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A RELATIONAL DATABASE FOR HOOK AND LINE ROCKFISH LOGBOOK DATA

by

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ABSTRACT

Haigh, R., and L. J. Richards. 1997. A relational database for hook and line rockfish logbook data. Can. Manuscr. Rep. Fish. Aquat. Sci. 2408: 46 p.

In 1986, commercial hook and line rockfish fishers were required to obtain a ZN category license, obligating them to keep logbook records. Currently, these records are coded and translated into electronic form by a Department of Fisheries and Oceans (DFO) contractor. The electronic records are then transferred to the Pacific Biological Station (PBS) where they are entered into a Microsoft ACCESS v.2.0 relational database called RFLOGS.MDB. This report serves to document the 1986-95 commercial hook and line rockfish logbook data, provide standardized field names and descriptions, describe the database structure, and present exploratory analyses.

RÉSUMÉ

Haigh, R., and L. J. Richards. 1997. A relational database for hook and line rockfish logbook data. Can. Manuscr. Rep. Fish. Aquat. Sci. 2408: 46 p.

En 1986, il a élé fait obligation aux ligneurs commerciaux de sébastes d'obtenir un permis de la catégorie ZN, qui exige de leur part la tenue de journaux de bord. À l'heure actuelle, ces registres sont codés et mis sous forme électronique par un fournisseur du ministère des Pêches et des Océans (MPO). Les registres électroniques sont alors transférés à la Station de biologie du Pacifique, où ils sont versés dans une base de données relationnelles appelée RFLOGS.MDB exploitée sous Microsoft ACCESS v.2.0. Ce rapport fait état des données recueillies grâce aux journaux de bord sur la pêche commerciale des sébastes aux lignes, fournit des noms et des descriptions standardisés pour les champs, décrit la structure de la base de données et présente des analyses exploratoires.

1. Introduction

In 1986, commercial hook and line rockfish fishers were required to obtain a ZN category license, obligating them to keep logbook records. Currently, these records are coded and translated into electronic form by a Department of Fisheries and Oceans (DFO) contractor with funds provided by fishers. The electronic records are then transferred to the Pacific Biological Station (PBS) where they are entered into a Microsoft ACCESS v.2.0 relational database called RFLOGS.MDB. This report serves to:

1) document the hook and line rockfish logbook data;
2) provide standardized field names and descriptions;
3) describe a relational database for the logbook data;
4) present exploratory analyses demonstrating the extent of the data.

The database currently contains ten years of logbook data from 1986 to 1995. Data from 1986 to 1988 were collected as part of a research program and were archived on PBS's VAX system. Data from 1989-92 are only partially represented in the database as funding was only sufficient for the keypunching of records associated with 28 of the more active fishing vessels; these funds also covered the keypunching of all 1993 data. The logbook program was changed to a user-pay system in 1994. The price of the logbook includes printing, administration, and data entry and verification.

The hook and line rockfish logbook database has the potential to enhance stock assessment. Historically, the sales slip system was the primary source of catch information; however, species were recorded as either "red snapper" or "other rockfish". Logbook data were originally collected to enhance rockfish research, but were soon incorporated into stock assessments. They have not been used as primary data sources until now for several reasons. Prior to 1995, there was little official verification of species composition. This meant that rockfish species could be mis-identified. Additionally, catches by set are estimates and do not necessarily match verified weights at offload time. Beginning in 1995, the dockside monitoring program (DMP) was set up to ensure proper sorting and enumeration at offload times. Currently, Archipelago Marine Research (AMR) is the designated contractor and provides observers certified by DFO.

There are 68 rockfish species in the genus *Sebastes* found along the coasts of North America and two species in the genus *Sebastolobus* (Kramer and O'Connell 1986); 22 species of rockfish are caught by hook and line gear along the BC coast (Yamanaka and Kronlund 1997). The commercial fishery markets live, fresh round, and filleted product to domestic markets and fresh round and filleted fish to US markets. Yelloweye rockfish (*Sebastes ruberrimus*), also known as red snapper, rougheye rockfish (*S. aleutianus*), and redbanded rockfish (*S. babcocki*) are targeted by longliners who deliver the product "iced" to the fresh round market. Handliners generally deliver "live" quillback rockfish (*S. maliger*) to the Vancouver area, as well as copper rockfish, china rockfish, and tiger rockfish. The majority of other rockfish are filleted for the fresh market.

All rockfish are long-lived. Yelloweye rockfish, quillback rockfish, and copper rockfish from BC have been aged to 102, 78, and 45 years, respectively; rougheye rockfish have

been aged to 147 years (PBS data files). Individual species tend to segregate by habitat type and depth. In the Strait of Georgia, copper rockfish is the dominant species shallower than 20 m (Richards 1987), while below 20 m, yelloweye rockfish tend to be found at deeper depths than quillback rockfish (Richards 1986).

The commercial British Columbia rockfish fishery is dominated by trawlers who harvest approximately $15 million of fish per year, chiefly Pacific ocean perch (*Sebastes alutus*) and yellowtail rockfish (*S. flavidus*). In contrast, the hook and line fishery is worth $5 million annually and is characterized by fairly simple fishing technology. Hook and line gear consists of (i) handlines, (ii) troll lines, or (iii) longlines. Handlines are basic rod and reel systems, most often used for fishing live rockfish in the waters east of Vancouver Island. The number of hooks used per rod and reel set-up can range from one to eight. Trolling involves towing weighted multiple hook lines from the boat. Trollers employ 8-12 hooks per line. Longlines are the most complicated system and utilize the most hooks per line. Typically, two buoys are anchored at some distance apart with a line or "skate" running between them. Along the skate, individual lines called "gangions" are attached with a snap or stainless steel fastener; each gangion has a hook. Therefore, each longline set can present thousands of hooks.

Section 2 provides a brief historical background of the hook and line rockfish fishery. Section 3 discusses the logbook format and describes the layout for transference to electronic form. Section 4 details how the raw data are transferred to Microsoft ACCESS and points out problems and concerns one should recognize in the rockfish logbook data. Section 5 describes the database set-up: field names, documentation, tables of information and data, and relationships among the tables. Section 6 gives a brief exploratory analysis of the data.

2. Background Information on the Hook and Line Rockfish Fishery

The hook and line rockfish fishery is divided into a number of management areas (Fig. 2.1a, b). The inside fishery is referred to as the Strait of Georgia fishery, but is comprised of all waterways between Vancouver Island and the mainland (areas 12-20, 28, 29). All other areas along the BC coast are referred to as the outside fishery: West Coast Vancouver Island (areas 11, 21-27, 111, 121-127), Queen Charlotte Islands (areas 1-2, 101-102, 130, 142), North Coast (areas 3-5, 103-105), and Central Coast (areas 6-10, 106-110).

The commercial catch from 1956-76 averaged 161 t coastwide (Yamanaka and Kronlund 1997) and was primarily incidental to other hook and line fisheries for halibut, lingcod, salmon, and dogfish. However, in 1977 the fishery began to expand (Fig. 2.2) when a market developed for live rockfish in Vancouver's restaurants and retail outlets (Richards 1988). Fishing activity was concentrated in waters of the Gulf Islands and those adjacent to the Nanaimo area. As the fishery expanded, fishing effort shifted northward to waters between Desolation Sound and Jervis Inlet, on the mainland side. By the early 1980s rockfish were being targeted in Area 13 - the waters off Cape Mudge and the inland waterways north of Campbell River. A further northward shift to Area 12 - the waters of Queen Charlotte Strait and adjacent inlets - had occurred by 1987. Areas 12 and 13 remained primary fishing grounds for rockfish, but fishing effort continued a northward expansion so that live rockfish are now air-freighted and trucked to Vancouver from all regions of the coast, including the Queen Charlotte Islands.

