Inshore Rockfish Stock Assessment for the West Coast of Canada in 1996 and Recommended Yields for 1997

K. L. Yamanaka, and A. R. Kronlund

Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
Nanaimo, British Columbia
V9R 5K6

1997

Canadian Technical Report of Fisheries and Aquatic Sciences No. 2175

Fisheries and Oceans / Pêches et Océans

Canada

Canadian Technical Report of
Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1 - 456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457 - 714 were issued as Department of the Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport technique canadien des
sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais que ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les scences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annual des publications scientifiques et techniques du Ministère.

Les numéros 1 à 456 de cette série ont été publiés à titre de rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Les rapports techniques sont produits à l'échelon regional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Technical Report of

Fisheries and Aquatic Sciences 2175

1997

INSHORE ROCKFISH STOCK ASSESSMENT FOR THE WEST COAST OF CANADA IN 1996 AND RECOMMENDED YIELDS FOR 1997

by

K. L. Yamanaka, and A. R. Kronlund

Fisheries and Oceans Canada

Science Branch, Pacific Region

Pacific Biological Station

Nanaimo, British Columbia

V9R 5K6

Cat. No. Fs 97-6/2175E ISSN 0706-6457

Correct citation for this publication:

Yamanaka, K. L., and A. R. Kronlund. 1997. Inshore rockfish stock assessment for the west coast of Canada in 1996 and recommended yields for 1997. Can. Tech. Rep. Fish. Aquat. Sci. 2175: 80 p.

TABLE of CONTENTS

LIST of TABLES

LIST of FIGURES

ABSTRACT

Yamanaka, K. L., and A. R. Kronlund. 1997. Inshore rockfish assessment for the west coast of Canada in 1996 and recommended yields for 1997. Can. Tech. Rep. Fish. Aquat. Sci. 2175: 80 p.

This paper is a major assessment of inshore rockfish inhabiting the waters of British Columbia, Canada. Fishery catch and effort data, research survey data, and biological data are used to assess the status of inshore rockfish in 31 statistical areas on the British Columbia coast. Advice to managers in the form of yield options is changed from previous assessments when yield options based on habitat analysis were recommended for *red snapper* and *other rockfish* species categories in each statistical area. In this document, yield recommendations are given only in areas where the catch history and effort are relatively high. The habitat-based analysis performed in past assessments is applied to a few areas where adequate data are available. For these cases, revised estimates of fishing depths from logbook records are incorporated into the calculations of habitat area. In most other areas, the recommended yield is the 25*th* percentile of the catch history since 1983. No yield recommendations are provided in areas where the catch and effort are low over the available time series. In these areas, managers are advised to adopt a precautionary approach to harvest by setting low, pre-emptive quotas. Where yields are recommended, yields for yelloweye rockfish and quillback rockfish are provided in addition to the traditional categories of *red snapper* and *other rockfish*.

New information on the species composition of the catch from fish slip records is included in the assessment. In addition, new graphical analyses suggest coast-wide fleet movement consistent with a progressive depletion of inshore rockfish. Catch statistics are updated and information from the directed fishery on the Bowie Seamount is summarised.

In general, the stock condition is poor in the Strait of Georgia, portions of the west coast of Vancouver Island and Queen Charlotte Islands and unknown in other areas.

RÉSUMÉ

Yamanaka, K. L., and A. R. Kronlund. 1997. Inshore rockfish assessment for the west coast of Canada in 1996 and recommended yields for 1997. Can. Tech. Rep. Fish. Aquat. Sci. 2175: 80 p.

Notre étude constitue une grande évaluation des sébastes des eaux côtières de la Colombie-Britannique, au Canada. À partir des données sur les captures et l'effort de pêche, de l'information fournie par les campagnes de recherche et des données biologiques, nous avons évalué la situation des sébastes des eaux côtières dans 31 secteurs statistiques de la côte de Colombie-Britannique. Les conseils aux gestionnaires, présentés sous la forme d'options de production, sont différents de ceux des évaluations antérieures. Jusque-là, on recommandait pour les catégories *sébastes rouges* et *autres sébastes* des options de production dans chaque secteur statistique, en fonction de l'analyse de l'habitat. Dans le présent document, nous ne présentons des recommandations de production que pour les secteurs où traditionnellement les captures et l'effort sont relativement élevés. L'analyse en fonction de l'habitat effectuée lors des évaluations antérieures est ici appliquée à quelques secteurs pour lesquels on dispose de données suffisantes; nous intégrons alors aux calculs de la superficie d'habitat des estimations révisées des profondeurs de pêche à partir des journaux de bord. Dans la plupart des autres secteurs, la production recommandée correspond au 25^{e} percentile des prises déclarées depuis 1983. Nous ne faisons aucune recommandation pour les secteurs où, d'après la série chronologique existante, les captures et l'effort ont été faibles. Dans ces secteurs, il est recommandé aux gestionnaires d'adopter une approche prudente de l'exploitation en établissant des quotas bas et préventifs. Lorsque des niveaux de production sont recommandés, ils visent, outre les catégories traditionnelles *sébastes rouges* et *autres sébastes*, le sébaste aux yeux jaunes et le sébaste à dos épineux.

L'évaluation comporte des informations nouvelles sur la composition spécifique des captures d'après les bordereaux de vente. De plus, de nouvelles analyses sous forme graphique font ressortir un déplacement de la flottille tout le long de la côte, ce qui correspond à un appauvrissement progressif des stocks côtiers de sébastes. Les statistiques des prises sont mises à jour, et nous résumons l'information concernant la pêche dirigée au-dessus du mont sous-marin Bowie.

De façon générale, l'état des stocks est médiocre dans le détroit de Géorgie, dans certaines parties de la côte ouest de l'île de Vancouver et dans les îles de la Reine-Charlotte, et il n'est pas connu dans les autres secteurs.

1. INTRODUCTION

This paper is a major assessment of inshore rockfish for the west coast of Canada and was originally prepared for the Pacific Stock Assessment Review Committee (PSARC) which met in July 1996. The document provides an overview of Pacific coast inshore rockfish assessments with a summary of the British Columbia (B. C.) fishery and management actions and a description of data sources and assessment methodology used in B. C.. An analysis of B.C. fishery trends is presented, followed by regional synopses of rockfish status with yield recommendations.

Inshore rockfish are described as rockfish primarily caught on hook and line gear and comprise over twenty species in the genus *Sebastes* (Hart 1973). The predominate species in the fishery are yelloweye (*Sebastes ruberrimus*) and quillback (*S. maliger*) rockfish. Inshore rockfish are difficult to assess due to their solitary distribution, sedentary adult life, sporadic recruitment, slow growth and extreme longevity (Matthews 1990, Archibald *et al.* 1983, Leaman and Beamish 1984, O'Connell and Funk 1986). The distribution and physiology of these rockfish complicate representative sampling and conventional assessment techniques such as abundance surveys and mark recapture studies are of little use. No biological information on stock delineation is available.

Conventional fishery-based abundance indices for inshore rockfish are difficult to interpret. Catch per unit effort (CPUE) may remain high within a large management region as the fishing fleet progressively depletes local populations of rockfish clustered on individual reefs. Under this scenario, a decline in CPUE may show that rockfish are over-exploited rather than providing a forewarning of stock decline. Once over-exploited, the life history of these fish imply that stock recovery may take decades (Leaman 1991). Various management measures imposed on a fishery may further complicate the interpretation of fishery-based indices.

The problems of inshore rockfish stock assessment are shared by assessment biologists on the Pacific coast of North America. Discussion conducted through the Technical Subcommittee (TSC) of the joint Canada/United States (U.S.) Groundfish Committee have highlighted the following concerns:

- the lack of biological information and abundance estimates for many nearshore rockfish species;
- the generally poor track record of rockfish management coast-wide;
- the notable difficulty in managing nearshore species; and
- the longevity and vulnerability to over-exploitation associated with these species, even when some biological parameters are known.

Along the Pacific coast two assessment methodologies have been employed. In B.C., assessments are based on fishery catch and effort, habitat analysis and limited biological

and survey data. In the U.S., assessments are largely based on direct observations of fish density which are used to estimate biomass and determine harvest levels.

In situ assessment techniques used in Washington and Alaska involve the use of underwater video camera sleds and manned submersibles, respectively. In Washington, the biomass of copper and quillback rockfish above 30 m is estimated directly from video tape for rockfish one metre from the bottom and from hydroacoustic surveys for the off bottom rockfish (Palsson, Washington State Department of Fisheries, pers. comm.). In Alaska, biomass estimates are derived by multiplying the density of yelloweye rockfish observed during submersible dives by estimates of rockfish habitat area (O'Connell and Carlile 1993). Recommended quotas are set at 2% of the lower bound of a 90% confidence interval on the biomass of yelloweye rockfish for a region (O'Connell and Carlile 1995).

These *in situ* methods have not been used to assess inshore rockfish in B.C.. In B.C., the quillback rockfish inhabit waters deeper than 30 m and commonly occur down to 90 m. With the exception of one submersible study conducted in the Strait of Georgia (Richards 1986), funding has not been available to carry out submersible assessment work at the required depths.

The inshore rockfish fishery in B.C. utilises longline and handline (rod and reel) gear and to a lesser extent troll and trawl gear. Historically, the inshore rockfish catch was incidental to other hook and line fisheries targetting on halibut, lingcod, salmon and dogfish. Directed fisheries have developed in recent years with the longline fishery landing the greatest portion of yelloweye rockfish (*Sebastes ruberrimus*) and the handline fishery landing the greatest portion of the quillback rockfish (*S. maliger*). Incidental rockfish catches are permitted in other commercial longline fisheries such as halibut, dogfish and the salmon troll fishery. A small portion of inshore rockfish is landed in the trawl fishery. These catches are incidental to directed lingcod and rock sole/Pacific cod fisheries. Inshore rockfish are also targeted in the recreational fishery coast-wide.

The commercial fishery supplies a live, fresh round and fillet market locally, as well as, a fresh round and fillet market in the United States. Quillback rockfish are sold on the live market and yelloweye rockfish are sold on the fresh round market. A small percent of other rockfish species are sold live and fresh round, but the majority are filleted for the fresh market. Live rockfish are three to five times more valuable than fresh rockfish.

The terms *statistical area* and *area* are used interchangeably in this document, as are the terms *management region* and *region*. Management regions represent geographic divisions of coastal B.C., each of which contains statistical areas. The species categories *red snapper* and *other rockfish* derive from historical data collected prior to 1994 when catch was not recorded by species. The *red snapper* category is predominantly yelloweye rockfish. These categories have been preserved in graphical and tabular summaries to allow comparison with historical data. The term *total rockfish* refers the combination of all rockfish species and species categories taken on hook and line gear.

2. FISHERY MANAGEMENT

Management measures for the inshore rockfish fishery are summarised in Table 1. A category Zn licence, which permits rockfish species to be taken by hook and line gear, was instituted in 1986. The fishery was unrestricted prior to the implementation of the Zn license. In 1991, area licensing (inside or outside of the Strait of Georgia) and catch quotas for five management regions on the coast were introduced. The statistical areas comprising each management area are listed in the following table.

Management Area	Code	Statistical Areas
Strait of Georgia:	SG	12-20, 28 and 29
West Coast Vancouver Island	WCVI	11, 21-27, 111, 121-127
Queen Charlotte Islands	QCI	1-2, 101-102, 142, 130
North Coast	NC	3-5, 103-105
Central Coast	CG	6-10, 106-110

Limited entry was implemented for the Strait of Georgia in 1992, and coast-wide in 1993. This action reduced the number of licences to 74 in the Strait of Georgia and 183 outside from over 2400 licenses coast-wide in 1986. In 1994, a user-pay logbook program was implemented, followed by a user-pay dockside monitoring program in 1995.

A major change in management of the fishery occurred in 1995 with the introduction of quota management for yelloweye rockfish and six species aggregates (Hook and line management plan, Fisheries and Oceans Canada 1995). This measure was accompanied by the implementation of monthly fishing periods, fishing period limits, annual landing options, and trip limits. The six species aggregates introduced in 1995 are contained in the following table.

Aggregate	Species
1	quillback, copper
2	china, tiger
3	canary, silvergray, yellowtail, widow
4	rougheye, shortraker, thornyheads
5	Pacific ocean perch, yellowmouth, redstripe
6	any combination of species other than yelloweye and other than species in aggregates 1-5

In 1995, management of the fishery was based on the attainment of the yelloweye rockfish and aggregates 1 and 2 (combined) quotas. Table 2 shows the quota and catch for the five coastal management regions between 1991 and 1994 by species, while Table 3 shows similar data for the 1995 fishery by species aggregate.

Since the institution of the halibut IVQ fishery in 1991, the halibut fleet has been permitted an incidental allowance of 20 percent round rockfish per dressed halibut landing. In

1993, the total incidental catch of rockfish in the halibut fishery was 212 t of which 170 t was yelloweye rockfish (D. Adams, pers. comm.).

The recreational fishery was restricted coast-wide by a daily bag limit of eight rockfish in 1986. A 100 t allocation for other rockfish was applied to the Strait of Georgia in 1990 and 1991. In 1992, the other rockfish allocation to the Strait of Georgia recreational fishery was reduced to 55 t. In addition, the daily bag limit was reduced to five rockfish for the Strait of Georgia Areas 12-19, 28 and 29 and subareas 20-4 and 20-7. In recent years the allocation between the recreational and commercial sectors in the Strait of Georgia for "other rockfish" has been approximately 30:70.

3. DATA SOURCES

3.1 Fish Slip Data

Historic catch information is based on fish slip records. Fish slip information is compiled and maintained by the Statistics Unit, Fisheries Branch of Fisheries and Oceans Canada. Prior to 1994, the majority of rockfish taken on hook and line gear were recorded as red snapper (code 48) and other rockfish (code 47). There are also small amounts of Pacific ocean perch (code 44), reedi (code 45) and greenies (code 46) recorded as catch on hook and line gear. In 1994, the database was upgraded to allow the entry of fish slip data by species.

Where appropriate, the fish slip categories of red snapper and other rockfish have been preserved in tabular summaries of data collected since 1994 to allow comparison with historical data. Catch is reported as round fish weight (kg). Effort is measured in two ways: (1) fishing days as recorded on a fish slip with a rockfish landing, and (2) the number of vessels in a year landing at least 50 kg of rockfish species. The 50 kg qualification level is intended to identify landings where rockfish were the target species.

Categories for hook and line gear include longline (code 40), handline (code 36), salmon troll (code 30) and salmon freezer troll (code 31). These gear types are combined into longline and handline/troll for this document. Fields in the fish slip database do not distinguish between statistical areas inside and outside the surfline. Therefore, catches from statistical areas 101-111 and 121-127 are reported under statistical areas 1-11 and 21-27, respectively. Catch data presented for 1995 are preliminary and were compiled in June 1996.

Coast-wide commercial rockfish catches are summarised by year and management region in Table 4. Total rockfish catch in the Strait of Georgia by year and statistical area is presented in Table 5 for longline gear and in Table 6 for handline/troll gear. Similar summaries for statistical areas outside of the Strait of Georgia appear in Table 7 and Table 8. Longline and handline/troll landings, nominal effort, and the number of qualified vessels by year and management region are shown for red snapper in Table 9 and for other rockfish in Table 10. Fish slip catch data by species for rockfish is shown in Table 11 for 1994 and Table 12 for 1995.

3.2 Zn Logbook Data

The format of Zn logbooks was updated in 1993. A user-pay program was instituted in 1994 to provide data entry for Zn logbooks. In addition, Fisheries and Oceans Canada has provided keypunching services for the 1993 logbook data and for a time series of logbook records for 26 fishers for the years 1989 through 1992. Logbook records are transferred directly to the Pacific Biological Station, Science Branch, Fisheries and Oceans Canada in the form of ASCII files. Pending the completion of a standardised database by Fisheries and Oceans, these data are manipulated by a custom PASCAL program prior to importation to a temporary relational database. Logbook records are summarised for 1993 in Table 13 and for 1994 in Table 14.

Beginning in 1996, fish slip data will no longer be collected for the Zn rockfish fishery. Thus, the Zn logbooks and the dockside monitoring program will be the only sources of fishery catch and effort data.

3.3 Recreational Catch Data

Catch statistics for the recreational fishery are available from the Strait of Georgia and West Coast creel surveys (Collicutt and Shardlow 1992b). The Strait of Georgia creel survey includes areas 13-19 (including the portion of area 20 east of Sheringham Point), 28 and 29 (Table 15). Between 1991 and 1993, a small creel survey was conducted in area 12 for a portion of the summer. In 1993, the creel survey was only conducted between January and September and the numbers for October to December were estimated by historical proportions. In 1994, the survey was conducted between January and October and no estimates were made for November and December. In 1995, the survey was shortened further to cover the months of March through October. The West Coast creel survey includes areas 23 (Alberni Canal, Barkley Sound) and 24 (124 southern portion) (Table 16). A Tidal Diary postal survey was conducted between 1987 and 1991. A summary of this information was presented in the 1994 stock assessment (Yamanaka and Richards 1995).

Angler interviews and aerial overflights provide recreational catch per unit of effort and total fishing effort in the study area. These data are combined to estimate the total catch of salmon and groundfish in the recreational fishery and total recreational fishing effort. Rockfish are not recorded by species for any of the creel surveys. An estimate of rockfish catch in pieces is recorded by month. Effort is recorded as the number of boat days observed in each month.

3.4 Biological Sampling Data

In the past, biological samples were collected through port sampling of commercial catches in Vancouver and Prince Rupert or by purchasing rockfish through fish buyers and retailers. In recent years, selected samples are purchased from the live rockfish

fishery in the Strait of Georgia. For these samples, an observer usually accompanies the fisher and measures (fork length) all fish landed. At day's end, a random sample of 50 fish is selected. Scientific permits were issued to commercial fishers in 1995 and 1996 to collect rockfish for biological samples. When fishers with scientific permits land their fish, a port monitor selects a random sample of 50 rockfish during the offloading process. Port sampling has provided length and sex information, while the purchased or scientific permit samples have provided length, sex, maturity, and age information.

A new sampling program to collect samples from specific locations in each management region was initiated in 1996. Each sample is collected using a 500 hook string of gear set at a specified location and depth. All rockfish retrieved from the string are retained for biological sampling. Since the opportunities to obtain these samples are limited, only two samples have been collected to date.

Inshore rockfish are slow growing and long lived (Leaman and Beamish 1984), thus, length is a poor predictor of age. Although the smallest fish are probably the youngest, the largest fish are not necessarily the oldest (Fig. 1). Mean ages of rockfish in samples taken from the commercial fishery are shown in Table 17.

Maximum age in the biological database for yelloweye rockfish is 98 yr, quillback rockfish is 76 yr, redbanded rockfish is 75 yr and copper rockfish is 41 yr. An estimate of instantaneous total mortality ($Z=0.0174 \pm 0.0053$) from a "lightly exploited" yelloweye rockfish stock in the SSEO (southern southeast outside) region of Alaska (adjacent to Canadian waters) was used to estimate an instantaneous natural mortality of $M=0.02$ (O'Connell and Carlile 1995). An estimate of Z from quillback rockfish age-frequency data from areas 7 and 12 were 0.06 and from area 13 was 0.09 (Richards and Hand 1990). Age at 50% maturity is approximately 18 yr for female and 15 yr for male yelloweye rockfish. Estimated age at 50% maturity for female quillback rockfish in area 12 is 11 yr with a 95% confidence interval (CI) of 10-12 yr (Yamanaka and Richards 1993b). The size at 50% maturity for female quillback rockfish from area 12 is 293 mm with a 95% confidence interval of 289-297 mm. A similar size of 292 mm with a 95% CI of 285-298 mm was estimated for quillback rockfish from area 13 (Richards and Hand 1990).

3.5 Research Survey Data - Area 12

Hook and line surveys for rockfish were conducted in June of 1986-1988 and 1992 (Richards and Cass 1987; Richards and Hand 1987; Richards *et al.* 1988; Yamanaka and Richards 1993a). The 1986 to 1988 surveys did not show any differences in CPUE among years so the data from these surveys were combined to compare with the 1992 survey (Yamanaka and Richards 1993a). Quillback rockfish CPUE was significantly higher in 1992 at 85% of the site/depth locations. Median lengths of quillback rockfish in 1992 were significantly smaller at each depth interval than in 1986-88. Age data showed that in the 1992 survey, age 7 quillback rockfish accounted for 28.5% of the total quillback rockfish catch. Because of this strong year-class recruiting to the fishery, the quillback rockfish CPUE appeared much higher in 1992 than in

the previous years. After adjusting the CPUE for quillback rockfish over the age of 10 (fully recruited), there was a significant decrease in CPUE between the 1992 and the 1986-88 surveys.

4. B.C. INSHORE ROCKFISH STOCK ASSESSMENT

Inshore rockfish are described as rockfish primarily caught on hook and line gear. In British Columbia, this group includes over twenty rockfish species in the genus *Sebastes*. The predominate rockfish species are yelloweye (*Sebastes ruberrimus*), quillback (*S. maliger*), redbanded (*S. babcocki*) and rougheye (*S. aleutianus*). Previous assessments were based on the fish slip species categories red snapper and other rockfish. In this assessment, however, recommended yields are provided for yelloweye and quillback rockfish as well as the red snapper and other rockfish species categories. Other inshore rockfish species are caught primarily in the trawl fishery and are included in either the slope or shelf rockfish assessments conducted by Fisheries and Oceans Canada.

Assessments for inshore rockfish have been conducted annually since 1986 (Richards 1986). Between 1987 and 1991, catch caps were recommended as yield options for inshore rockfish (Richards 1988; 1989; Richards and Hand 1990; Hand and Richards 1991). In the last major review (Yamanaka and Richards 1992), a habitat based assessment was introduced and yield options were recommended for the species categories red snapper and other rockfish in each of 31 statistical areas on the coast. Refinements to the habitat areas were made in subsequent years (Yamanaka and Richards 1993b; 1994). The most recent assessment was conducted in 1994 (Yamanaka and Richards 1995).

4.1 Habitat based assessment methodology

Four steps were used in the 1992 to 1995 assessments to determine yield recommendations for all statistical areas of the B.C. coast. Areas where sufficient information was available to assess rockfish status were used to estimate yields in adjacent areas with little or no information. Specifically, the habitat-based assessment procedure included the following steps:

1. estimate the habitat area for a species (yelloweye, quillback rockfish) within each statistical area;
2. divide the catch series by the habitat area to produce a catch density series for each statistical area;
3. determine low and high risk catch densities from the catch density series, survey data, and biological data, where available;
4. calculate low and high risk yield options by multiplying the low (high) risk catch densities by the habitat area associated with a species.

The methodology assumes that habitat is equivalent among areas. This assumption is unlikely to be true, however, no data are available to evaluate differences in habitat quality. Note that term *risk* has no formal definition in this document. Steps 1 and 2 of the

habitat analysis are retained in this document as a tool to assess rockfish status within each statistical area. However, yields are only recommended for areas where sufficient data are available and the practice of providing low and high risk options is discontinued. Each of the steps is discussed in detail below.

4.2 Habitat area

The habitat associated with rockfish is estimated by computing the bottom area bounded by the depth ranges for quillback and yelloweye rockfish. When habitat-based assessment was introduced, the depth ranges were determined by submersible observations in the Strait of Georgia (Richards 1986). In consultation with industry, the depth ranges were later refined to 50-200 m for red snapper coast-wide, 0-80 m for other rockfish in the Strait of Georgia, and 30-80 m for other rockfish in the outside areas (Yamanaka and Richards 1993; 1994; 1995). For this assessment, the depth ranges (minimum and maximum depth fished for a fishing event) associated with yelloweye and quillback rockfish were estimated based on logbook records. The 1989 to 1992 series on 26 fishers was used in addition to the 1993 and 1994 logbooks. Habitat depth ranges were estimated for quillback (yelloweye) using the 25*th* percentile of the distribution of minimum depth fished and the 75*th* percentile of the maximum depth fished for all records containing catch of quillback (yelloweye). Fig. 2 show boxplots of minimum or maximum depth fished by species and year. The horizontal dotted lines within each panel represent the 25*th* percentile, median, and 75*th* percentile of the depth fished over all years. The depth range for quillback was estimated at 20-90 m, while that for yelloweye was estimated at 30-170 m.

A geographic information system (GIS) was used to estimate area bounded by the habitat depth range for each species and statistical area. Bathymetric contours from digitized hydrographic charts were used to interpolate a bottom surface using a distance weighted smoothing algorithm (Geo-spatial Systems 1993) at a resolution of one hectare. The maximum of the slope in the north-south and east-west directions of each hectare was used to correct the area estimate. All bottom areas recorded as "soft" on the hydrographic charts were excluded from the area calculations. The estimated habitat areas used for 1996 yield calculations and the revised estimates for 1997 yields are shown by species and statistical area in Table 18. The interpolation algorithm does not perform well in areas where there are very steep slopes. Thus, the estimated bottom area for statistical areas 130 and 142, in particular, are expected to be too small.

4.3 Catch density series

Catch density series are calculated by dividing the rockfish historical catch in a statistical area by the corresponding estimate of rockfish habitat in that area. Catch density series are used to scale the catches among statistical areas within a management region. Some statistical areas within each management region have experienced relatively higher levels of catch and effort than others. Inspection of trends for these areas may provide reference points for

areas with little or no information (see, for example, the regional synopsis for the Strait of Georgia).

The catch density series are derived from the fish slips for red snapper and other rockfish from 1982 to the present. Prior to 1982, catch was recorded only as total rockfish by gear type. These records exists as hardcopy; electronic data files are not available.

4.4 Determination of rockfish status and yield recommendations for 1997

General indicators of inshore rockfish status are based on fleet dynamics, trends in CPUE, changes in the age composition of the catch, and survey data where available. In areas where the catch history is long and effort is relatively high over the series, the catch history and habitat analyses are used to assess specific statistical areas.

The provision of yield recommendations in this document differs from that used in previous assessments. Yield recommendations are provided based on the availability and relative quality of catch and effort data, survey data, and biological data. The available data for each statistical area are used to assign the area to one of three assessment methods:

1. **Habitat**: Where there exists a long catch history with relatively high effort (more than 100 days fishing per year), survey data and biological data, habitat-based analysis (Yamanaka and Richards 1992) is used to determine recommended yield. Yield is selected at a level below the habitat analysis reference point from portions of the data series where catch is judged to be sustainable;
2. **Catch History**: Where the catch history is long and effort is relatively high (more than 100 days fishing per year) over the series, but little or no other data are available, the yield recommendation is based on the 25*th* percentile of the catch history since 1982. In these cases, there is no information with which to evaluate the sustainability of the 25*th* percentile of the catch series. The 25*th* percentile was intended to provide a conservative level of catch within the historical range.
3. **None**: Where there is no reasonable catch history and effort has been relatively low, yield recommendations are not provided. Managers are advised to be precautionary in these areas. Quotas, if implemented, should be designed to limit expansion of the fishery.

Management measures in the most recent two years have contributed to lower catches in some areas. The effects of these measures will be reflected in the yield recommendations based on catch history, however, the 25*th* percentile is reasonably robust to extreme values in a data series.

Previous assessments have recommended yield options for the species categories red snapper and other rockfish. In this assessment, rockfish catches by species from 1994 and 1995 data were used to estimate quillback and yelloweye rockfish yields. The mean proportion of yelloweye (quillback) rockfish in the red snapper (other rockfish) category was estimated from 1994 and 1995 sales slip data for each management region. The yield for yelloweye or quillback

rockfish was then estimated as the appropriate regional proportion of the yield recommended for red snapper or other rockfish, respectively. The yields are based on the commercial fishery and do not include an allocation to the sport fishery.

Yield options are not provided in this assessment since there appears to be little basis for distinguishing low and high risk levels based on available data.

5. REGIONAL SYNOPSES

5.1 Coastal Overview

From the mid 1950's to the mid 1970's the British Columbia hook and line rockfish catch was less than 200 t annually (Table 4). By the late 1970's, a market developed for live rockfish in Vancouver prompting expansion of the Strait of Georgia fishery. The fishery for live rockfish moved from areas 17 and 18, adjacent to Vancouver, farther north to areas 15 and 16 and into area 13 by the early 1980's. Catches began to decline in area 13 and increase in area 12 by 1987. The live fishery extended into the Central Coast management region in the late 1980's and continues to move northward. Live fish are now air-freighted and trucked to Vancouver from all areas of the coast including the Queen Charlotte Islands. The fresh/frozen rockfish fishery off the west coast of Vancouver Island developed rapidly in the early 1980's, followed closely by the fisheries off the Queen Charlotte Islands and Central Coast regions. Coast-wide catches of hook and line rockfish were 500 t in 1980, 800 t in 1985, 2100 t in 1990 and reached a high of 2645 t in 1995 (Table 4).

