	760	0	0.000 ~

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter

Appendix table 2.1. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Queen Charlotte Is. stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	1130	1480	1097	264	169	99	0	0	0	7080	4213	0.06
1951/52	2675	760	955	584	130	83	48	0	0	5721	2578	-0.22
1952/53	14148	1592	238	214	127	28	18	10	0	13442	7555	0.00
1953/54	2486	9537	1073	161	144	86	19	12	7	20716	12408	0.06
1954/55	1947	1673	6295	690	103	92	55	12	12	11670	6437	-0.02
1955/56	1052	1312	1127	4186	435	64	57	34	15	11971	6042	-0.11
1956/57	1365	647	408	182	626	65	9	8	7	1865	1592	0.42
1957/58	5282	622	83	32	14	47	5	1	1	1740	815	-0.18
1958/59	832	1903	72	7	3	1	4	0	0	10668	8981	0.40
1959/60	2534	394	894	34	3	1	1	2	0	11741	6599	0.00
1960/61	2838	1708	266	603	23	2	1	0	1	14391	8981	0.10
1961/62	5471	1905	1125	174	394	15	2	1	1	11849	5730	-0.15
1962/63	1580	3651	1128	506	74	167	6	1	1	14110	7297	-0.08
1963/64	5171	1045	1980	441	188	27	62	2	1	5789	4104	0.23
1964/65	296	3379	475	388	72	30	4	10	0	2147	1378	0.13
1965/66	475	67	203	22	18	3	1	0	0	3072	2824	0.49
1966/67	441	210	30	90	10	8	1	1	0	1528	710	-0.19
1967/68	558	297	138	18	53	6	5	1	1	1926	833	-0.26
1968/69	1086	376	199	90	11	34	4	3	1	3692	2075	0.00
1969/70	2299	732	254	134	61	8	23	2	3	9878	5552	0.00
1970/71	2852	1549	493	171	91	41	5	15	3	21285	13291	0.11
1971/72	6276	1921	1041	331	115	61	27	3	13	17032	9542	0.00
1972/73	5084	4211	1217	579	180	62	33	15	9	20369	7960	-0.36
1973/74	4812	3412	2668	635	286	88	31	16	12	35882	14510	-0.33
1974/75	1217	3230	2186	1571	368	165	51	18	16	42072	9686	-0.89
1975/76	2151	816	2049	1280	907	212	95	29	19	32360	15986	-0.13
1976/77	2133	1447	533	1145	650	451	105	47	24	26907	15717	0.04
1977/78	1095	1426	881	274	564	315	218	51	34	20527	16885	0.38
1978/79	17304	728	835	429	123	248	136	94	37	11742	12236	0.62
1979/80	1197	11628	466	407	167	46	91	50	48	50723	30455	0.07
1980/81	583	803	7556	294	229	89	24	48	52	56046	18823	-0.51
1981/82	515	392	525	4661	173	126	48	13	54	46351	22159	-0.16
1982/83	3373	345	253	327	2868	105	74	28	39	35843	19470	-0.03
1983/84	1386	2239	212	149	191	1656	60	43	39	27715	22120	0.35
1984/85	359	923	1376	123	85	108	933	34	46	24254	17232	0.23
1985/86	754	239	568	762	65	44	55	474	40	17163	5679	-0.53
1986/87	5883	508	157	326	410	35	23	29	272	11875	10751	0.48
1987/88	1706	3957	331	90	179	224	19	13	165	17076	12814	-0.29
1988/89	683	1148	2621	212	57	114	143	12	113	30925	22031	-0.34
1989/90	286	457	740	1652	133	36	72	90	79	21063	23263	0.10
1990/91	2087	190	274	399	848	67	18	35	82	11817	15061	0.24
1991/92	171	1386	110	136	191	397	30	8	53	10830	9990	-0.08
1992/93	119	115	854	60	73	103	213	16	33	8086	5801	-0.33
1993/94	288	79	67	409	28	34	48	99	23	5638	12149	0.77
1994/95	1004	187	45	37	222	15	18	26	66	4061	4061	0.00
1995/96	1201	677	126	31	25	150	10	12	62	6646	6646	0.00
1996/97	3230	809	456	85	21	17	101	7	50	10080	9576	-0.05
1997/98	193	2173	538	301	56	14	11	67	38	11314	18673	0.50
1998/99	610	128	1308	299	166	31	7	6	58	8578	8475	-0.01
1999/00	576	396	65	552	122	61	10	2	21	4336	4925	0.13
2000/01	596	376	198	24	202	44	22	4	9	6143	12757	0.73
2001/02	1798	394	239	125	15	127	28	14	8	3106	2029	-0.43
2002/03	116	1151	175	80	41	5	41	9	7	6305	6985	0.10
2003/04	1580	78	712	103	47	24	3	24	9	7320	4715	-0.44

Estimated average availability at age (Si): 0.14 0.54 0.90 0.99 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.01 0.04 0.26 0.60 0.83 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 0.56

Estimated instantaneous natural mortality rate is 0.394

Appendix table 2.2. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Prince Rupert District stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	3659	4695	7303	1144	456	277	0	0	0	41088	27149	0.05
1951/52	5182	2697	2469	2762	425	169	103	0	0	25682	24047	0.40
1952/53	7734	3863	1618	823	864	133	53	32	0	28000	28468	0.48
1953/54	2235	5806	2851	1175	597	627	96	38	23	14442	13535	0.40
1954/55	5008	1660	3165	582	210	106	112	17	11	15938	14482	0.37
1955/56	1736	3749	1114	1226	203	73	37	39	10	35176	14533	-0.42
1956/57	3362	1189	2218	652	717	119	43	22	28	18412	27518	0.87
1957/58	6380	2297	463	759	222	245	41	15	17	32462	9882	-0.73
1958/59	1640	4527	1492	299	490	143	158	26	20	37679	40961	0.55
1959/60	11853	1215	2919	913	183	300	88	96	29	42208	16545	-0.47
1960/61	5390	7468	627	1489	466	93	153	45	64	37156	12059	-0.66
1961/62	2627	3713	3301	254	602	188	38	62	44	45402	26329	-0.08
1962/63	8791	1879	2109	1801	139	328	103	21	58	38209	16981	-0.35
1963/64	1060	5200	847	936	799	61	146	46	35	35577	26919	0.19
1964/65	919	714	2667	423	467	398	31	73	40	18763	6055	-0.67
1965/66	851	568	238	820	130	143	122	9	35	7131	7105	0.46
1966/67	1066	636	367	87	277	44	48	41	15	5211	3386	0.03
1967/68	622	352	161	92	22	69	11	12	14	6153	5197	0.30
1968/69	1992	357	202	92	53	13	40	6	15	1535	965	0.00
1969/70	1510	1497	269	152	69	40	9	30	16	13871	8814	0.01
1970/71	751	1114	1038	185	105	48	27	6	32	15346	8480	-0.13
1971/72	2798	542	700	640	114	64	29	17	23	10440	8774	0.29
1972/73	1790	2102	404	445	333	58	33	15	21	18850	10959	-0.08
1973/74	1586	1344	1538	283	311	232	41	23	25	24604	9244	-0.51
1974/75	887	1190	983	1029	178	194	145	25	30	25220	10565	-0.41
1975/76	1481	666	882	694	722	125	136	102	39	20366	15199	0.17
1976/77	769	1113	500	641	439	446	77	84	87	21879	10425	-0.28
1977/78	742	575	760	288	348	236	239	41	91	16692	4734	-0.80
1978/79	5193	556	393	409	140	164	110	112	62	13499	7600	-0.11
1979/80	1032	3894	394	232	230	77	90	61	96	28369	11001	-0.48
1980/81	1274	769	2704	260	145	141	47	55	96	27364	12939	-0.28
1981/82	1838	955	554	1835	172	94	92	31	98	27741	16108	-0.08
1982/83	4954	1378	689	387	1279	120	66	64	90	29510	23575	0.24
1983/84	898	3721	1024	505	283	937	88	48	113	32503	25667	0.23
1984/85	958	674	2711	720	344	185	584	55	100	35850	39606	0.56
1985/86	3312	713	470	1828	466	207	98	311	83	32066	24055	0.18
1986/87	2608	2473	493	295	1058	261	112	53	214	28496	38673	0.77
1987/88	1378	1954	1765	328	176	591	139	60	142	26082	30519	0.16
1988/89	878	1029	1337	1112	185	84	250	59	85	22329	13487	-0.50
1989/90	3215	653	683	818	601	80	31	94	54	19917	19209	-0.04
1990/91	3564	2407	457	436	492	337	42	17	78	21953	22340	0.02
1991/92	782	2670	1715	304	273	294	187	23	53	28626	35773	0.22
1992/93	354	586	1915	1183	181	143	140	89	36	24890	21594	-0.14
1993/94	911	265	410	1247	703	85	54	53	48	16354	13613	-0.18
1994/95	3590	682	184	256	728	373	34	22	41	13434	15486	0.14
1995/96	1485	2691	487	122	161	440	208	19	35	20885	20487	-0.02
1996/97	2181	1112	1951	340	78	84	207	98	25	18757	21078	0.12
1997/98	583	1636	813	1373	201	31	18	44	26	19529	16271	-0.18
1998/99	1636	437	1193	573	895	112	4	3	10	19795	25033	0.23
1999/00	2264	1228	321	826	383	550	62	2	7	16326	15478	-0.05
2000/01	1395	1694	858	211	489	211	251	28	4	18999	31277	0.50
2001/02	6011	1043	1195	579	136	269	108	128	17	16049	17868	0.11
2002/03	633	4495	718	755	331	65	98	39	53	25526	28216	0.10
2003/04	2884	474	3224	493	445	147	21	31	29	24917	25433	0.02