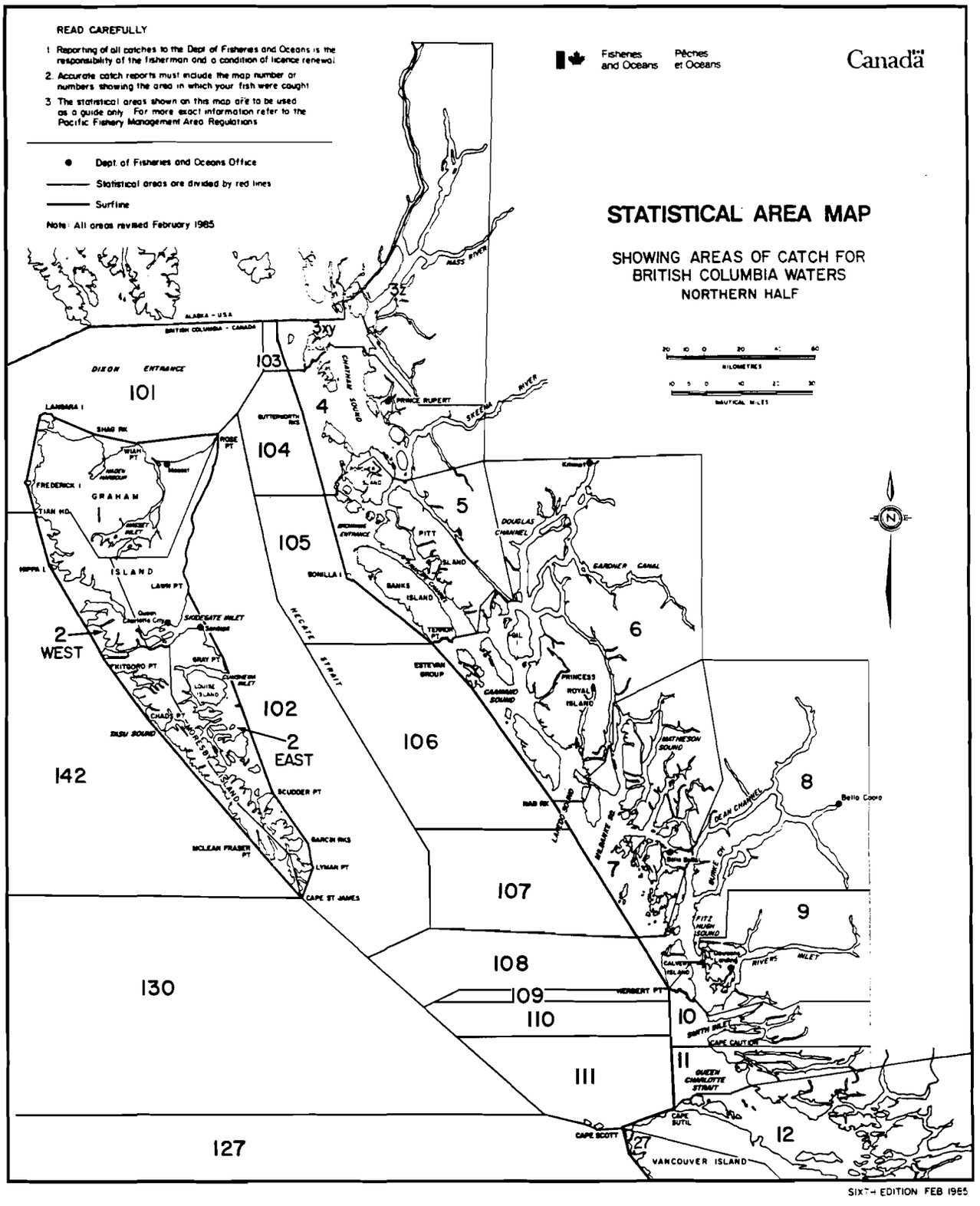


Fig. 2.1a. Statistical area map for BC waters, northern half

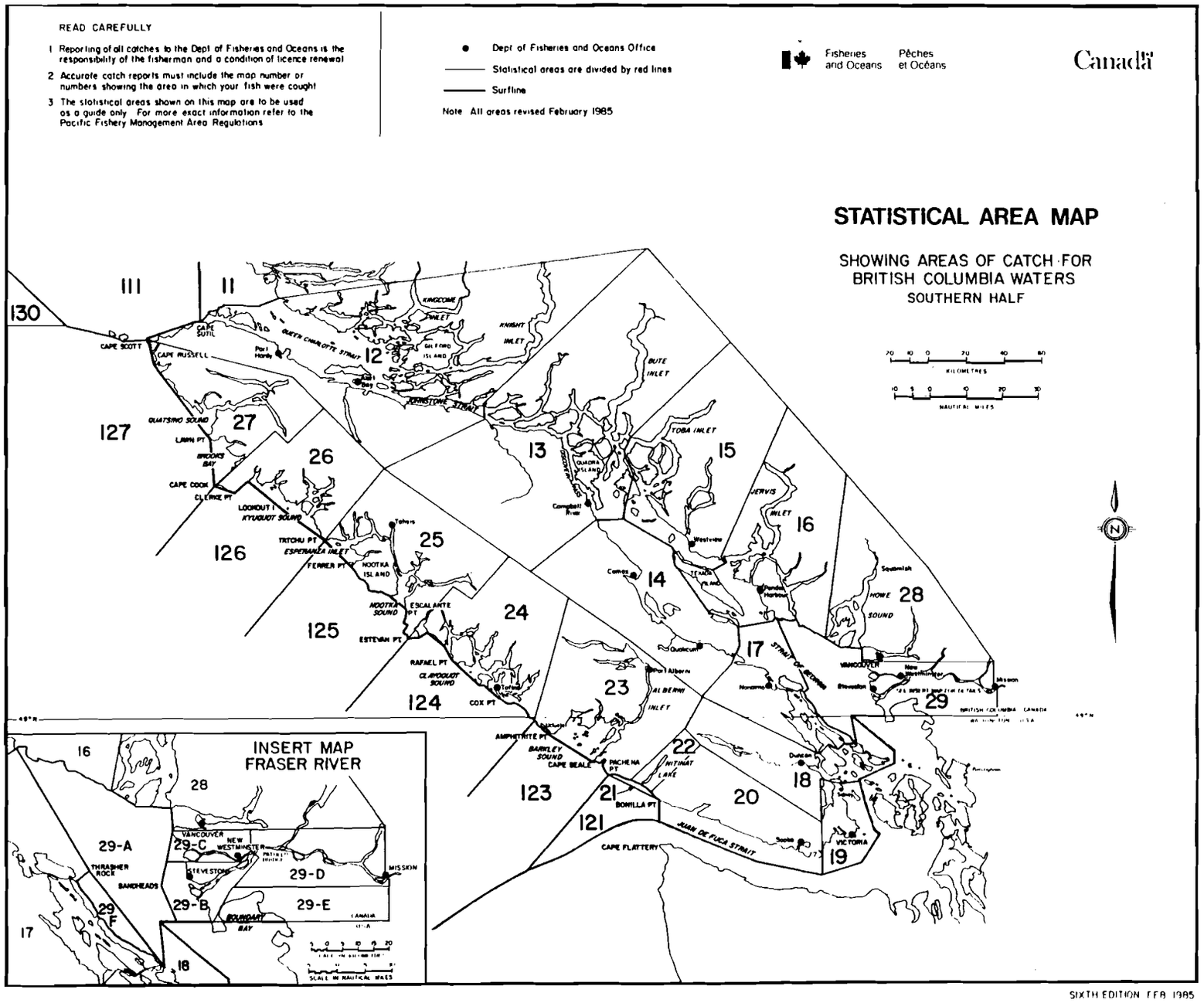


Fig. 2.1b. Statistical area map for B.C. waters, southern half.

Until 1986, any commercial vessel with a C license could harvest rockfish without limit. To gain a better understanding of this fishery, the category ZN license was created in 1986 specifically for rockfish. However, licenses continued to be issued without limit (see Table 2.1) until 1990 when 2,396 ZN licenses were in use. Additionally, the incidental catch of rockfish by trawlers targeting rock sole, Pacific cod, and lingcod increased from 26 t in 1988 to 94 t in 1995 (Yamanaka and Kronlund 1997).

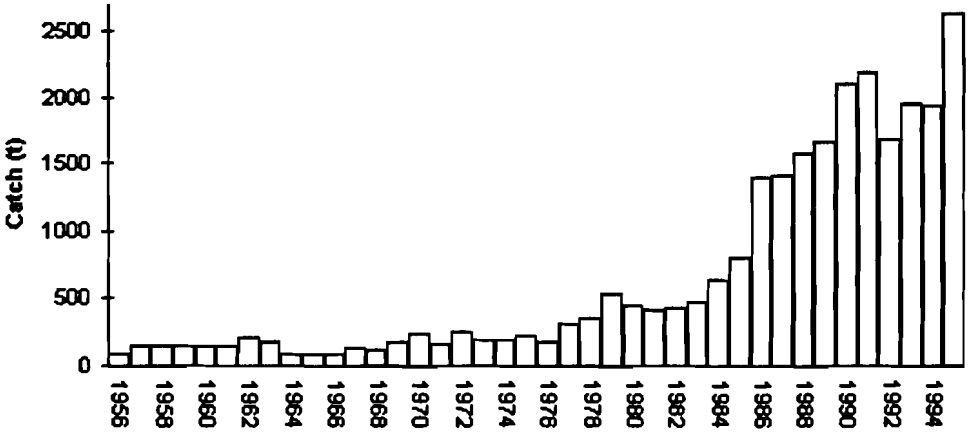


Fig. 2.2. Coastwide rockfish catch (t) of commercial hook and line fishery.

In 1990, the Groundfish Hook and Line Advisory Committee (GHLAC) was established to advise DFO on issues concerning the hook and line fisheries. The GHLAC proposed limited-entry licensing which was implemented in 1992 for the inside fishery and in 1993 for the outside one. With a drastic decrease in operating vessels and the implementation of quota restrictions, the inside fishery experienced a reduction in catch (Table 2.1). The catch from the outside fishery continued to increase after license limitation.

Table 2.1. Commercial hook and line rockfish fishery statistics, 1986-95.

Year	Licenses[A]			Quota[B](t)-some rockfish		Catch[C](t)-all rockfish	
	Inside	Outside	Total	Inside	Outside	Inside	Outside
1986	NA	NA	1362[U]	—	—	525	871
1987	NA	NA	1935[U]	75[D]	—	414	1003
1988	NA	NA	2105[U]	—	—	497	1077
1989	NA	NA	2319[U]	—	—	460	1216
1990	NA	NA	2396[U]	—	650	470	1635
1991	592	1595	2187[U]	350	1000	481	1715
1992	70	1223[U]	1293	189	1000	177	1513
1993	73	178	251	210	1040	199	1757
1994	74	181	255	220	924	274	1668
1995	76	183	259	212[E]	1088[E]	183[F]	2456[F]
1996	67	168	235	176[E]	820[E]	194[F]	1445[F]

[A]Darrius Yu (DFO Vancouver, pers. comm.)

[B]Red snapper and other rockfish combined. Managers applied the quota to those species historically taken by the hook and line sector which included (quillback, copper, china and tiger rockfish). The hook and line sector was also entitled to slope and shelf rockfish quotas which were historically fished by trawl. Quotas for these species are not captured in this table.

[C]BC Catch Statistics, Annual Reports, total commercial hook and line rockfish catch (including non-quota species), cited in Yamanaka and Kronlund (1997)

[D]applied to Area 12 only

[E]quota is for yelloweye rockfish and aggregates 1 and 2 only (see Table 2.2)

[F]Dockside Monitoring Program, Archipelago Marine Research

[U]Unlimited entry license

Inside = Statistical Areas 12-20, 28, 29; Outside = Statistical Areas 1-11, 21-27, 101-111, 121-127, 130, 142

Table 2.2. Coastwide aggregate rockfish species quotas for 1996 and hook and line catch.

Agg	Rockfish Species	Quota[A] (t) Hook & Line + Trawl		Hook & Line Catch[B]	
		Species	Aggregate	tonnes	%Agg Quota
1	Quillback and Copper	—	523	412.75	94.26
2	China and Tiger	—		80.24	
3	Canary	738	1,813	58.48	8.69
	Silvergray	1,075		99.12	
4	Rougheye	700	1,794	173.91	15.46
	Shortraker	440		92.98	
	Thornyheads (Idiots)	654		10.47	
5	Pacific Ocean Perch	3,350	6,585	1.15	0.21
	Redstripe	1,760		0.52	
	Yellowmouth	1,475		12.28	
6	Yellowtail	4,675	6,725	9.65	0.47
	Widow	2,050		0.42	
	Black	—		21.63	
7	All others (*Sebastes* spp)	—	monthly limit	223.51	—
	Yelloweye	473	473	442.04	93.45

[A]DFO Pacific Region 1996 Management Plan: Groundfish by Hook and Line, 22 Dec 95.

[B]Hook and Line Catch Report: Fishing Options A, B, C, Inside - Archipelago Marine Research.

3. Hook and Line Rockfish ZN Logbooks

The rockfish harvest log program was initiated in 1986 as a research program at the Pacific Biological Station to improve information on the hook and line commercial rockfish fishery (Hand and Richards 1988). The initial datasheets were simple (Appendix A-1) and required each licensed operator to identify the skipper, vessel, fishing method, and CFV number. Additionally, for each fishing set the operator was to record the date, statistical area, location, depth, time spent fishing, and number caught of quillback rockfish, copper rockfish, yelloweye rockfish, lingcod, and others. The data collected from 1986 to 1988 were keypunched by PBS researchers and stored on the VAX system.

After 1988, the rockfish harvest log program was transferred to the Groundfish Management Unit (DFO Pacific Region). The datasheets (Appendix A-2) were amended to include the above variables plus information on gear type, hook size, hook type, number of hooks/skate(line), hook spacing, bait used, management subarea, loran readings, and number of skates used. Species fields were also expanded to include nine explicitly specified rockfish species, with room for three others, and lingcod. Catch information was now to be expressed in round weight (lbs). Logbook data from 1989 to 1993 were converted to electronic form using government funds. As these funds were limited and many logbooks contained obvious coding errors or omissions, only records from 28 selected fishers were keypunched for the 1989-92 datasheets. All records from 1993 were converted.

In 1994, the format of the logbook datasheet changed again with input from industry advisors and the GHLAC (Appendix A-3). The new form was more complex, with nearly half the requested information being optional. The obligatory logbook fields now included:

- CFV number
- vessel
- gear type
- captain
- target species
- date
- location (latitude/longitude)
- depth (min/max)
- management area (including subarea)
- number of hooks
- time spent fishing
- catch in pieces
- date unloaded
- hail report number
- buyer/processor number

Each page of the datasheet had space for recording six sets per fishing trip. Trips with more than six sets used multiple pages. Additionally, catch per set was to be recorded in pieces while total catch for the trip was to be recorded in weight.