5.1.1 Catch and effort trends

Inshore rockfish are sedentary as adults (Matthews 1991). Their distribution is clustered since they aggregate with respect to specific bathymetric features (Leaman *et al.* 1990). Therefore, the spatial distribution of catch and effort over time may serve as an indirect measure of rockfish status. For example, the Alaskan rockfish fleet showed evidence of progressive fleet movement away from home ports over time (O'Connell and Bracken 1990). This behaviour was interpreted as strong evidence that productive fishing near major ports had declined. Movement of fishing effort from areas close to home ports to more distant areas is consistent with a fishery that operates by progressively depleting local populations of rockfish.

Changes in the spatial distribution of catch and effort over time are shown in Fig. 3 and Fig. 4 for red snapper and Fig. 5 and Fig. 6 for other rockfish. Each figure consists of an array of panels, where each panel shows the spatial distribution of catch (effort) on a map for a group of years. The time series begins at the lower left panel for 1983-1985 and proceeds from left to right, bottom to top to 1994-1995 at the upper right panel. The total catch (effort) for each statistical area is shown as a framed-rectangle plot (Cleveland 1985). The shaded portion of each rectangle indicates the magnitude of the catch (effort) within a given statistical area. The catch

(effort) in each statistical area is scaled relative to the maximum catch (effort) within a panel. A legend in the lower left corner of each panel indicates the maximum value.

Early in the red snapper time series, catch and effort are concentrated in the Strait of Georgia (area 13) and the lower west coast of Vancouver Island. Over time, catch and effort shift northwards in the Strait of Georgia (area 12) and the west coast of Vancouver Island. By 1992-1993, the catch is taken largely from the upper west coast of Vancouver Island (area 11), lower central coast (area 10), and the lower west coast of the Queen Charlotte Islands (area 142). However, effort is spread throughout the west coast of Vancouver Island and the Strait of Georgia. Most recently, the catch is taken from the Queen Charlotte Islands and the northern portion of Vancouver Island (areas 10 and 11). Effort is currently focused in the Queen Charlotte Islands, with some effort occurring in the Strait of Georgia and on the west coast of Vancouver Island. Similar patterns of movement can be seen for the other rockfish species category.

Catch and effort series by management region, statistical area, gear, and species category are shown in Fig. 7 through Fig. 16. Each figure consists of an array of panels where data for a given statistical area is arranged across the rows, while the columns represent individual and combined gear types. Catch is shown by the solid line overlaid with circles within each panel while effort appears as a solid line. The first two columns of panels show catch (t) and effort (days fished) data by handline and longline gear types. The last column of panels shows only total rockfish catch. Panels in the last column also show two dashed horizontal lines representing the 25*th* percentile and median catch, which are given as the lower and upper number, respectively, in the upper left corner of each panel.

5.1.2 Catch per unit effort

Catch per unit effort is computed using the ratio of means (pooled) estimator, i.e. total catch (t) divided by total effort (fishing days) for each statistical area and year combination. Problems in interpreting fishery-dependent CPUE data (Hilborn and Walters 1992) are exacerbated for inshore rockfish due to their clumped distribution and to the variety of management measures applied in recent years. Thus, trends in CPUE should be evaluated with caution.

Plots of CPUE against time are shown for red snapper and other rockfish by statistical area and gear in Fig. 17 through Fig. 20. Lowess trend lines (Cleveland 1985) are included for statistical areas where the effort exceeds 100 days annually over most of the series. Catch per unit effort trends are not considered for areas were annual effort is less than 100 days over the time series. The series begins at the bottom left panel with area 20 at the southern extreme of Vancouver Island and progresses to the right and up as the areas, in general, move from the south to the north. The order of the statistical areas corresponds roughly to the Strait of Georgia region, followed by the west coast of Vancouver Island, central coast, north coast and the Queen Charlotte Islands.

In general, CPUE is currently lower in the southern areas and higher in the north. This result is consistent with the fleet dynamics discussed above; southern areas should be less

productive in recent years if localised stock declined occurred early in the time series. Catch per unit effort trends are similar by gear type for red snapper and other rockfish. This is probably due to the mixed catch of both red snapper and other rockfish on either handline or longline gear. A declining red snapper CPUE coincident with an increase of other rockfish CPUE on longline gear can be seen in areas outside of the Strait of Georgia. The increase in other rockfish CPUE is due to increases in both the amount of individual species landed and the diversity of species landed over time. Trends in CPUE over time by region show declines in the Strait of Georgia and some areas of the West Coast Vancouver Island region. The northern regions show increasing CPUE over time.

5.1.3 Species composition from fish slips and logbooks

Catch by species from fish slips for 1994 and 1995 is summarized by gear type and management region in Table 11 and Table 12. In 1994, the largest proportion of the rockfish catch consisted of yelloweye rockfish at 38%, followed by quillback, redbanded, rougheye, canary and silvergray rockfish at 24%, 10%, 7%, 6% and 6%, respectively. In 1995, yelloweye and rougheye rockfish each comprised 26% of the catch followed by quillback, redbanded, shortraker and silvergray rockfish at 16%, 11%, 6%, and 6%, respectively. A 500 t increase in catch of rougheye rockfish between 1994 and 1995 is notable. The increase may be a consequence of aggregate management. The catch of redbanded and shortraker rockfish also increased about 100 t. A decrease in catch of about 50 t is shown for quillback, canary, and yelloweye rockfish.

Yelloweye and quillback rockfish comprised the largest proportions of the catch on both the fish slips and logbook records (Table 11, Table 14). The fish slips show yelloweye rockfish at 38% and quillback rockfish at 24% compared with the logbooks where yelloweye rockfish comprise 46% and quillback rockfish comprise 18% of the total rockfish catch. Less rougheye and quillback rockfish were reported on logbooks than fish slips.

Yelloweye rockfish made up 56% of the total catch reported on logbooks in 1993, followed by quillback, silvergray and canary rockfish at 21%, 5% and 5%, respectively. In 1994, yelloweye and quillback rockfish proportions were lower at 46% and 18% and silvergray, redbanded and canary rockfish proportions were higher at 9%, 7% and 7%, respectively.

Total catch recorded by logbooks was 1615 t and 918 t in 1993 and 1994, respectively. The decrease in catch was not mirrored by the total catch determined from fish slips where 1956 t and 1942 t were reported in 1993 and 1994. This discrepancy between fish slip and logbook landings was examined for 1994 when catch data are available by species from both sources. Fig. 21 shows the weight of landings by species estimated from fish slips plotted against the weight of landings reported from Zn logbooks. The results show that rockfish weights by species reported on fish slips were about 50% higher than those estimated from logbooks. Some of the discrepancy between fish slips and logbooks may be due to a recent change in logbook format causing confusion in 1994 reporting year. In addition, the 1994 logbook data did not identify sets that comprise a unique landing. Thus, a computer algorithm

was used to match sets to a unique landing in the 1994 logbook data based on vessel, date, species, pieces, and weight information. The algorithm may have failed to correctly match sets to a landing in some cases, or to estimate weights correctly in cases where only pieces were recorded. Starting in 1996, this problem will be avoided by the inclusion of a key field to link sets to a unique landing.

5.1.4 Trawl catch

Trawl catches of quillback, copper and yelloweye rockfish in areas outside the Strait of Georgia have increased from 26 t in 1988 to 94 t in 1995 (source: Pacific Biological Station Groundfish data files). Of this 94 t, approximately 42 t was yelloweye rockfish, 33 t quillback rockfish and 19 t copper rockfish. The majority of these rockfish were taken incidentally to the rock sole/Pacific cod and lingcod trawl fisheries.

5.1.5 Biological data

In recent years, the youngest yelloweye, quillback and copper rockfish are from the Strait of Georgia (Table 17). The oldest yelloweye and quillback rockfish are from the Queen Charlotte Islands.

5.2 Strait of Georgia (areas 12-20, 28 and 29)

5.2.1 Commercial catch and effort data

Prior to 1985, the majority of the coast-wide rockfish landings originated from the Strait of Georgia (Table 4). Catches increased in the late 1970's to a peak of 525 t in 1986 and dropped dramatically to 177 t in 1992 due to the implementation of limited entry licensing and catch quotas (Table 4). The Strait of Georgia fishery is largely a handline fishery for species in the other rockfish category. In recent years the bulk of the Strait of Georgia catch is taken in areas 12, 13 and 17-19 combined, with little effort occurring elsewhere (Table 5, Table 6, Fig. 7, Fig. 12). The red snapper and other rockfish catch declined in 1995 due to decreases in the longline catch (Table 9).

Fish slip records for 1995 and logbook records for 1993 show that 70% of the rockfish catch in the Strait of Georgia consisted of quillback rockfish, 91% (fish slip) to 95% (logbook) of which was taken on handline gear (Table 12). Yelloweye rockfish comprised 19% (fish slip) to 20% (logbook) of the catch, 75% of which was taken on longline gear. Copper rockfish comprised 4% (fish slip) to 7% (logbook) of the catch.

Catch per unit effort has declined in the longline fishery over time partly due to management actions that require a "live only" fishery in the Strait of Georgia. The longline

CPUE for other rockfish has declined at a greater rate than that for red snapper. The handline CPUE shows declines for red snapper coincident with increases for other rockfish.

5.2.2 Recreational fishery data

The recreational catch of rockfish in the Strait of Georgia is almost equivalent to the commercial catch over the areas covered by the creel survey. A 1995 estimate of recreational rockfish catch between March and September over the areas included in the creel survey is 92 t compared with the annual commercial catch of 110 t. In areas 14 - 16, 28 and 29 the estimated recreational catch of rockfish is greater than the commercial catch. Species of rockfish taken in this fishery are not summarised by area, however, the proportion by species is estimated at 32% quillback, 20% copper, 4% yelloweye, 1% black and 43% other (tiger, yellowtail, china, canary and unidentified species) (Collicutt and Shardlow 1990).

The 1995 estimated catch of 62 t from March to September is about half the estimated recreational catch in 1989, partly attributable to declining effort since 1989 (Table 15). A lowered bag limit introduced in 1992 may have caused the decline in catch per unit of effort between 1991 and 1993. Increased CPUE in 1994 and 1995 may be due to a shift in target species from salmon to rockfish or groundfish in general. An estimated 110,708 rockfish pieces were caught in the recreational fishery in 1995. This catch of rockfish was second only to the catch of pink salmon at 181,779 pieces and far outnumbered chinook and coho salmon at 61,469 and 85,609 pieces, respectively (L. Nagy, pers. comm.).

5.2.3 Biological sampling data

A yelloweye rockfish sample from area 12 in 1994 has the youngest mean age of any sample collected coast-wide at 17 yr (Table 17). This sample is at the age of 50% maturity for yelloweye. The youngest quillback rockfish sampled were from area 18 in 1991 at 11 yr and from area 13 in 1993 at 12 yr. In area 12, the mean age for quillback rockfish has declined from 38 yr in 1984 to 19 in 1991 and 23 in 1994.

Quantile-quantile plots (qq-plots) of quillback rockfish ages from area 12 are shown in Fig. 22. The qq-plot is a graphical tool for comparing two data distributions; if two data distributions are identical, then all of the points of a plot of the quantiles for one distribution against those of the other should lie along a straight line with slope one. The qq-plots are arrayed to allow pairwise comparisons of year groups. Comparison of the 1992-1994 age sample to previous year groups (moving to the left within a row) reveals that the proportion of ages between about 10 and 60 years differ dramatically. Earlier samples show a higher proportions of rockfish in these age classes. Years are pooled into groups because of inadequate sample sizes in any one year.

5.2.4 Stock status

Limited biological sampling of yelloweye rockfish in the Strait of Georgia suggests that the stock has been depleted to a point where the mean age in the fishery is at 50% maturity. Quillback rockfish biosamples show dramatic changes in the age structure of the stock in area 12 and a low mean age. Research surveys show a decline in CPUE for fully recruited quillback rockfish in this area (Yamanaka and Richards 1993).

Relatively high red snapper catches in the late 1980's have not been repeated, with the exception of catches in area 12. The catch and effort of other rockfish has been high since the beginning of the series in 1983. Declining catch trends over the series, despite high effort, are apparent in areas 13, 15, 16, 18 and 19. Because the declines occurred prior to any management action in the Strait of Georgia fishery, they are interpreted as an indicator of stock decline in the region.

5.2.5 Habitat analysis

Other rockfish catch densities were determined for areas 12 to 19 in the Strait of Georgia (Fig. 23). Peak catch densities were compared in areas 13, 15, 16, 18 and 19 where the catch has been declining over the series. These extreme catches were judged to be "unsustainable". The lowest "peak" catch density (0.064 t/km^2) occurred in area 15 in 1985. This catch density was selected as the reference point for the Strait of Georgia. A catch density of about one third the reference point was chosen to determine yield levels (0.025 t/km^2) for the Strait of Georgia other rockfish fishery. Yield recommendations for areas 12 - 19 were derived by multiplying the catch density of 0.025 t/km^2 by the habitat within each area to determine the appropriate total allowable catch.

5.2.6 Yield recommendations

Recommended yield options for red snapper and yelloweye rockfish are shown in Table 19. Data from fish slips indicate that 100% of the red snapper catch is yelloweye rockfish in the Strait of Georgia. Therefore, no adjustments to the red snapper catch has been made to recommend a yield for yelloweye rockfish. Yield options were derived by taking the 25*th* percentile of the catch history for areas 12 to 18 and no recommendations were made for areas 19, 20, 28 and 29.

Recommended yield options for other rockfish and quillback rockfish are shown in Table 20. Data from fish slips showed that quillback rockfish made up 85% of the other rockfish catch in the Strait of Georgia. Therefore the yields recommended for quillback rockfish are adjusted by this proportion. Yield options were derived by habitat analysis for areas 12 to 19 and no recommendations are made for areas 20, 28 and 29.

5.3 West Coast Vancouver Island (areas 11, 21-27, 111, 121-127)

5.3.1 Commercial catch and effort data

Catches fluctuated between 25 t and 100 t in the years from 1956 to 1978 (Table 4). The west coast fishery increased slightly between 1979 and 1985, coincident with the expansion of the fishery in the Strait of Georgia. In 1986, the fishery expanded rapidly with catches reaching over 800 t in 1990. The implementation of limited entry licensing in 1993 did not reduce the rockfish catch on the west coast of Vancouver Island or any other area outside the Strait of Georgia. The rockfish catch in 1995 is 708 t, an increase of over 40 t from 1994. Catch and effort by statistical area are shown in Fig. 8 and Fig. 13.

The catch of red snapper decreased from 218 t in 1994 to 171 t in 1995 (Table 9). The other rockfish catch increased between 1994 and 1995, largely due to increases in the longline catch (Table 10). The fish slip catch data for 1995 show that the 27% of the catch was yelloweye rockfish, 17% was redbanded rockfish, 14% was quillback rockfish and 10% was rougheye rockfish (Table 12). The majority of this catch (95%) is taken on longline gear.

The west coast of Vancouver Island longline and handline fishery for other rockfish show declines in CPUE (Fig. 19, Fig. 20). In area 27 the longline and handline effort is increasing and CPUE is decreasing, while other areas show declines in effort in recent years. Red snapper CPUE in the longline fishery varies inversely with effort in the southern areas (Fig. 17). In northern area, CPUE increases with increasing effort. The handline fishery CPUE has been decreasing with decreasing effort (Fig. 18).

5.3.2 Recreational fishery data

The West Coast creel survey shows a general decline in CPUE between 1989 and 1995 in all areas (Table 16). Rockfish catches are low in Alberni Inlet (Area 23A). In 1995, CPUE in Barkley Sound and area 24 is less than that in the Strait of Georgia. Seventy-four percent of the total commercial and recreational catch in area 23 is taken by the recreational fishery. In area 24, only 2% of the total catch is taken by the recreational fishery.

5.3.3 Biological sampling data

There are few biological samples for quillback rockfish from the west coast of Vancouver Island (Table 17). Four samples were taken between 1991 and 1994 and have mean ages from 26 to 35 yr. Yelloweye rockfish samples were taken between 1988 and 1994. Mean ages range from 22 yr in area 27 to 45 yr in area 26.

5.3.4 Yield recommendations

Yield recommendations for yelloweye and quillback rockfish are shown in Table 20 and Table 19. There is little information to assess rockfish stocks on the west coast of Vancouver Island. No recommendations are provided for red snapper (yelloweye) in areas 21 and 22, or for other rockfish (quillback) in area 22. A concentration of the fishery in areas 11 and 27 is evident, however, declining CPUE associated with increasing effort for these areas may indicate stock decline. Quota recommendations, where provided, are based on the 25*th* percentile of the catch history.

5.4 Queen Charlotte Islands (areas 1-2, 101-102, 142, 130)

5.4.1 Commercial catch and effort data

In 1984, the rockfish catch reached 100 t in the Queen Charlotte Islands (Table 4). Catches have increased steadily, more than doubling between 1994 and 1995, to an all time high of 1306 t. This increase in catch is attributed to a change in the management plan in 1995. The move to aggregate quota management shifted monitoring from red snapper and other rockfish quotas to yelloweye rockfish and quillback/copper rockfish quotas. This allowed the catch of other species of rockfish to be taken under trawl trip limits.

The red snapper catch increased from 290 t in 1994 to 336 t in 1995 (Table 9). The other rockfish catch almost tripled between 1994 and 1995 to a high of 970 t (Table 10). From the fish slip records by species, 41% of the total catch is rougheye rockfish, 23% is yelloweye rockfish and 12% is redbanded rockfish (Table 12). Ninety-eight percent of this catch is taken on longline gear. The large increase in rockfish catch is due to the increases in the catch of species other than yelloweye and quillback rockfish, in particular, the catch of rougheye, redbanded and shortraker rockfish. Catch and effort by statistical area are shown in Fig. 9 and Fig. 14.

The Queen Charlotte Island red snapper longline fishery shows dramatic increases in CPUE with increasing effort in areas 130 and 142 (Fig. 17). Area 1 shows a decline in CPUE with an increase in effort (similar to the handline fishery) and area 2 shows an increase in CPUE with a decrease in effort. The other rockfish CPUE increases with increasing effort, with the exception of statistical area 1, where the CPUE has decreased with increasing effort.

5.4.2 Biological sampling data

One sample of redbanded rockfish was taken from the Queen Charlotte Islands in 1995 (Table 17). The mean age of these fish was 30 yr. Three samples of quillback rockfish were taken between 1992 and 1994; their mean ages were 30 yr to 33 yr. Yelloweye rockfish samples were taken between 1986 and 1994. A qq-plot of yelloweye ages from areas 2 and 42

combined is shown in Fig. 24. Age distributions were the most dissimilar between 1994 and 1989-1990. Comparison of the 1986 sample to the 1994 sample shows a higher proportions of ages 10 to 70 in the 1986 sample. Years are pooled into groups because of inadequate sample sizes in any one year.

5.4.3 Yield recommendations

Yield options based on catch history for yelloweye and quillback rockfish are shown in Table 19 and Table 20. Biological samples from areas 2 and 42 show that the age distribution of the yelloweye rockfish stock has changed. The decrease in CPUE with increasing effort for yelloweye and quillback rockfish from statistical area 1 may indicate that these stocks are in decline, however, the CPUE has increased with increasing effort in areas 2, 30 and 42. The 1995 catches of yelloweye and quillback rockfish exceeded the median level in all areas.

5.5 Central Coast (areas 6-10, 106-110)

5.5.1 Commercial catch and effort data

The central coast rockfish fishery began from an northern expansion of the Strait of Georgia fishery. During the mid 1980's catches increased and peaked at 333 t in 1991 (Table 4). Since 1991 catches have declined and in 1995 were 209 t. The decline in catch is due largely to a decrease in the red snapper catch by longline gear (Table 9). The other rockfish longline catch increased between 1994 and 1995 from 119 t to 144 t (Table 10). The fish slip records by species show the central coast catch to be largely yelloweye (43%) and quillback (39%) rockfish (Table 12). Catch and effort by statistical area are shown in Fig. 10 and Fig. 15.

Catch per unit effort trends in the longline fishery for other rockfish show declines in all areas since about 1990 (Fig. 19). The other rockfish handline fishery shows an increasing CPUE trend over the time series, primarily due to declining effort (Fig. 20). In central coast areas, CPUE for the red snapper longline fishery has generally declined or shown little evidence of a trend over the time series. Areas 10 and 11 show evidence of a decline in recent years (Fig. 17).

5.5.2 Biological sampling data

A redbanded rockfish sample was taken in area 7 in 1995 (Table 17). This sample had a mean age of 49 yr. Quillback rockfish taken from areas 6, 7 and 8 between 1988 and 1993 have mean ages that range from 24 to 33 yr. Yelloweye rockfish samples taken from areas 6 and 7 between 1989 and 1995 have mean ages that range from 26 to 49 yr.

5.5.3 Yield recommendations

Yield recommendations based on catch history for yelloweye and quillback rockfish are shown in Table 19 and Table 20. The longline CPUE has increased in recent years due to a decline in longline effort. CPUE for the handline fishery has declined dramatically in areas 7, 8 and 10 in recent years although the effort seems to be unchanged. This may indicate stock decline in these areas.

5.6 North Coast (areas 3-5, 103-105)

5.6.1 Commercial catch and effort data

The north coast rockfish landings began to increase in the late 1980's and by 1990 had reached 106 t (Table 4). Catches continue to increase and doubled between 1994 and 1995 to a high of 223 t. This increase in catch is due to a 100 t increase in other rockfish longline catch (Table 10). From the fish slip records by species, 45% of the rockfish catch from the north coast is quillback rockfish and 40% is yelloweye rockfish (Table 12). Eighty-two percent of this catch is taken on longline gear. Catch and effort by statistical area are shown in Fig. 11 and Fig. 16.

In the north coast areas, CPUE shows little trend for the red snapper longline fishery since 1982 (Fig. 17). The red snapper handline CPUE trend shows some evidence of increase over time (Fig. 18). The other rockfish longline fishery has generally increased since 1982 except in area 5 which shows a decreasing trend in CPUE over the last several years (Fig. 19). There is evidence of a strong increasing trend in CPUE for the other rockfish handline fishery (Fig. 20).

5.6.2 Biological sampling data

Copper rockfish have been sampled from the area 5 trawl fishery between 1991 and 1994 (Table 17). Mean ages are between 14 and 17. No other rockfish samples have been taken from this management region.

5.6.3 Yield recommendations

Recommended yields for yelloweye and quillback rockfish based on catch history are shown in Table 19 and Table 20. There is little information available to assess the rockfish stocks in the north coast. No yield is provided for area 3, while yields for areas 4 and 5 are based on the catch history. Recommended yields based on catch history are low due to the low historical level of fishing effort in these areas.

5.7 Bowie Seamount Rockfish Fishery

Vessels with Zn licences have been granted permits to fish for rockfish at Bowie Seamount. There were nine trips completed by five vessels between 1992 and 1995. Observer data from these trips were combined with data from two research cruises in 1980 and 1981. Histograms of total effort, total rockfish catch, yelloweye rockfish catch and rougheye rockfish catch and box-whisker plots of mean depth, total rockfish CPUE (ln(kg/hooks)), yelloweye rockfish CPUE (ln(kg/hooks)), and rougheye rockfish CPUE (ln(kg/hooks)) are shown in Fig. 25. Total fishing effort was slightly lower in 1995 than in 1994, however, the 1995 total rockfish catch was over double the 1992 catch. The greatest proportion of the rockfish catch in 1992 was yelloweye and in 1995 this had shifted to rougheye rockfish. The depths fished were somewhat deeper in 1995 than in 1992 which may account for part of the shift in species. Total rockfish CPUE increased between 1992 and 1995, mainly due to the increase in rougheye CPUE. The decline in yelloweye CPUE and catch between 1992 and 1995 may indicate that the yelloweye stock on Bowie Seamount has declined.

Length frequency data for yelloweye and rougheye rockfish are shown in Fig. 26. The research surveys in 1980 and 1981 show higher proportions of smaller fish than those of the permitted fishery. Although the length frequency distributions for yelloweye between 1992 and 1995 do not differ dramatically, the 1995 sample may favour slightly larger fish. This could be due to the increase in depth fished in 1995. The length frequency distribution for rougheye rockfish in 1995 show higher proportions of small fish than in 1992. This may be caused by a fishing effect on the rougheye stock. No age data are available.

Bowie Seamount is approximately 26 km^2 in area above the 220 metre depth contour. Yelloweye rockfish catch density in 1992 was 2.31 t/km^2 and in 1995 was 0.50 t/km^2. Rougheye rockfish catch densities were 0.62 t/km^2 in 1992 and 5.92 t/km^2 in 1995. These catch densities far exceed the yield levels recommended for the commercial nearshore fishery.

6. SUMMARY AND RECOMMENDATIONS

In general, stock condition is poor in the Strait of Georgia, portions of the west coast of Vancouver Island and Queen Charlotte Islands and unknown in other areas. Yield recommendations, where provided, are more conservative than those supported in past assessments. This stance reflects the uncertainty in the data and highlights the discrepancy between the data available for stock assessment and the necessary total allowable catch (TAC) or quota required for managing the fishery by region.

Available data for the assessment of inshore rockfish consist primarily of a short time series of fishery-dependent catch and effort data by statistical area and species group. Species-specific catch data is only available since 1994, and biological data are sporadically distributed across species, time, and space. No absolute abundance measures are available; relative abundance using CPUE seems to be of questionable value given the evidence that rockfish are potentially vulnerable to localized depletion. Graphical analyses presented in this

paper suggest localized depletion is plausible. No data are available to provide a direct estimate of sustainable yield. Habitat-based assessment models were introduced in 1992 (Yamanaka and Richards 1992) in recognition of these difficulties, however, little data are available to strengthen that approach. For example, direct observation of rockfish densities to assign species and area-specific densities has not been possible.

The limitations of the analysis performed in this assessment suggest that management TACs over large management regions is not adequate for sustainable exploitation of inshore rockfish. This is attributed to the mismatch of spatial scale between regional fishery management and reef specific processes dictated by the biology of rockfishes. Further analysis of the Zn logbooks may allow the spatial resolution of catch, effort, and fleet behaviour to be increased, but is unlikely to resolve the fundamental problem. A more likely outcome of such analysis is a confirmation, and greater understanding, of localised stock depletion.

Several issues are highlighted by analyses in this assessment:

1. Fish slip data will not be collected in 1997 with the result that Zn logbooks and dockside monitoring program will be the only source of commercial catch data for the Zn fishery. The unresolved disparity between fish slips and Zn logbooks reported in this assessment demonstrates that the logbook data will not exactly reflect the fish slip data of previous years. A discontinuity in the data series can be expected as logbooks and the dockside monitoring program become the primary sources of commercial catch data for the fishery.
2. Analysis of spatial trends in catch and effort suggest that local area depletion of rockfish does occur in the fishery. Managers are advised to consider this issue when settings overall quotas for large management regions. Conservation objectives may be achieved if pre-emptive quotas, designed to reduce (or limit) expansion of the fishery, were applied in areas with low historic catch and effort.
3. The possibility of progressive depletion of localised populations means that CPUE, calculated over a large area, is a poor index of abundance for inshore rockfish.
4. The biological sampling for inshore rockfish, although sporadic, does suggest that the population age distribution has changed since 1982.

Recommendations:

1. Subsequent assessment of the fishery should focus on detailed analysis of the Zn logbook data to provide species composition of the catch and investigate spatial-temporal trends in catch, effort, and fleet behavior.
2. Future work on inshore rockfish should concentrate on evaluating alternative approaches to harvest management, including consideration of rotational schemes, marine zones, and marine protected areas.

7. ACKNOWLEDGEMENTS

We thank Jeff Fargo and Skip McKinnell for reviewing the manuscript. Greg Workman provided the estimates of bottom area used for the habitat analysis. We are grateful to Devona Adams for helping to clarify information on quotas and realised catch (Table 1, Table 2, Table 3).

LITERATURE CITED

Archibald, C.P., D.A. Fournier, and B.M. Leaman. 1983. Reconstruction of stock history and development of rehabilitation strategies for Pacific ocean perch in Queen Charlotte Sound, Canada. N. Amer. J. Fish. Manage. 3: 283-294.

Cleveland, W.S. 1985. The elements of graphing data. Wadsworth, Monterey. xii+323 p.

Collicutt, L.D., and T.F. Shardlow. 1990. Strait of Georgia sport fishery creel survey statistics for salmon and Groundfish, 1989. Can. Manuscr. Rep. Fish. Aquat. Sci. 2087: 175 p.

Collicutt, L. D., and T. F. Shardlow. 1992a. Strait of Georgia sport fishery creel survey statistics for salmon and Groundfish, 1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2109: 76 p.

Collicutt, L.D., and T.F. Shardlow. 1992b. Strait of Georgia sport fishery creel survey statistics for salmon and Groundfish, 1991. Can. Manuscr. Rep. Fish. Aquat. Sci. 2137: 76 p.