Estimated average availability at age (Si): 0.12 0.59 0.94 0.98 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.01 0.15 0.44 0.70 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 0.63

Estimated instantaneous natural mortality rate is 0.286

Appendix table 2.3. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Central Coast stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	1705	3233	4255	788	330	123	0	0	0	25119	15390	-0.08
1951/52	3063	1293	1438	1291	233	97	36	0	0	10105	10295	0.43
1952/53	13904	2333	543	329	281	51	21	8	0	13180	18237	0.73
1953/54	1196	11132	1849	418	252	215	39	16	6	14011	13967	0.41
1954/55	1330	906	4399	366	78	47	40	7	4	34046	13564	-0.51
1955/56	3069	998	564	2653	220	47	28	24	7	10475	6626	-0.05
1956/57	3886	1946	245	108	500	41	9	5	6	4183	4607	0.51
1957/58	4014	2788	566	41	17	80	7	1	2	11813	3549	-0.79
1958/59	1148	2852	1267	233	17	7	33	3	1	7526	3909	-0.25
1959/60	2336	884	1335	347	61	4	2	9	1	20089	12615	-0.06
1960/61	6140	1647	605	912	237	42	3	1	7	7491	4265	-0.15
1961/62	3798	4599	645	147	215	56	10	1	2	15995	11948	0.12
1962/63	3121	2990	2887	315	70	103	27	5	1	7930	6485	0.21
1963/64	1825	2420	1403	528	51	11	17	4	1	9335	6464	0.04
1964/65	2526	1063	586	290	108	10	2	3	1	3211	2097	-0.02
1965/66	4662	1931	433	99	44	16	2	0	1	2884	1863	-0.03
1966/67	1563	1526	161	30	7	3	1	0	0	4606	5434	0.57
1967/68	357	278	272	29	5	1	1	0	0	5296	5790	0.50
1968/69	1117	219	171	167	18	3	1	0	0	2765	1837	0.00
1969/70	1231	895	176	137	134	14	3	1	0	14295	8230	-0.14
1970/71	1596	979	705	138	108	105	11	2	1	15206	4156	-0.89
1971/72	2551	1239	652	450	88	69	67	7	2	10369	3572	-0.66
1972/73	1538	2017	802	303	200	39	30	30	4	19978	12447	-0.06
1973/74	2200	1218	1407	486	176	115	22	17	19	18634	8924	-0.33
1974/75	887	1757	926	857	246	80	51	10	16	23400	8060	-0.66
1975/76	722	707	1312	594	466	124	39	25	13	20008	13893	0.04
1976/77	738	571	502	816	296	206	52	16	16	16354	14619	0.30
1977/78	525	586	411	306	419	134	90	23	14	6433	7749	0.60
1978/79	4416	411	375	167	71	57	15	10	4	8482	5676	0.01
1979/80	873	3537	329	298	132	56	45	12	11	29097	12958	-0.40
1980/81	885	699	2821	260	227	97	40	32	16	30690	15845	-0.25
1981/82	422	708	553	2146	181	134	49	21	25	30481	16238	-0.22
1982/83	351	335	536	398	1408	113	80	29	27	23560	18217	0.15
1983/84	1295	280	256	380	261	874	68	48	34	15009	13795	0.32
1984/85	552	1026	199	161	218	136	433	34	40	16052	8498	-0.23
1985/86	1102	436	732	126	95	125	75	240	41	15849	19061	0.59
1986/87	6077	876	320	492	82	61	79	47	177	14653	12493	0.25
1987/88	439	4852	662	212	309	51	37	48	138	33193	25134	-0.28
1988/89	396	349	3630	467	143	202	33	24	121	33729	20708	-0.49
1989/90	1278	310	243	2357	268	76	101	16	73	26197	27629	0.05
1990/91	5880	1019	230	162	1470	156	42	56	50	19403	17833	-0.08
1991/92	706	4683	739	139	92	803	83	22	56	33011	41559	0.23
1992/93	1272	559	3317	482	88	57	482	50	47	33267	30917	-0.07
1993/94	374	1001	384	2083	285	48	29	246	49	26304	27468	0.04
1994/95	1079	289	646	229	1179	154	25	15	150	16293	20272	0.22
1995/96	4299	856	199	360	120	596	75	12	80	14689	18665	0.24
1996/97	3624	3401	588	121	213	70	345	44	53	19994	24999	0.22
1997/98	799	2883	2475	390	79	135	44	216	61	26533	28363	0.07
1998/99	1425	630	1932	1470	227	45	70	23	142	24689	28464	0.14
1999/00	600	1132	450	1215	878	130	20	32	75	21567	28484	0.28
2000/01	1877	475	779	271	706	493	70	11	58	16469	22552	0.31
2001/02	4576	1491	332	452	154	390	267	38	37	15596	18917	0.19
2002/03	710	3638	1070	212	283	95	235	161	45	24820	20993	-0.17
2003/04	1377	567	2756	758	148	195	64	160	140	30236	24104	-0.23

Estimated average availability at age (Si): 0.15 0.64 0.96 1.00 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.03 0.19 0.50 0.76 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor (q) is 0.66