Also starting in 1994, the logbook program became a user-pay system. License holders were now required to submit a hard copy and an electronic copy of logbook records to DFO (Offshore Division, Suite 418, 555 W. Hastings St., Vancouver BC, V6B 5G3). Fishers could purchase official logbooks from JO Thomas & Associates Ltd. (1370 Kootenay St., Vancouver BC, V5K 4R1), the current contractor, and could either have this company perform the keypunch service or submit a DOS-compatible diskette with the data stored as an ASCII file. The contractor then produces a fixed-width ASCII file which is transferred to PBS's VAX system. For the purposes of this report we assume that the ASCII file is called YYRFLOGS.TXT where YY = year

Logbook information is more detailed than that obtained from sales slips, which have been the "official" catch record. Landings reported by sales slips tend to be less variable

than those reported by harvest logs because sales slips report catch and effort over a number of days while logbooks report it daily (Hand and Richards 1988). The sales slip database (stored as ASCII files at the Statistics Unit, DFO Vancouver) contains information on statistical area fished, number of days fished, gear used, and the total weight of catch by market category. It should be noted that originally fishers were required to report only one statistical area fished per trip even if they had fished more. Consequently, to compare the sales slip data with logbook data, analysts allocated catch artificially (usually equal-weights) to all areas fished per trip, thus creating comparison errors. Also, prior to 1994, there was no detailed breakdown of rockfish catch by species on sales slips; rockfish were identified as either "red snapper" or "other rockfish". After 1994, sales slips reported catch per species. Additionally, localities were not geo-referenced (latitudes/longitudes). Beginning in 1996, sales slips were not required for ZN license holders who had their landings verified by port monitors via a dockside monitoring program. This latter system, in conjunction with logbook records, is expected to replace the sales slip system.

In the early years of ZN licensing, sales slip records generally recorded more of the rockfish landings than their harvest log counterparts, though logbook data do uniquely identify a small percentage of the total catch not reported by sales slips (Hand and Richards 1988). Hand et al. (1990) noticed that between 1986 and 1988 the two methods agreed best for the longline fishery but even here discrepancies were large for the west coast of Vancouver Island and the North Coast. The handline/troll fishery around Port Hardy and along the west coast of Vancouver Island also showed poor agreement between the two methods. Similarly, the 1993 logbook data only account for 40% of yelloweye rockfish (red snapper) reported through sales slips and 57% of all other rockfish (Yamanaka and Richards 1995). The 1994 and 1995 logbook data are presumably more complete, though the number of records were similar to those for 1993. Fig. 3.1 illustrates the number of logbook records currently available in RFLOGS.MDB and the number of Canadian Fishing Vessels (CFVs) which have contributed to the database.

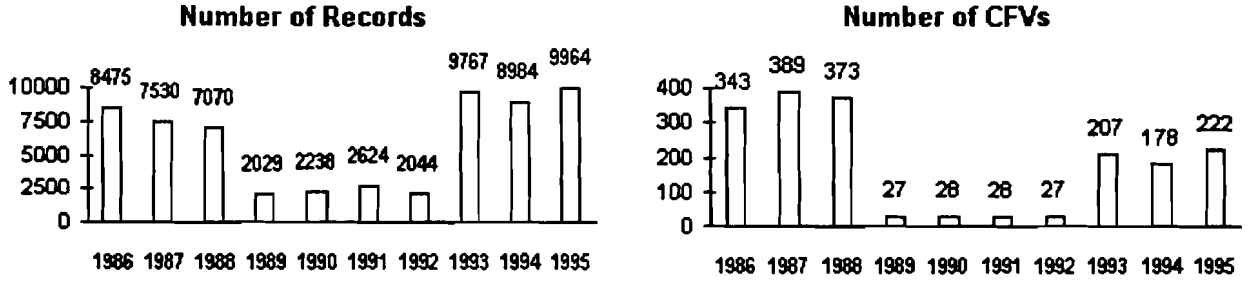


Fig. 3.1. Count of records per year and the number of CFVs contained in the database. Note: Records from 1989-92 are for selected fishers only; not all records were transferred to the database.

4. Importing Text Files

To import fixed-width text files into ACCESS, an import set-up file is first created which specifies the text file columns in which information is stored, the data-type designations, and the type of text delimiter. The 1986-88 data were obtained from the PBS VAX system where they are stored on tape under the filenames 86MAINLOG to 88MAINLOG (see Appendix B for

details of fixed-width format). The import set-up files 86MLOGS to 88MLOGS are used to import 86MLOG.TXT to 88MLOG.TXT, respectively.

The data for years 1989-95 were processed by the keypunch contractor and each fixed-width ASCII file (see Appendix C for format details) was separated into a file containing the fishing details (SETYY.TXT) and a file containing the catch information (CATYY.TXT) by running a Pascal program NORMYY.PAS, YY=year (Appendix D). The program assigns an identification number to each set. A set can be defined differently depending on gear type:

Longline.....1 set = 1 string of gear per boat, or
= fishing activity of a vessel in one management area on a given day
Handline/Troll.....1 set = fishing activity of a vessel in one management area on a given day

SETYY.TXT should have the same number of records as the original file YYRFLOGS.TXT. CATYY.TXT will have as many records as species caught; for example, if there are 1,000 sets or records in the original file, each indicating 5 species caught, then there will be 5,000 records in the created catch file. The ACCESS import set-up SETRECYY provides the data type designations, starting columns, and widths of each field in the fixed-width ASCII file SETYY.TXT, and specifies that the field separator is a space with no text delimiters. The import set-up CATCHREC specifies the details for importing the file CATYY.TXT.

Following are some problems and concerns to consider before loading these data into ACCESS:

1) There are numerous keypunching errors, some of which can be corrected without returning to the physical logbooks. One can check easily for these errors once the data are loaded into ACCESS. For instance, check for the correct year, check that maximum depths fished are greater than minimum depths fished, etc. Often, comparison with the surrounding values will give a clue as to what the value should be. Other keypunching errors may only be obvious once data analysis is performed. For instance, the landed weight of some species may be 10 times higher than all other observed values. Such an outlier should be investigated by returning to the original logbook records.

2) Other data errors are due to recording erroneous values. For example, latitudes and longitudes may not fall within the boundaries of management areas and subareas.

3) The set-up of the 1986-88 raw datasets is significantly different from that of the 1989-95 raw datasets. For instance, the 1986-88 catch data are included with the fishing details whereas catch and fishing details are separated in the 1989-95 raw data tables; hence the need for a relational database. Also, there are separate fields for measurements and their units in the 1986-88 raw data. The 1989-95 raw datasets assume consistent units of measure (e.g., depth in fathoms, weight in lbs, etc.).

4) Gear codes differ between the 1986-88 and the 1989-95 raw datasets. The earlier codes have been converted wherever possible.

5) Latitudes and longitudes, recorded as single integers, are actually composites of degrees and minutes (e.g., 5950 = 59° 50'). It might be necessary to convert these values to decimal numbers for use in other applications.

6) There are a few alpha-numeric species codes (e.g., 92A for squid, 97A for octopus). The alpha part can be dropped to allow this field a numeric designation.

7) Starting in 1995, buyer/processor numbers are alpha-numeric; previously they were numeric.

8) Comment codes are alpha-numeric in the 1989-93 data and numeric in the 1994-95 data.

9) Error codes are alpha in the 1986-88 data and numeric in the 1989-95 data.

10) Since 1994, the logbook sheets record pieces caught per set. Each datasheet can accommodate six sets after which there is a field for total species weight for the trip. The keypunch contractor replicated these weight data for each recorded set, even though the weight data do not correspond directly to the piece data. Section 5.4 addresses this problem.

5. Database Set-up

Before describing the rockfish logbook database, it is worthwhile to provide a broad overview of the relational structure of the data. Until 1993, the structure of the data is straightforward (Fig. 5.1a): data describing fishing details are organized by set and linked to catch data describing weight or pieces caught per set. Set is defined as the fishing activity by an individual vessel in a management area on a given day; alternatively, set may be defined as one string of gear for each longliner. Starting in 1994, the data structure becomes more convoluted (Fig. 5.1b). Information is available for sets, catch (pieces) per set, and catch (weight) per trip. Unfortunately, catch information is not complete for all sets or for all trips. Catch (weight) can be derived for all sets using average species weights.

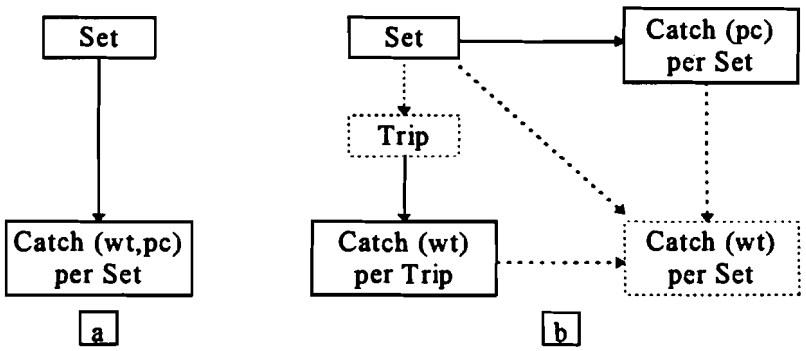


Fig. 5.1. Relational structure of the data.
a. Simple structure of the 1986-93 data; catch is expressed as either weight per set or number of pieces per set.
b. Complex structure of the 1994-95 data; solid lines indicate original data, dashed lines indicate derived data.

Rather than rely on species weights from independent studies or from the literature, we decided to use weights calculated from the logbook data, in particular, average species weights per trip. This required the identification of a "trip" which logically should be a collection of sets where catches are accumulated until offload at an officially recognized port. Once trips are identified, weights caught per trip can be divided by the total number of pieces caught per trip to obtain an average species weight per trip. This allows the allocation of trip weight to sets based on pieces caught per set. For sets where total weight per trip is not given, derived average species weights per management area can be used. These are derived using total allocated trip weights within an area divided by the total pieces caught in that area. Should average species weights per trip and per area be unavailable, average species weights can be

derived from the data for each year. It should be noted that trips are not identifiable for the 1986-93 data; therefore, some of these data are redundant.

The rockfish database is organized into four sets of tables, following the suggestion of Schnute et al. (1996). The first set documents the database; the tables are prefixed with 00. The second set provides supporting information which further describes the logbook data or provides conversion factors for calculations. These tables are prefixed with 01. The raw logbook data are entered into tables prefixed with 02 and are used to derive data tables, prefixed with 03, which can be used for analysis. At the 02 level, data have not been standardized to the same units of measure, whereas at the 03 level all tables have the same units of measure. The current ACCESS rockfish database is named RFLOGS.MDB and contains the following tables:

DOCUMENTATION TABLES:

00 CONCERNS	Concerns and problems.
00 FIELDS	Description of all fields in each table, including type and size.
00 HART SPECIES CODES	Species codes based on page numbers in Hart (1980).
00 READ ME FIRST	Document to be read before a user can access the database.
00 TABLES IN RFLOGS	Tables in RFLOGS.MDB and their numbers of fields and records.