Hand, C. M., and L. J. Richards. 1991. Inshore rockfish, p. 277-302. *In* Fargo, J. and B. M. Leaman [eds.]. Groundfish stock assessments for the west coast of Canada in 1990 and recommended yield options for 1991. Can. Manuscr. Rep. Fish. Aquat. Sci. 1778.

Hart, J.L. 1973. Pacific fishes of Canada. Bull. Fish. Res. Bd. Can. 180: 740 p.

Hilborn, R., and C.J. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Chapman and Hall, New York. 570 p.

Geo-spatial Systems Ltd. 1993. Compugrid user manual. Geo-spatial Systems.

Leaman, B.M. 1991. Reproductive styles and life history variables relative to exploitation and management of *Sebastes* stocks. Env. Biol. Fishes 30: 253-271.

Leaman, B.M., and R.J. Beamish. 1984. Ecological and management implications of longevity in some Northeast Pacific groundfishes. Int. North Pac. Fish. Comm. Bull. 42: 85-97.

Leaman, B.M., R. Kieser, P. Withler, and R.D. Stanley. 1990. W.E. Ricker hydroacoustic cruise to study rockfish behavior off northern Vancouver Island, March 14-23, 1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2091: 63 p.

Matthews, K.R. 1991. An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (*Sebastes* spp). Environ. Biol. Fishes 29: 161-178.

O'Connell, V.M., and B.E. Bracken. 1990. Demersel Shelf Rockfish, p. 169-183. *In* Stock assessment and fishery evaluation report for the 1991 Gulf of Alaska groundfish fishery. Alaska Dept. Fish and Game.

O'Connell, V.M., and D. W. Carlile. 1993. Habitat-specific density of adult yelloweye rockfish Sebastes ruberrimus in the eastern Gulf of Alaska: Fishery Bull., US 91: 304-309.

O'Connell, V. M., and D. W. Carlile. 1995. Demersal shelf rockfish, p. 7.2-7.15. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska as projected for 1996.

O'Connell, V.M., and F.C. Funk. Age and growth of yelloweye rockfish (*Sebastes ruberrimus*) landed in southeastern Alaska. Proc. Int. Rockfish Symp. 171-185.

Richards, L. J. 1986. Depth and habitat distributions of three species of rockfish (Sebastes) in British Columbia: observations from the submersible PISCES IV: Environ. Biol. Fishes, 17: 13-21.

Richards, L. J. 1986. PSARC Working paper G86-1. 1986 assessment for commercially exploited rockfish stocks in the Strait of Georgia. Can. Manuscr. Rep. Fish. Aquat. Sci. 1885: 55 p.

Richards, L. J. 1988. Inshore rockfish, p. 273-294. *In* Fargo, J., M. W. Saunders, and A. V. Tyler [eds.]. Groundfish stock assessments for the west coast of Canada in 1987 and recommended yield options for 1988. Can. Manuscr. Rep. Fish. Aquat. Sci. 1617.

Richards, L. J. 1989. Inshore rockfish, p. 267-286. *In* Fargo, J and A. V. Tyler [eds.]. Groundfish stock assessments for the west coast of Canada in 1988 and recommended yield options for 1989. Can. Tech. Rep. Fish. Aquat. Sci. 1646.

Richards, L. J., and A. J. Cass. 1987. 1986 research catch and effort data on nearshore reef-fishes in British Columbia statistical area 12, 13 and 16. Can Manuscr. Rep. Fish. Aquat. Sci. 1903: 119 p.

Richards, L. J., and C. M. Hand. 1987. 1987 research catch and effort data on nearshore reef-fishes in British Columbia statistical areas 12 and 13. Can. Manuscr. Rep. Fish. Aquat. Sci. 1958: 59 p.

Richards, L. J., and C. M. Hand 1990. Inshore rockfish, p. 305-330. *In* Tyler, A. V., and J. Fargo [eds.]. Groundfish stock assessments for the west coast of Canada in 1989 and recommended yield options for 1990. Can. Tech. Rep. Fish. Aquat. Sci. 1732.

Richards, L. J., C. M. Hand, and J. R. Candy. 1988. 1988 research catch and effort data on nearshore reef-fishes in British Columbia statistical areas 12 and 13. Can. Manuscr. Rep. Fish. Aquat. Sci. 1988: 89 p.

Shardlow, T.F., and L.D. Collicutt. 1989a. Strait of Georgia sport fishery creel survey statistics for salmon and groundfish, 1984. Can. Manuscr. Rep. Fish. Aquat. Sci. 2032: 61 p.

Shardlow, T.F., and L.D. Collicutt. 1989b. Strait of Georgia sport fishery creel survey statistics for salmon and groundfish, 1985. Can. Manuscr. Rep. Fish. Aquat. Sci. 2033: 60 p.

Shardlow, T.F., and L.D. Collicutt. 1989c. Strait of Georgia sport fishery creel survey statistics for salmon and groundfish, 1986. Can. Manuscr. Rep. Fish. Aquat. Sci. 2034: 61 p.

Shardlow, T.F., and L.D. Collicutt. 1989d. Strait of Georgia sport fishery creel survey statistics for salmon and groundfish, 1987. Can. Manuscr. Rep. Fish. Aquat. Sci. 2035: 62 p.

Shardlow, T.F., and L.D. Collicutt. 1989e. Strait of Georgia sport fishery creel survey statistics for salmon and groundfish, 1988. Can. Manuscr. Rep. Fish. Aquat. Sci. 2036: 63 p.

Yamanaka, K. L., and L. J. Richards. 1992. Inshore rockfish, p. 221-266. *In* Leaman, B. M. [ed.]. Groundfish stock assessments for the west coast of Canada in 1991 and recommended yield options for 1992. Can. Tech. Fish. Aquat. Sci. 1866.

Yamanaka, K. L., and L. J. Richards. 1993a. 1992 research catch and effort on nearshore reef-fishes in British Columbia Statistical Area 12. Can. Manuscr. Rep. Fish. Aquat. Sci. 2184: 77 p.

Yamanaka, K. L., and L. J. Richards. 1993b. Inshore rockfish, p. 336-359. *In* Leaman, B. M. and M. Stocker [eds.]. Groundfish stock assessments for the west coast of Canada in 1992 and recommended yield options for 1993. Can. Tech. Fish. Aquat. Sci. 1919.

Yamanaka, K. L., and L. J. Richards. 1994. Inshore rockfish, p. 317-338. *In* Stocker M. [ed.]. Groundfish stock assessments for the west coast of Canada in 1993 and recommended yield options for 1994. Can. Tech. Fish. Aquat. Sci. 1975.

Yamanaka, K. L., and L. J. Richards. 1995. Inshore rockfish, p. 394-422. *In* Stocker M. and J. Fargo [eds.] Groundfish stock assessments for the west coast of Canada in 1994 and recommended yield options for 1995. Can. Tech. Fish. Aquat. Sci. 2069.

Table 1. History of management actions by year and area.

Year	Area	Management Action
<1986	coast-wide	unrestricted fishery
1986	coast-wide	introduced Zn licence
	SG	Feb 15 - Apr 15 closure
1987	SG	Jan 1 - Apr 15 closure
	SG - area 12	75 t quota
1987-1990	SG	incidental yelloweye rockfish catch permitted during the winter closure
1988	SG - area 13 - Discovery	year round commercial closure
	SG	Jan 1 - Apr 30 closure
1990	SG	Jan 1 - Apr 30 and Nov 1 - Dec 31 closure
	outside	650 t quota
	CC - area 7	portions closed
1990-1991	WCVI inside the surfline	Jan 1 - Apr 30 closed
1991	inside/outside	area licensing, 592 inside (SG) and 1,591 outside (all remaining regions)
	SG	trawl closure
	SG	live rockfish fishery only
	SG	Jan 1 - May 14 closure with no incidental rockfish catch allowances
	SG - area 13	2-3 day opening in Discovery Pass
	CC - area 7	rotational closure was initiated
	coast-wide	limited entry licensing program was announced
1992	SG	limited entry licensing with 74 eligible inside licences
1993	outside	limited entry licensing with 183 eligible outside licences
	coast-wide	quota management by region
	coast-wide	region/time closures
1994	coast-wide	user pay logbook program
	coast-wide	trip limits for trawl species
	coast-wide	incidental catch allowances
1995	coast-wide	user pay dockside monitoring program
	coast-wide	aggregate species quota management
	coast-wide	monthly fishing periods, fishing period limits, annual landing options and trip limits
	coast-wide	relinquishment of period limit overages

Table 2. Red snapper and other rockfish fishery open time (days), quota (t), catch (t) and catch per day (t/day) for the five management regions between 1991-94.

		RED SNAPPER				OTHER ROCKFISH			
	Year	Open	Quota	Catch	C/Day	Open	Quota	Catch	C/Day
SG	1991	203	50	115	0.57	203	300	366	1.80
	1992	183	59	30	0.16	144	130	148	1.03
	1993	365	70	42	0.12	145	140	157	1.08
	1994	205	70	86	0.42	145	150	188	1.29
WCVI	1991	328	250	476	1.45	328	150	302	0.92
	1992	208	250	321	1.54	208	150	251	1.21
	1993	177	250	455	2.57	113	150	342	3.03
	1994	48	200	218	4.54	163	150	448	2.75
QCI	1991	238	200	332	1.39	238	100	142	0.60
	1992	183	200	386	2.11	365	100	176	0.48
	1993	140	200	374	2.67	365	100	199	0.55
	1994	107	200	290	2.71	365	54	369	1.01
NC	1991	365	80	57	0.16	201	20	73	0.36
	1992	365	80	87	0.24	156	20	38	0.24
	1993	275	80	98	0.36	275	60	65	0.24
	1994	205	60	47	0.23	145	60	62	0.43
CC	1991	171	100	177	1.04	171	100	156	0.91
	1992	137	100	132	0.96	128	100	130	1.02
	1993	94	100	114	1.21	106	100	110	1.03
	1994	51	100	105	2.06	119	100	127	1.07

Table 3. Overall commercial fishery quota and catches (fish slip data base) in tonnes for yelloweye rockfish and the aggregates 1 and 2 and 3 to 6. by region for 1995.

Species or Aggregate	SG		WCVI		QCI		NC		CC		Coast-wide	
	quota	catch	quota	catch	quota	catch	quota	catch	quota	catch	quota	catch
yelloweye	62	38	231	159	291	194	60	52	118	74		
(1,2) quillback, copper, china, tiger	150	147	144	92	76	65	63	62	105	68		
(3) silvergray, yellowtail, canary, widow		4		92		135		6		6	8925[b]	
(4) rougheye and shortraker rockfish[a]		0		85		690		2		3	735[b]	
(5) Pacific ocean perch, yellowmouth, redstripe		1		3		10		0		0	8522[b]	
(6) all other rockfish species		6	none	108	none	175	none	1	none	12		

[a] aggregate 4 also contains thornyhead which are not included in this table.

[b] coast-wide quota available to trawl and hook and line gears.

[c] no species specific quota for this area.

Table 4. Total coast-wide commercial hook and line rockfish catch (t) by region and for all regions combined, from British Columbia Catch Statistics, Annual Reports, 1956-95.

Year	SG	WCVI	QCI	NC	CC	Total
1956	58.0	26.3	1.7	0.1	5.6	91.7
1957	86.9	45.0	9.1	0.3	5.5	146.8
1958	109.2	36.9	0.6	0.1	8.0	154.8
1959	105.0	41.7	0.8	0.0	3.6	151.1
1960	83.9	49.3	8.5	2.0	7.5	151.2
1961	69.2	59.2	3.7	0.7	11.3	144.1
1962	110.4	79.2	14.0	0.0	11.9	215.5
1963	84.2	53.9	13.3	2.8	24.2	178.4
1964	50.1	33.3	2.9	0.2	4.6	91.1
1965	43.3	27.3	10.1	1.1	4.4	86.2
1966	37.0	31.8	6.4	0.5	8.4	84.1
1967	55.6	43.4	9.4	7.3	11.3	127.0
1968	56.6	35.3	2.8	0.0	18.7	113.4
1969	82.2	45.8	10.5	0.5	46.6	185.6
1970	87.2	58.3	12.8	11.4	65.7	235.4
1971	74.5	25.6	27.2	10.2	31.4	168.9
1972	94.4	88.9	19.0	17.1	30.2	249.6
1973	100.8	48.1	14.3	15.1	20.2	198.5
1974	37.5	73.7	38.6	22.3	25.2	197.3
1975	40.3	57.3	74.7	18.9	30.4	221.6
1976	48.1	58.2	23.0	13.3	39.0	181.6
1977	138.0	100.0	35.6	14.2	25.4	313.2
1978	156.0	73.5	61.0	34.0	33.5	358.0
1979	250.0	148.0	87.0	15.5	40.0	540.5
1980	180.0	130.0	90.0	19.0	24.0	443.0
1981	211.6	102.9	71.2	13.2	14.0	412.9
1982	281.1	80.6	48.8	9.8	13.9	434.2
1983	298.7	112.3	41.5	13.6	15.9	482.0
1984	347.3	140.1	100.4	30.9	16.2	634.9
1985	436.8	130.2	155.1	39.8	38.9	800.8
1986	525.4	579.0	192.7	39.1	60.3	1396.5
1987	413.7	553.3	256.7	70.6	122.3	1416.6
1988	496.7	538.2	300.6	63.2	175.4	1574.1
1989	460.2	642.7	290.6	94.2	188.9	1676.6
1990	469.6	807.0	435.2	105.6	286.9	2104.3
1991	480.6	777.6	474.0	129.9	333.2	2195.3
1992	177.2	569.6	556.0	122.2	264.8	1689.8
1993	198.8	796.9	573.0	163.2	224.1	1956.0
1994	274.4	666.5	659.8	109.3	232.4	1942.4
1995	199.6	708.1	1306.0	222.5	208.6	2644.8

Table 5. Total rockfish longline catch (t) for the Strait of Georgia by statistical area and for all areas combined catch, from British Columbia Catch Statistics, Annual Reports, 1954-1995.

	Statistical Area											
Year	12	13	14	15	16	17	18	19	20	28	29	Total
1954	9.3	0.0	0.0	0.0	1.2	0.0	0.0	0.7	0.0	0.0	0.0	11.2
1955	12.3	0.0	0.0	0.8	4.2	0.0	0.0	0.0	0.0	0.0	0.0	17.3
1956	18.2	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	20.1
1957	15.1	0.0	0.0	0.1	1.4	0.3	0.0	0.0	0.0	0.0	0.0	16.9
1958	8.1	0.0	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	9.5
1959	3.7	0.0	0.8	1.9	0.5	7.6	0.1	0.0	0.0	0.0	0.0	14.6
1960	3.2	0.3	0.2	1.4	1.3	3.3	0.1	0.1	0.0	0.0	0.0	9.9
1961	10.4	0.4	0.1	0.3	0.2	3.5	0.6	0.1	0.1	0.1	0.0	15.8
1962	8.7	0.9	0.0	0.0	0.2	0.8	0.0	0.0	0.0	0.0	0.0	10.6
1963	16.7	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.1	17.5
1964	9.3	0.1	0.0	0.0	7.0	0.0	0.0	0.0	0.2	0.1	0.0	16.7
1965	11.6	0.0	0.0	0.0	5.1	0.2	0.0	0.0	0.0	0.0	0.0	16.9
1966	4.5	0.1	0.0	0.0	4.3	0.6	0.0	0.0	0.0	0.0	0.0	9.5
1967	10.8	0.0	0.0	0.0	4.3	0.1	0.0	0.0	0.1	0.0	0.0	15.3
1968	11.9	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	13.6
1969	11.5	0.1	0.1	0.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8
1970	22.8	1.7	0.1	0.2	0.1	0.6	0.2	0.0	0.8	0.0	0.0	26.5
1971	25.3	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0	25.7
1972	34.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6
1973	40.8	4.8	0.0	4.1	14.2	2.0	0.0	0.0	0.0	0.0	0.0	65.9
1974	2.7	0.0	0.0	0.0	0.7	1.3	0.7	0.0	0.0	0.0	0.0	5.4
1975	4.1	0.6	0.0	2.7	0.6	2.3	0.0	0.0	0.0	0.0	0.0	10.3
1976	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
1977	30.4	0.0	0.5	8.6	2.7	2.3	0.0	0.0	0.0	2.1	1.0	47.6
1978	7.0	0.0	1.0	6.0	13.0	15.0	2.0	1.0	1.0	1.0	2.0	49.0
1979	23.0	6.0	4.0	7.0	18.0	22.0	8.0	1.0	0.0	1.0	4.0	94.0
1980	9.0	2.0	4.0	4.0	11.0	7.0	18.0	1.0	1.0	2.0	1.0	60.0
1981	8.7	2.6	6.0	2.2	2.7	8.8	17.1	0.1	0.0	0.4	0.4	49.0
1982	6.6	2.4	3.4	1.3	2.2	2.1	9.4	0.1	0.1	0.2	0.6	28.4
1983	3.2	1.9	0.2	3.0	1.5	6.9	11.5	0.2	0.1	0.1	0.0	28.6
1984	9.1	1.9	1.3	0.3	0.2	20.1	7.6	0.2	0.0	0.1	0.6	41.4
1985	11.6	5.9	3.1	5.6	14.3	39.2	11.5	1.3	0.3	0.0	0.0	92.8
1986	31.3	7.9	14.7	12.4	49.4	37.8	6.4	1.5	4.5	0.2	0.0	1661
1987	27.3	3.2	5.5	13.0	12.9	12.1	9.7	4.6	1.8	12.3	9.4	1118
1988	26.3	9.9	11.6	18.4	26.7	30.6	4.2	0.4	4.5	0.0	7.1	1397
1989	44.9	6.3	15.2	7.2	3.1	8.0	1.2	0.5	2.1	0.0	0.1	88.6
1990	49.1	16.8	9.9	10.8	3.9	4.8	0.7	0.1	2.4	1.5	2.5	1025
1991	12.6	17.7	1.2	3.6	1.0	7.9	0.1	0.0	0.1	0.2	0.1	44.5
1992	4.2	2.3	2.7	0.6	2.1	5.8	0.7	0.0	0.0	0.0	0.0	18.4
1993	25.1	1.0	0.8	0.0	0.5	9.0	0.0	0.1	0.9	0.0	0.8	38.2
1994	88.2	5.4	9.5	0.4	0.4	4.9	0.1	0.1	0.5	0.1	1.5	111.1
1995	25.8	4.4	0.9	0.2	0.4	7.9	0.6	0.0	1.7	0.0	2.4	44.3

Table 6. Total rockfish handline/troll catch (t) for the Strait of Georgia by statistical area and for all areas combined, from British Columbia Catch Statistics, Annual Reports, 1954-95.

	Statistical Areas											
Year	12	13	14	15	16	17	18	19	20	28	29	Total
1954	0.0	6.8	0.8	0.5	5.8	15.1	6.7	0.0	0.0	0.4	0.0	36.1
1955	0.0	3.5	0.5	1.0	2.8	16.1	4.2	0.1	0.1	0.0	0.0	28.3
1956	6.5	1.9	0.1	1.0	5.0	17.6	5.4	0.1	0.1	0.0	0.2	37.9
1957	5.6	6.1	2.4	2.5	13.4	25.5	6.9	6.4	0.0	0.1	1.1	70.0
1958	2.6	10.7	9.7	5.5	14.9	29.2	15.8	6.2	3.2	0.0	1.9	99.7
1959	5.6	16.2	8.7	9.3	10.4	31.2	3.9	3.9	0.5	0.1	0.6	90.4
1960	3.5	19.9	4.2	10.8	10.3	17.5	3.4	3.1	0.9	0.3	0.1	74.0
1961	3.4	16.6	6.3	2.5	4.6	13.8	2.8	1.3	0.6	0.1	1.4	53.4
1962	46.9	14.5	4.6	5.8	2.9	19.0	2.4	2.5	0.5	0.2	0.5	99.8
1963	27.9	7.7	3.6	1.6	5.6	16.3	2.8	0.9	0.2	0.0	0.1	66.7
1964	4.9	4.4	2.1	0.8	8.1	8.8	2.8	1.1	0.3	0.0	0.1	33.4
1965	2.4	3.5	2.1	0.1	5.3	9.0	3.2	0.4	0.1	0.0	0.3	26.4
1966	1.1	3.6	3.7	0.5	10.1	4.1	4.1	0.2	0.1	0.0	0.0	27.5
1967	2.7	7.6	5.8	3.4	13.8	6.1	0.8	0.1	0.0	0.0	0.0	40.3
1968	3.7	8.2	0.4	1.0	17.9	10.3	1.3	0.1	0.1	0.0	0.0	43.0
1969	17.5	11.9	3.8	3.5	15.2	8.8	4.1	2.7	0.9	0.0	0.0	68.4
1970	8.5	15.8	3.9	4.8	9.8	15.7	1.4	0.6	0.2	0.0	0.0	60.7
1971	11.7	9.4	2.7	5.1	6.6	12.1	1.0	0.2	0.0	0.0	0.0	48.8
1972	10.9	13.8	4.3	4.6	11.7	12.2	1.2	0.8	0.1	0.0	0.2	59.8
1973	3.6	8.2	2.7	4.5	5.4	9.1	1.4	0.0	0.0	0.0	0.0	34.9
1974	7.0	7.3	3.2	3.2	2.3	6.8	2.3	0.0	0.0	0.0	0.0	32.1
1975	3.2	5.4	2.3	4.5	1.4	7.7	4.5	0.5	0.0	0.0	0.5	30.0
1976	3.6	10.4	5.0	7.7	2.7	7.3	2.7	0.0	0.9	0.0	0.5	40.8
1977	25.4	17.7	8.6	7.3	2.7	8.6	15.0	2.7	0.5	1.4	0.5	90.4
1978	14.0	30.0	6.0	9.0	4.0	11.0	27.0	4.0	0.0	0.0	2.0	107.0
1979	17.0	57.0	8.0	9.0	4.0	15.0	38.0	4.0	1.0	2.0	1.0	156.0
1980	18.0	41.0	6.0	8.0	9.0	13.0	17.0	4.0	1.0	1.0	2.0	120.0
1981	12.1	53.1	6.8	25.7	25.6	11.4	21.2	3.2	0.8	0.7	2.0	162.6
1982	14.7	104.3	5.6	74.3	31.5	8.5	8.8	2.2	0.1	0.3	2.4	252.7
1983	8.4	197.9	9.2	8.3	28.9	8.2	4.6	1.6	0.2	1.9	0.9	270.1
1984	23.7	196.2	2.2	13.0	24.5	19.7	16.1	7.8	2.1	0.3	0.3	305.9
1985	94.7	147.2	1.9	12.1	8.6	45.7	23.2	7.8	1.1	0.1	1.6	344.0
1986	105.0	134.7	3.7	12.5	9.3	25.3	39.4	22.1	4.8	0.0	2.5	359.3
1987	85.9	116.7	4.5	5.8	4.9	20.8	20.7	30.4	10.8	0.1	1.3	301.9
1988	159.3	80.4	2.0	7.2	4.7	30.4	25.3	27.6	15.6	0.0	4.5	357.0
1989	185.2	61.8	5.2	5.6	9.4	49.0	17.8	34.0	2.9	0.1	0.6	371.6
1990	205.6	64.8	8.4	1.5	8.4	47.0	14.5	15.6	0.4	0.0	0.9	367.1
1991	165.9	174.9	3.8	4.9	5.6	38.0	25.9	15.6	0.4	0.0	1.5	436.5
1992	56.0	53.8	2.7	0.4	1.0	16.9	21.1	4.9	1.6	0.0	0.0	158.4
1993	55.2	51.2	4.1	0.5	0.3	12.6	20.0	16.0	0.8	0.0	0.0	160.7
1994	47.9	65.1	1.5	0.0	0.3	21.6	11.3	12.7	4.4	0.0	0.2	165.0
1995	57.7	60.9	2.7	0.0	0.0	14.8	6.4	7.9	3.7	0.0	1.3	155.4

Table 7. Total rockfish longline catch (t) by statistical area for areas outside the Strait of Georgia, from British Columbia Catch Statistics, Annual Reports, 1956-95.

Year	1	2	3	4	5	6	7	8	9	10	11	21	23	24	25	26	27	30	42
1956	0.2	1.5	0.0	0.1	0.0	0.6	3.1	0.2	0.3	1.0	0.7	0.1	0.6	1.5	0.0	2.2	18.8		
1957	1.2	7.9	0.3	0.0	0.0	0.2	3.9	1.4	0.0	0.0	0.0	0.0	2.9	6.8	3.1	3.9	23.4		
1958	0.1	0.5	0.1	0.0	0.0	0.3	0.6	1.5	0.0	0.0	0.0	0.8	1.0	0.0	6.0	6.8	17.7		
1959	0.1	0.7	0.0	0.0	0.0	0.1	1.0	1.6	0.2	0.7	0.0	0.0	0.3	2.1	3.0	5.0	25.2		
1960	1.6	6.9	0.3	1.5	0.1	0.8	0.0	1.5	2.0	0.1	3.0	0.0	0.6	1.2	5.9	5.2	25.7		
1961	0.8	2.9	0.0	0.0	0.7	1.0	0.3	0.0	0.0	0.6	1.0	0.1	2.2	1.3	5.9	24.4	16.9		
1962	0.0	13.8	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	1.8	0.4	3.2	2.5	5.6	23.5	21.0		
1963	0.0	13.2	0.0	1.9	0.4	2.2	3.9	1.2	0.0	0.1	0.1	0.0	2.8	1.4	0.9	13.6	11.2		
1964	0.0	2.5	0.0	0.2	0.0	0.2	0.0	0.3	0.0	0.8	0.7	1.5	1.1	1.0	0.8	8.6	14.9		
1965	0.0	10.1	0.1	0.7	0.2	1.4	0.1	0.0	1.0	0.0	0.1	0.6	1.2	0.0	1.6	8.9	9.5		
1966	2.7	3.7	0.0	0.2	0.0	1.1	3.4	0.3	0.4	0.8	0.0	0.1	1.4	0.0	1.7	14.3	8.4		
1967	0.9	8.4	0.0	0.8	6.4	0.0	1.1	0.8	0.0	0.0	0.0	0.6	1.0	1.5	4.6	18.9	9.1		
1968	1.5	1.3	0.0	0.0	0.0	0.0	1.2	2.0	0.0	0.0	0.0	0.1	2.7	0.0	1.4	6.7	17.1		
1969	0.0	10.5	0.0	0.5	0.0	2.9	15.9	1.0	0.2	3.4	1.8	1.3	1.2	0.5	2.7	19.9	0.8		
1970	0.0	12.7	0.0	0.2	3.8	24.4	9.3	6.8	0.0	0.4	1.2	0.5	4.2	3.6	0.9	8.2	8.4		
1971	2.0	25.1	0.0	1.1	5.6	4.3	2.7	9.0	3.1	2.0	1.8	0.0	1.2	0.8	0.0	1.9	2.1		
1972	0.0	19.0	0.0	2.6	4.9	0.3	7.5	6.4	0.5	0.0	6.0	0.3	1.1	0.0	0.5	8.6	7.2		
1973	0.0	11.5	2.7	2.7	8.8	8.2	0.2	6.1	0.0	3.4	6.1	0.7	0.7	0.7	0.7	3.4	7.5		
1974	0.7	36.3	0.7	8.8	11.6	15.0	0.2	4.1	0.0	1.6	3.4	0.0	0.7	0.7	0.0	1.4	4.1		
1975	3.4	69.4	0.7	8.2	7.5	6.1	8.2	2.0	2.0	4.1	2.7	1.4	1.4	0.0	0.7	0.0	8.8		
1976	4.1	17.3	0.9	1.8	9.1	5.4	19.5	4.5	0.0	1.4	2.7	2.7	1.8	0.2	0.2	0.2	12.2		
1977	2.3	29.5	0.5	3.6	7.3	4.5	8.2	5.0	0.2	0.2	23.1	0.2	0.5	0.9	0.5	0.9	15.0		
1978	3.0	51.0	8.0	14.0	5.0	4.0	11.0	8.0	1.0	0.5	9.0	0.0	1.0	2.0	0.5	1.0	13.0		
1979	15.0	66.0	2.0	3.0	8.0	6.0	7.0	5.0	1.0	3.0	27.0	1.0	1.0	3.0	3.0	5.0	30.0		
1980	22.0	61.0	1.0	3.0	4.0	5.0	4.0	3.0	1.0	0.5	20.0	0.5	6.0	0.5	4.0	7.0	22.0		
1981	17.1	46.4	2.5	3.7	4.7	1.5	1.5	6.2	0.0	0.6	18.1	0.8	1.0	0.5	2.7	4.3	11.1		
1982	8.2	11.5	2.1	3.7	1.7	5.2	2.6	1.1	0.9	0.3	11.3	0.4	1.1	2.9	0.0	2.0	10.5	0.0	6.0
1983	10.1	22.3	0.6	6.2	1.0	4.2	1.4	1.0	0.0	0.0	9.2	0.5	2.5	0.1	1.4	0.5	23.5	2.2	4.0
1984	8.3	21.7	2.6	12.0	1.0	1.7	2.3	0.6	0.5	2.9	13.8	0.8	6.5	1.3	0.0	0.9	63.3	0.0	60.0
1985	29.5	96.6	6.5	15.2	4.9	9.3	4.9	7.6	0.0	1.6	32.8	3.9	0.0	4.5	5.5	8.7	16.9	18.5	23.5
1986	24.9	78.0	3.7	9.4	14.5	18.2	5.1	19.7	0.1	0.3	55.9	2.0	36.3	56.9	75.6	76.8	116.3	79.0	82.0
1987	55.1	195.7	5.8	12.9	39.9	31.7	19.3	21.6	1.5	17.4	90.8	22.2	30.3	37.8	40.4	37.7	104.0	1.2	38.8
1988	100.0	110.5	9.6	13.4	8.5	37.6	14.6	25.3	0.6	16.9	146.1	6.3	26.3	77.6	36.3	30.5	108.4	3.7	83.0
1989	76.9	91.4	6.1	37.8	22.7	39.3	33.6	35.2	0.1	25.8	169.2	14.0	37.0	66.3	47.5	30.0	169.3	14.8	90.9
1990	176.9	98.6	11.5	29.1	42.1	60.3	137.0	16.5	8.6	48.6	219.1	4.2	31.3	110.4	74.2	36.5	108.0	16.1	124.5
1991	163.5	48.6	8.0	29.4	32.3	100.9	83.3	24.0	3.6	28.5	219.2	3.2	34.8	56.5	98.0	75.9	124.7	130.5	92.5
1992	95.5	65.1	10.1	13.3	60.8	85.6	68.2	24.6	1.1	13.3	185.7	2.5	15.1	38.7	31.1	17.2	88.2	53.4	292.6
1993	97.1	72.7	15.4	26.8	94.9	82.3	63.8	21.9	2.6	14.6	137.2	3.5	13.8	28.0	44.5	60.7	349.9	35.7	288.7
1994	120.0	98.0	12.1	37.0	28.8	58.8	82.3	40.5	17.6	22.1	151.9	1.3	15.0	25.3	21.6	59.9	311.6	72.8	337.8
1995	314.1	255.9	31.3	74.1	88.3	49.3	20.2	22.2	8.7	66.4	166.4	1.9	4.8	82.5	41.9	38.5	312.9	125.1	548.5

Table 8. Total rockfish handline/troll catch (t) by statistical area for areas outside the Strait of Georgia, from British Columbia Catch Statistics, Annual Reports, 1956-95.