Estimated instantaneous natural mortality rate is 0.222

Appendix table 2.4. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Strait of Georgia stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	19440	11306	4428	1039	282	179	0	0	0	30037	66143	0.38
1951/52	20829	11487	3826	946	218	59	38	0	0	35439	72376	0.31
1952/53	31694	12107	3652	920	226	52	14	9	0	56124	111307	0.28
1953/54	18223	19206	6933	2018	508	125	29	8	5	38897	82141	0.34
1954/55	9078	10971	8546	1608	446	112	28	6	3	64511	69854	-0.33
1955/56	9928	5197	3845	2657	498	138	35	9	3	23101	25667	-0.30
1956/57	9298	5774	1542	782	533	100	28	7	2	13604	24126	0.17
1957/58	17280	5479	1848	296	147	100	19	5	2	12347	16149	-0.14
1958/59	12815	10255	1949	406	64	32	22	4	1	40869	47864	-0.25
1959/60	6699	7197	3833	685	143	22	11	8	2	37184	55082	-0.01
1960/61	19478	3690	2393	1181	211	44	7	3	3	25169	42864	0.13
1961/62	16708	10885	1185	690	339	61	13	2	2	21719	31078	-0.05
1962/63	15970	9668	3138	240	138	68	12	3	1	23012	35135	0.02
1963/64	10001	9094	2616	639	49	28	14	2	1	16544	33117	0.29
1964/65	3912	5864	2642	417	99	8	4	2	0	23284	37116	0.06
1965/66	3993	1689	1295	556	88	21	2	1	1	4969	7153	-0.04
1966/67	3251	1896	209	122	52	8	2	0	0	5342	9619	0.18
1967/68	1343	407	237	26	15	7	1	0	0	5487	9128	0.10
1968/69	3878	741	198	115	13	7	3	0	0	9755	14644	0.00
1969/70	4323	2357	451	121	70	8	5	2	0	22459	33970	0.01
1970/71	3456	2623	1422	272	73	42	5	3	1	28182	38180	-0.10
1971/72	4259	2089	1537	829	158	42	25	3	2	23653	25165	-0.34
1972/73	7042	2522	988	673	357	68	18	10	2	16963	16191	-0.45
1973/74	9977	4269	1398	429	259	134	25	7	5	40909	40354	-0.42
1974/75	6394	6048	2527	729	211	124	80	15	7	48750	70208	-0.04
1975/76	13104	3882	3609	1416	339	89	51	32	9	45328	60511	-0.12
1976/77	9498	7950	2254	1780	599	130	33	19	16	55888	78113	-0.07
1977/78	4948	5739	4376	1097	754	230	48	12	13	50552	101784	0.29
1978/79	7680	2984	3029	2036	442	269	77	16	8	37310	63973	0.13
1979/80	6259	4651	1643	1354	762	149	87	25	8	43650	85679	0.27
1980/81	5498	3795	2721	923	694	366	70	41	15	47135	54754	-0.26
1981/82	4134	3299	2090	1428	431	299	152	29	23	42197	100611	0.46
1982/83	3333	2478	1771	1041	662	179	120	61	21	23888	64243	0.58
1983/84	4384	1986	1191	652	287	161	34	23	16	17978	26054	-0.04
1984/85	6856	2597	968	464	169	59	31	7	8	23630	22890	-0.44
1985/86	4247	4065	1379	429	150	41	13	7	3	38513	37844	-0.42
1986/87	11558	2575	2442	828	257	90	25	8	6	31082	38905	-0.18
1987/88	3362	6986	1443	1235	345	86	24	7	4	51049	22813	-0.81
1988/89	9916	2036	4067	753	549	136	30	8	4	43994	62432	0.35
1989/90	4651	6004	1187	2207	342	220	50	11	4	56383	61239	0.08
1990/91	13258	2826	3614	683	1102	149	91	20	6	48323	42468	-0.13
1991/92	9427	8046	1665	1969	321	452	55	34	10	59567	77802	0.27
1992/93	10015	5709	4625	873	869	122	162	20	16	74848	84050	0.12
1993/94	4574	6011	3242	2419	394	346	44	59	13	57888	63917	0.10
1994/95	10130	2752	3369	1634	996	126	96	12	20	49927	60317	0.19
1995/96	14492	6108	1554	1729	694	372	42	32	11	54365	65984	0.19
1996/97	15316	8689	3334	797	783	271	136	15	16	59812	54640	-0.09
1997/98	7525	9219	4710	1666	341	268	80	40	9	64971	70018	0.07
1998/99	11952	4546	5214	2469	750	124	60	18	11	63263	78766	0.22
1999/00	16238	7222	2575	2749	1148	291	39	19	9	63059	67606	0.07
2000/01	24811	9768	4036	1353	1253	374	73	10	7	70227	94255	0.29
2001/02	24088	15024	5516	2120	602	467	115	23	5	99285	108173	0.09
2002/03	11994	14558	8463	2911	1027	224	146	36	9	111326	132782	0.18
2003/04	9406	7252	8207	4493	1430	468	71	46	14	105009	105179	0.00

Estimated average availability at age (Si): 0.13 0.80 0.99 1.00 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.02 0.20 0.51 0.80 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 1.5

Estimated instantaneous natural mortality rate is 0.498

Appendix table 2.5. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the west coast of Vancouver Island stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	5154	2908	3534	557	173	120	0	0	0	27657	19597	-0.33
1951/52	6899	3025	1039	1201	189	59	41	0	0	4900	13310	1.02
1952/53	11915	4441	1383	155	165	26	8	6	0	32874	39571	0.20
1953/54	5418	7723	2877	896	101	107	17	5	4	7795	20648	0.99
1954/55	9142	3260	1435	330	102	11	12	2	1	9245	15112	0.51
1955/56	7497	5799	1769	762	175	54	6	6	2	13861	27183	0.69
1956/57	8538	4498	2180	629	271	62	19	2	3	45749	44114	-0.02
1957/58	10526	5517	2787	1336	386	166	38	12	3	43515	18986	-0.81
1958/59	6820	6816	3549	1792	859	248	107	25	10	14861	12979	-0.12
1959/60	4206	4188	1500	465	232	111	32	14	4	6644	6015	-0.08
1960/61	10477	2418	630	155	48	24	11	3	2	10198	10556	0.05
1961/62	4943	5950	625	148	36	11	6	3	1	21382	34470	0.49
1962/63	6075	3068	2336	223	53	13	4	2	1	11559	11245	-0.01
1963/64	2180	3886	1264	592	56	13	3	1	1	16990	22761	0.31
1964/65	1957	1372	1495	405	189	18	4	1	1	10877	11891	0.11
1965/66	1762	1232	485	403	108	51	5	1	0	4049	3722	-0.07
1966/67	1229	1133	550	96	76	21	10	1	0	4833	4813	0.01
1967/68	1237	560	217	100	17	14	4	2	0	11215	11029	0.00
1968/69	4993	802	363	140	65	11	9	2	1	10642	10465	0.00
1969/70	9476	3236	520	235	91	42	7	6	2	27366	26912	0.00
1970/71	7204	6142	2098	337	153	59	27	5	5	36817	36206	0.00
1971/72	8715	4669	3981	1360	218	99	38	18	7	56750	41857	-0.29
1972/73	9376	5645	2919	2310	786	126	57	22	14	62087	19481	-1.14
1973/74	15718	6064	3355	1512	1177	399	64	29	18	78842	25540	-1.11
1974/75	6640	10111	3567	1862	799	611	207	33	24	96566	49149	-0.66
1975/76	4362	4286	6004	1939	950	404	309	104	29	61268	64200	0.06
1976/77	7737	2825	2681	2951	760	352	149	113	49	49533	58679	0.19
1977/78	2564	5008	1720	1303	1289	312	143	60	66	44309	45607	0.05
1978/79	5141	1656	2993	930	551	466	106	48	43	33461	66397	0.70
1979/80	3752	3323	971	1500	378	205	170	39	33	42860	62308	0.39
1980/81	1945	2423	2087	599	875	209	112	93	39	40100	52014	0.28
1981/82	1437	1238	1404	1167	300	418	97	52	61	29862	33047	0.12
1982/83	2426	924	751	814	623	144	190	44	51	19773	16771	-0.15
1983/84	5047	1549	481	349	343	251	57	75	38	22240	23872	0.09
1984/85	5176	3156	800	235	166	162	118	27	53	40714	27437	-0.38
1985/86	2032	3352	2039	517	152	107	104	76	51	49964	36971	-0.28
1986/87	11977	1316	2165	1316	334	98	69	67	82	38209	16858	-0.80
1987/88	2191	7622	679	1017	601	151	44	31	68	51356	44193	-0.15
1988/89	2790	1416	4552	377	549	323	81	24	53	49461	45735	-0.08
1989/90	1668	1792	812	2419	191	272	159	40	38	39700	42887	0.08
1990/91	5259	1075	1039	439	1272	100	142	83	41	28755	27736	-0.04
1991/92	2692	3378	607	545	222	628	49	69	61	32436	39476	0.20
1992/93	2012	1741	2070	355	314	127	359	28	74	34465	32061	-0.07
1993/94	950	1289	997	1161	199	176	71	201	57	26749	23656	-0.12
1994/95	1278	607	718	535	610	103	90	37	133	20878	25496	0.20
1995/96	6922	827	371	417	310	354	60	52	98	19716	30902	0.45
1996/97	1893	4469	505	223	251	187	213	36	91	27943	42573	0.42
1997/98	1027	1207	2337	252	111	125	93	106	63	18402	39419	0.76
1998/99	918	651	603	1056	107	38	36	27	49	11056	18498	0.51
1999/00	2060	585	318	266	426	41	12	12	25	9734	11553	0.17
2000/01	3835	1329	343	176	137	209	20	6	18	13083	12113	-0.08
2001/02	4972	2483	845	216	111	87	132	12	15	21171	19154	-0.10
2002/03	2192	3216	1554	520	129	64	49	75	15	24530	27684	0.12
2003/04	5884	1418	1947	880	280	64	30	23	42	25433	13953	-0.60