INFORMATION TABLES:

01 BAIT CODES	Codes for bait type.
01 CFV DETAILS	Personal codes for holders of a CFV license.
01 COMMENT CODES	Comment codes.
01 GEAR CODES	Codes for gear type.
01 MEAN WEIGHTS	Mean weights (lb) for quillback rockfish, yelloweye rockfish, and copper rockfish in various management areas; data from independent studies.
01 REGIONS	Five BC coastal regions and their associated management areas.
01 SPECIES CODES	Species codes found in the rockfish database, 1986-95.
01 SPP AREA WEIGHT 1994	Species average weights for all combinations of species caught and management areas fished in 1994; calculated using average weights per trip in those areas.
01 SPP AREA WEIGHT 1995	Species average weights for all combinations of species caught and management areas fished in 1995; calculated using average weights per trip in those areas.
01 SPP AVG WEIGHT 1994	Species average weights for all species caught in 1994, regardless of management area; calculated using average weights per trip.
01 SPP AVG WEIGHT 1995	Species average weights for all species caught in 1995, regardless of management area; calculated using average weights per trip.
01 SPP AVG WEIGHT 1994-95	Species average weights for all species caught in 1994-95, regardless of management area; calculated using average weights per trip.
01 SPP TRIP WEIGHT 1994	Species average weights for all combinations of species caught and trips taken in 1994.
01 SPP TRIP WEIGHT 1995	Species average weights for all combinations of species caught and trips taken in 1995.

01 SUBAREAS	List of subareas for each management area.

RAW DATA TABLES:

02 CATCH 1989-92	Catch information by species, rockfish logbook entries, 1989-92.
02 CATCH 1993	Catch information by species, rockfish logbook entries, 1993.
02 CATCH 1994	Catch information by species, rockfish logbook entries, 1994.
02 CATCH 1995	Catch information by species, rockfish logbook entries, 1995.
02 MAIN LOG 1986	Fishing details and catch information, logbook entries, 1986.
02 MAIN LOG 1987	Fishing details and catch information, logbook entries, 1987.
02 MAIN LOG 1988	Fishing details and catch information, logbook entries, 1988.
02 SET 1989-92	Daily fishing statistics from rockfish logbook entries, 1989-92.
02 SET 1993	Daily fishing statistics from rockfish logbook entries, 1993.
02 SET 1994	Daily fishing statistics from rockfish logbook entries, 1994.
02 SET 1995	Daily fishing statistics from rockfish logbook entries, 1995.
02 TRIP ID 1994 NULL	Trip identification number assigned to unique combinations of CFV number, target species, captain code, and hail report number for records where date unloaded is not reported, 1994.
02 TRIP ID NUMBER 1994	Trip identification number assigned to unique combinations of CFV number and date unloaded, 1994 (excluding records where date unloaded is not reported).
02 TRIP ID NUMBER 1995	Trip identification number assigned to unique combinations of CFV number and date unloaded, 1995.

USER DATA TABLES

03 CATCH PER SET 1986	Species catch per set, in pieces or weight (kg), 1986.
03 CATCH PER SET 1987	Species catch per set, in pieces or weight (kg), 1987.
03 CATCH PER SET 1988	Species catch per set, in pieces or weight (kg), 1988.
03 CATCH PER SET 1989-92	Species catch per set, in pieces or weight (kg), 1989-92.
03 CATCH PER SET 1993	Species catch per set, in pieces or weight (kg), 1993.
03 CATCH PER SET 1994	Species catch per set, in pieces and/or weight (kg), 1994.
03 CATCH PER SET 1995	Species catch per set, in pieces and/or weight (kg), 1995.
03 CATCH PER TRIP 1994	Species catch per trip, in weight (kg), 1994.
03 CATCH PER TRIP 1995	Species catch per trip, in weight (kg), 1995.
03 SET 1986	Daily fishing statistics per set, 1986; trips not identified.
03 SET 1987	Daily fishing statistics per set, 1987; trips not identified.
03 SET 1988	Daily fishing statistics per set, 1988; trips not identified.
03 SET 1989-92	Daily fishing statistics per set, 1989-92; trips not identified.
03 SET 1993	Daily fishing statistics per set, 1993; trips not identified.
03 SET 1994	Daily fishing statistics per set, 1994.
03 SET 1995	Daily fishing statistics per set, 1995.
03 TRIP 1994	Fishing information per trip, 1994.
03 TRIP 1995	Fishing information per trip, 1995.

5.1 Documentation Tables

The documentation tables are prefixed with 00. There is a table that alerts users to potential concerns about the rockfish logbook data (00 CONCERNS) and a table that details the database tables and their fields (00 TABLES and 00 FIELDS, respectively). There is also a table of Hart codes used at PBS (00 HART SPECIES CODES).

5.2 Information Tables

The information tables are labelled 01 and provide (i) code keys for fields found in the raw data and user data tables and (ii) supplementary information, e.g., mean weights of species by trip, by area, and by year. The information tables can be linked to the data tables to expand search criteria or add information. For instance, the data tables contain gear codes which can be linked to a gear code table so that a user can create datasets with gear types explicitly identified. Table 5.2.1 illustrates two of the smaller descriptive tables and Appendix E lists the species found in the database to date.

Table 5.2.1. Information tables.

a. 01 GEAR CODES

GEAR_TYP	GEAR	Valid
1	Trawl	1986-95
8	Trap	1986-95
30	Troll	1989-95
31	Freezer Troll	1989-95
36	Handline	1989-95
40	Longline	1989-95

b. 01 BAIT CODES

BAIT_TYPE	BAIT	Comment
1	Herring (live)	
2	Herring	Other than live
3	Other fish	Groundfish, shiners
4	Invertebrates	Incl. squid, octopus
5	Artificial lures	e.g., hoochies
6	Salmon	

5.3 Raw Data Tables

The raw data tables are labelled 02 and contain data imported from ASCII files as described in Section 4. Details of the data from 1986-88 appear in Table 5.3.1. The fields for these data are as follows:

- Index is simply a counter used to assign a set identification number in the user data tables.
- Page numbers and letters refer to the original logbooks.
- Captain describes the name of the skipper using an initial plus five letters of the last name.
- Gear types are coded as follows:
  1 = trawl; 3 = longline; 6 = troll; 7 = handline, jig, rod and reel; 8 = trap.
- Lines refer to the number of lines a handline fisher uses or the number of skates a longliner uses.
- "Hooks" is the total number of hooks used.
- Error codes were originally intended to give guidance on which records were not to be used for certain calculations (e.g., fishing effort calculations).
- Date refers to the date of fishing.
- Management areas are statistical.
- Minimum depth is only present if a depth range was specified.
- Maximum depth either refers to the deeper end of the range or the total depth fished. Note that the units of depth are given separately and can vary from record to record.
- Total catch is seldom specified; units of measure are given separately

- There are fixed catch fields for quillback rockfish, copper rockfish, yelloweye rockfish, lingcod, and unidentified rockfish; the units of measure are given separately.
- There are also additional fields for other species codes, catches, and units of catch.

Table 5.3.1. Field details of raw data tables **02 MAIN LOG 1986** to **02 MAIN LOG 1988**. Count = number of non-null entries in each field.

Field Name	Data Type	1986 Count	%	1987 Count	%	1988 Count	%
INDEX[A]	Counter	8,475	100	7,530	100	7,070	100
PAGE_NUMBER	Integer	8,437	99.6	7,530	100	7,070	100
PAGE_LETTER	Text	2,309	27.2	2,672	35.5	2,036	28.8
CAPTAIN	Text	8,475	100	7,526	99.9	7,070	100
CFV_NUMBER	Long Integer	8,475	100	7,530	100	7,070	100
GEAR_TYPE	Byte	8,457	99.8	7,515	99.8	7,070	100
LINES	Integer	—	—	52	—	52	0.7
HOOKS	Long Integer	—	—	2,577	—	5,544	78.4
ERROR	Text	822	9.7	3,335	44.3	1,677	23.7
DATE	Date/Time	8,475	100	7,530	100	7,070	100
MGMT_AREA	Integer	8,417	99.3	7,520	99.9	7,068	100
MGMT_SUBAREA	Text	—	—	—	—	2,040	28.9
TARGET_SPECIES	Integer	430	5.1	357	4.7	518	7.3
MIN_DEPTH	Integer	4,964	58.6	4,631	61.5	4,216	59.6
MAX_DEPTH/DEPTH_UNIT	Integer/Text	8,085	95.4	7,308	97.1	6,700	94.8
TIME_FISHED	Integer	7,979	94.1	7,319	97.2	6,672	94.4
TOTAL_CATCH/_UNIT	L.Integer/Text	166	2.0	40	0.5	—	—
SPP_UNIT	Text	8,295	97.9	7,386	98.1	6,906	97.7
QB_CATCH	Integer	6,443	76.0	5,206	69.1	5,025	71.1
CP_CATCH	Integer	3,590	42.4	2,519	33.5	2,133	30.2
YE_CATCH	Integer	3,992	47.1	4,085	54.2	4,025	56.9
LC_CATCH	Integer	3,377	39.8	4,195	55.7	3,480	49.2
ROCK_CATCH	Integer	527	6.2	647	8.6	303	4.3
SP1_UNIT/_CODE/_CATCH	Text/Int/Int	1,824	21.5	1,616	21.5	1,987	28.1
SP2_UNIT/_CODE/_CATCH	Text/Int/Int	382	4.5	396	5.3	510	7.2
SP3_UNIT/_CODE/_CATCH	Text/Int/Int	119	1.4	41	0.5	142	2.0
SP4_UNIT/_CODE/_CATCH	Text/Int/Int	36	0.4	6	0	34	0.5
SP5_UNIT/_CODE/_CATCH	Text/Int/Int	12	0.1	2	0	16	0.2
SP6_UNIT/_CODE/_CATCH	Text/Int/Int	6	0	—	—	—	—

[A]INDEX specifies the record number in these raw data files.

Details of the raw data tables for 1989-95 are given in Table 5.3.2. The fields for these data are as follows:

- The captain code is a numeric identification number rather than the alpha-code used in 1986-88.
- Bait and gear types are coded as in Table 5.2.1.
- "Hooks" refers to the total number of hooks used.
- The date of fishing is for each set.
- Location of the set is given by latitude and longitude.
- Minimum and maximum depths of the set are expressed in fathoms.
- The management areas and subareas are statistical.
- Time fished is the number of hours that the set was in the water.
- Date unloaded is the date the fisher unloaded the catch of any given trip; the catch may be comprised

of more than one set.

- Hail report number refers to the landing authorization given by an officially recognized port.
- Each buyer and processor has an alpha-numeric code.
- Comment codes specify short messages which might be relevant to analyses.
- The error field simply gives an indication of an error or not (0 = no error, 1 = error).
- The field labelled "flag" acts as an identifier of records which have either been altered or possess some noteworthy feature. This field will be updated as database managers need to make adjustments for manipulation purposes.

Table 5.3.2. Field details of raw data tables **02 SET 1989-92** to **02 SET 1995**.
Count = number of non-null entries in each field.