Year	1	2	3	4	5	6	7	8	9	10	11	21	23	24	25	26	27	30	42
1956	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.1	1.6	0.2	0.0	0.5		
1957	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.5	0.4	0.7	2.1		
1958	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.7	0.8	0.6	1.3		
1959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.8	1.0	0.9	0.7		
1960	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.1	0.1	2.4	0.2	0.0	0.5	3.9	1.1	0.5	1.5		
1961	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.3	0.2	2.3	0.1	0.0	1.2	1.5	1.1	0.6	2.9		
1962	0.2	0.0	0.0	0.0	0.0	0.0	6.3	0.5	0.2	3.3	0.7	0.5	2.4	7.5	3.6	1.9	4.6		
1963	0.1	0.0	0.0	0.0	0.5	0.4	8.2	3.9	1.4	2.9	4.0	0.4	5.2	1.3	4.6	3.5	4.9		
1964	0.0	0.4	0.0	0.0	0.0	0.0	2.5	0.5	0.3	0.0	0.0	0.1	0.8	0.3	0.2	0.3	3.0		
1965	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.9	0.0	0.4	0.4	0.2	1.0	0.8	0.6	0.9	1.5		
1966	0.0	0.0	0.0	0.0	0.3	0.0	1.0	0.6	0.0	0.8	1.8	0.1	0.7	0.1	0.9	1.2	1.1		
1967	0.1	0.0	0.0	0.0	0.1	3.8	2.9	0.6	0.1	2.0	0.2	0.0	1.1	1.8	1.6	2.3	0.7		
1968	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.9	1.3	0.4	0.1	0.2	0.8	1.0	1.7	0.8	2.7		
1969	0.0	0.0	0.0	0.0	0.0	0.5	0.9	0.0	1.0	2.1	0.0	1.2	1.5	4.7	3.7	2.0	1.8		
1970	0.0	0.1	0.6	0.0	6.8	2.7	17.3	2.3	2.0	0.5	0.0	2.3	2.5	7.3	5.4	6.8	7.0		
1971	0.0	0.1	0.1	0.0	3.4	1.4	6.8	1.3	0.5	0.3	0.8	1.6	5.3	3.8	2.9	2.7	0.7		
1972	0.0	0.0	0.0	0.0	9.6	4.9	7.5	2.4	0.0	0.7	2.0	1.8	9.7	10.7	9.5	15.6	15.9		
1973	0.5	2.3	0.2	0.5	0.2	0.2	0.9	0.5	0.5	0.2	0.9	1.4	6.4	6.8	0.5	8.2	4.1		
1974	0.5	1.1	0.2	0.5	0.5	0.9	0.9	1.4	0.2	0.9	2.3	2.7	13.2	20.9	5.9	11.8	5.9		
1975	0.9	1.0	0.9	0.2	1.4	0.5	1.8	1.4	0.2	0.2	0.5	4.1	14.1	8.6	1.8	6.4	6.8		
1976	0.2	1.4	0.5	0.5	0.5	0.9	4.1	1.8	0.5	0.9	1.4	2.7	11.8	8.2	1.8	5.9	6.4		
1977	0.2	3.6	0.5	0.9	1.4	0.9	3.6	1.4	0.9	0.5	11.3	3.6	16.8	12.7	2.7	5.9	5.9		
1978	2.0	5.0	0.5	6.0	0.5	1.0	2.0	4.0	1.0	1.0	7.0	1.0	14.0	11.0	3.0	6.0	5.0		
1979	1.0	5.0	1.0	1.0	0.5	3.0	3.0	1.0	1.0	1.0	8.0	3.0	25.0	20.0	7.0	6.0	9.0		
1980	4.0	3.0	3.0	4.0	4.0	4.0	4.0	0.5	1.0	1.0	7.0	4.0	18.0	16.0	6.0	7.0	12.0		
1981	2.4	5.3	0.4	1.2	0.7	1.2	0.9	1.2	0.2	0.7	3.4	1.0	11.8	26.1	5.2	8.4	8.5		
1982	1.7	0.5	0.4	1.1	0.8	0.2	1.8	0.5	0.9	0.4	5.8	2.7	6.9	14.1	6.8	4.5	11.6	0.4	5.0
1983	3.1	1.3	0.8	4.7	0.3	3.1	0.8	2.3	1.6	1.5	8.5	5.2	17.1	15.3	8.7	7.5	12.3	0.5	0.8
1984	3.9	2.0	6.0	2.7	6.8	3.4	2.3	2.6	0.0	0.2	8.1	0.8	6.5	9.9	1.7	2.7	24.0	1.8	4.8
1985	1.5	1.4	1.3	10.7	1.4	5.4	5.5	0.4	0.1	4.1	12.6	0.2	13.6	11.3	2.6	6.6	27.9	0.0	2.9
1986	3.4	1.8	0.2	7.0	4.3	6.7	7.4	1.3	0.4	1.1	9.2	2.2	31.2	50.8	9.6	10.6	45.6	0.0	7.7
1987	2.9	1.3	1.4	6.1	4.5	8.1	3.6	6.4	0.4	12.3	37.0	5.8	22.4	62.6	37.1	13.1	46.1	0.0	4.7
1988	3.5	2.7	5.7	3.9	22.1	11.9	50.2	5.4	10.1	2.8	24.3	8.5	14.1	27.8	6.8	5.8	19.4	0.3	1.2
1989	22.5	3.4	1.0	13.5	13.1	12.3	17.1	11.4	3.1	11.0	27.5	4.1	8.9	17.1	6.5	7.9	37.4	1.5	5.5
1990	14.4	5.3	0.9	15.2	7.8	27.6	18.6	12.7	9.4	29.6	40.2	13.9	22.2	77.7	16.6	27.4	35.5	0.5	10.3
1991	32.0	1.6	7.9	39.2	13.2	23.0	49.5	7.8	6.5	6.0	32.1	15.1	11.2	32.3	14.8	9.8	49.9	0.0	5.3
1992	14.4	5.8	1.4	2.1	36.6	20.1	41.5	5.3	0.7	1.6	82.5	4.7	14.1	14.6	9.3	22.5	45.2	26.8	8.1
1993	10.7	8.4	0.9	15.9	9.4	12.9	24.8	0.6	0.4	0.3	8.5	3.0	3.1	14.5	3.4	14.2	112.5	0.0	14.8
1994	4.6	11.2	1.8	21.9	7.6	7.6	0.8	1.0	0.0	1.5	5.7	2.2	5.7	3.0	1.7	11.8	49.1	0.1	15.3
1995	23.5	19.4	2.1	19.7	6.7	8.2	3.1	0.2	0.0	0.4	5.9	2.0	5.3	7.8	11.3	3.5	23.6	2.1	17.5

Table 9. Red snapper longline and handline/troll landings (t), nominal effort in days fished, number of qualified vessels and total red snapper landings by year and management region.

		Longline			Handline/Troll			
Region	Year	Landings	Effort	Vessels	Landings	Effort	Vessels	Total
SG	1982	9.6	183	13	12.6	1676	49	22.2
	1983	7.8	264	14	19.0	2295	51	26.8
	1984	14.0	301	16	32.4	2863	82	46.4
	1985	23.1	410	24	58.9	3608	93	82.0
	1986	51.0	478	42	42.9	2459	66	93.9
	1987	71.4	651	47	29.2	2549	66	100.6
	1988	71.7	1034	66	59.1	3831	95	130.8
	1989	65.7	691	54	59.8	3960	100	125.5
	1990	75.2	1049	57	60.0	4688	99	135.2
	1991	31.5	832	38	83.4	2918	61	114.9
	1992	11.5	332	23	18.6	1273	22	30.1
	1993	28.6	331	23	13.0	1278	29	41.6
	1994	77.0	297	18	9.4	848	30	86.4
	1995	28.4	655	2	10.1	1479	2	38.5
WCVI	1982	7.1	190	13	13.4	2240	32	20.5
	1983	18.9	131	8	14.8	1738	34	33.7
	1984	50.8	231	16	16.3	1121	43	67.1
	1985	74.2	266	26	32.8	1456	68	107.0
	1986	286.6	801	63	77.2	1437	110	363.8
	1987	266.4	1007	90	82.8	1914	111	349.2
	1988	266.8	1088	111	47.3	941	63	314.1
	1989	395.9	691	129	52.7	858	62	448.6
	1990	420.3	1677	169	84.7	2179	112	505.0
	1991	419.0	3604	198	56.5	1305	79	475.5
	1992	245.0	1353	137	75.6	1927	75	320.6
	1993	386.6	1576	119	68.3	1672	47	454.9
	1994	185.6	967	98	32.8	670	24	218.4
	1995	161.2	1060	6	9.6	943	12	170.8
QCI	1982	17.6	565	24	1.2	862	7	18.8
	1983	16.4	311	16	1.4	741	5	17.8
	1984	21.3	430	32	5.8	1035	17	27.1
	1985	74.2	647	43	2.2	563	4	76.4
	1986	106.8	647	45	8.8	402	8	115.6
	1987	122.5	674	74	5.7	407	10	128.2
	1988	184.3	809	84	5.0	465	14	189.3
	1989	169.7	1026	104	23.6	485	27	193.3
	1990	298.2	1028	143	21.1	887	30	319.3
	1991	310.3	2761	127	21.3	256	25	331.6
	1992	352.0	1180	127	34.4	457	18	386.4
	1993	351.0	1458	140	22.7	596	15	373.8

Table 9 - Cont'd

		Longline			Handline/Troll			
Region	Year	Landings	Effort	Vessels	Landings	Effort	Vessels	Total
	1994	269.7	1253	145	20.6	599	13	290.3
	1995	307.8	779	9	28.3	1011	15	336.1
NC	1982	4.3	191	10	0.8	129	4	5.1
	1983	4.5	160	9	3.8	241	4	8.3
	1984	10.9	110	10	7.3	191	7	18.2
	1985	19.6	314	23	4.2	161	8	23.8
	1986	10.8	234	26	6.3	170	7	17.1
	1987	43.2	406	38	9.2	203	16	52.4
	1988	24.4	299	26	23.1	325	19	47.5
	1989	53.0	329	49	25.1	298	22	78.1
	1990	48.0	352	48	6.8	146	21	54.8
	1991	46.6	609	42	10.7	137	14	57.3
	1992	59.3	513	50	27.2	240	19	86.5
	1993	88.7	634	53	9.7	177	12	98.4
	1994	39.1	390	43	7.8	113	11	46.9
	1995	61.3	615	4	8.6	449	6	69.9
CC	1982	2.5	207	9	1.8	87	6	4.3
	1983	3.9	87	9	3.6	196	6	7.5
	1984	1.8	125	6	10.6	216	12	12.4
	1985	21.9	144	20	6.4	151	16	28.3
	1986	86.6	155	18	9.5	236	23	96.1
	1987	37.3	311	39	11.6	277	27	48.9
	1988	44.7	343	40	24.8	724	32	69.5
	1989	94.1	678	72	23.9	387	40	118.0
	1990	126.8	698	75	27.8	640	44	154.6
	1991	157.6	1114	87	19.4	423	36	177.0
	1992	113.4	845	74	19.0	443	32	132.4
	1993	106.9	624	56	6.8	193	9	113.7
	1994	102.3	665	58	2.9	101	8	105.2
	1995	53.0	302	5	8.2	179	9	61.2

Table 10. Other rockfish longline and handline/troll landings (t), nominal effort in days fished, number of qualified vessels and total other rockfish landings by year and management region.

		Longline			Handline/Troll			
Region	Year	Landings	Effort	Vessels	Landings	Effort	Vessels	Total
SG	1982	18.8	573	27	240.2	9097	231	259.0
	1983	20.7	575	22	251.2	8090	219	271.9
	1984	27.4	619	30	273.5	8065	231	300.9
	1985	69.5	952	50	285.1	7193	211	354.6
	1986	115.1	1498	72	316.4	7001	200	431.5
	1987	49.5	1038	67	272.6	6451	167	322.1
	1988	67.9	1456	82	297.8	6740	178	365.7
	1989	22.9	569	39	311.8	7476	191	334.7
	1990	27.3	797	38	307.4	7926	213	334.7
	1991	12.9	320	22	352.8	7977	200	365.7
	1992	6.9	245	10	140.7	3084	61	147.6
	1993	9.5	239	10	147.8	3304	62	157.3
	1994	32.5	320	12	155.5	2057	65	188.0
	1995	15.9	522	2	145.3	1906	2	161.2
WCVI	1982	21.7	536	29	45.2	10634	126	66.9
	1983	19.4	515	26	50.1	10514	119	69.5
	1984	36.1	507	32	37.6	7704	88	73.7
	1985	49.3	548	37	42.4	4885	90	91.7
	1986	133.5	1142	77	86.8	3732	106	220.3
	1987	158.3	1501	122	149.7	4173	171	308.0
	1988	173.0	1438	127	66.8	4968	113	239.8
	1989	137.4	1122	111	56.7	3551	88	194.1
	1990	163.4	1687	164	148.5	5501	190	311.9
	1991	193.3	2562	165	108.8	1763	136	302.1
	1992	133.5	1264	102	117.3	3831	123	250.8
	1993	251.2	1361	92	90.9	3729	61	342.1
	1994	401.7	1200	91	46.4	2499	48	448.1
	1995	487.5	1118	6	49.8	2957	38	537.3
QCI	1982	24.1	807	38	6.1	1424	15	30.2
	1983	20.0	649	31	3.8	1537	13	23.8
	1984	68.7	489	37	4.8	1292	13	73.5
	1985	75.0	714	60	3.7	818	11	78.7
	1986	78.1	636	70	4.6	365	12	82.7
	1987	181.4	1403	137	4.1	790	19	185.5
	1988	109.2	927	89	6.3	753	11	115.5
	1989	89.5	623	76	7.8	487	16	97.3
	1990	124.7	856	120	9.6	767	26	134.3
	1991	124.8	2361	105	17.6	230	17	142.4
	1992	155.0	1186	96	20.7	624	14	175.7

Table 10 - Cont'd

		Longline			Handline/Troll			
Region	Year	Landings	Effort	Vessels	Landings	Effort	Vessels	Total
	1993	187.8	1374	103	11.4	521	18	199.2
	1994	358.9	1271	118	10.5	986	20	369.4
	1995	935.7	807	10	34.2	1930	41	969.9
NC	1982	1.5	123	8	0.9	158	3	2.4
	1983	2.3	150	11	1.8	264	3	4.1
	1984	3.7	134	11	1.4	241	9	5.1
	1985	7.1	316	23	9.3	292	11	16.4
	1986	15.4	315	27	5.6	314	11	21.0
	1987	24.6	452	46	3.2	318	15	27.8
	1988	7.0	194	20	9.0	403	16	16.0
	1989	13.6	225	32	2.5	252	14	16.1
	1990	34.7	378	49	17.2	249	19	51.9
	1991	23.0	584	41	49.6	672	28	72.6
	1992	24.9	401	35	12.7	275	18	37.6
	1993	48.4	582	44	16.5	266	16	64.9
	1994	38.9	317	31	23.5	218	17	62.4
	1995	132.4	627	4	20.2	648	13	152.6
CC	1982	9.7	246	18	3.4	719	18	13.1
	1983	6.0	230	10	6.7	1057	10	12.7
	1984	8.3	227	11	6.5	826	21	14.8
	1985	20.2	302	28	9.3	438	17	29.5
	1986	38.2	368	36	11.5	682	26	49.7
	1987	60.8	733	70	21.2	725	37	82.0
	1988	53.9	509	53	56.0	1064	47	109.9
	1989	39.9	507	48	31.0	736	46	70.9
	1990	144.1	744	62	70.1	836	50	214.2
	1991	82.5	592	68	73.5	327	62	156.0
	1992	79.5	757	49	50.3	914	38	129.8
	1993	78.2	654	42	32.1	353	18	110.3
	1994	119.2	562	45	8.1	198	11	127.3
	1995	143.6	289	5	3.7	304	5	147.3

Table 11. Rockfish catch (t) by species, gear type, and management region from fish slip records in 1994.

	Longline					Handline					Troll					
Species	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	Total
rougheye	3.2	21.8	95.8	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	122.7
aurora	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
redbanded	3.6	62.0	117.0	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	184.8
shortraker	2.0	8.0	29.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	40.7
silvergray	0.4	49.2	52.4	0.9	1.7	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	105.3
copper	0.1	5.3	1.9	0.4	0.4	12.9	4.3	0.0	6.7	0.5	0.0	0.3	0.0	0.0	0.0	32.9
dusky	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
darkblotched	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
splitnose	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
greenstriped	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
yellowtail	0.3	1.9	0.8	1.0	1.2	1.6	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	7.4
rosethorn	0.1	1.2	0.8	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6
quillback	19.9	120.0	19.4	35.0	81.7	136.9	9.5	4.4	14.3	3.1	0.0	6.3	0.0	0.0	0.4	451.1
black	0.4	3.3	0.9	1.5	0.6	2.0	2.1	0.3	0.6	0.0	0.0	0.1	0.0	0.0	0.0	11.8
vermillion	0.0	6.4	0.2	0.0	0.6	0.3	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	8.2
blue	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
china	0.8	29.9	0.6	2.2	3.4	0.4	1.3	0.2	2.4	0.1	0.0	3.8	0.0	0.0	0.0	45.2
tiger	1.0	3.6	0.7	1.0	1.1	0.0	0.1	0.0	0.3	0.0	0.0	0.4	0.0	0.0	0.0	8.2
canary	1.7	70.9	20.0	1.8	3.5	0.7	2.9	0.4	0.2	0.0	0.0	8.5	0.0	0.0	0.1	110.7
redstripe	0.0	0.2	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
yellowmouth	0.0	5.8	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0
yelloweye	77.7	180.0	265.4	28.1	88.2	9.2	3.6	12.6	6.6	1.7	0.0	28.3	0.0	0.0	0.1	701.5

Table 12. Rockfish catch (t) by species, gear type and management region from the fish slip records in 1995.

	Longline					Handline					Troll					Total
Species	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	
rougheye	0.0	53.3	573.3	1.9	1.9	0.0	0.0	0.4	0.0	0.0	0.0	7.3	0.0	0.0	0.0	638.0
aurora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
redbanded	0.1	96.2	167.8	0.3	6.3	0.0	0.0	0.1	0.0	0.0	0.0	2.9	0.0	0.0	0.0	273.7
shortraker	0.4	32.1	116.3	0.2	1.1	0.0	0.0	0.2	0.0	0.0	0.0	1.2	0.0	0.0	0.0	151.6
silvergray	0.1	30.9	111.2	3.0	2.2	0.2	0.0	1.2	0.4	0.1	0.0	0.4	0.0	0.0	0.0	149.7
copper	0.7	3.1	2.4	0.9	0.5	7.4	3.3	1.0	1.4	0.2	0.0	0.0	0.0	0.0	0.0	20.8
dusky	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
darkblotched	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
splitnose	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
greenstriped	0.0	0.4	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
yellowtail	0.1	36.1	1.7	0.4	0.3	2.7	0.3	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	42.4
rosethorn	0.0	1.2	1.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
quillback	11.9	66.1	52.9	45.7	64.2	126.6	11.7	8.0	11.9	3.0	0.2	0.2	1.4	0.1	0.2	404.2
black	0.6	1.0	2.1	0.4	1.5	4.5	1.5	0.8	0.4	0.0	0.0	0.1	0.0	0.0	0.0	12.9
vermillion	0.1	6.1	1.0	0.3	4.1	0.1	0.8	0.2	0.0	0.1	0.0	0.5	0.0	0.0	0.0	13.4
blue	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
china	0.8	25.7	8.0	4.2	6.7	1.0	3.3	1.3	1.1	0.1	0.0	0.0	0.0	0.0	0.0	52.3
tiger	0.3	4.7	1.3	2.2	2.2	0.5	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	12.0
canary	0.5	22.8	20.1	1.9	3.5	0.4	1.2	0.9	0.2	0.3	0.0	0.2	0.1	0.0	0.0	52.2
redstripe	0.0	0.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
yellowmouth	0.0	2.8	9.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	14.1
yelloweye	28.4	152.3	306.3	45.1	64.3	9.3	3.4	17.6	6.4	9.0	0.7	2.9	2.9	0.2	0.5	649.4

Table 13. Rockfish catch (t) by species, gear type, and management region from logbook records in 1993.

	Longline					Handline					Toll					
Species	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	Total
rougheye	0.0	3.5	12.1	0.1	0.4	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.4
POP	0.0	0.0	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
redbanded	0.0	22.4	9.4	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.8
shortraker	0.0	0.1	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3
silvergray	0.0	20.2	54.2	3.6	1.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	81.1
copper	0.1	1.3	1.7	0.9	2.9	12.0	7.2	0.9	2.5	3.3	0.0	0.2	0.0	0.0	0.3	33.7
dusky	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
darkblotched	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
greenstriped	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
yellowtail	0.1	6.0	7.2	0.2	1.0	1.3	1.5	0.1	1.3	0.3	0.0	0.0	0.0	0.0	0.0	19.1
rosethorn	0.1	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
quillback	5.5	79.8	21.4	27.2	60.4	110.8	8.0	3.8	6.9	9.0	0.0	0.9	0.0	0.0	0.1	337.4
black	0.0	3.7	0.1	0.2	0.0	1.5	1.8	0.0	0.3	0.5	0.0	5.3	0.0	0.0	0.0	14.8
blue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
vermillion	0.0	1.7	0.0	0.0	0.0	0.2	1.5	0.0	0.0	0.3	0.0	0.5	0.0	0.0	0.0	4.9
boccacio	0.0	4.2	2.1	0.2	0.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
china	0.0	29.2	0.9	2.1	4.1	0.0	2.8	0.0	0.7	1.4	0.0	0.0	0.0	0.0	0.0	42.2
tiger	0.0	1.7	0.5	2.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
canary	0.2	52.6	14.3	2.2	2.8	0.2	5.9	0.0	0.2	0.5	0.0	0.7	0.0	0.0	0.0	81.2
redstripe	0.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
yellowmouth	0.0	3.3	6.9	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5
yelloweye	25.3	414.4	224.2	83.8	89.1	8.5	12.3	2.6	17.9	12.3	0.0	2.0	0.2	0.0	0.0	907.8

Table 14. Rockfish catch (t) by species, gear type, and management region from logbook records in 1994.

	Longline					Handline					Troll					
Species	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	SG	WC	QCI	NC	CC	Total
rougheye	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
POP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
redbanded	0.0	0.0	61.2	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.5
shortraker	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5
silvergray	0.0	0.0	77.6	0.2	0.5	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0
copper	0.1	1.6	6.8	4.6	2.6	10.9	1.2	1.7	2.2	0.2	0.0	0.0	0.0	0.0	0.0	31.9
dusky	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
darkblotched	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
greenstriped	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
yellowtail	0.0	0.1	0.7	0.0	0.2	0.8	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.1
rosethorn	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
quillback	3.6	4.4	48.8	12.8	21.7	57.5	0.6	3.0	8.4	0.9	0.0	0.0	0.0	0.0	0.0	161.7
black	0.1	0.2	0.7	0.1	0.2	1.0	0.1	1.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	3.5
blue	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
vermillion	0.0	0.1	3.8	0.0	0.1	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
boccacio	0.0	0.0	12.0	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6
china	0.1	2.0	13.7	1.2	2.3	0.1	0.0	0.7	1.4	0.0	0.0	0.0	0.0	0.0	0.0	21.5
tiger	0.1	0.2	3.4	1.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
canary	0.4	0.3	61.4	0.5	1.2	0.1	0.2	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	65.2
redstripe	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
yellowmouth	0.0	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2
yelloweye	69.3	5.2	290.3	15.6	20.3	6.4	0.3	8.4	4.8	0.0	0.0	0.0	0.0	0.0	0.0	420.6

Table 15. Total rockfish recreational catch (t) by statistical area, combined area catch, total effort (boat trips), and overall catch per effort (kg per 10 boat trips) for the Strait of Georgia from the creel survey 1982-1995 (Shardlow and Collicutt 1989a-e, Collicutt and Shardlow 1990, 1992a, 1992b, L. Collicutt and L. Nagy pers. comm.).

	Statistical Area[b]													March-September Only		
Year	12	13	14	15	16	17	18	19	28	29	Total	Effort	C/E	Total	Effort	C/E
1982	-	17.5	10.9	3.2	27.0	18.3	20.9	8.4	25.3	6.1	137.6	682,733[c]	1.99	-	-	-
1983	-	26.0	12.5	2.7	29.4	16.4	16.5	26.1	10.4	6.4	146.4	574,257	2.54	112.0	304,127	3.68
1984	-	15.9	10.1	3.0	11.3	24.7	14.2	18.7	7.6	5.6	111.1	651,090	1.70	91.5	525,878	1.74
1985	-	10.1	8.7	1.2	27.0	14.5	8.5	14.2	5.0	4.6	93.8	628,513	1.49	72.6	484,346	1.50
1986	-	14.8	14.5	1.9	34.2	12.9	9.0	20.0	4.9	5.0	117.2	582,246	2.01	95.6	458,581	2.08
1987	-	11.5	15.9	2.1	14.4	16.1	10.4	19.5	2.9	2.5	95.3	589,731	1.61	79.1	469,965	1.68
1988	-	17.3	21.0	2.0	26.7	21.4	12.0	24.4	4.2	7.4	136.4	664,517	2.05	124.2	603,430	2.06
1989	-	13.1	22.3	2.2	33.9	23.6	13.9	20.4	4.2	6.3	139.9	603,331	2.31	126.0	546,881	2.30
1990	-	13.0	16.7	1.7	30.2	11.1	5.6	20.0	4.4	5.5	108.2	543,368	1.99	101.8	510,165	1.99
1991	9.2[d]	12.0	16.4	1.5	33.8	14.4	5.9	12.4	8.3	16.6	130.5	490,149	2.60[e]	106.8	417,677	2.56[e]
1992	10.3[f]	10.4	9.7	0.9	30.5	12.6	6.7	14.4	5.1	4.7	105.3	501,811	2.03[e]	90.1	437,225	2.06[e]
1993[g]	9.3[f]	11.1	6.5	0.9	14.6	10.5	3.7	14.8	3.9	6.8	72.8	528,508	1.38[e]	69.7	486,189	1.43[e]
1994[h]	-	20.0	17.6	2.0	21.6	14.3	4.6	15.4	9.1	9.1	113.7	461,129	2.47	88.5	363,234	2.44
1995[i]	-	13.5	8.7	1.6	20.0	10.5	3.9	9.8	3.7	5.8	77.5	319,464	2.43	62.3	240,640	2.59

[a]All catch converted from pieces to kg using average weight of 0.7 kg.
[b]The portion of area 20 east of Sheringham Point is covered by the creel survey.
[c]Mean of 1980-82 estimates from creel survey.
[d]For July and August only.
[e]excludes Area 12.
[f]For June, July and August only.
[g]survey months from January to September only, October to December catches were estimated.
[h]survey months from January to October only.
[i]survey months from March to October only.