Estimated average availability at age (Si): 0.09 0.75 0.99 1.00 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.03 0.29 0.66 0.87 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 0.98

Estimated instantaneous natural mortality rate is 0.434

Appendix 3. 2005 recruitment forecast for West Coast Vancouver Island and Strait of Georgia herring. Ron Tanasichuk, Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, B. C.

The recruitment forecast is made using the methodology described in Tanasichuk (2002). It has two parts. The first forecasts the proportion of age 3 (recruit fish) in the incoming prespawning biomass. It is based on the linear relationship between the proportion of age 2+ herring trawled during August off the southwest coast of Vancouver Island and the proportion of age 3 fish "observed" by the age-structured herring stock assessment model (Schweigert 2004) in the prefishery biomass during the subsequent spring prefishery season. (The current aging convention is that birthdays occur at spawning time (March)). JMP (2002) is used for regression analyses. Proportion data are transformed using the logit transformation (Sokal and Rohlf 1995). Predictive regressions are re-expressed as geometric mean regressions (GMR) because both variables were measured with error (Ricker 1973). The time series is updated annually using age compositions estimated during the most recent iteration of the stock assessment model (Appendix Table 1).

The second part of the methodology consists of calculating the number of incoming age 3 recruits using the forecasted proportion age 3 from the regression and the number of returning adults (age 4 and older) forecasted by the stock assessment model. Number of age 3 fish in the (R_t) prefishery biomass is estimated as:

(1) $$R_t = (N_t \bullet (1 - p_t)^{-1}) - N_t,$$

where N_t is the number of age 4 and older fish forecasted to be in the prefishery biomass and p is the proportion of age 3 fish forecasted from the offshore survey and t is prefishery year. The logic of the calculation is as follows. The offshore survey samples the entire prefishery biomass (age 3, and age 4 and older (age 2 recruitment is assumed to be negligible)) but the stock assessement model forecasts age 4 and older only. Based on the offshore survey, the number of age 4 and older forecasted by the stock assessment model is $1\text{-}p_t$ of the entire number of forecasted fish in the prefishery biomass. By multiplication then, the total number of fish in the prefishery biomass is $N_t \bullet (1 - p_t)^{-1}$. The number of recruits (R_t) is the forecasted total number of fish in the prefishery biomass minus the forecasted number of age 4 and older fish.

Data collection

Data for the 2005 forecasts are from the offshore fisheries oceangraphic survey done over August 18-23, 2004 using the R/V W. E. Ricker equipped with a midwater trawl. The southwest coast of Vancouver Island (Appendix Fig. 1) was surveyed intensively. Over 590 n.m. was steamed in the 6 days. Herring distributions were very unusual, as they were in 2003. Historically, pre-recruit herring concentrate on Swiftsure Bank whereas recruits and adults are distributed over 40 Mile and Finger Banks and on the Southwest Corner. Last summer, pre-recruit fish were found at the Southwest Corner and adults were in one immense school on Swiftsure Bank. This summer, most adult and recruit herring were in one very large (1 n.m. x 1 n. m. by 10 fm thick) school at the Southwest Corner. There were some herring on the bottom at Swiftsure Bank and very small concentrations on 40 Mile and Finger Banks. The survey strategy that evolved during the survey was to visit twice each area where herring occurred.

Herring were collected in 8 of the 13 midwater tows made. The catch was weighed. Fish were sampled from the six tows where catch exceeded 100 kg. A subsample of 150 fish was taken. Standard length (mm) was measured for all fish. In addition, for the first 25 fish, total mass (g) was measured and stomach contents were described and stomach volume was measured (mL). For Tows 3, 4, 6, and 10, scales from the first 100 fish were removed for aging by the Aging Laboratory at the Pacific Biological Station.

Identification of age 2+ (recruit) herring

Fish were assigned to age 2+ or not age 2+ using the methods described in Tanasichuk (2002). Age-length data were pooled over tows and stratified by 2 mm length intervals. For the pooled data, the proportion of fish at age *j* in length interval *l* was estimated as:

(2) $P_{j,l} = N_{j,l} \bullet N_l^{-1}$.

Number of fish at age 2+ in each tow (N_{2+}) was then estimated as:

(3) $N_{2+} = \sum_{i=120}^{240} P_{2+,l} \bullet N_l$.

Proportion of age 2+ fish in a sample in a given tow was estimated by dividing N_{2+} by the number of fish sampled. Appendix Fig. 2 shows the assignment of fish to age 2+ or not age 2+ for the 2004 survey. Appendix Table 2 presents catch information for the 2004 survey and the proportion of age 2+ fish estimated for each tow. The mean proportion of age 2+ fish, weighted by CPUE, was 0.41.

Performance of recruitment forecasts

Incoming recruitments are forecast as categories for all other B. C. herring stocks because there is no forecasting methodology developed for them. Recruitments are classified as Poor, Average or Good. Boundaries between Poor and Average, and Average and Good recruitments, are calculated as the 33 and 66 percentiles respectively of the cumulative frequency distributions of the forecast year-specific age 2+ abundance time series from the stock assessment model. At the 2004 PSARC Subcommittee meeting, new rules were developed to assign recruitment categories for those stocks which had no recruitment forecastin methodoloies developed. These rules were: “1) if the prefishery biomass was below Cutoff in the previous year, then assume POOR recruitment for the forecast, 2) if the prefishery biomass was above Cutoff in the previous year and recruitment has been GOOD in the two previous years, then assume GOOD recruitment for the forecast, and 3) if Rule 1 or Rule 2 do not apply then assume AVERAGE recruitment for the forecast”. Also, “For stocks near the Cutoff level (e.g., those where a 20% exploitation rate would reduce biomass to a level below the Cutoff) a modified harvest rule is used (Catch = Forecast Abundance - Cutoff) ”. The stock assessment model estimates recruit biomasses associated with the recruitment categories. The biomass for the recruitment category chosen by the Pelagics Subcommittee is added to the forecasted biomass of returning adults to generate the forecast of prefishery biomass.