Field Name	Data Type	1989-92 Count	%	1993 Count	%	1994 Count	%	1995 Count	%
CFV_NUMBER	Long Integer	8,935	100	9,767	100	8,972	100	9,964	100
CAPTAIN	Long Integer	7,703	86.2	8,920	91.3	8,281	92.3	9,107	91.4
TARGET_SPECIES	Integer	0	0	0	0	8,712	97.1	9,334	93.7
BAIT_TYPE	Byte	8,734	97.8	8,907	91.2	8,269	92.2	8,933	89.7
GEAR_TYPE	Integer	8,935	100	9,767	100	8,963	99.9	9,956	99.9
HOOKS	Integer	8,093	90.6	8,965	91.8	8,703	97.0	9,618	96.5
DATE	Date/Time	8,935	100	9,767	100	8,972	100	9,953	99.9
LATITUDE	Long Integer	2,399	26.8	3,727	38.2	6,481	72.2	6,783	68.1
LONGITUDE	Long Integer	2,399	26.8	3,727	38.2	6,480	72.2	6,667	66.9
MIN_DEPTH	Integer	8,471	94.8	9,428	96.5	8,732	97.3	9,686	97.2
MAX_DEPTH	Integer	8,759	98.0	9,428	96.5	8,739	97.4	9,712	97.5
MGMT_AREA	Integer	8,837	98.9	9,633	98.6	8,910	99.3	9,373	94.1
MGMT_SUBAREA	Integer	7,881	88.2	7,920	81.1	7,853	87.5	8,110	81.4
TIME_FISHED	Integer	8,189	91.7	9,084	93.0	8,650	96.4	9,581	96.2
DATE_UNLOADED	Date/Time	0	0	0	0	7,723	86.1	9,940	99.8
HAIL_REPORT_NO	Long Integer	0	0	0	0	3,609	40.2	6,915	69.4
BUYER_PROCESSOR	Text	0	0	0	0	7,388	82.3	6,926	69.5
COMMENT	Text/Integer	1,366	15.3	2,147	22.0	549	6.1	375	3.8
ERROR[A]	Byte	0	0	1,456	14.9	144	1.6	0	0
FLAG	Text	0	0	0	0	38	0.4	285	2.9
SET_ID[B]	Long Integer	8,935	100	9,767	100	8,972	100	9,964	100

[A]Only errors = 1 are counted

[B]Counts of SET_ID will equal the number of records in these raw data files. Also SET_ID is designated as the primary key, allowing relationships with other files.

Each table contains approximately 9,000-10,000 records. From 1989 to 1993, certain fields were not recorded (e.g., date unloaded, buyer/processor, see Appendix C). In general, the percentage of non-null fields is higher in the 1994-95 data than in the 1989-93 data, i.e., the compliance has improved. Every record had a CFV number and nearly every record reported gear type and date fished. There was 90%+ recording of captain ID, target species, bait type, hooks, depths fished, management area, and time spent fishing. Other parameters were reported less frequently (e.g., latitudes and longitudes).

Details of the 1989-95 catch tables are presented in Table 5.3.3. The field SET_ID is used to relate catch data to set data. Catch is expressed as pieces or weight (lbs) caught per set for 1989-93; during these years, catch was reported as weight 95-96% of the time. Starting in

1994, catch was expressed as either pieces per set or total weight (lbs) per trip. In the raw data tables, the weight per trip data were repeated for each set. This is an important concern in the interpretation of the logs and in subsequent machinations.

Table 5.3.3. Field details of raw data tables **02 CATCH 1989-92** to **02 CATCH 1995**.
Count = number of non-null entries in each field.

Field Name	Data Type	1989-92 Count	%	1993 Count	%	1994 Count	%	1995 Count	%
SET_ID	Long Integer	22,812	100	31,136	100	40,385	100	48,544	100
SPECIES[A]	Integer	22,812	100	31,136	100	40,385	100	48,544	100
PIECES	Integer	1,130	5.0	1,241	4.0	30,316	75.1	40,430	83.3
WEIGHT	Long Integer	21,682	95.0	29,895	96.0	31,325	77.6	22,364	46.1

[A]Counts of SPECIES will equal the number of records in these raw data tables.

5.4 User Data Tables

The fishing logs have not been designed to partition the data into individual fishing trips. Indeed, the definition of a trip is somewhat unclear because many boats make daily excursions from their home ports. Despite this problem, there must be some way of identifying trip number to interpret the weight data in 1994-95. This can be accomplished by using ACCESS queries to group records by CFV number and date unloaded, assuming that the offload date can be used to define the end of a trip. Theoretically, this combination will describe all trips contained in the database, provided these data are present for all records. This grouping identified 1,899 trips in 1995 and 1,417 trips in 1994. However, in 1994, approximately 14% of the "date unloaded" fields were null. To capture the remaining possible trip combinations, these data were grouped by CFV number, target species, captain, and hail report number. Where trips created thus did not partition contiguous sets, the null "date unloaded" fields were replaced by the date of the last set within a logical series. This replacement was necessary to delimit only 9 trips. Consequently, the grouping of records with null "date unloaded" fields identified 159 additional trips for a 1994 total of 1,585 trips. Once the trips were identified, the tables **03 TRIP 19YY** (YY = 94 and 95) were created (Table 5.4.1) to contain trip details which were otherwise repeated for every set in the original set tables. Also, the data unique to each set were placed in the tables **03 set 19YY**, and the catch tables **03 catch 19YY** were created from **02 catch 19YY** by appending trip identification numbers to each record.

The derivation of weight caught per set can be summed up in four basic steps:

1) Once the records are grouped by trip, allocation of trip weights to individual sets is possible. In essence, it is possible to derive an average species weight for each trip (see Fig. 5.4.1) and use this to calculate the weight of each species caught per set by multiplying the average trip weight by the number of pieces caught per set. Note that at this stage, **03 catch 19YY** are intermediary tables where weights have not yet been allocated.

2) For those records with no reported weights per trip, the pieces can be converted to weights using a derived average species weight per management area (Figs. 5.4.2 and 5.4.3).

3) If neither trip weight nor area weight are available for a particular record, an average species weight per year, calculated regardless of area (Fig. 5.4.4) can be used.

4) For those few records with weights per trip and no information on pieces caught per set, one can simply assume that there were equal catches by each set within a trip.

Once the average weights per trip, per area, and per year are calculated the algorithm in Fig. 5.4.5 is applied to every record to derive a weight caught per set. The query to perform this algorithm is somewhat convoluted (Fig. 5.4.6). Because the query is selecting average conversion factors from three separate tables, and because the critical fields are TRIP_ID, MGMT_AREA, and SPECIES, the mean weight tables must possess dimensions which will accommodate every combination of the critical fields. For example, the table **01 SPP TRIP WEIGHT 1995** must have 98,748 conversion factors (1,899 trips by 52 species), the table **01 SPP AREA WEIGHT 1995** must have 2,444 conversion factors (47 areas by 52 species), and the table **01 SPP AVG WEIGHT 1995** must have 52 conversion factors (52 species). Otherwise, the query will not perform as intended. Unfortunately, most combinations do not, in fact, exist. This means that the conversion tables must be padded with zeroes, an operation which requires the exporting of data from the queries in Figs. 5.4.1 and 5.4.3 to text files and the insertion of zeroes where necessary. This cannot be done manually but requires manipulation by tailored computer programs (see Appendix F). The table created by Fig. 5.4.4 is small enough that it can be manually manipulated to create table **01 SPP AVG WEIGHT 19YY**. This table must contain a conversion factor for every species present in any given year since these estimates are used when no other is available.

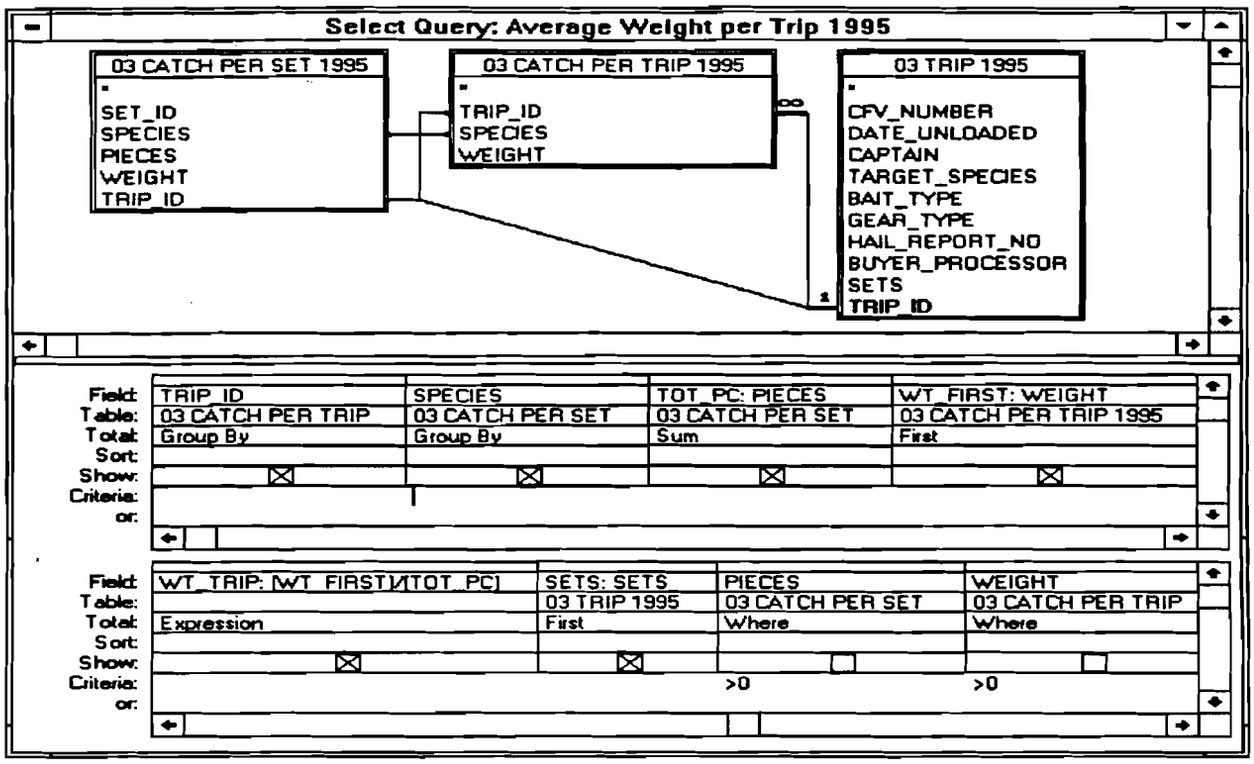


Fig. 5.4.1. Query to calculate average species weight per trip, 1995. Note that weight at this stage in the tables is strictly weight per trip.

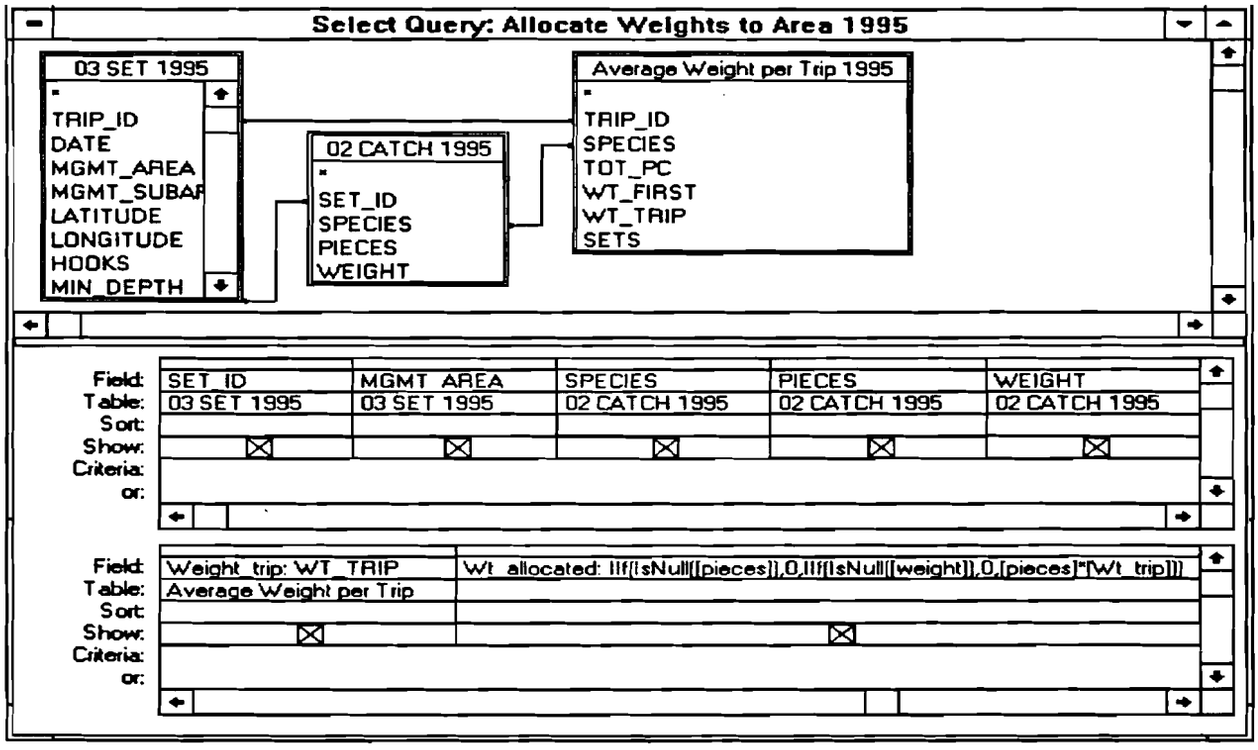


Fig. 5.4.2. Query to allocate trip weights to sets in management areas, 1995.