Table 16. Total rockfish recreational catch (t) by statistical area, total effort (boat trips), and overall catch per effort (kg per 10 boat trips) for the West Coast Vancouver Island statistical areas 23 A (Alberni Inlet), 23 B (Barkley Sound including statistical area 123) and 24 (and 124, survey limited to southern portion) from the creel survey July - September 1989 - 1995 (W. Luedke pers. comm.).

	AREA 23 A			AREA 23 B			AREA 24		
Year	Catch	Effort	C/E	Catch	Effort	C/E	Catch	Effort	C/E
1989	0.3	2,705	0.13	15.9	4,219	3.76			
1990	0.1	2,651	0.03	17.5	4,929	3.55			
1991	0.0	4,312	0.00	10.0	4,466	2.23			
1992	0.4	5,301	0.08	13.9	5,823	2.39	2.9	383	7.52
1993	0.2	3,691	0.06	11.3	4,312	2.62	1.8	456	3.86
1994	0.1	3,393	0.03	12.9	5,287	2.43			
1995	0.0	821	0.01	7.5	3,639	2.06	1.7	708	2.35

[a]All catch converted from pieces to kg using average weight of 0.7 kg.

Table 17. Rockfish age samples obtained from the commercial fishery by species, region, area and year. The sample size (n), mean age and standard error of each sample is shown for each sample.

Species	Region	Area	Year	n	Mean	StdErr
redbanded	QCI	42	1995	50	30	2.88
redbanded	CC	7	1995	50	49	2.20
shortraker	SG	12	1995	31	51	2.73
copper	SG	13	1984	107	11	0.52
	SG	13	1986	14	10	1.08
	SG	13	1988	51	10	0.55
	SG	13	1992	50	7	0.44
	SG	17	1986	21	13	1.00
	SG	17	1993	54	13	0.72
	SG	18	1992	50	15	1.17
copper	NC	5	1991	59	15	0.84
	NC	5	1992	55	15	1.06
	NC	5	1993	50	17	1.34
	NC	5	1994	50	14	0.77
quillback	SG	12	1984	53	38	1.95
	SG	12	1985	79	31	1.44
	SG	12	1986	200	26	0.76
	SG	12	1987	75	23	1.32
	SG	12	1988	203	23	0.76
	SG	12	1989	75	23	1.37
	SG	12	1990	162	21	1.01
	SG	12	1991	101	19	0.96
	SG	12	1992	131	20	0.93
	SG	12	1993	54	21	1.27
	SG	12	1994	52	23	2.23
quillback	SG	13	1984	146	18	0.68
	SG	13	1986	385	17	0.50
	SG	13	1987	101	14	0.70
	SG	13	1988	52	18	0.98
	SG	13	1992	50	16	0.97
	SG	13	1993	72	12	0.55
	SG	13	1994	70	18	1.16
quillback	SG	17	1986	320	19	0.49
	SG	17	1991	52	25	1.65
	SG	17	1992	50	24	1.52
	SG	17	1993	51	14	0.89
	SG	17	1994	50	27	1.41
quillback	SG	18	1988	146	15	0.81
	SG	18	1991	50	11	1.07

Table 17 - Cont'd

Species	Region	Area	Year	n	Mean	StdErr
	SG	18	1992	98	13	0.80
quillback	QCI	2	1992	50	33	2.13
	QCI	2	1993	95	30	1.41
	QCI	42	1994	10	32	2.11
quillback	CC	6	1991	60	24	1.91
	CC	7	1988	233	25	0.77
	CC	7	1989	50	24	1.82
	CC	7	1993	50	33	2.17
	CC	8	1993	50	25	2.33
quillback	WCVI	11	1994	50	26	1.11
	WCVI	23	1994	61	35	1.86
	WCVI	27	1991	39	30	2.25
	WCVI	27	1992	22	30	2.62
yelloweye	SG	12	1994	50	17	2.20
	SG	17	1988	225	33	0.78
yelloweye	QCI	2	1991	50	52	2.20
	QCI	2	1992	52	22	1.94
	QCI	2	1993	66	28	2.32
	QCI	30	1991	49	38	2.77
	QCI	30	1994	50	29	1.52
	QCI	42	1986	260	38	1.05
	QCI	42	1989	70	45	2.35
	QCI	42	1990	78	53	2.76
	QCI	42	1994	201	32	1.13
yelloweye	CC	6	1989	50	42	2.12
	CC	6	1995	50	26	2.49
	CC	7	1990	50	49	2.79
yelloweye	WCVI	11	1989	100	36	1.76
	WCVI	11	1991	52	29	2.60
	WCVI	11	1992	50	47	3.02
	WCVI	24	1989	57	30	1.85
	WCVI	24	1992	50	31	2.89
	WCVI	24	1993	53	28	2.00
	WCVI	25	1988	100	32	1.27
	WCVI	25	1989	50	30	2.00
	WCVI	26	1992	80	45	1.53
	WCVI	27	1991	50	29	2.15
	WCVI	27	1992	51	22	1.71
	WCVI	27	1993	50	28	2.37
	WCVI	27	1994	182	28	0.97

Table 18. Comparison of habitat area (km^2) estimates for 1997 based on new depth ranges determined from logbook data and 1996 habitat areas.

		1996		1997	
Region	Statistical Area	Yelloweye 50-200m	Quillback 0-80m, 30-80m	Yelloweye 30-170m	Quillback 20-90m
SG	12	1543	1306	1577	727
	13	514	557	548	333
	14	820	512	759	365
	15	418	316	433	208
	16	390	310	384	199
	17	239	453	340	307
	18	332	306	344	215
	19	505	471	572	398
	20	743	267	494	161
	28	179	216	191	124
	29	652	434	502	146
WCVI	11	4018	1595	2668	1891
	21	644	353	1002	427
	23	2840	1116	3288	1506
	24	2325	1612	3153	1925
	25	1478	795	1702	907
	26	1014	853	1225	978
	27	2050	806	1949	1081
QCI	1	2741	1082	2694	1397
	2	3865	3249	5063	5220
	30	383	33	215	52
	42	525	47	382	59
NC	3	643	189	630	245
	4	2123	1617	2572	2473
	5	2508	2269	3407	2821
CC	6	4837	1266	4521	1764
	7	4072	845	3657	1129
	8	3091	1866	3395	2098
	9	789	139	720	194
	10	1197	377	1248	474

Table 19. Recommended yields for red snapper and yelloweye rockfish by statistical area and method of determining recommendations. Methods used to derive yields are based on habitat analysis (Habitat), the 25*th* percentile of the catch history from 1983 to 1995 (Catch history), or no recommendation (None). Yields do not include allocation to the recreational fishery.

Region	Area	Method	Red Snapper Yield (t)	Proportion Yelloweye	Yelloweye Yield (t)
SG	12	Catch history	20	1.0	20
	13	Catch history	7		7
	14	Catch history	1		1
	15	Catch history	1		1
	16	Catch history	1		1
	17	Catch history	3		3
	18	Catch history	1		1
	19	None			
	20	None			
	28	None			
	29	None			
WCVI	11	Catch history	33	0.95	31
	21	None			
	22	None			
	23	Catch history	5		5
	24	Catch history	9		9
	25	Catch history	10		10
	26	Catch history	14		13
	27	Catch history	66		63
QCI	1	Catch history	15	0.97	15
	2	Catch history	35		34
	30	None			
	42	Catch history	12		12
CC	6	Catch history	8	0.74	6
	7	Catch history	5		4
	8	Catch history	5		4
	9	None			
	10	Catch history	3		2
NC	3	None		0.86	
	4	Catch history	12		10
	5	Catch history	8		7

Table 20. Recommended yields for other rockfish and quillback rockfish by statistical area and method of determining recommendations. Methods used to derive yields are based on habitat analysis (Habitat), the 25*th* percentile of the catch history from 1983 to 1995 (Catch history), or no recommendation (None). Yields do not include allocation to the recreational fishery.

Region	Area	Method	Other Rockfish Yield (t)	Proportion Quillback	Quillback Yield (t)
SG	12	Habitat	23	0.85	20
	13	Habitat	11		9
	14	Habitat	12		10
	15	Habitat	7		6
	16	Habitat	6		5
	17	Habitat	10		9
	18	Habitat	7		6
	19	Habitat	13		11
	20	None			
	28	None			
	29	None			
WCVI	11	Catch history	27	0.22	6
	21	Catch history	3		1
	22	None			
	23	Catch history	8		2
	24	Catch history	20		4
	25	Catch history	13		3
	26	Catch history	8		2
	27	Catch history	42		9
QCI	1	Catch history	15	0.06	1
	2	Catch history	31		2
	30	None			
	42	Catch history	27		2
CC	6	Catch history	9	0.58	5
	7	Catch history	8		5
	8	Catch history	13		8
	9	None			
	10	Catch history	4		2
NC	3	None		0.56	
	4	Catch history	5		3
	5	Catch history	7		4

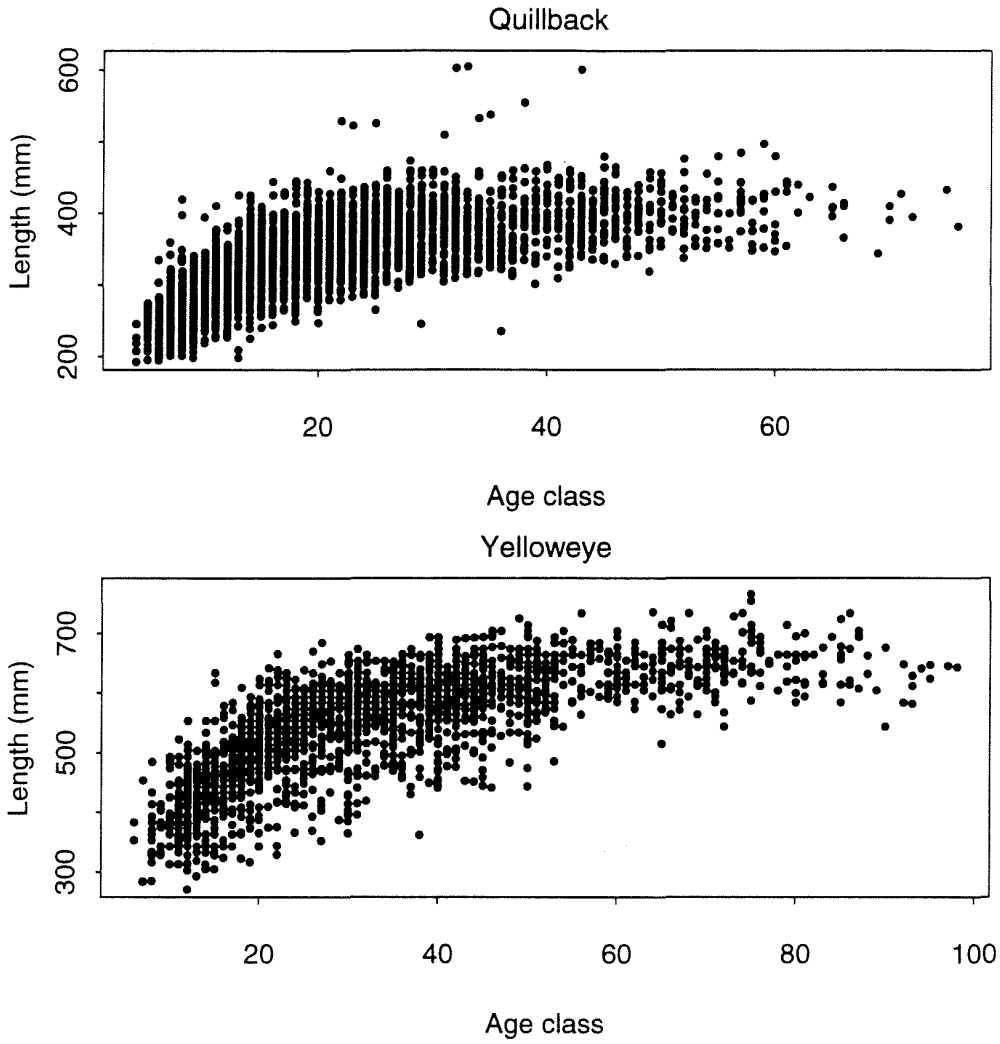


Fig. 1. Length (mm) versus age (yr) for quillback and yelloweye rockfish.

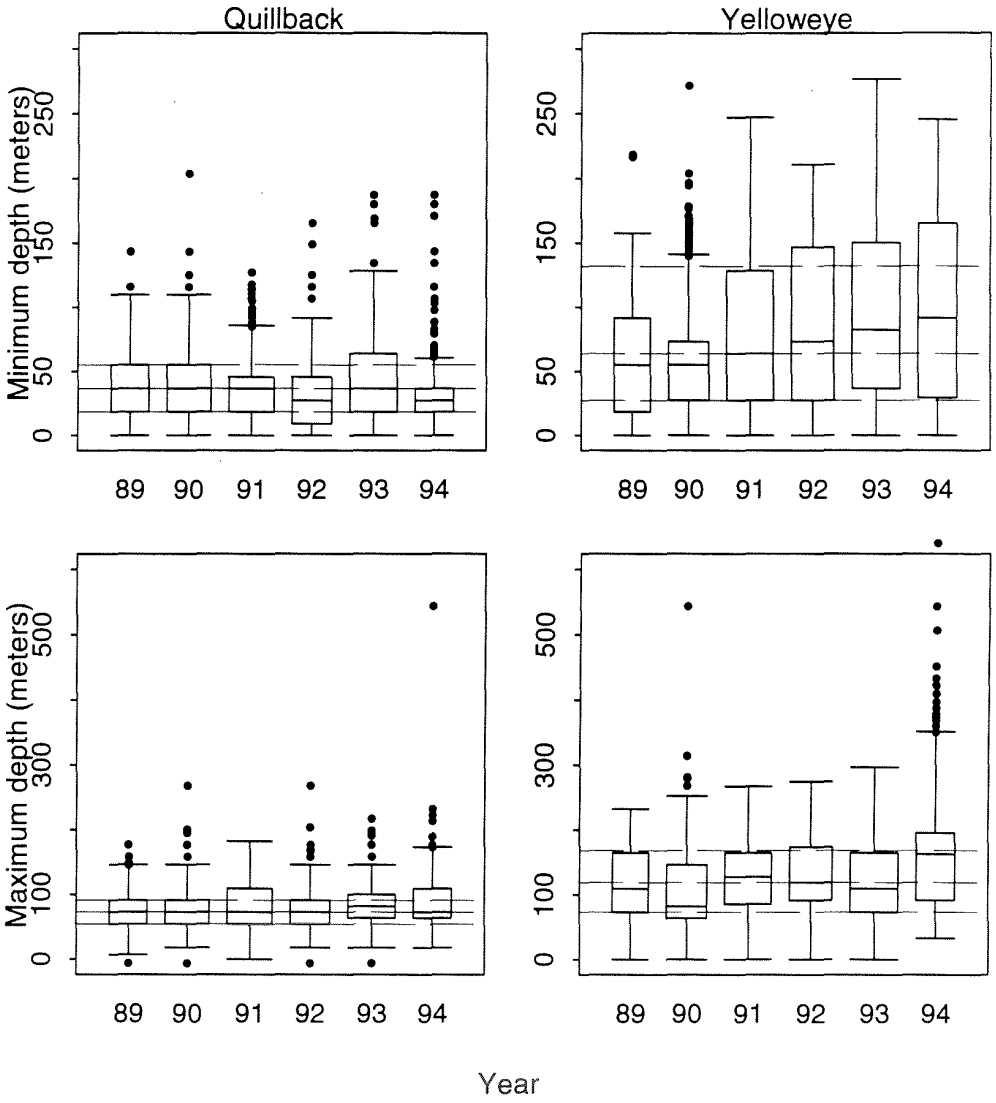


Fig. 2. Boxplots of the minimum and maximum depths fished for quillback and yelloweye rockfish from logbook data for the years 1989 - 1994. The horiontal dashed lines represent the 25*th*, 50*th*, and 75*th* percentiles of the aggregate depths fished.

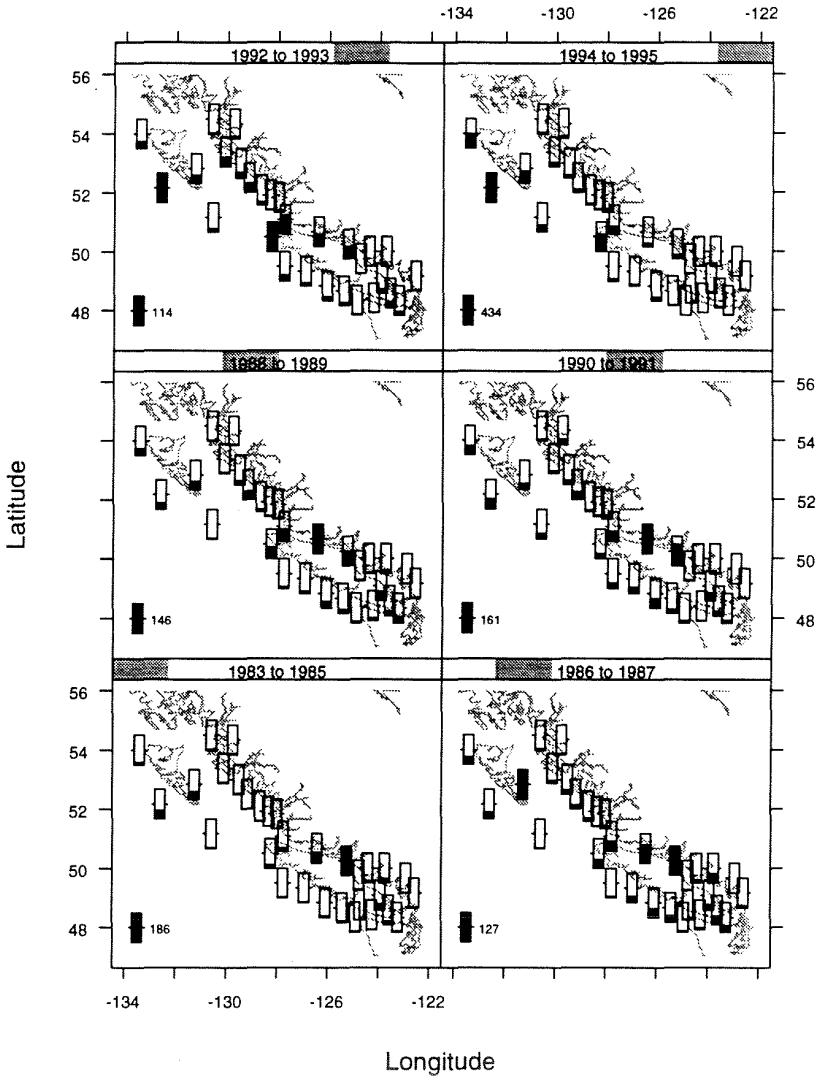


Fig. 3. Red snapper catch (t) plotted on a map of the coast for the years 1983-85, 1986-87, 1988-89, 1990-91, 1992-93 and 1994-95. The solid bar in each rectangle represents the catch per statistical area for the year group. All other bars are scaled in relation to the largest catch within a panel. The size of the largest catch is shown in the bottom left hand corner of each panel.

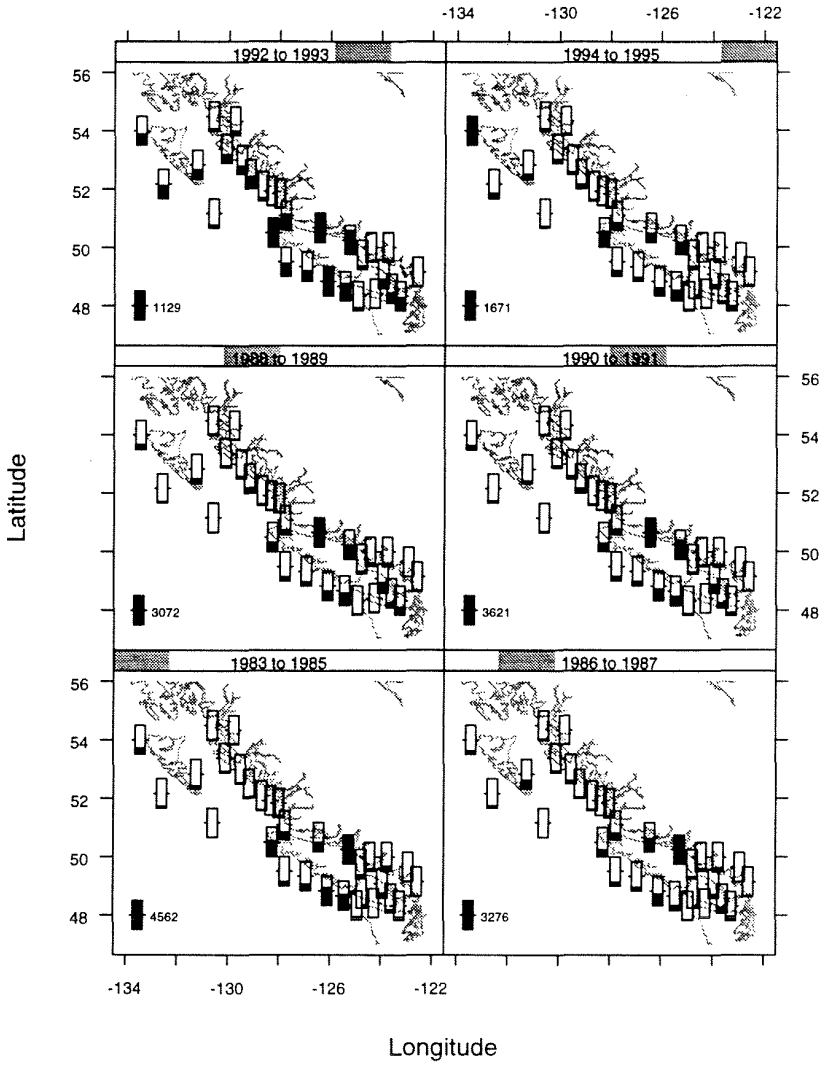


Fig. 4. Red snapper effort (days) plotted on a map of the coast for the years 1983-85, 1986-87, 1988-89, 1990-91, 1992-93 and 1994-95. The solid bar in each rectangle represents the total effort per statistical area for the year group. All other bars are scaled in relation to the largest effort within each panel. The magnitude of the largest effort is shown in the bottom left hand corner of each panel.

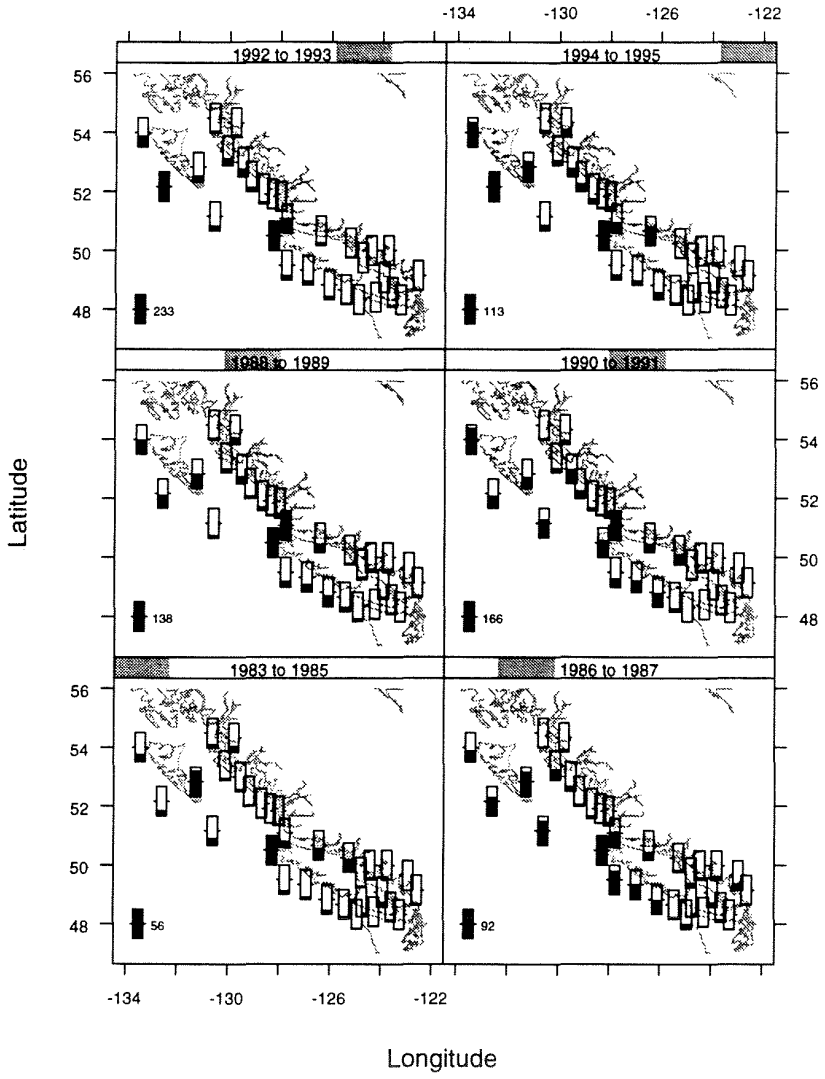


Fig. 5. Other rockfish catch (t) plotted on a map of the coast for the years 1983-85, 1986-87, 1988-89, 1990-91, 1992-93 and 1994-95. The solid bar in each rectangle represents the total catch per statistical area for the year group. All other bars are scaled in relation to the largest catch within each panel. The size of the largest catch is shown in the bottom left hand corner of each panel.

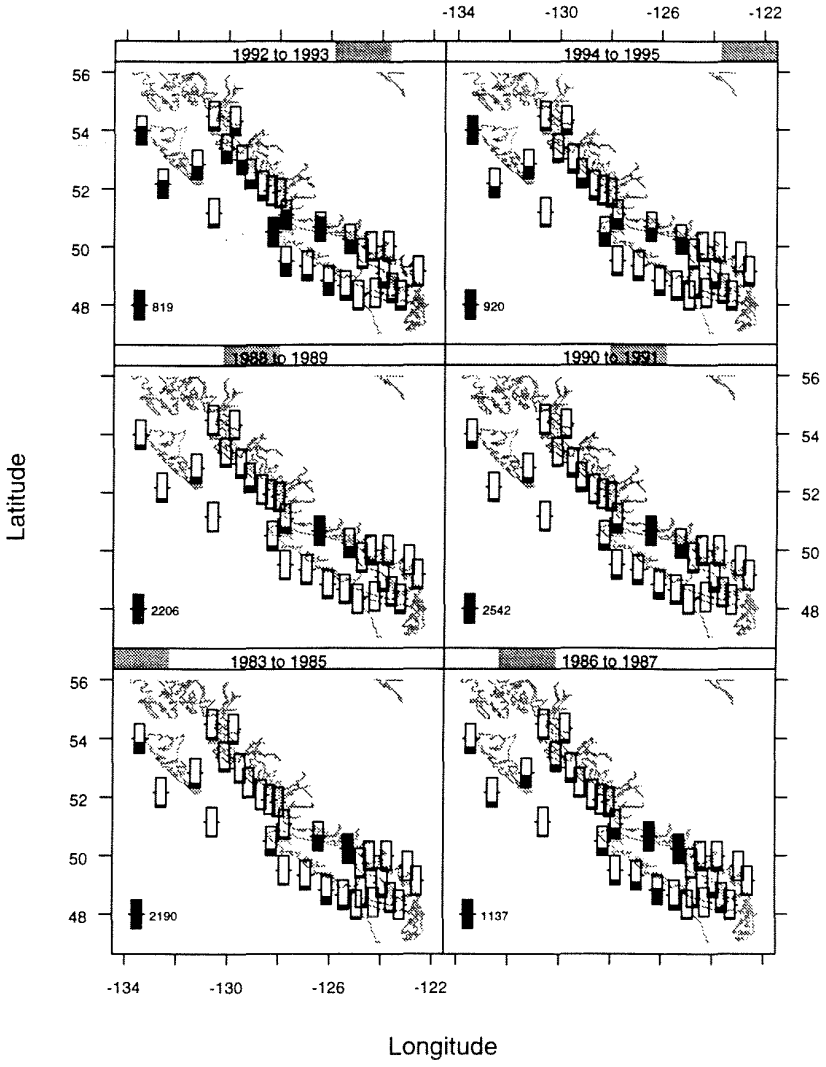


Fig. 6. Other rockfish effort (days) plotted on a map of the coast for the years 1983-85, 1986-87, 1988-89, 1990-91, 1992-93 and 1994-95. The solid bar in each rectangle represents the total effort per statistical area for the year group. All other bars are scaled in relation to the largest effort within each panel. The magnitude of the largest effort is shown in the bottom left hand corner of each panel.