Appendix Table 3 shows the performance of the recruitment forecasts for WCVI herring. The 2004 forecasted recruitment category was Poor and the observed, based on the stock assessment model estimate, was Poor. The recruitment forecast has been correct in 9 of 12 years.

Appendix Table 4 shows the performance of the recruitment forecasts for Strait of Georgia herring. Results show that the forecasts were accurate in eight of the 10 years.

2005 recruitment forecast

Results of the 2004 offshore survey suggest that 0.41 of the number of fish trawled were age 2+. Consequently, using the regression based on data to the 2004 fishing season inclusive (Appendix Fig. 3), 0.46 of the fish in the WCVI 2005 prefishery biomass are forecasted to be age 3. The stock assessment model forecast of the number of age 4 and older fish in the 2005 prefishery biomass is $1735 \bullet 10^{-5}$. Therefore, the forecasted number of age 3 herring is $1478 \bullet 10^{-5}$. The current breakpoints between Poor/Average and Average/Good recruitments are $708 \bullet 10^{-5}$ and $1646 \bullet 10^{-5}$ fish respectively. Consequently, recruitment for WCVI herring in 2005 is forecast to be Average.

The recruitment forecast for Strait of Georgia herring is Good. The forecasted proportion of age 3 fish in the 2005 Strait of Georgia prefishery biomass is 0.50 (Appendix Fig. 4). The RASM forecast for number of age 4 and older fish is $7634 \bullet 10^{-5}$ and the forecasted number of age 3 fish is $7634 \bullet 10^{-5}$. The current breakpoints between Poor/Average and Average/Good recruitments are $1833 \bullet 10^{-5}$ and $3500 \bullet 10^{-5}$ fish respectively.

REFERENCES

JMP. 2002. SAS Institute Inc., SAS Campus Drive, Cary, NC. USA.

Ricker, W. E. 1973. Linear regressions in fishery research. J. Fish. Res. Board Can. 30:409-434.

Schweigert, J. F. 2004. Stock Assessment for British Columbia herring in 2004 and forecasts of the potential catch in 2005. PSARC Working Paper P2004-01. 76p.

Sokal, R. R. and F. J. Rohlf. 1995. Biometry. 3rd edition. W. H. Freeman and Co. New York, NY. 887p.

Tanasichuk, R. W. 2002. An evaluation of a recruitment forecasting procedure for Strait of Georgia herring. PSARC Working Paper P2002-01. 24p.

Appendix Table 1. Data used to estimate recruitment forecasting regressions for 2005.

Summer trawled	Fishing season	Proportion age 3 Trawled	WCVI prefishery	Georgia Strait prefishery
1986	1987	0.19	0.16	0.29
1987	1988	0.46	0.67	0.61
1988	1989	0.25	0.15	0.19
1989	1990	0.25	0.25	0.51
1990	1991	0.10	0.18	0.23
1991	1992	0.62	0.51	0.53
1992	1993	0.16	0.27	0.36
1993	1994	0.24	0.25	0.40
1994	1995	0.27	0.16	0.23
1995	1996	0.25	0.21	0.44
1996	1997	0.34	0.67	0.49
1997	1998	0.19	0.22	0.48
1998	1999	0.14	0.20	0.26
1999	2000	0.42	0.25	0.39
2000	2001	0.38	0.44	0.43
2001	2002	0.61	0.50	0.50
2002	2003	0.17	0.48	0.45
2003	2004	0.09	0.22	0.27

Appendix Table 2. Tow information, herring catch, proportion of age 2+ herring from mid-water trawl tows along the southwest coast of Vancouver Island, 2004. Subareas are defined in Appendix Fig. 1.

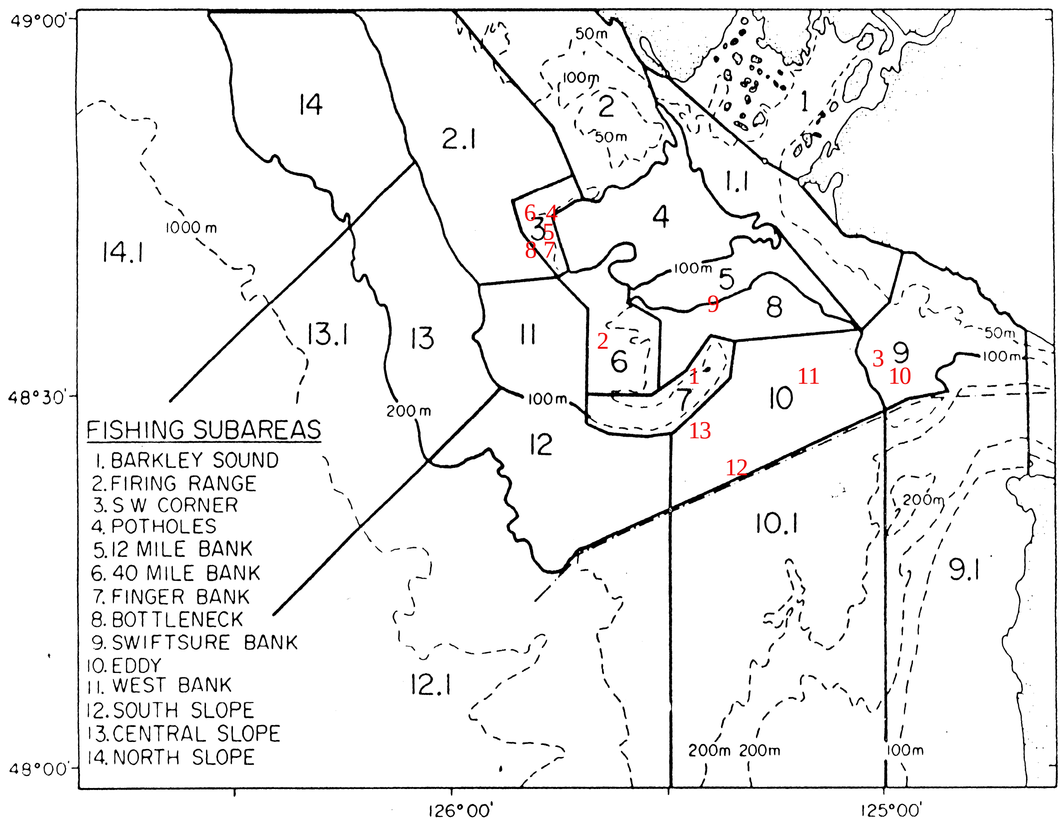
Tow	Day	Month	Subarea	Catch (kg)	CPUE ($kg \bullet m^{-3}$)	Prop. Age 2+
1	18	8	7	1	0.0000004	.
3	19	8	9	568	0.00019	0.34
4	20	8	3	2100	0.00258	0.42
5	20	8	3	1150	0.0035	0.46
6	20	8	3	600	0.00149	0.50
7	21	8	3	31	0.000008	.
8	21	8	3	175	0.00085	0.41
10	22	8	9	326	0.00153	0.22

Appendix Table 3. Recruitment forecasts for WCVI herring, 1993-2004. Numbers of fish - $\bullet 10^{-5}$. All observed estimates, and forecasted number of age 4++ fish, are age-structured model output and are multiplied by forecast year-specific survival and forecast year-specific and age -specific availability to generate prefishery estimates. Recruitment distribution breakpoints for Poor/Average (p=0.33) and Average/Good (p=0.67) are from age 2+ time series for the 1993-2004 forecasts. APE – absolute percent error, $\left((observed - forecasted)\bullet observed^{-1}\right)\bullet 100$.