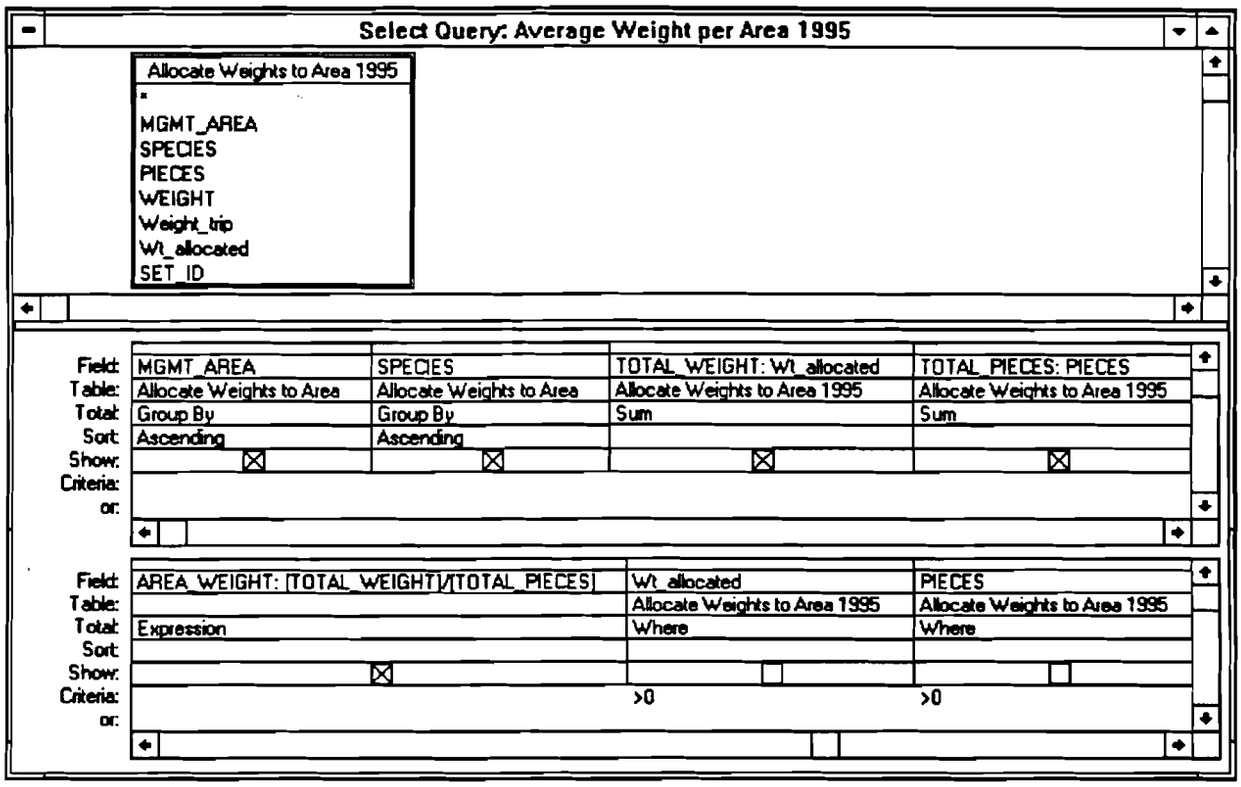


Fig. 5.4.3. Query to calculate average species weight per area, 1995.

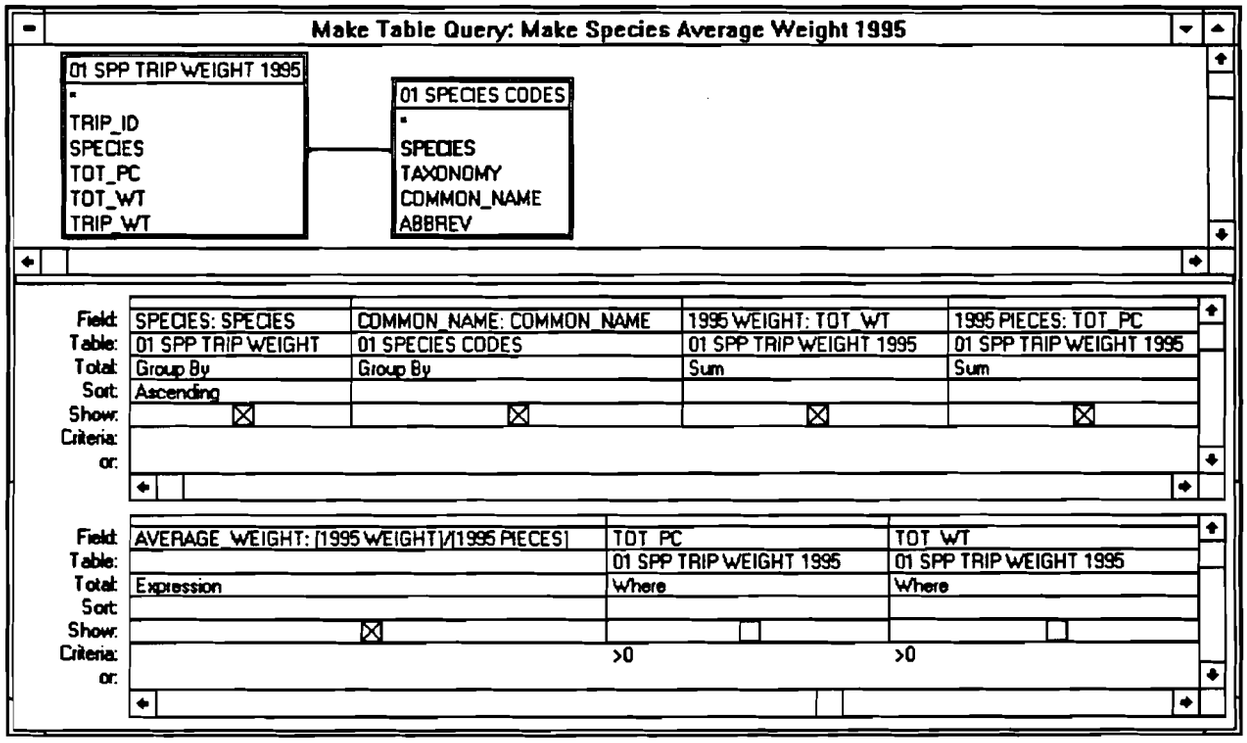


Fig. 5.4.4. Query to calculate average species weight per year (1995), regardless of area.

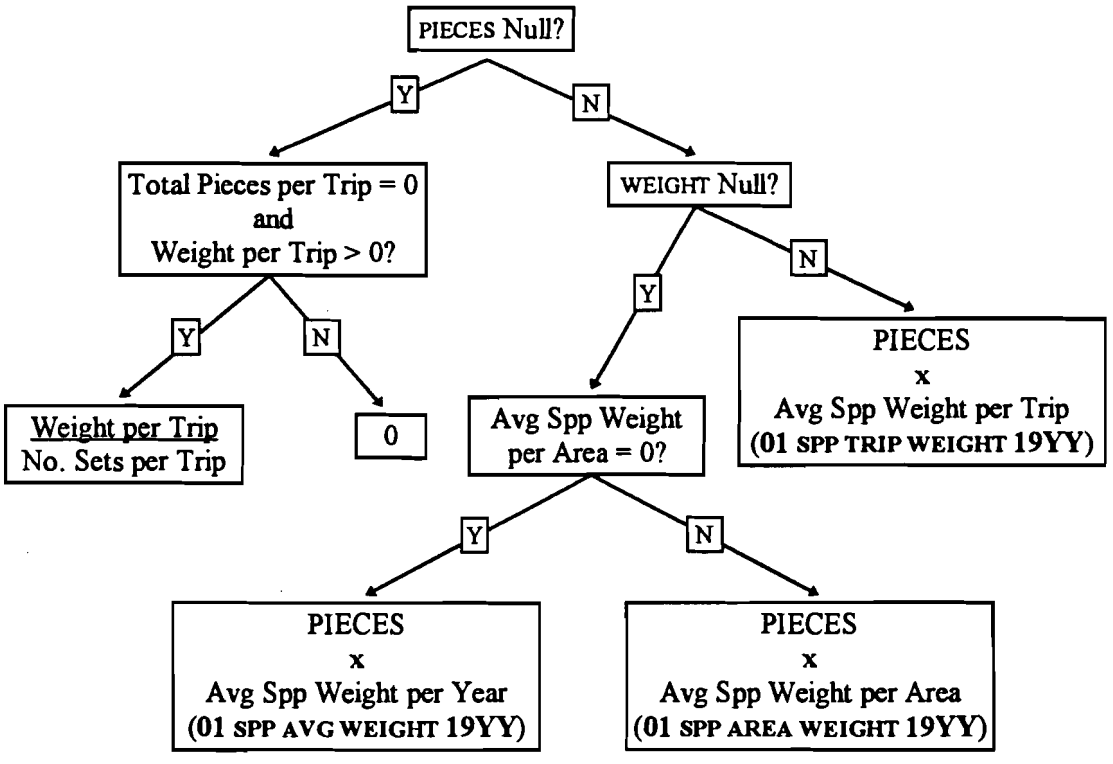
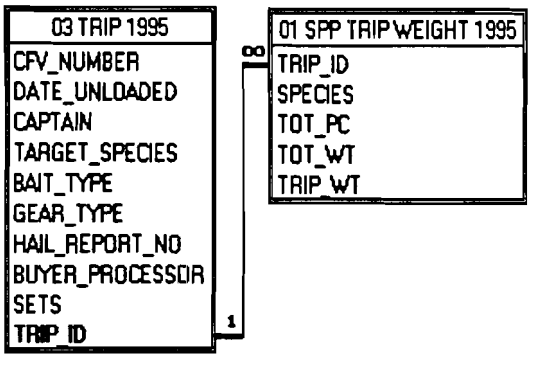


Fig. 5.4.5. Algorithm to derive weight of catch per set by species, 1994-95.



There is also an anomaly, internal to ACCESS v.2.0, which allows the efficient running of the query in Fig. 5.4.6. A one-to-many relationship with enforced referential integrity must be established between **03 TRIP 19YY** and **01 SPP TRIP WEIGHT 19YY**. It is unclear why this should help the query other than to anchor a rather large file with many combinations to a key field. When this relationship is not established, the query simply runs indefinitely, though it sometimes works for small subsets (e.g., the calculation of weights per set for one species).