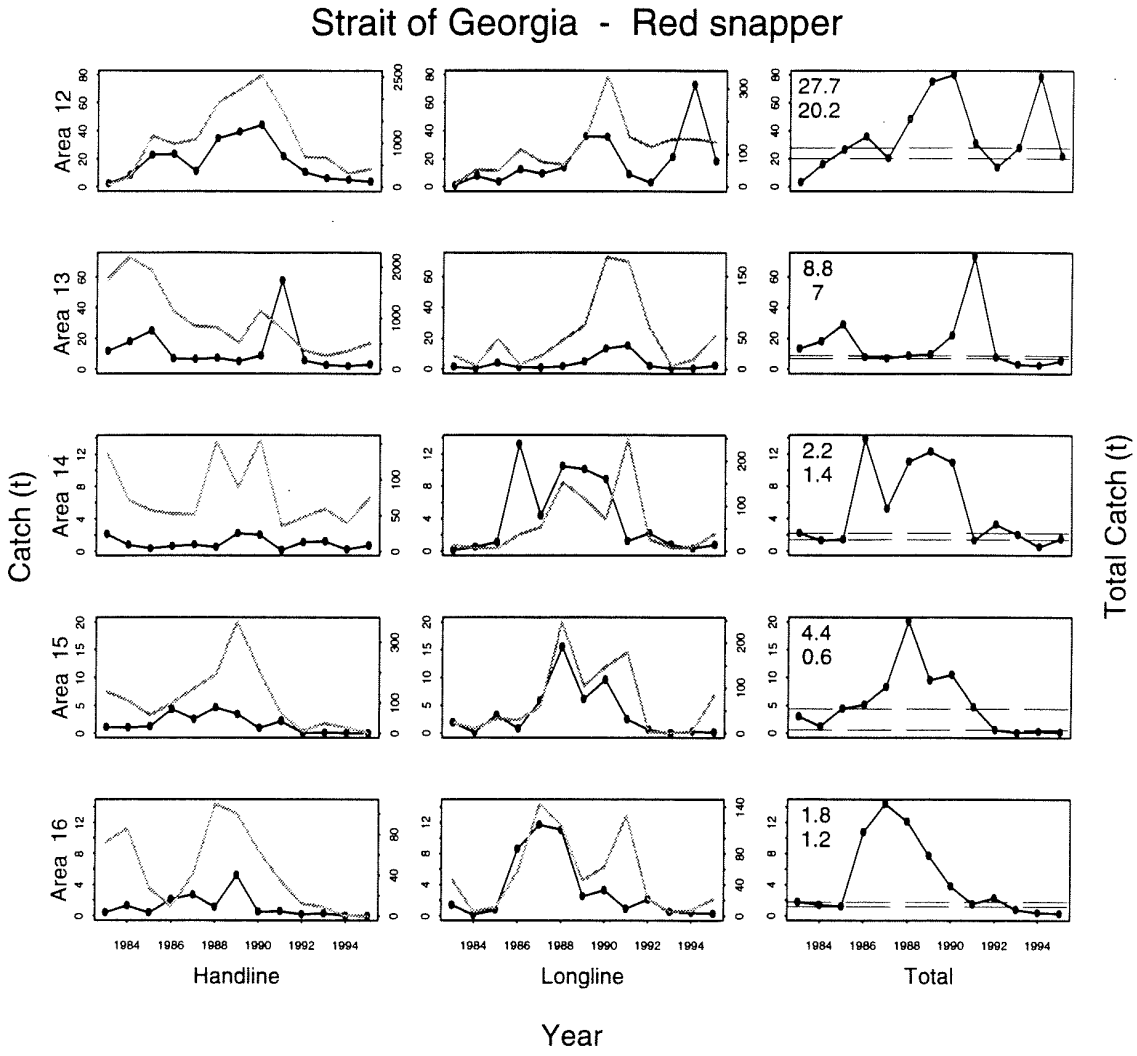


Fig. 7. Red snapper catch (t) and effort (days) by gear for statistical areas in the Strait of Georgia management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

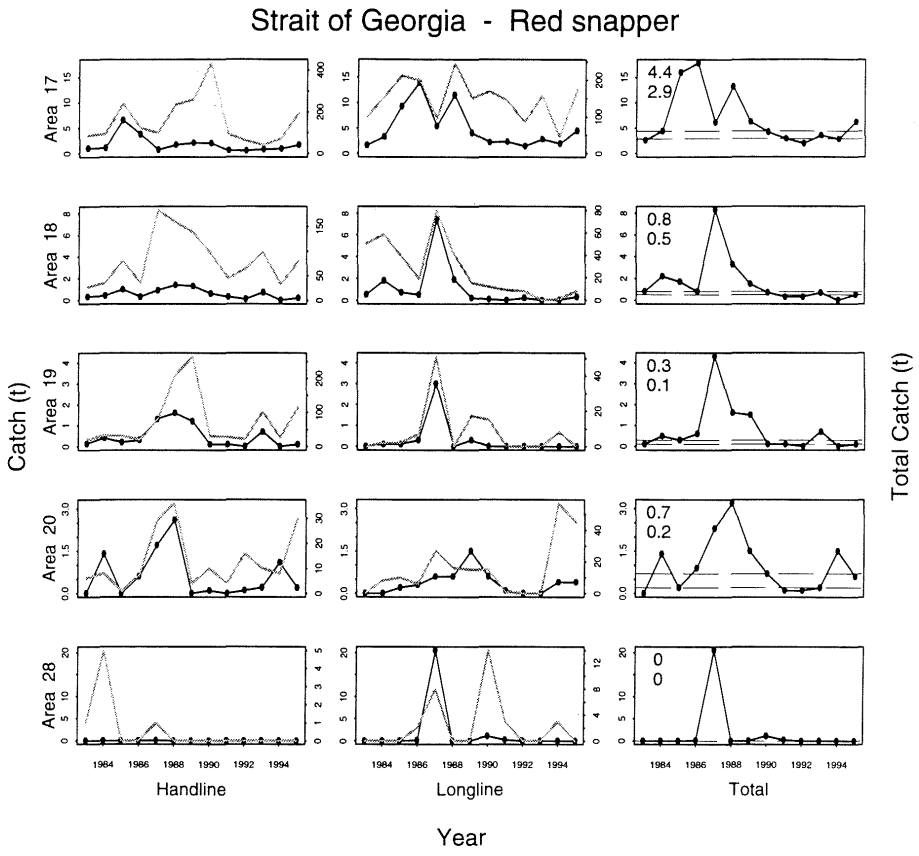
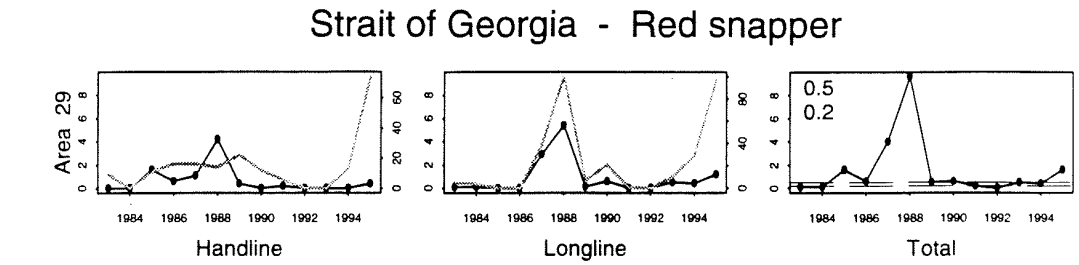


Fig. 7 - Cont'd



Catch (t)

Total Catch (t)

Year

Fig. 7 - Cont'd

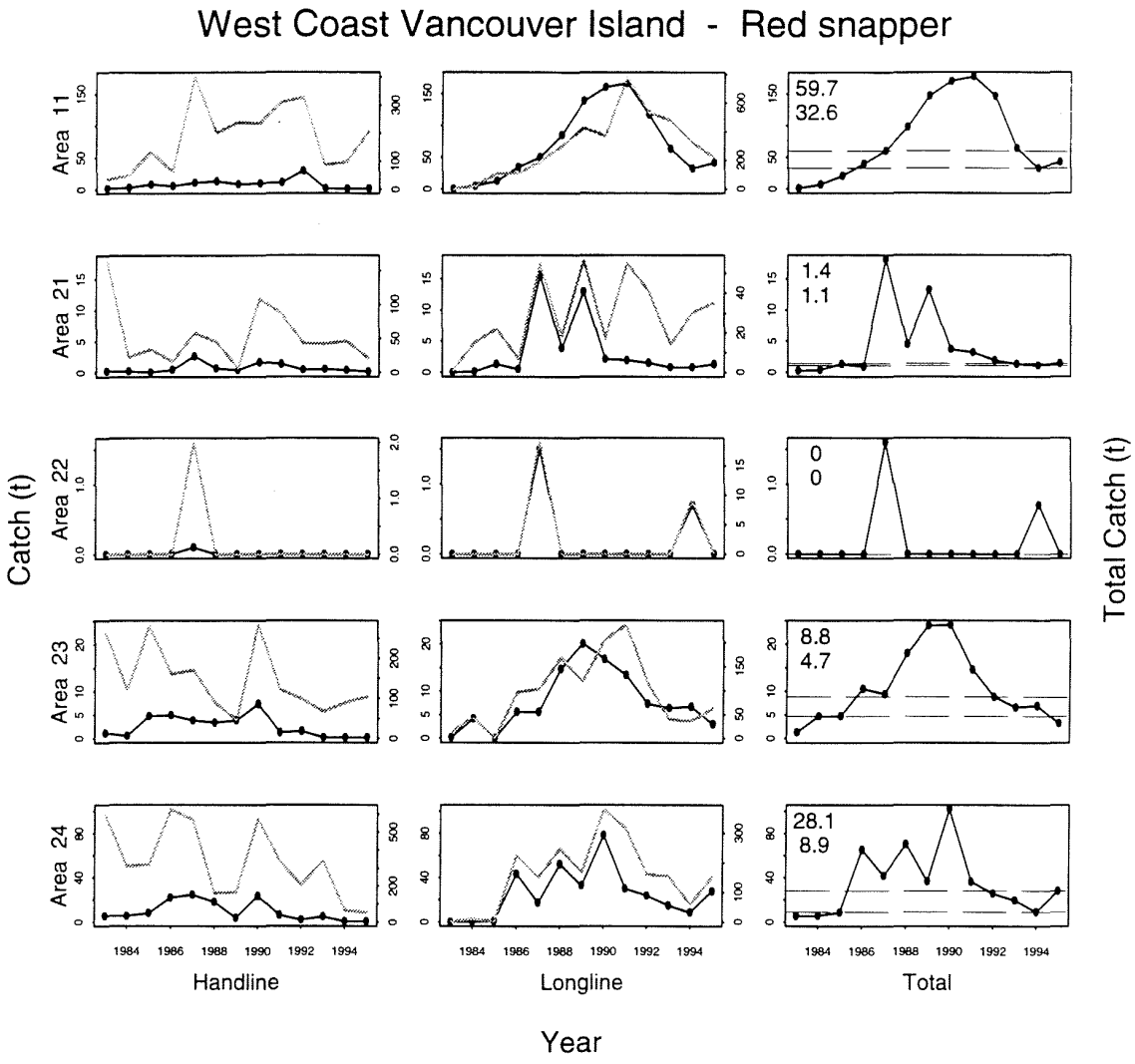


Fig. 8. Red snapper catch (t) and effort (days) by gear for statistical areas in the West Coast Vancouver Island management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

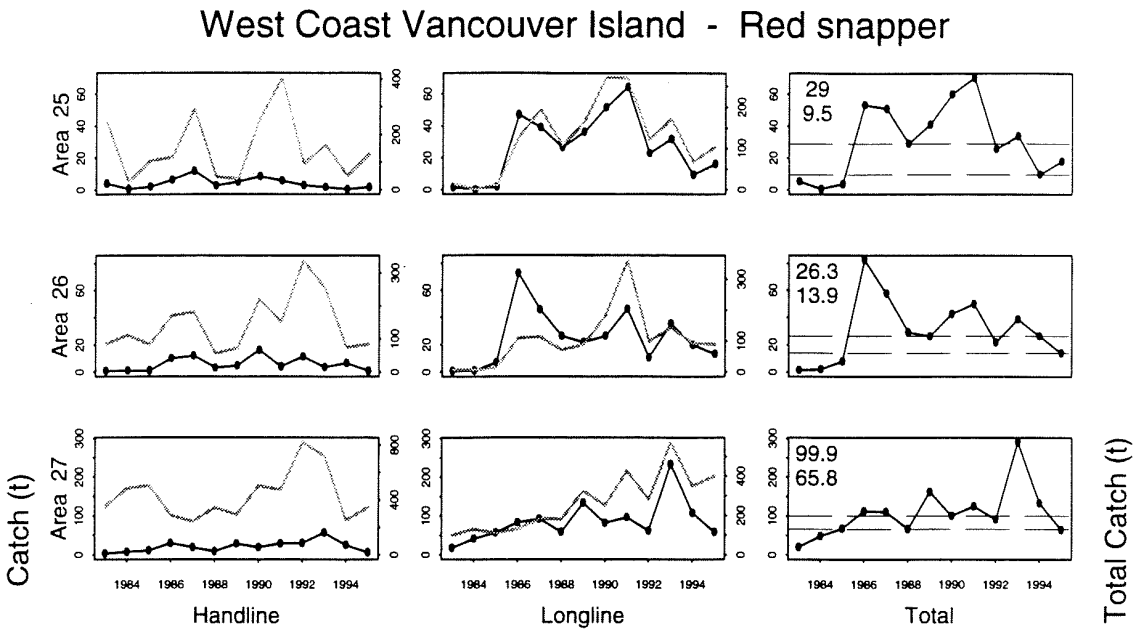


Fig. 8 - Cont'd

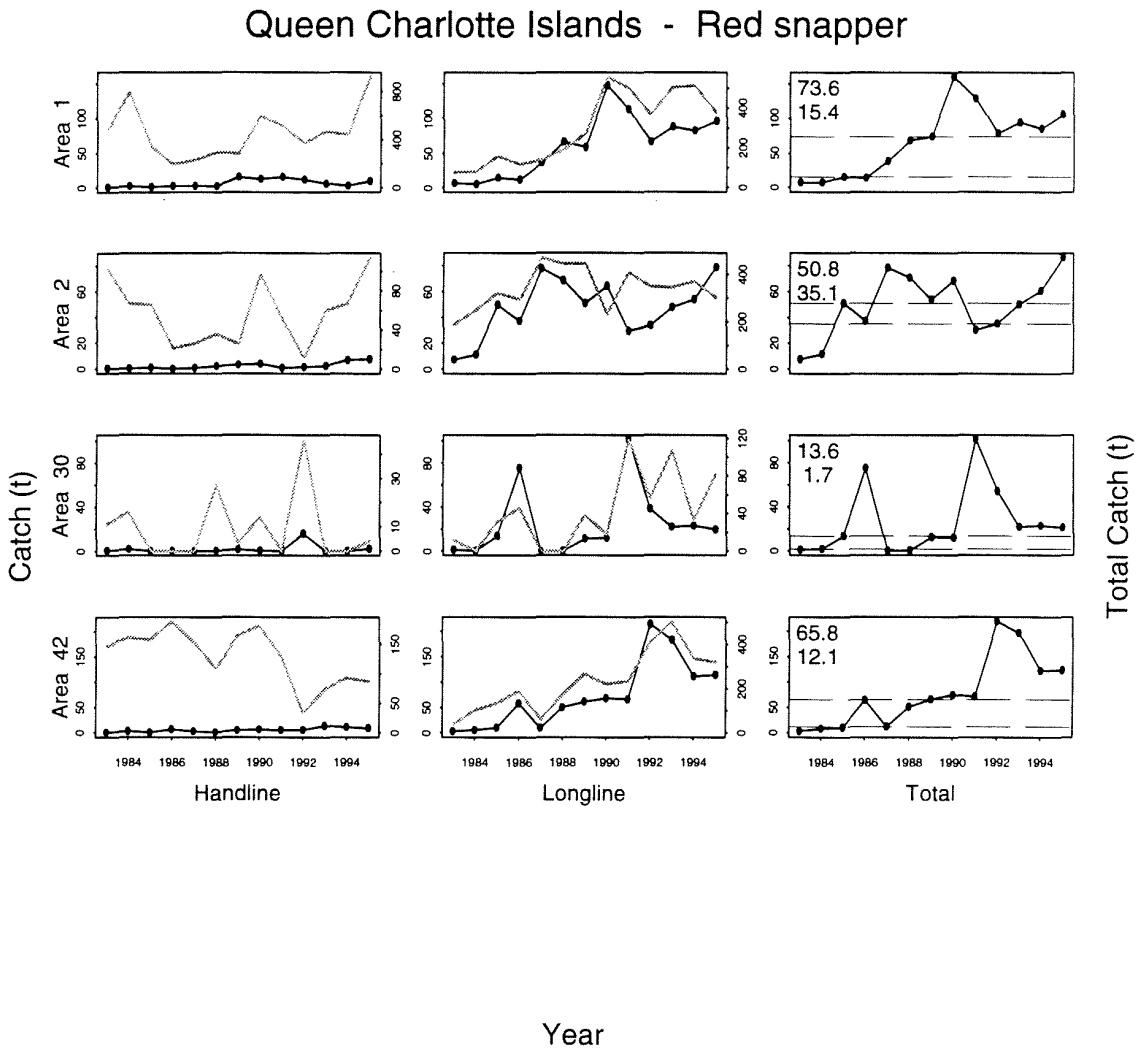


Fig. 9. Red snapper catch (t) and effort (days) by gear for statistical areas in the Queen Charlotte Islands management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

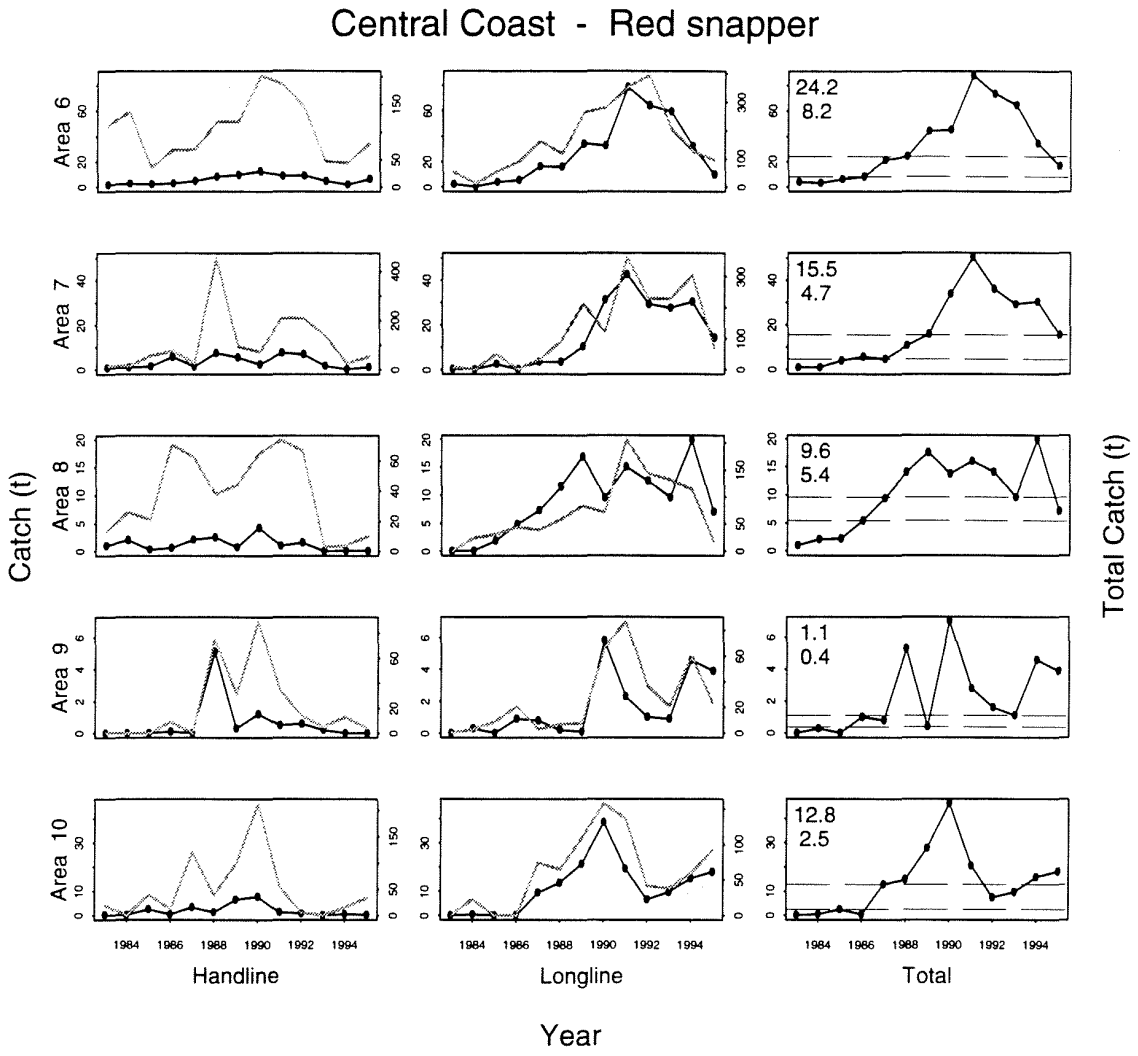


Fig. 10. Red snapper catch (t) and effort (days) by gear for statistical areas in the Central Coast management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

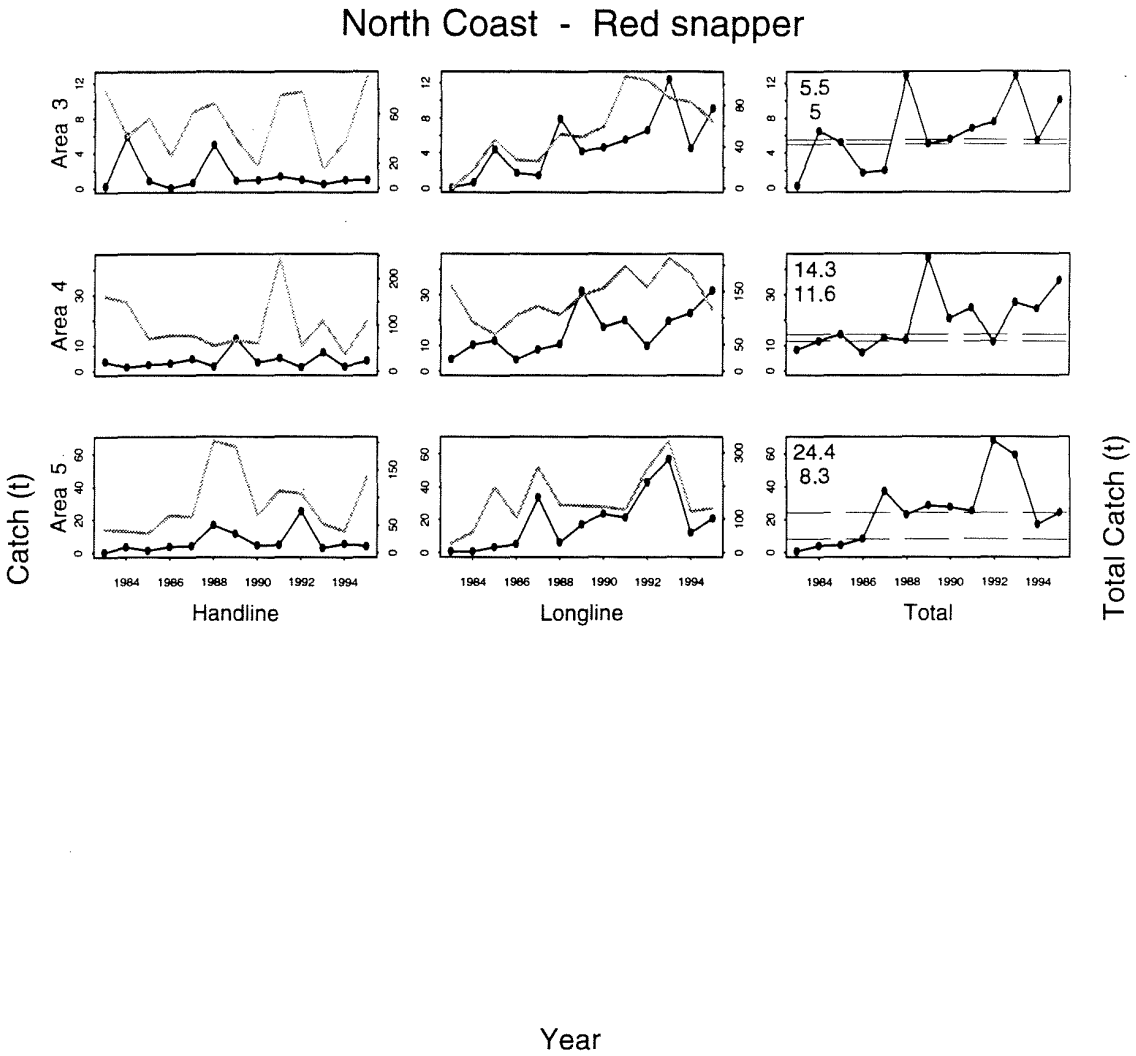


Fig. 11. Red snapper catch (t) and effort (days) by gear for statistical areas in the North Coast management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

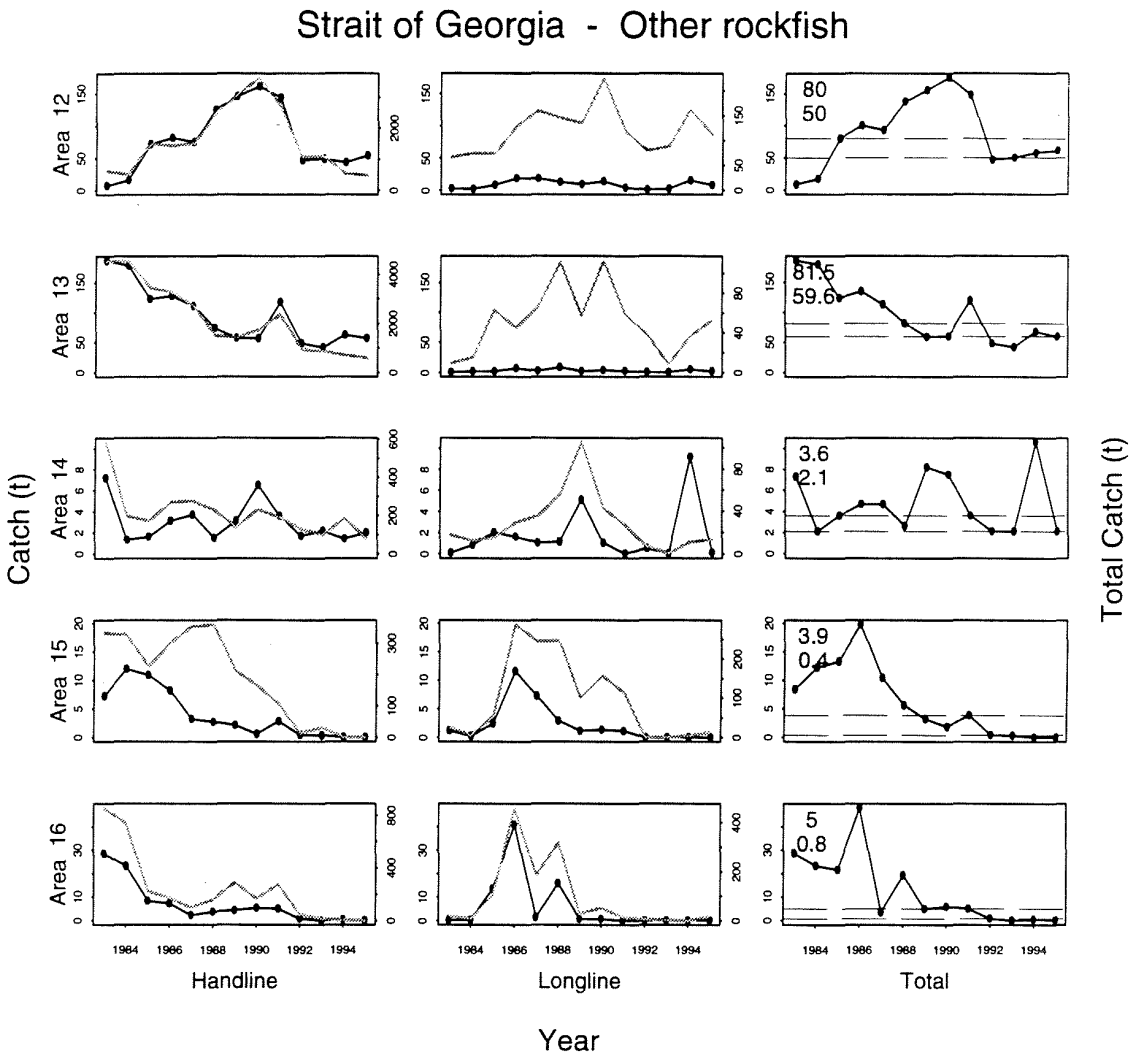


Fig. 12. Other rockfish catch (t) and effort (days) by gear for statistical areas in the Strait of Georgia management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