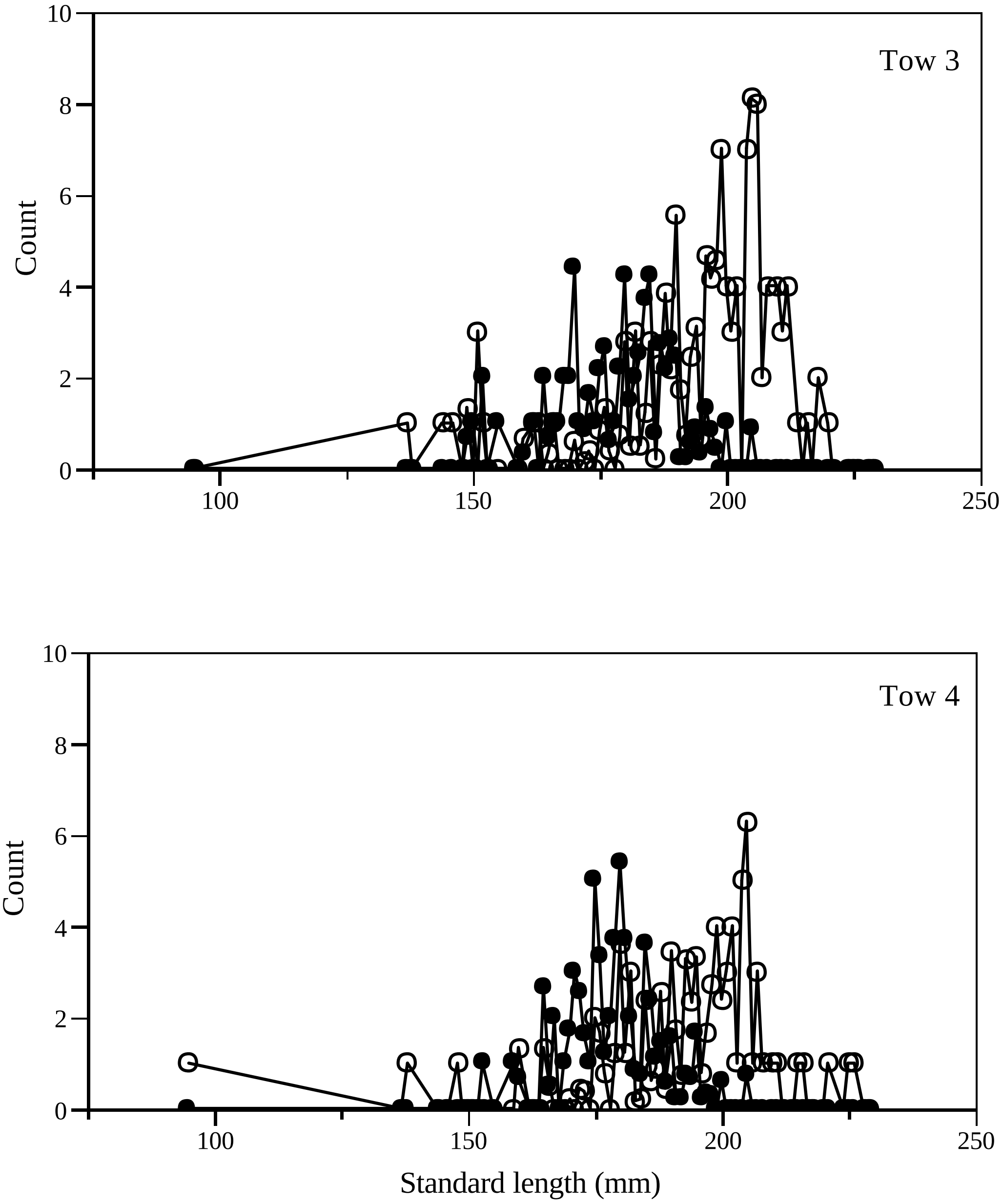
	Proportion age 3		Forecast		Observed		Proportion age 3		No. age 4++			
Season	Forecast	Observed	Number	Category	Number	Category	Residual	APE	Observed	Forecast	Residual	APE
1993	0.16	0.29	331	Poor	785	Poor	0.13	45	1928	1737	191	10
1994	0.27	0.25	665	Poor	521	Poor	-0.02	-8	1718	1798	-80	-5
1995	0.30	0.16	576	Poor	249	Poor	-0.14	-87	1586	1343	243	15
1996	0.26	0.25	434	Poor	444	Poor	-0.01	-4	1346	1234	112	8
1997	0.37	0.71	759	Average	3102	Good	0.34	48	1284	1292	-8	-1
1998	0.19	0.25	736	Average	1018	Average	0.06	24	3586	3136	450	13
1999	0.13	0.21	460	Poor	691	Poor	0.08	38	2335	3082	-747	-32
2000	0.54	0.31	2261	Good	452	Poor	-0.23	-74	1370	1926	-556	-41
2001	0.46	0.48	1021	Average	993	Average	0.02	4	1042	1199	-157	-15
2002	0.74	0.52	4353	Good	1741	Good	-0.22	-42	1343	1529	-186	-14
2003	0.16	0.56	456	Poor	2493	Good	0.4	71	1929	2393	-464	-24
2004	0.10	0.22	249	Poor	594	Poor	0.12	55	2106	2241	-135	-6
Mean							0.04	6			-111	-8

Appendix Table 4. Recruitment forecasts for Strait of Georgia herring, 1995-2004. Numbers of fish - • 10^{-5}. All observed estimates, and forecasted number of age 4++ fish, are age-structured model output and are multiplied by $e^{-M} \bullet \lambda$ (age-independent and year-dependent survival • age-and year-dependent availability) to generate prefishery estimates. Recruitment distribution breakpoints (Poor/Average, p=0.33) and (Average/Good, p=0.67) were estimated from age 2+ time series for each of the 1995-2004 forecasts. APE – absolute percent error, $((observed - forecasted) \bullet observed^{-1}) \bullet 100$.