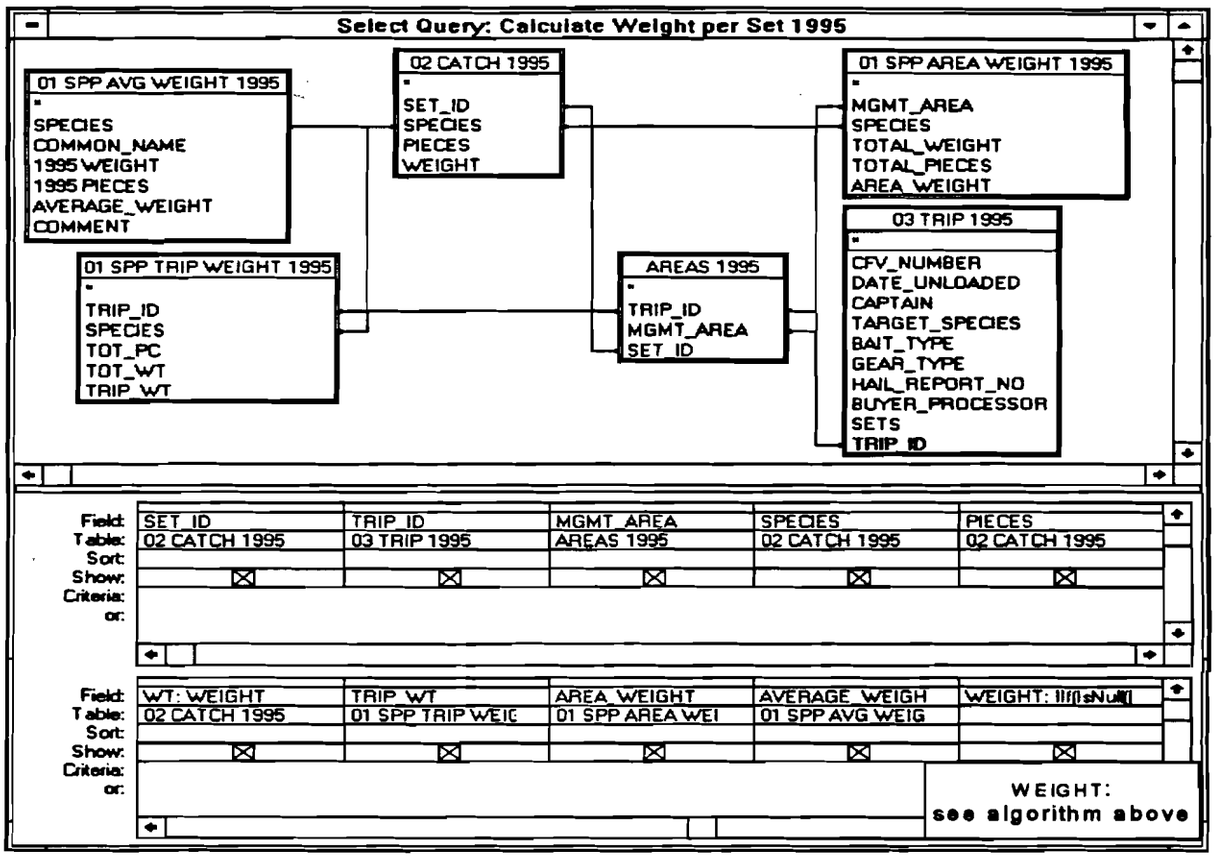


Fig. 5.4.6. Query to calculate weights per set, 1995.

Once weights have been derived for each set, they can be appended to the catch in pieces per set to create **03 CATCH PER SET 19YY** (YY = 94 and 95). Appendix G details the sequence of queries to be followed from start to finish when a new year's set of data is to be incorporated into the database.

Table 5.4.1 presents the details of the user data tables. For the years 1986-88, only fields comparable to those found in the 1989-95 tables were transferred from the raw data tables. Measurement units were standardized (depths in metres, weights in kg), and gear codes were converted to those presently in use, where possible. There is no information on bait-type, latitude, longitude, date unloaded, hail report number or buyer/processor during the first three years. The reporting of number of hooks and management subarea did not begin until 1987 and 1988, respectively. There are numerous instances where records are marked as unusable for certain calculations in the 1986-88 tables.

There was no attempt made to identify trip for years prior to 1994; therefore, trip information is repeated for each set during these years. As detailed above, trip is identified for 1994-95, and it is only these years which have separate trip and catch per trip tables. Catch per set for 1986-93 is reported as either pieces or weight (kg) so that there is no ambiguity. In the raw data files, catch per set for 1994-95 was reported in pieces or not reported; in the user data files, the catch in weight has been derived for every instance that a species was caught.

Table 5.4.1. Number of records available in each field of the User Data Tables

03 SET FIELD NAME	Data Type	1986	1987	1988	1989-92	1993	1994	1995
TRIP_ID	Long Integer	—	—	—	—	—	8,984	9,964
CFV_NUMBER	Long Integer	8,475	7,530	7,070	8,935	9,767	—	—
CAPTAIN	Text/LongInt	8,475	7,526	7,070	7,703	8,920	—	—
TARGET_SPECIES	Integer	430	357	518	0	0	—	—
BAIT_TYPE	Byte	0	0	0	8,734	8,907	—	—
GEAR_TYPE	Integer	8,457	7,515	7,070	8,935	9,767	—	—
DATE	Date/Time	8,475	7,530	7,070	8,935	9,767	8,984	9,953
MGMT_AREA	Integer	8,417	7,520	7,068	8,837	9,633	8,922	9,373
MGMT_SUBAREA	Integer	0	0	2,040	7,881	7,920	7,865	8,110
LATITUDE	Single	0	0	0	2,399	3,727	6,493	6,783
LONGITUDE	Single	0	0	0	2,399	3,727	6,492	6,667
HOOKS	Integer	0	2,577	5,544	8,093	8,965	8,715	9,618
MIN_DEPTH	Integer	6,634	4,659	4,228	8,471	9,428	8,739	9,686
MAX_DEPTH	Integer	8,072	7,304	6,698	8,759	9,428	8,746	9,712
TIME_FISHED	Integer	7,979	7,319	3,372	8,189	9,084	8,662	9,581
COMMENT	Text/Integer	0	0	0	1,371	2,147	549	375
ERROR	Text/Byte	822	3,335	1,677	0	1,456[A]	144[A]	0[A]
FLAG	Text	0	0	0	0	0	38	285
DATE_UNLOADED	Date/Time	0	0	0	0	0	—	—
HAIL_REPORT_NO	Long Integer	0	0	0	0	0	—	—
BUYER_PROCESSOR	Integer	0	0	0	0	0	—	—
SET_ID	Long Integer	8,475	7,530	7,070	8,935	9,767	8,984	9,964
03 TRIP FIELD NAME	**Data Type**	**1986**	**1987**	**1988**	**1989-92**	**1993**	**1994**	**1995**
CFV_NUMBER	Long Integer	—	—	—	—	—	1,585	1,899
DATE_UNLOADED	Date/Time	—	—	—	—	—	1,426	1,899
CAPTAIN	Long Integer	—	—	—	—	—	1,460	1,724
TARGET_SPECIES	Integer	—	—	—	—	—	1,526	1,781
BAIT_TYPE	Byte	—	—	—	—	—	1,441	1,644
GEAR_TYPE	Integer	—	—	—	—	—	1,576	1,891
HAIL_REPORT_NO	Long Integer	—	—	—	—	—	453	1,258
BUYER_PROCESSOR	Text	—	—	—	—	—	1,344	1,313
SETS	Integer	—	—	—	—	—	1,585	1,899
TRIP_ID	Long Integer	—	—	—	—	—	1,585	1,899
03 CATCH PER SET FIELD NAME	**Data Type**	**1986**	**1987**	**1988**	**1989-92**	**1993**	**1994**	**1995**
SET_ID	Long Integer	20,269	18,710	17,655	22,812	31,136	30,869	40,956
SPECIES	Integer	20,269	18,710	17,655	22,812	31,136	30,869	40,956
PIECES	Integer	19,404	18,002	17,178	1,130	1,241	30,291	40,436
WEIGHT	Double	865	708	477	21,682	29,895	30,869	40,956
TRIP_ID	Long Integer	—	—	—	—	—	30,869	40,956
03 CATCH PER TRIP FIELD NAME	**Data Type**	**1986**	**1987**	**1988**	**1989-92**	**1993**	**1994**	**1995**
TRIP_ID	Long Integer	—	—	—	—	—	4,998	3,873
SPECIES	Integer	—	—	—	—	—	4,998	3,873
WEIGHT	Double	—	—	—	—	—	4,998	3,873

[A]Only errors = 1 are counted — indicates no field present in user table

5.5 Relationships

Fig. 5.5.1 illustrates the relational structure of the raw data tables. The connections indicate that one field in **02 SET 1995**, say, is related or linked to many fields in **02 CAT 1995**. Fig. 5.5.2 illustrates the relationships among the user data tables for 1994-95. Similarly, these connections can be made for other years.

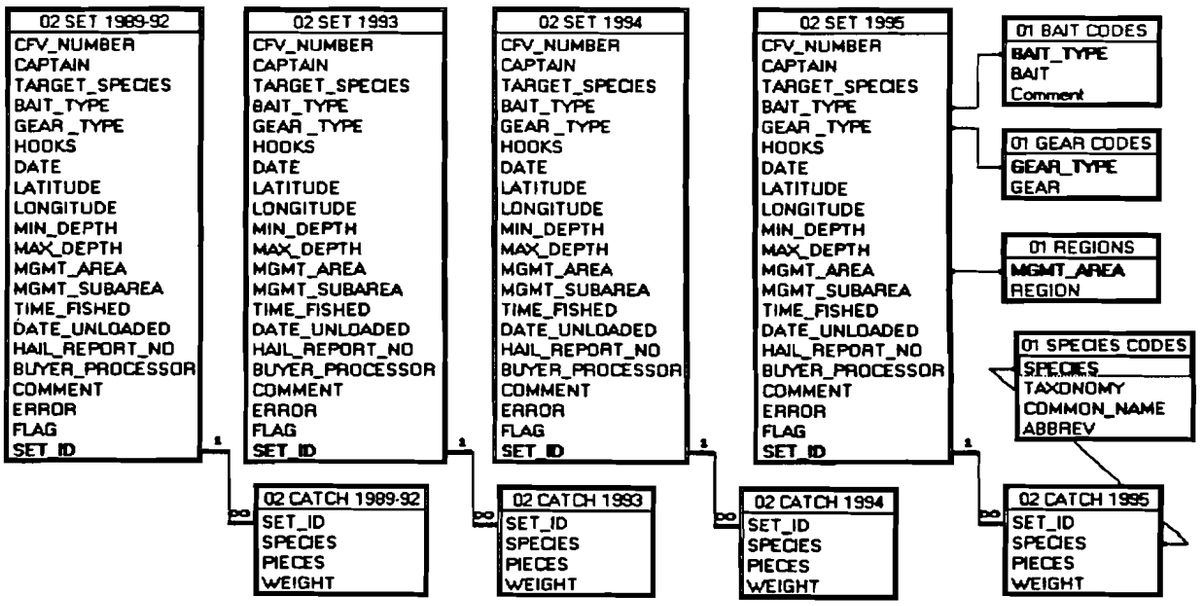


Fig. 5.5.1. Relationships among the raw data tables in the logbook database.