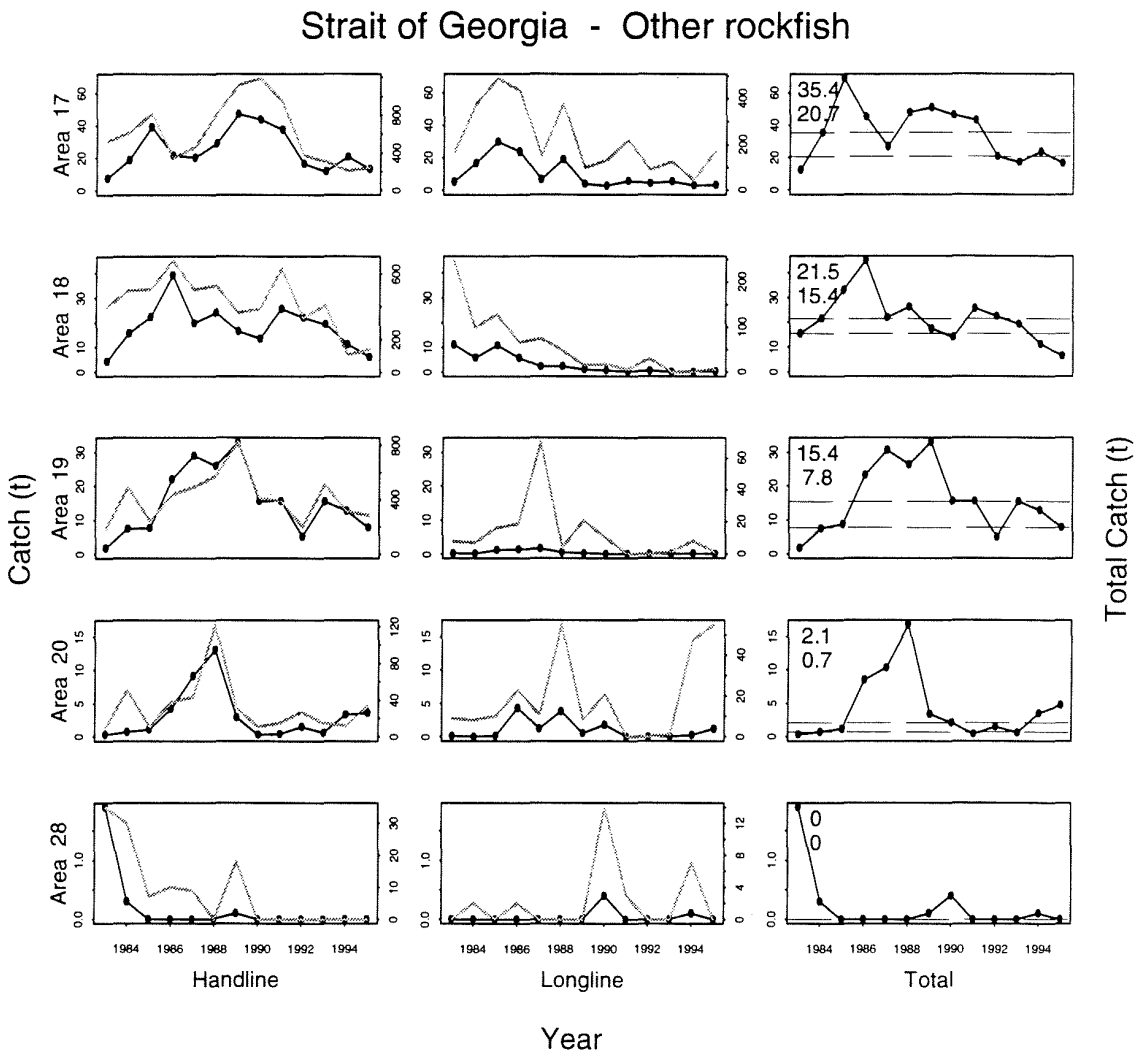
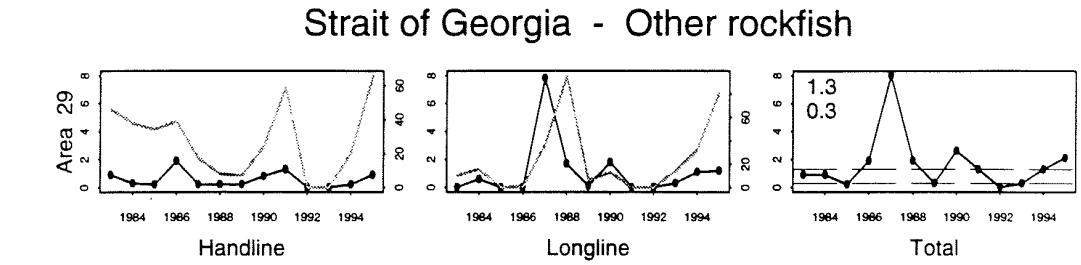


Fig. 12 - Cont'd



Catch (t)

Total Catch (t)

Year

Fig. 12 - Cont'd

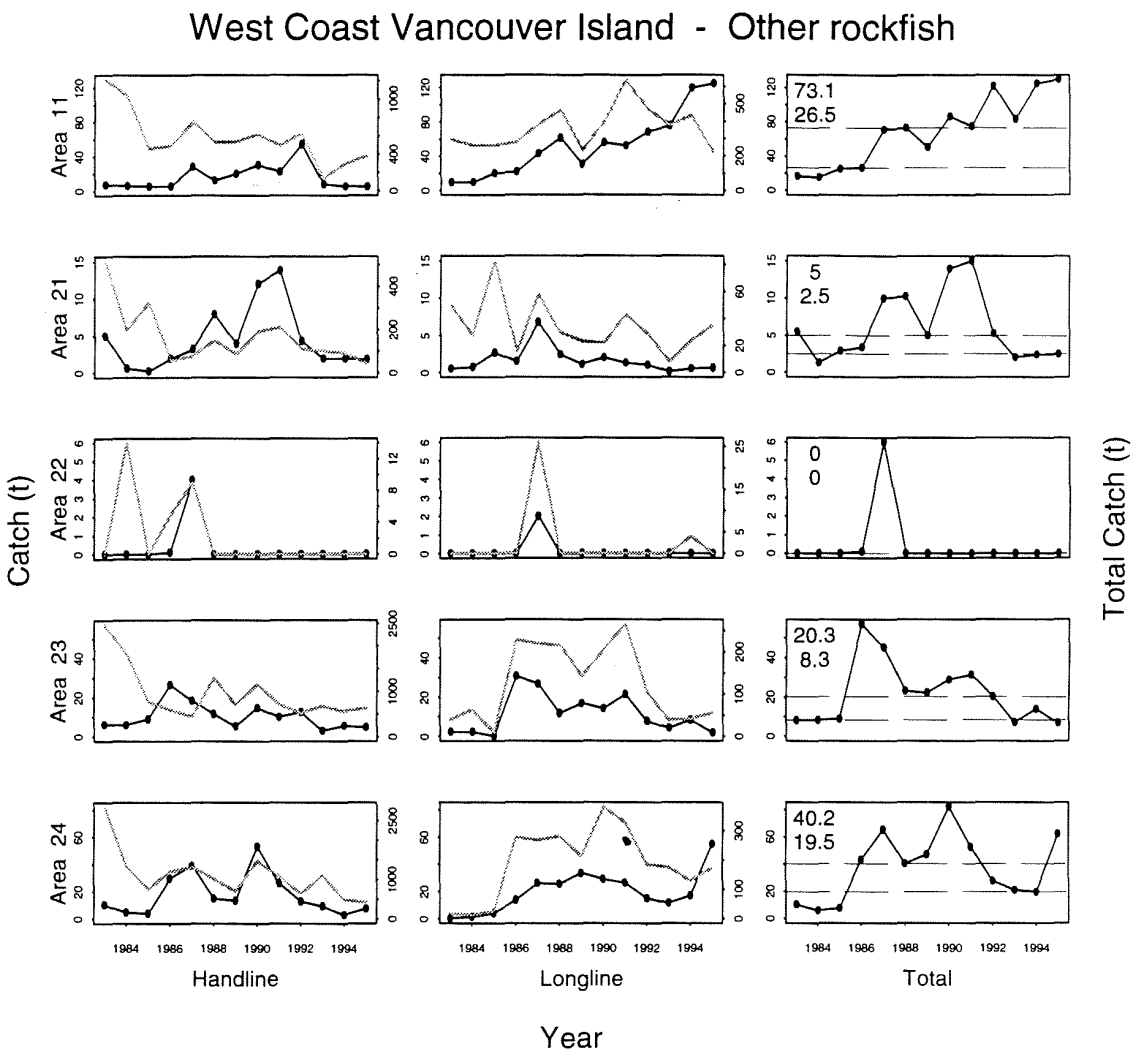


Fig. 13 Other rockfish catch (t) and effort (days) by gear for statistical areas in the West Coast Vancouver Island management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

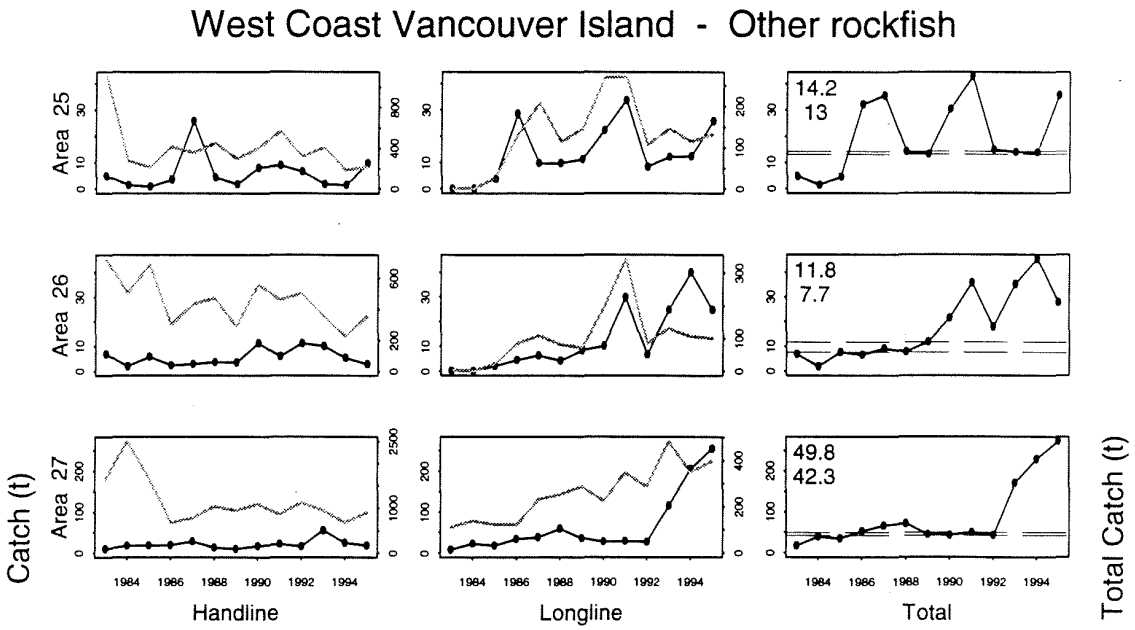


Fig. 13 - Cont'd

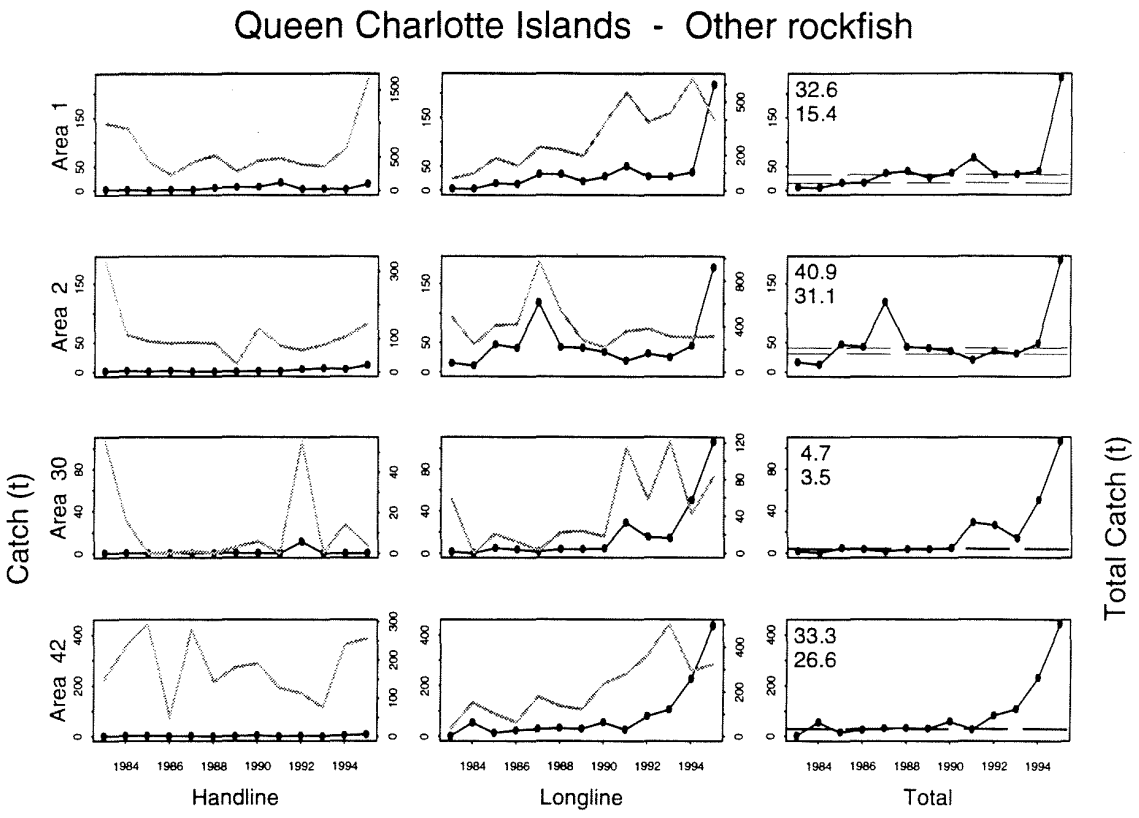


Fig. 14. Other rockfish catch (t) and effort (days) by gear for statistical areas in the Queen Charlotte Islands management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

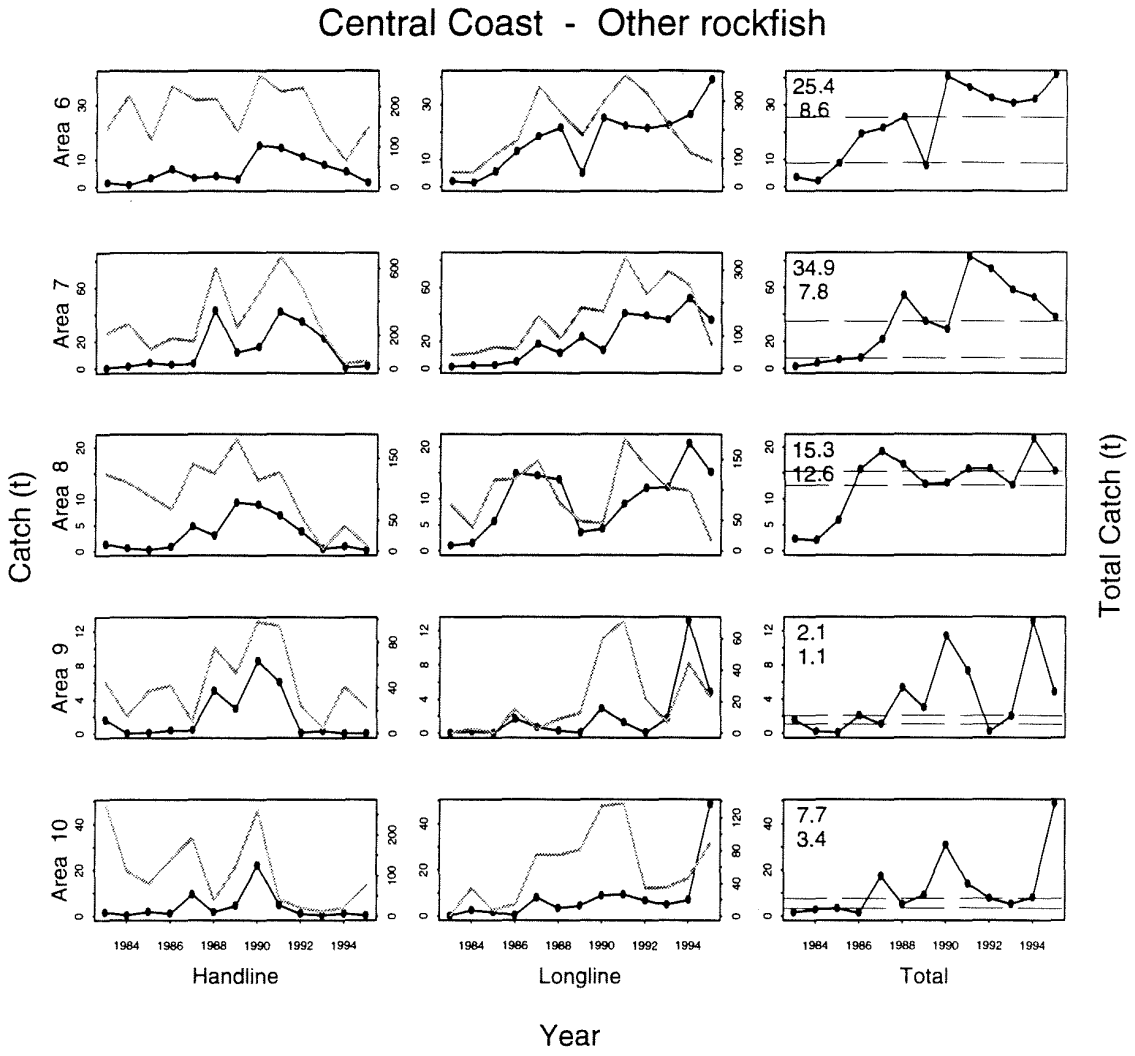


Fig. 15. Other rockfish catch (t) and effort (days) by gear for statistical areas in the Central Coast management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

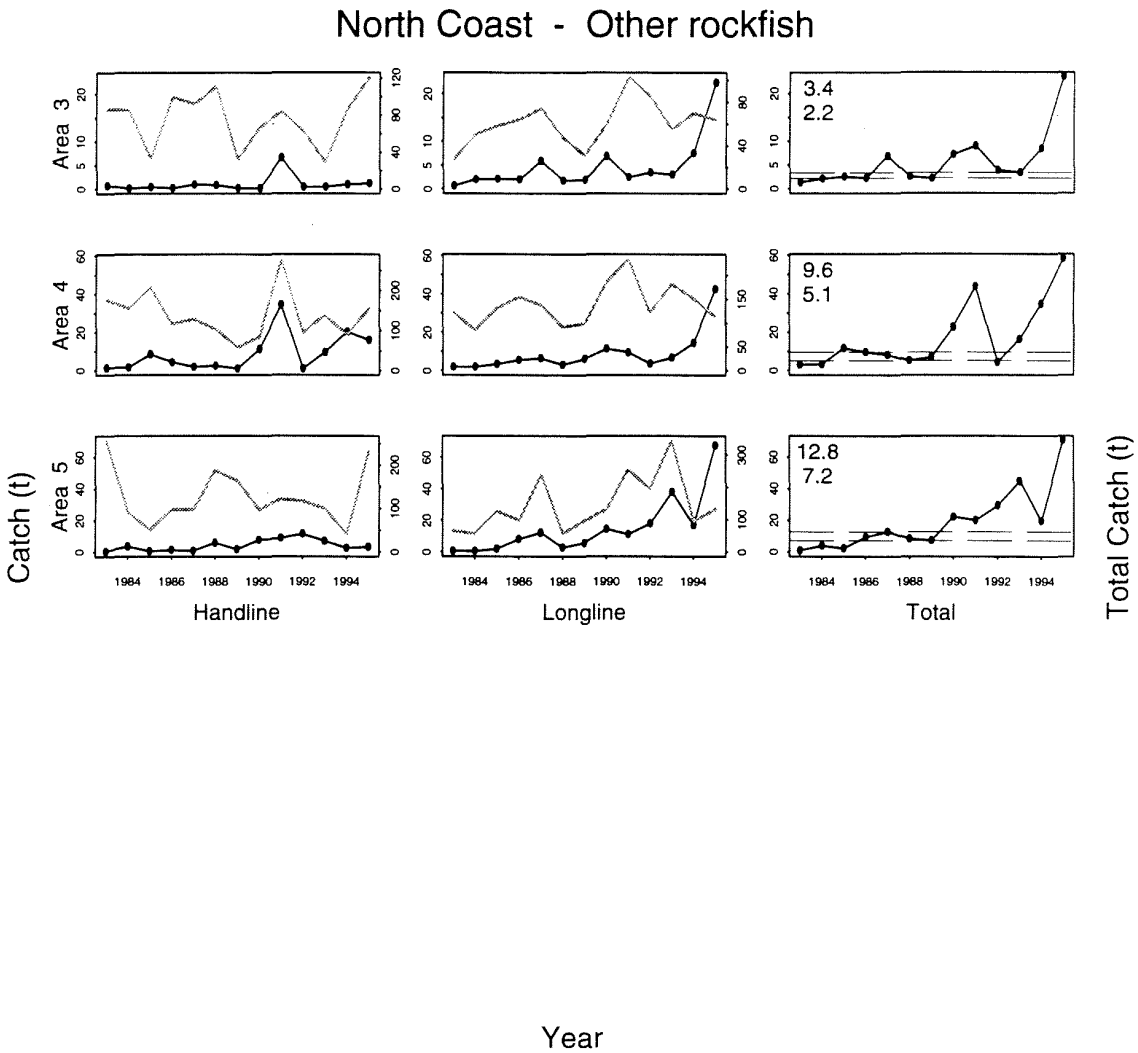


Fig. 16. Other rockfish catch (t) and effort (days) by gear for statistical areas in the North Coast management region. Catch is shown using a solid black line overlaid with circles. Effort is shown by the solid gray line. Horizontal dashed lines in the last panel of each row (and the lower and upper number in the top left) indicate the 25*th* percentile and median catch levels.

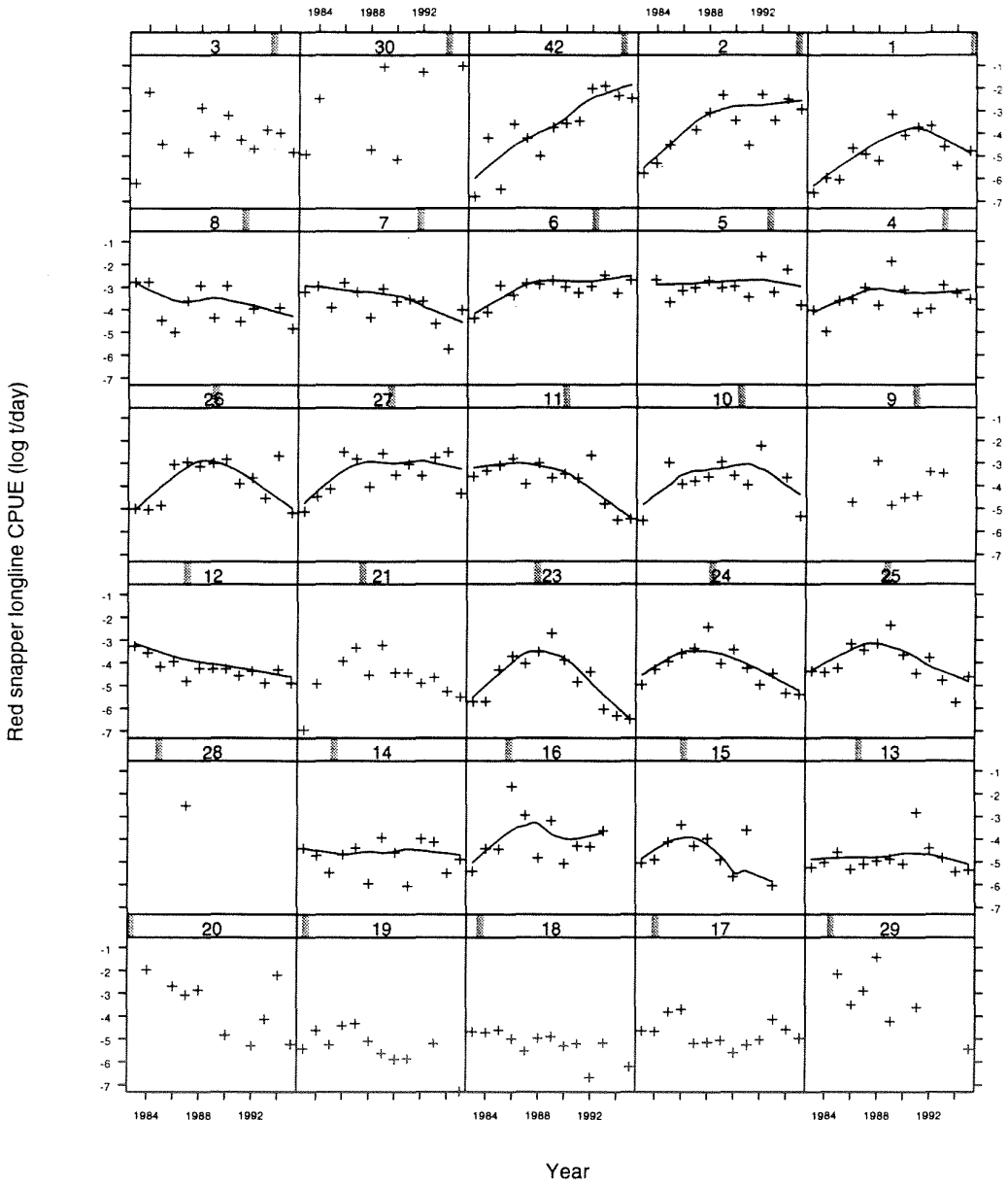


Fig. 17. Red snapper longline CPUE (ln(t/day)) for years 1983 - 1995. Loess smooths of the trend are shown for statistical areas with greater than about 100 days fished per year.