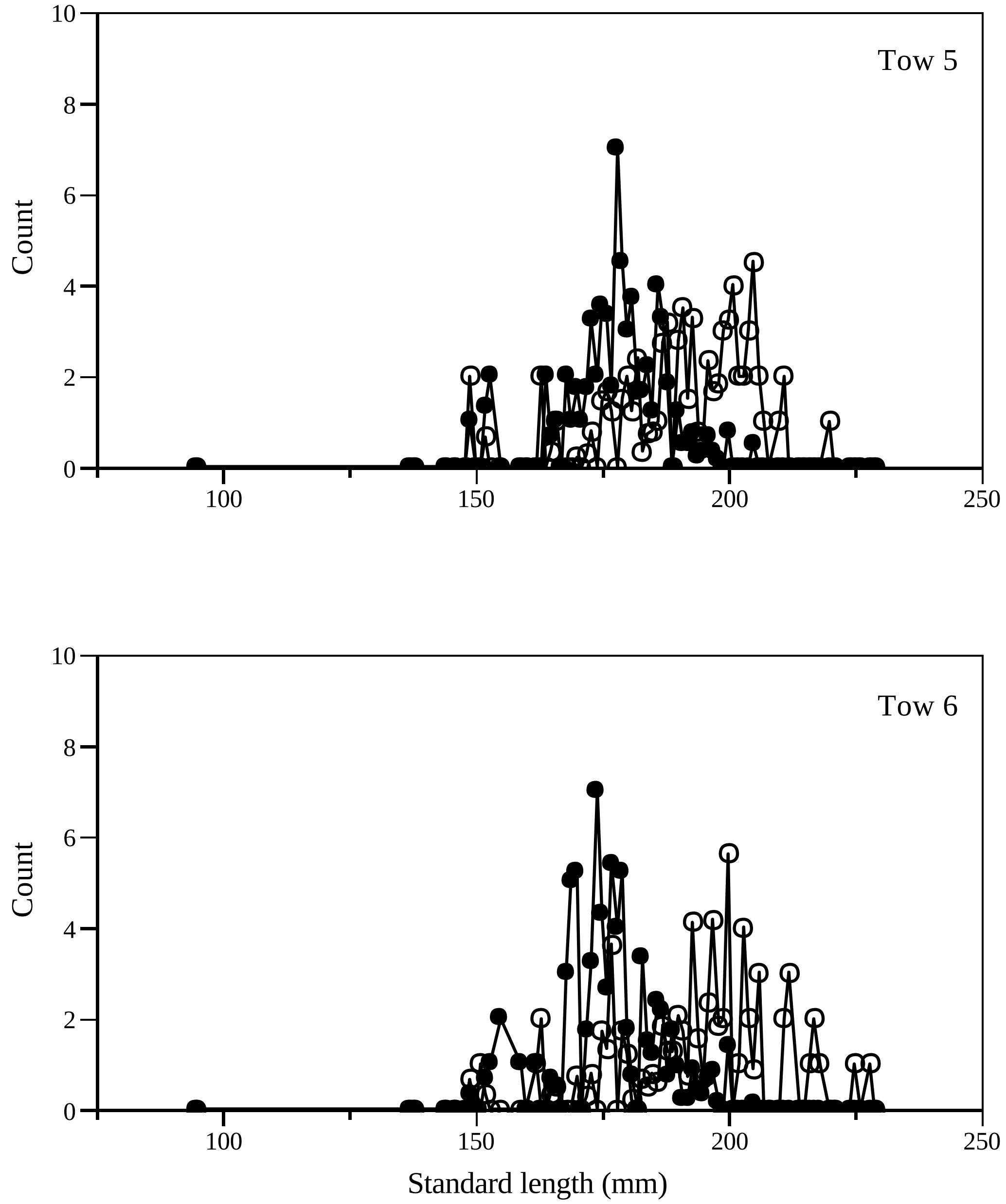
	Proportion age 3		Forecast		Observed		Proportion age 3		No. age 4++			
Season	Forecast	Observed	Number	Category	Number	Category	Residual	APE	Observed	Forecast	Residual	APE
1995	0.38	0.26	2827	Average	1699	Average	-0.12	-46	4864	4613	251	5
1996	0.34	0.49	1910	Average	4442	Good	0.15	31	3354	3708	-354	-11
1997	0.43	0.50	3602	Good	5343	Good	0.07	14	3981	4775	-794	-20
1998	0.29	0.44	2329	Average	4156	Good	0.15	34	4267	5703	-1436	-34
1999	0.24	0.24	1567	Average	2305	Average	0	0	6051	4961	1090	18
2000	0.52	0.38	5139	Good	3388	Good	-0.14	-37	4227	4743	-516	-12
2001	0.48	0.35	3854	Good	5053	Good	-0.13	-37	5572	4176	1396	25
2002	0.65	0.51	11634	Good	8046	Good	-0.14	-27	6410	6264	146	2
2003	0.28	0.48	3499	Good	10788	Good	0.2	42	10203	8997	1206	12
2004	0.20	0.27	2145	Average	3300	Average	0.07	26	8922	8581	341	4
Mean							0.01	-0.1			133	-1



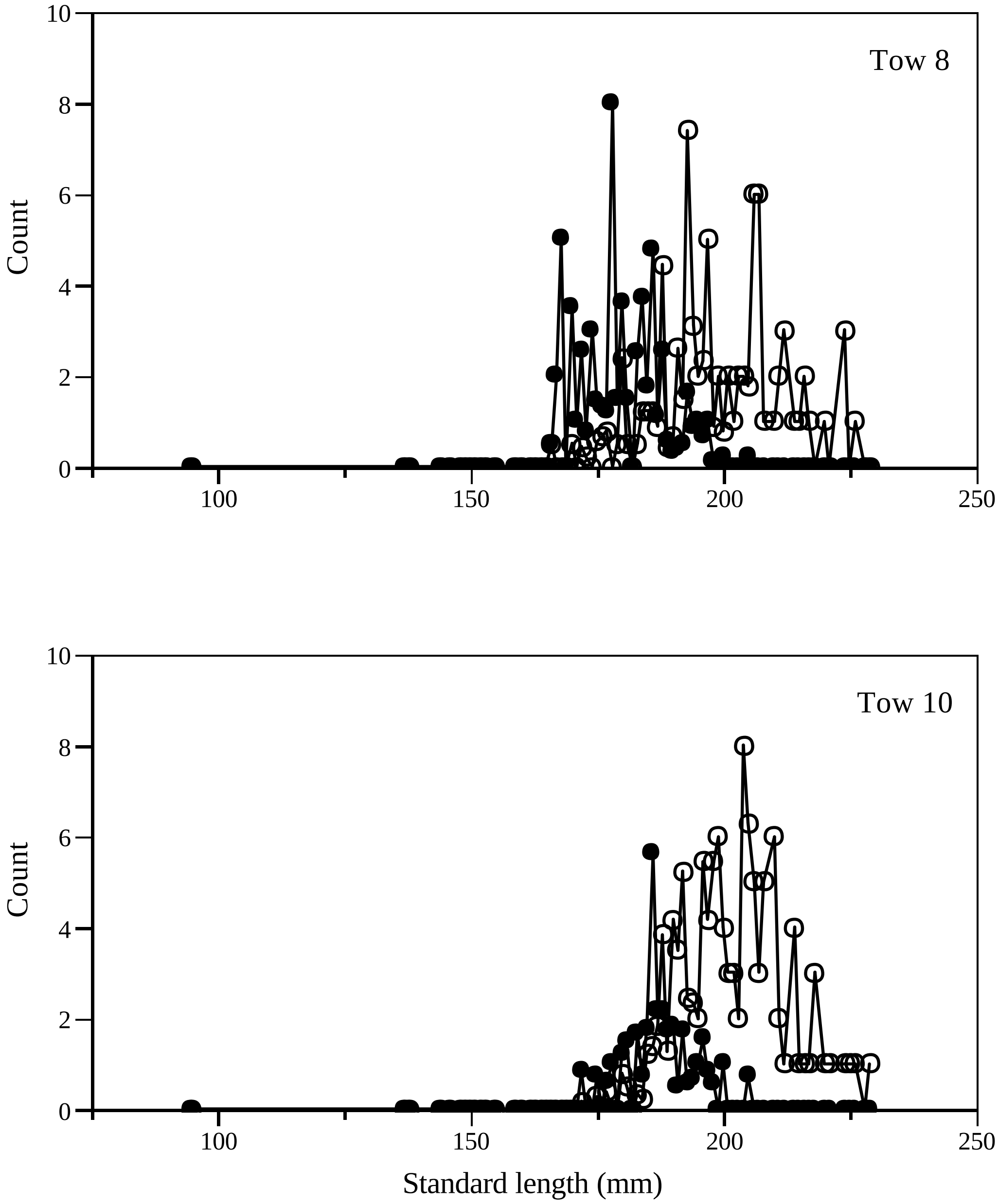
Appendix Fig. 1. Laperouse study area. Outlined numbers show mid-water trawl locations the for August 18-23, 2004 herring survey.



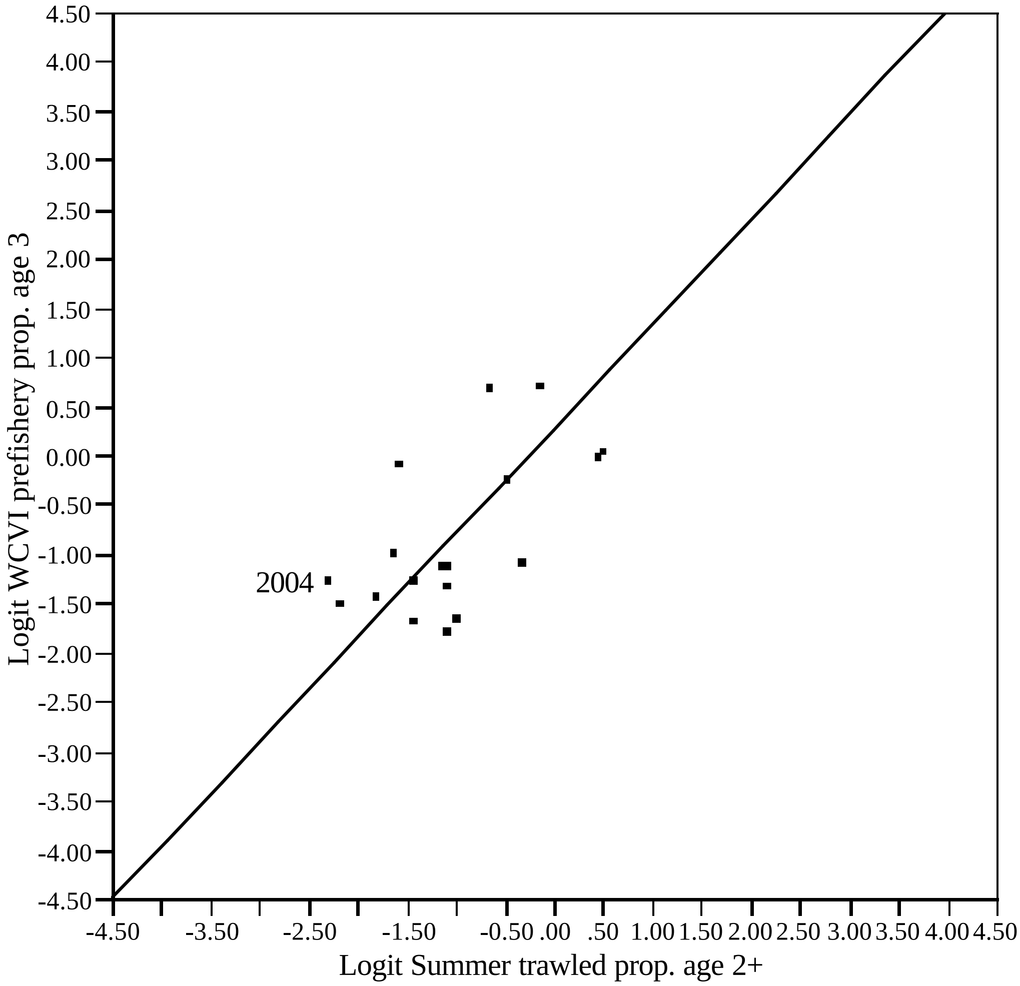
Appendix Fig. 2. Length-frequencies for herring trawled during the 2004 offshore herring survey. Filled circles indicate fish presumed to be age 2+.



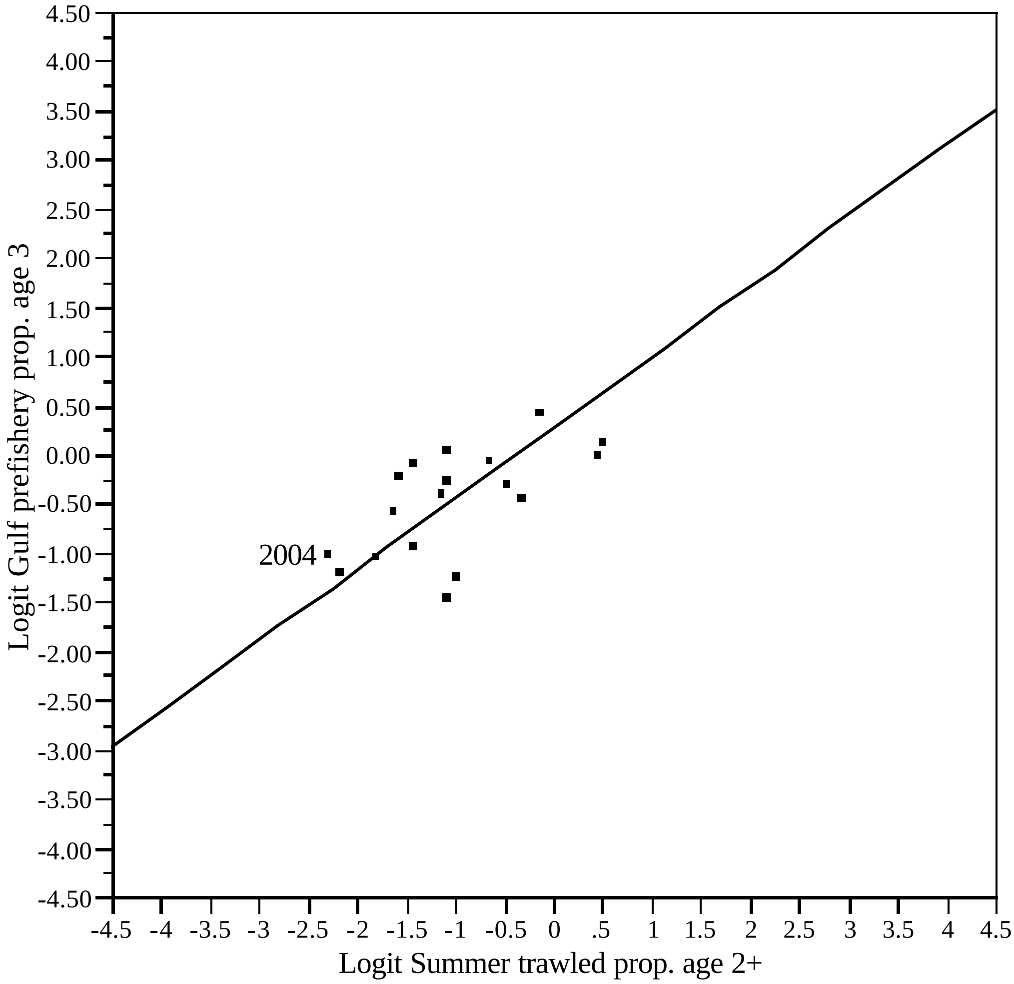
Appendix Fig. 2 cont.



Appendix Fig. 2 cont.



Appendix Fig. 3. Scatterplot of logit observed proportion age 3 against logit trawled proportion age 2+ for WCVI herring. Line is GMR regression used to forecast recruitment for 2005 where y'=1.06•x'+0.23, p=0.006, adjusted R^2=0.34. 2004 – trawled and observed data pair for 2004 fishing season. Minimum and maximum axes values are transformed values for 1 and 99% respectively.



Appendix Fig. 4. Scatterplot of logit observed proportion age 3 against logit trawled proportion age 2+ for Strait of Georgia herring. Line is GMR regression used to forecast recruitment for 2005 where y'=0.72•x′+0.25, p=0.006, adjusted R^2=0.34.