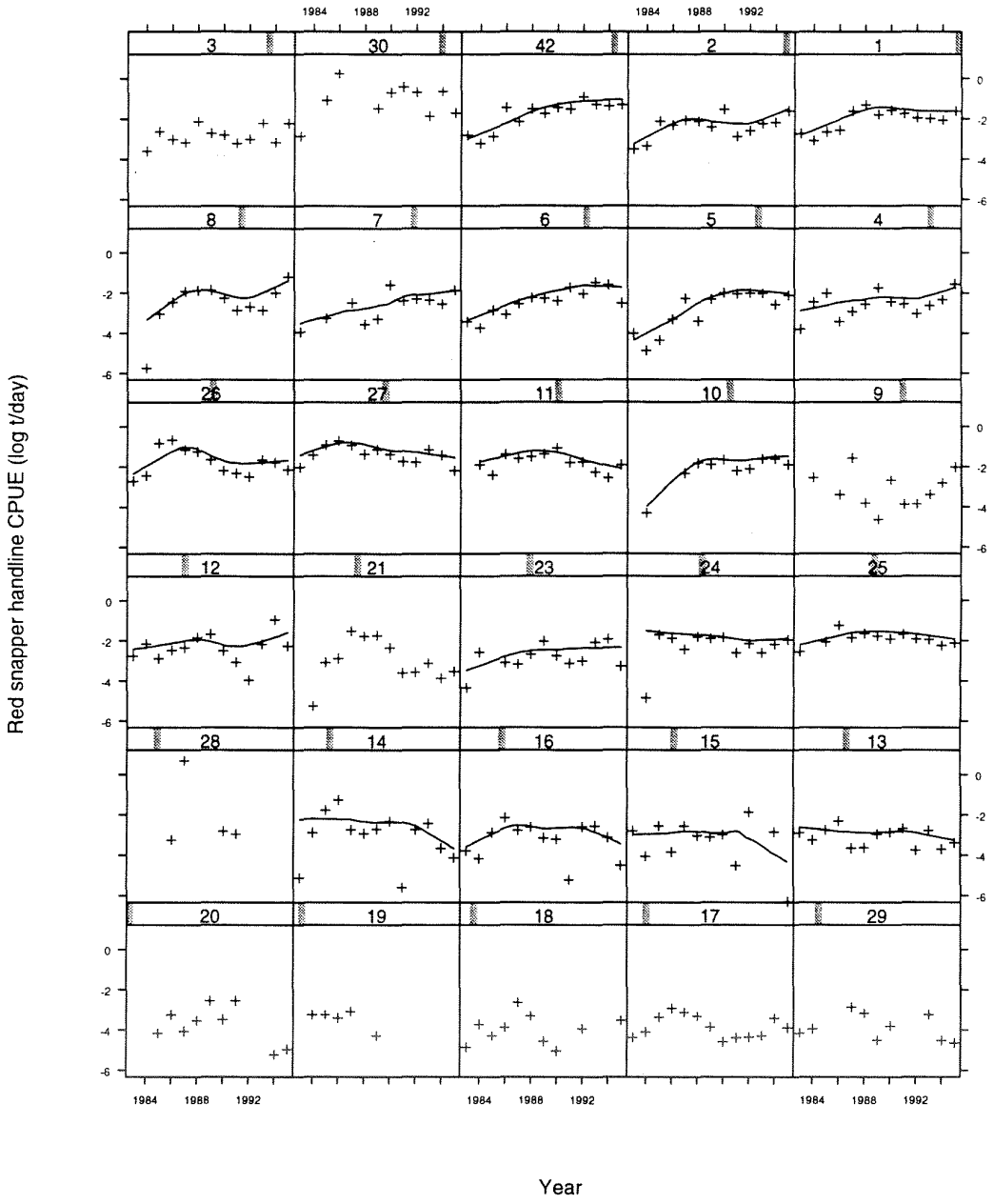


Fig. 18. Red snapper handline CPUE (ln(t/day)) for years 1983 - 1995. Loess smooths of the trend are shown for statistical areas with greater than about 100 days fished per year.

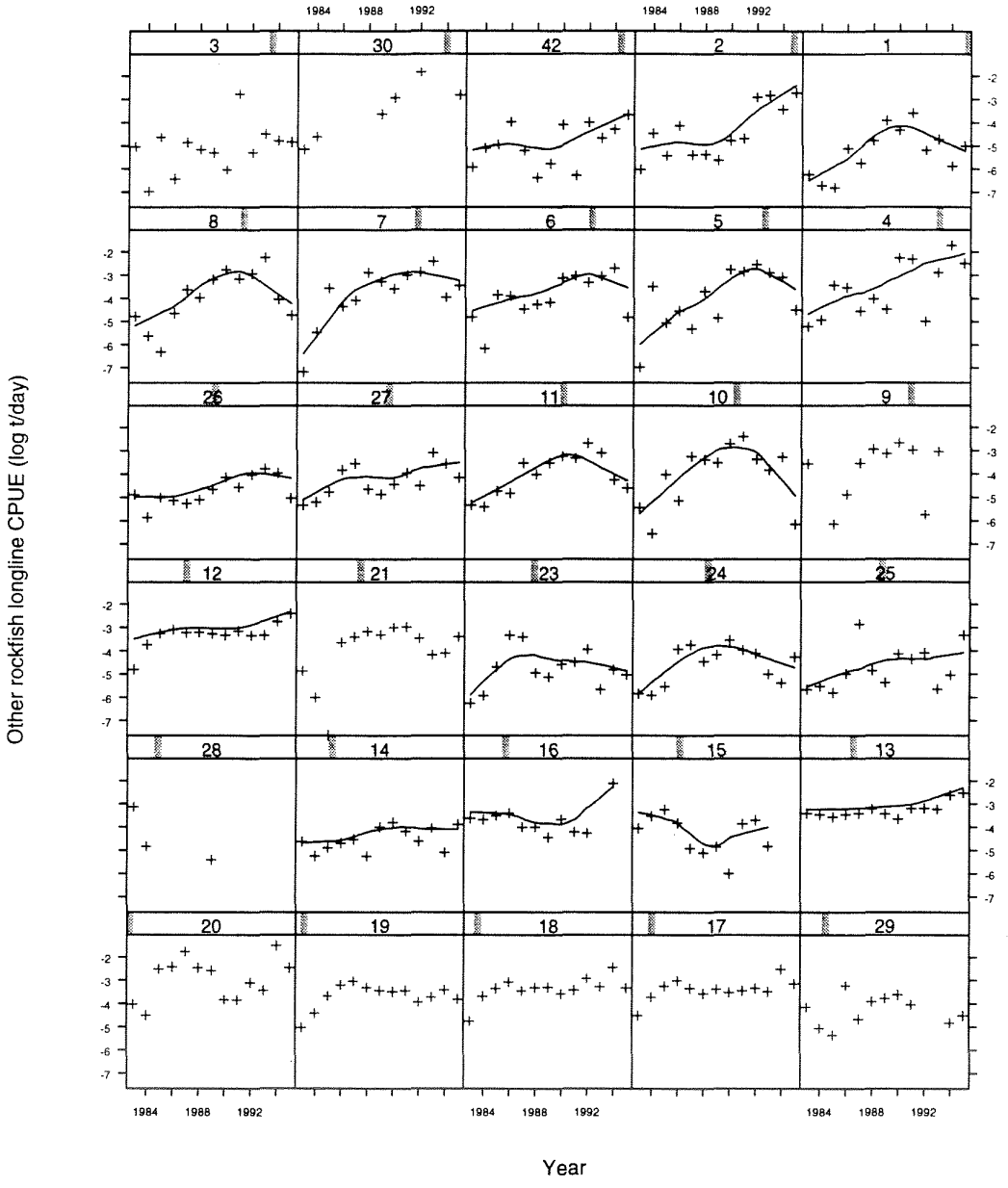


Fig. 19. Other rockfish longline CPUE (ln(t/day)) for years 1983 - 1995. Loess smooths of the trend are shown for statistical areas with greater than about 100 days fished per year.

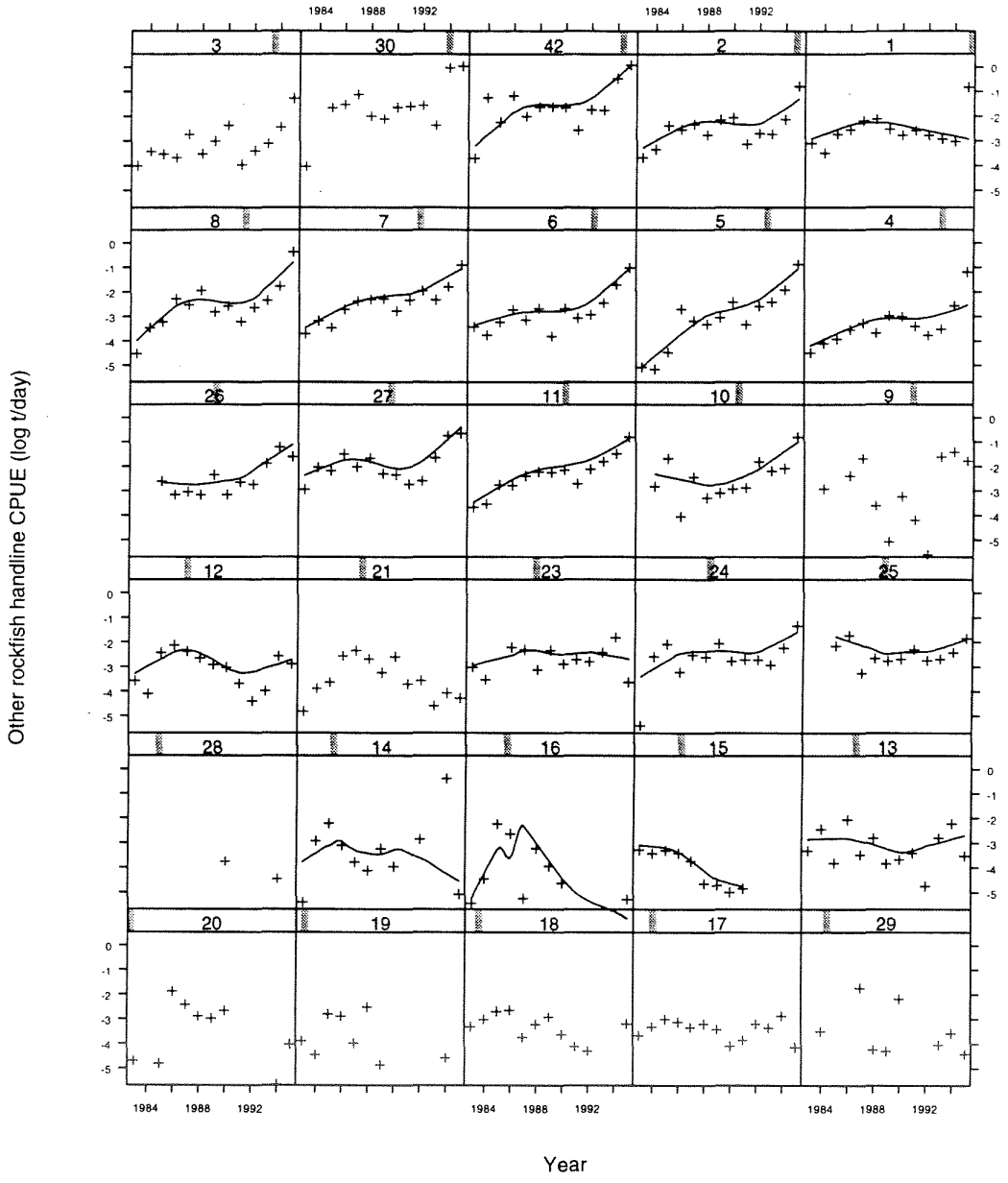


Fig. 20. Other rockfish handline CPUE (ln(t/day)) for years 1983 - 1995. Loess smooths of the trend are shown for statistical areas with greater than about 100 days fished per year.

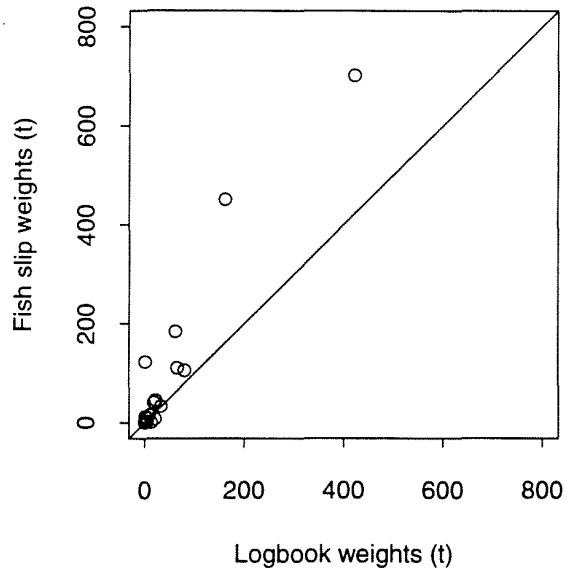


Fig. 21. Comparison of rockfish weights by species between logbooks and fish slips in 1994.

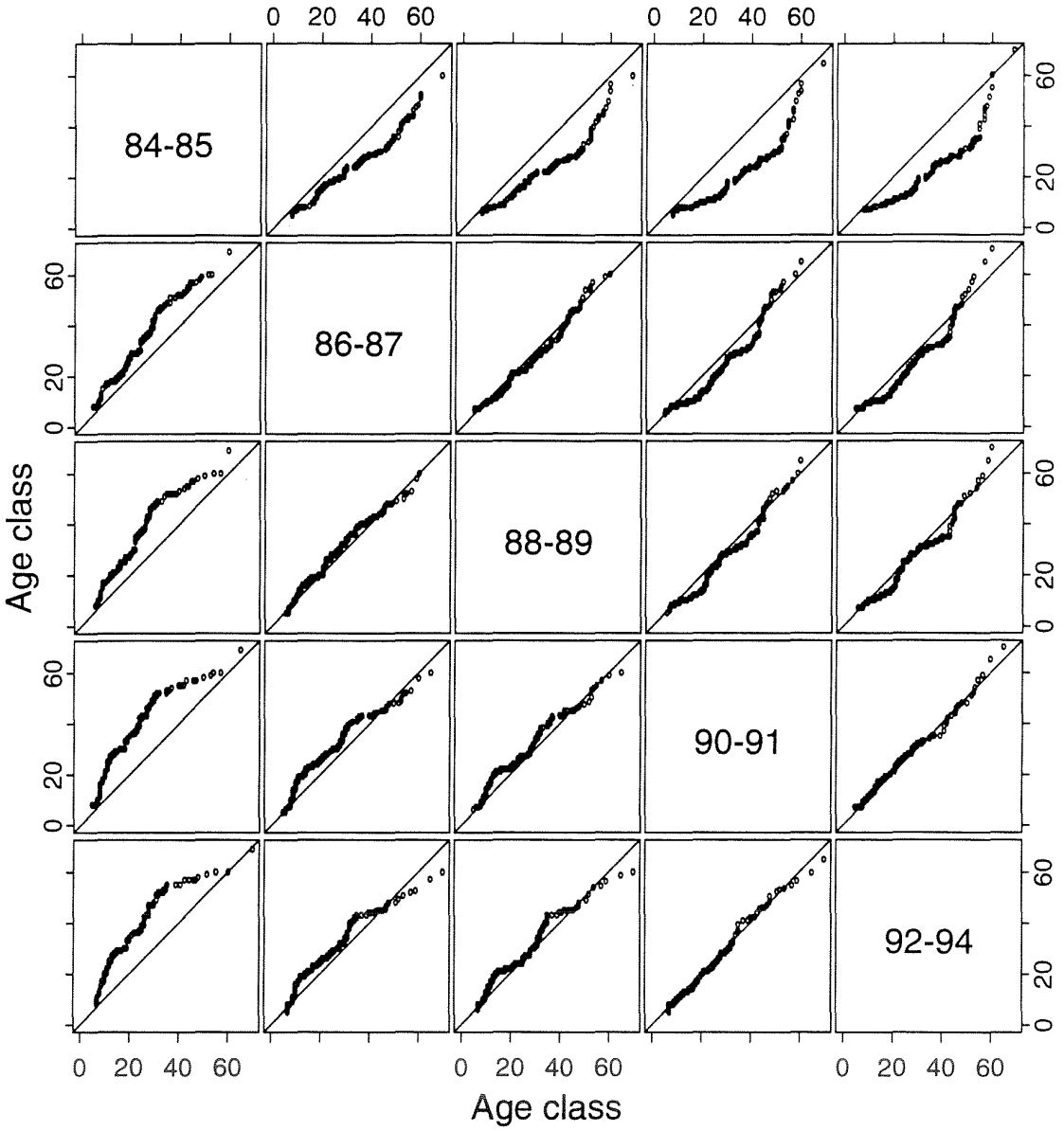


Fig. 22. QQ-plot of quillback rockfish ages for the years 1984-85, 1986-87, 1988-89, 1990-91 and 1992-94.

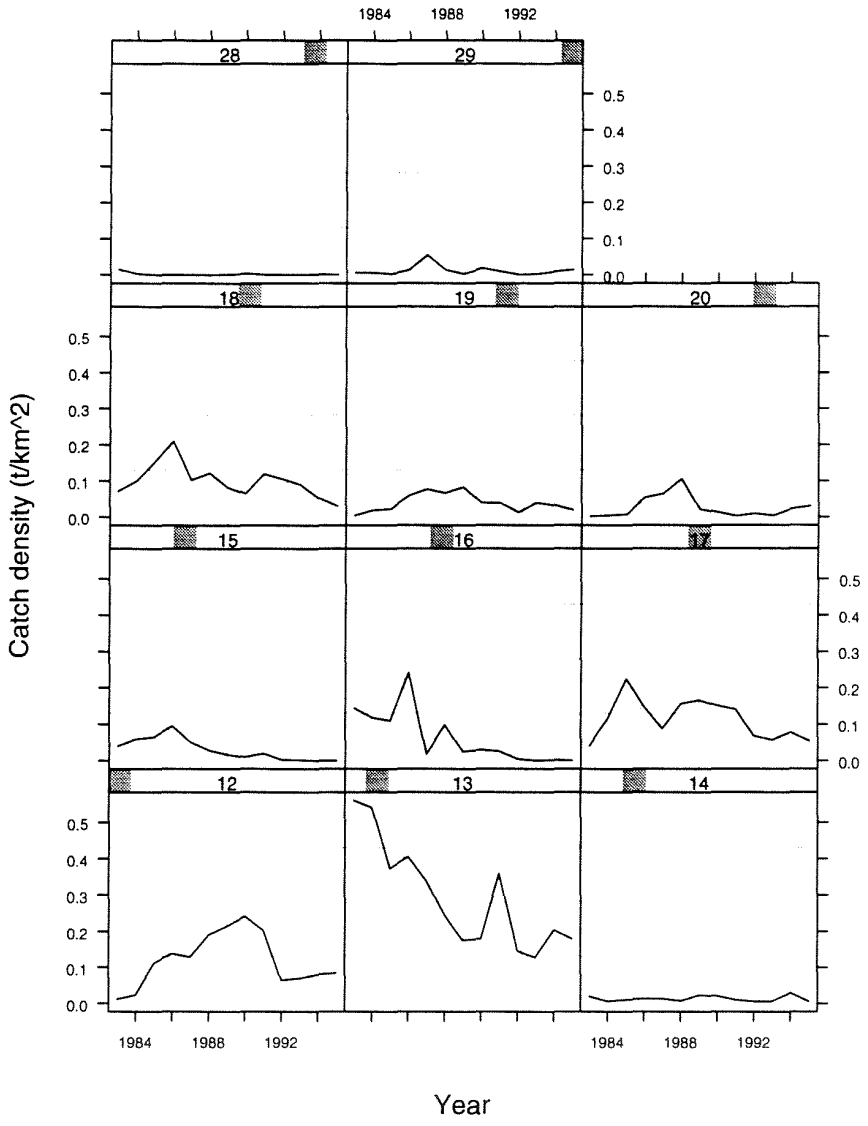


Fig. 23. Other rockfish catch density (t/km^2) as a function of year given statistical area in the Strait of Georgia.

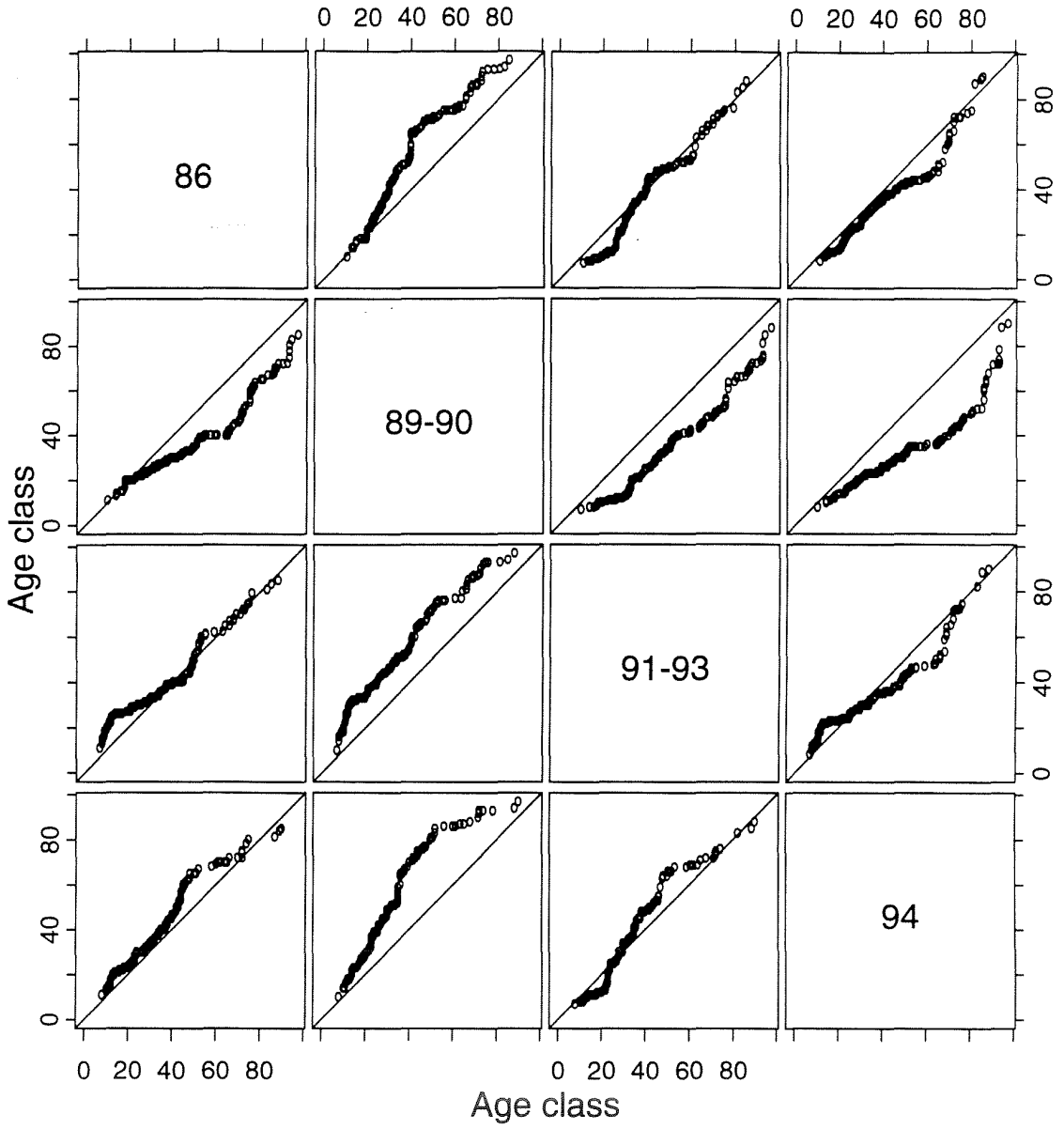


Fig. 24. QQ-plot of yelloweye rockfish ages for the years 1986, 1989-90, 1991-93 and 1992-94.

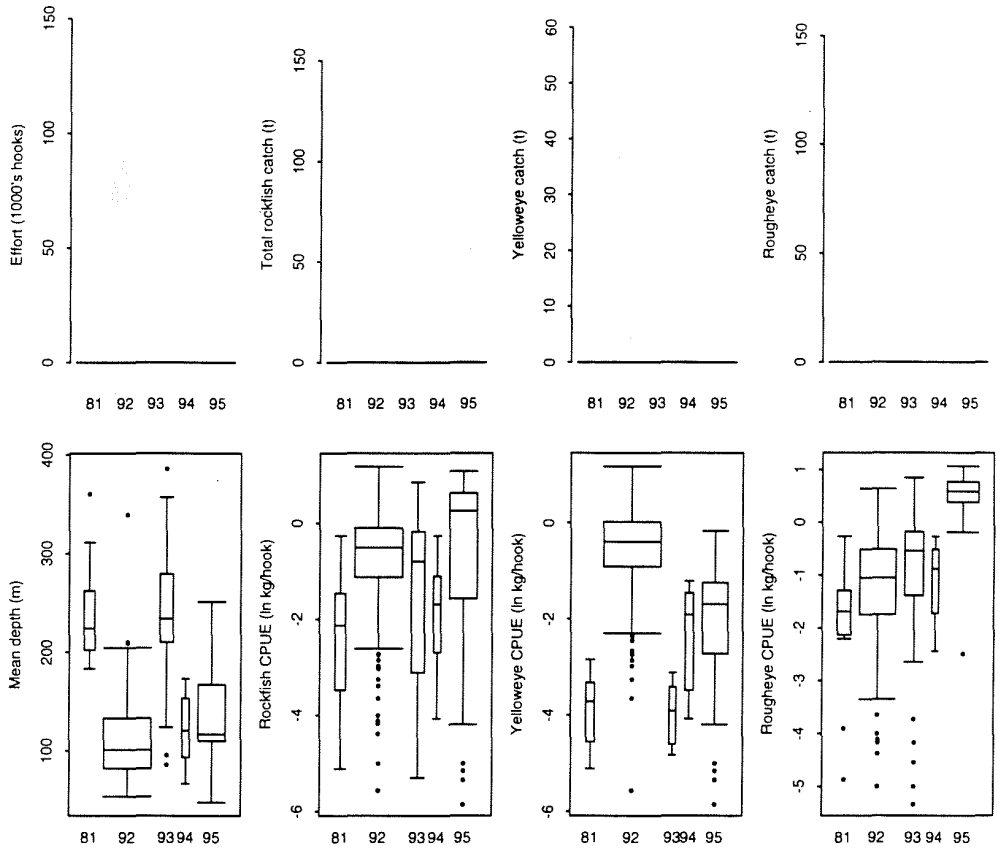


Fig. 25. Catch, effort, and CPUE data from the Bowie Seamount by year and species. The width of boxplots is proportional to the sample size within each year.

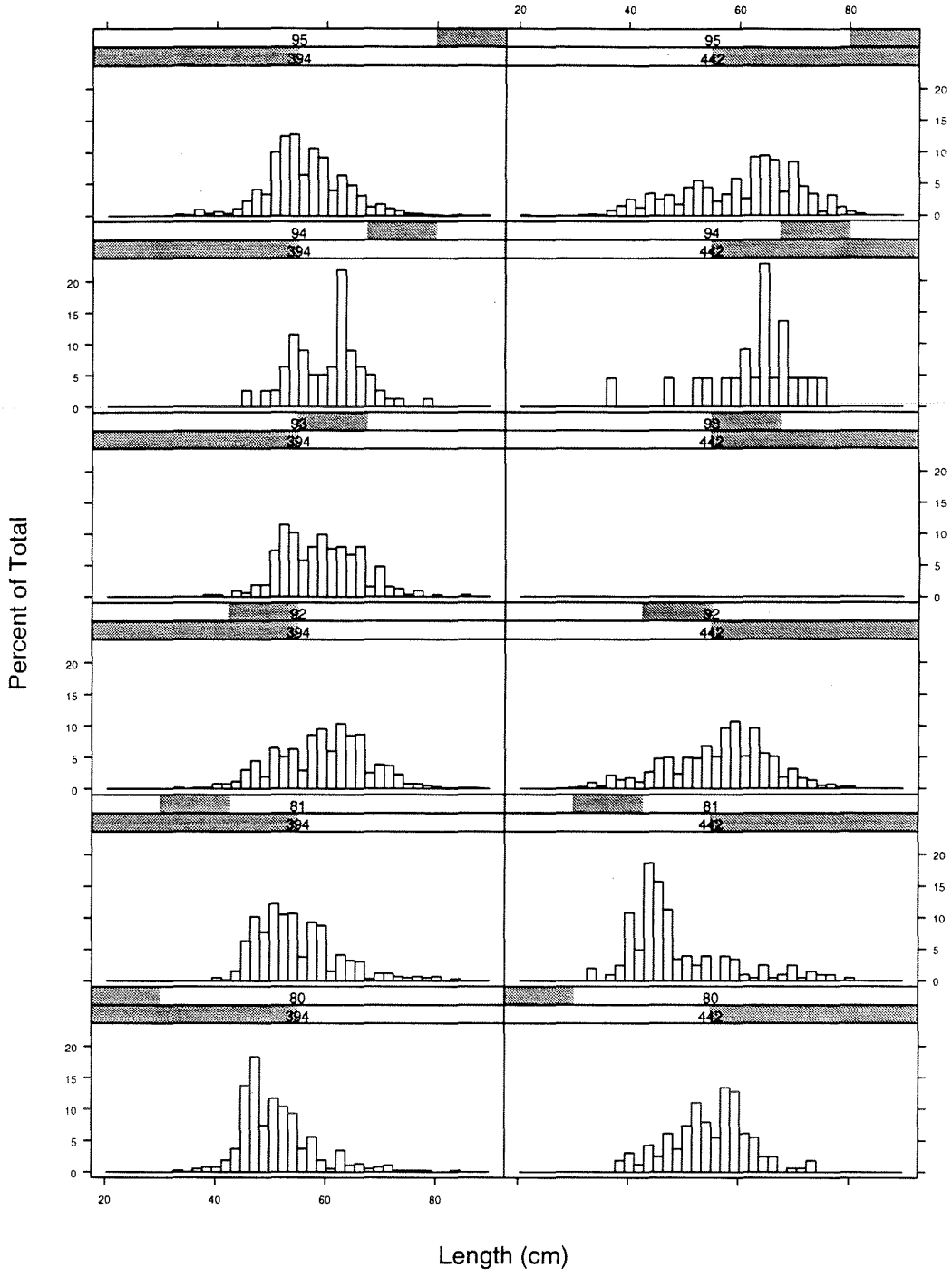


Fig. 26. Length frequency histograms by year given species (rougheye=396, yelloweye=442) from the Bowie Seamount.