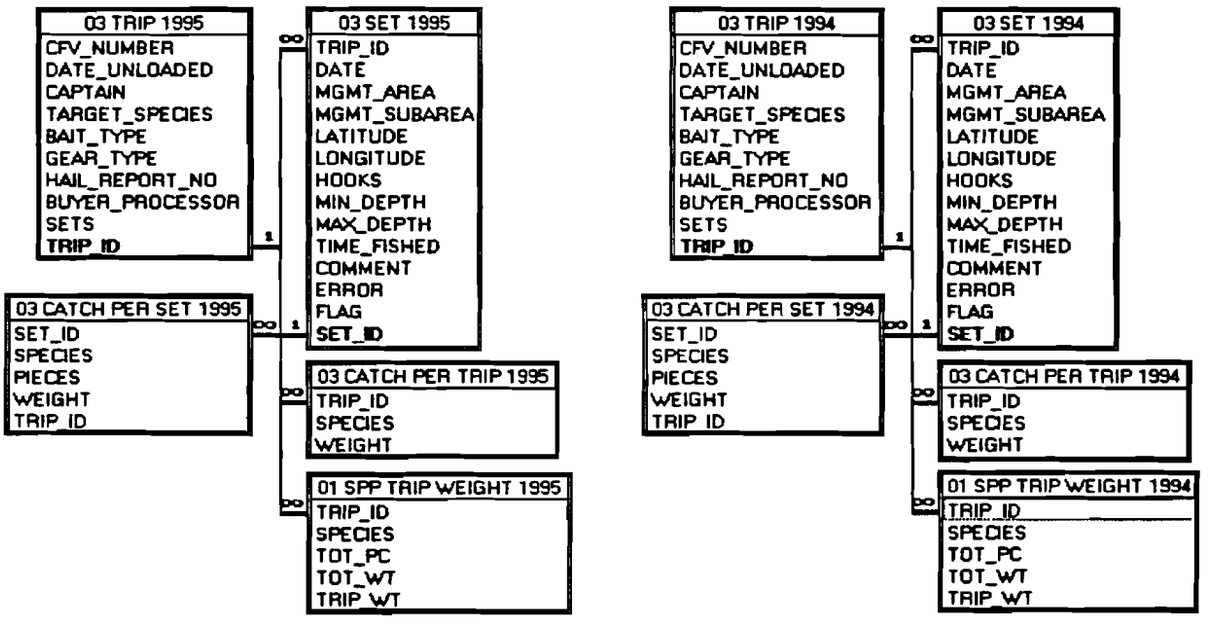


Fig. 5.5.2. Relationships among the user data tables for 1994-95 in the rockfish database.

6. Exploratory Data Analysis

The rockfish logbook data indicate that handline fishing activity is highest in the Strait of Georgia; longline activity is highest on the west coast of Vancouver Island and in the Queen Charlotte Islands (Table 6.1). Trolling activity is generally low, though during 1987-88 it appeared elevated. This may be due to the inclusion of license holders of other fisheries (salmon and halibut) who have caught rockfish as by-catch. It might also be due to mis-coded data or keypunching errors.

Table. 6.1. Number of sets fished by gear and by region, 1986-95.

Gear	Region	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Longline	WCVI	442	761	572	287	366	588	323	2,726	2,086	1,823
	SG	1,402	787	785	400	253	45	180	406	265	285
	QCI	46	220	245	11	20	339	359	1,043	1,318	1,656
	NC	42	54	62	7	5	3	76	655	335	445
	CC	87	190	194	201	366	631	452	854	813	878
Handline	WCVI	619	889	543	19	10	54	75	282	392	200
	SG	5,336	3,230	3,575	856	905	796	521	2963	3,295	3,517
	QCI	72	48	85	---	2	---	3	78	57	151
	NC	102	103	84	4	24	23	14	230	230	191
	CC	148	174	467	29	121	17	13	208	45	59
Troll	WCVI	---	390	227	23	41	16	11	75	14	80
	SG	---	92	124	115	95	89	---	---	72	81
	QCI	---	73	33	---	17	11	---	25	---	3
	NC	---	21	44	---	---	---	---	12	---	1
	CC	---	18	17	---	8	12	---	13	---	4

SG= Strait of Georgia, WCVI= West Coast Vancouver Island, QCI= Queen Charlotte Islands, NC= North Coast, CC= Central coast

Fig. 6.1 illustrates a query which groups rockfish caught by longliners, handliners, and trollers in five regional areas during 1995 and sums the weights caught. Catch values are either total trip weights allocated to sets or average species weights multiplied by the number of pieces caught per set (see section 5.4). The results of this query, and a similar one for 1994, are presented in Tables 6.2 and 6.3, respectively. According to the logbook records, the 1995 rockfish fishery landed 2,418 t coastwide from 1,899 trips. Meanwhile, the dockside monitoring program reported a total catch of 2,639 t from 1,929 offloads. As these figures should agree, the logbooks appear to have underestimated the catch by 8.4%. In general, however, the two programs reported roughly comparable species catch figures (Table 6.2).

In 1995, more rougheye rockfish (596 t) was caught than any other species (Table 6.2), followed by yelloweye rockfish (553 t), quillback rockfish (413 t) and redbanded rockfish (278 t). This compares to a 1994 coastwide catch of 1,776 t (Table 6.3), more than a third of which was yelloweye rockfish (654 t). Other species predominantly landed in 1994 were quillback rockfish (367 t), redbanded rockfish (187 t), and silvergray rockfish (129 t).The Queen Charlotte Islands longline fishery accounted for 47% of the coastwide catch and was dominated by rougheye rockfish (511 t). The west coast of Vancouver Island longline fishery accounted for 25% of the coastwide catch and consisted chiefly of yelloweye rockfish, redbanded rockfish, and

rougheye rockfish. Quillback rockfish was the dominant species caught along the north and central coasts.

Catch per unit effort (CPUE) is sometimes used in fisheries management as an index of abundance. Figure 6.2 illustrates two possible measures of CPUE for the logbook data: catch (kg) per hook and catch (kg) per time spent fishing. The CPUE data were transformed by natural logarithms. Only those records with non-null fields of hooks or time fished were selected for the calculations.

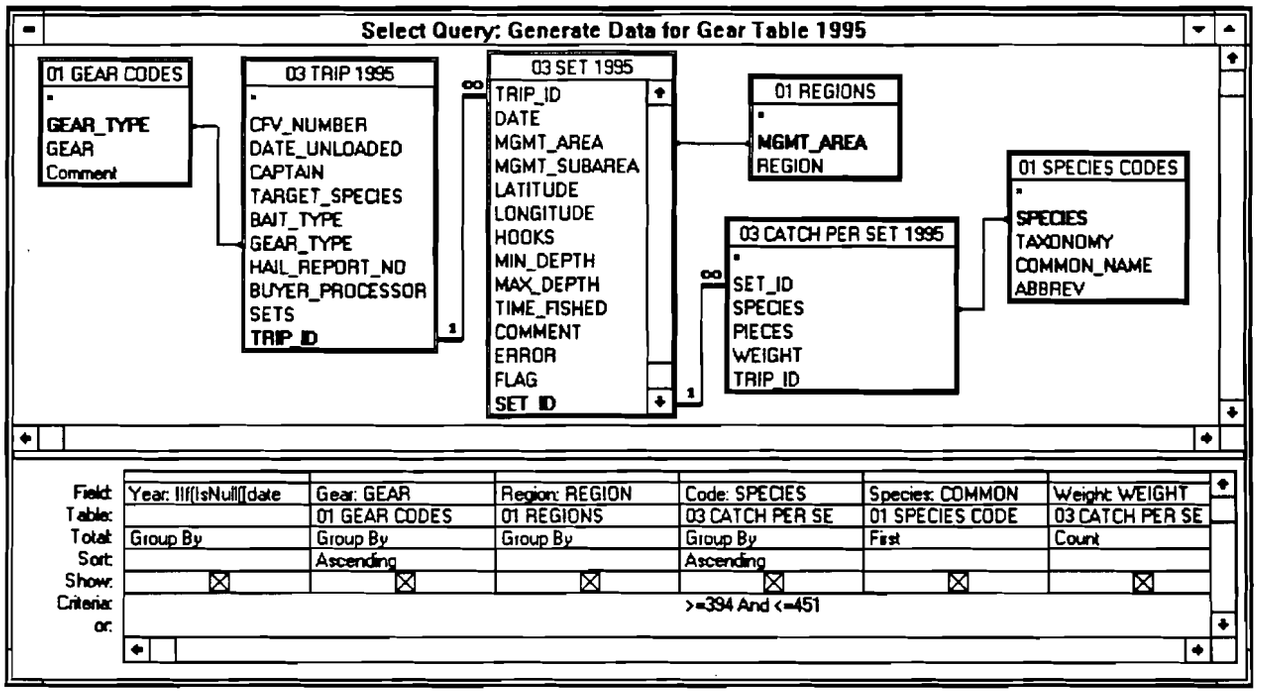


Fig. 6.1. Query to group 1995 rockfish records by gear type and regional area to provide a sum of weight caught in each area.

Depending on gear type, there were differences in catch per hook. Handliners might have used as few as one hook and caught numerous fish over the course of a "set", whereas longliners put out numerous hooks and caught no more than one fish per hook. This precludes comparing inter-gear efficiency (note the much higher CPUE values for trollers and handliners over the longliners - Fig. 6.2); however, exploring intra-gear efficiency with respect to, say, regional area is valid. Trollers in the Strait of Georgia were the most efficient fishers while handliners on the north coast had the highest median CPUE values. Longliners were equally efficient in all regions. CPUE data derived from hours fished appear to allow meaningful inter-gear comparisons. This makes sense in that time is experienced the same way by all fishers. However, the CPUE based on time suggests that longliners are somewhat more efficient than handliners: an opposite trend to that above.

Yearly catch per unit effort changes can suggest the state of a fishery. In the early years of a new fishery, total catches remain low because the fishers are inexperienced and/or the vessels are inefficient (Gulland 1983). As experience is gained - more efficient gear deployment, increasing knowledge of the best fishing grounds, etc. - catches per vessel increase. At the same

time, there is an increase in the number of fishers, each exerting a similar fishing effort. The combined fishing effort at some point causes the removal of the stock faster than its capacity to recruit replacements. A decrease in abundance leads to a decline in CPUE and a diminishing return on investment. Fig. 6.3 illustrates quillback rockfish CPUE fluctuations for the past 10 years. Trends in the data appear to be weak, perhaps because catch efficiencies specific to smaller management areas are not looked at in isolation. For instance, declining CPUE in the Gulf Islands might be offset by increasing CPUE in Queen Charlotte Strait so that the Strait of Georgia, as a whole, shows no trend in CPUE. Trollers seem to have experienced an efficiency increase in all regions. There is also an indication that CPUE declined in the handline fisheries of the central coast and the west coast of Vancouver Island. It should be noted, however, that CPUE values for 1989-92 might be artificially high as only experienced fishers were selected for data entry. Certainly, the variation in CPUE is smaller for these years.

Table. 6.2. Rockfish catch (kg) by species, gear type, and management region from 1995 logbook data.

1995	Longline					Handline					Troll					Total	DMP
CodeSpecies	SG	WCVI	QCI	NC	CC	SG	WCVI	QCI	NC	CC	SG	WCVI	QCI	NC	CC	Coastwide	A,B,C,I
394 Rougheye	30	78,092	511,520		5,083	10	136	1,495								596,366	618,560
396 PO perch		274	949		136											1,359	1,340
401 Redbanded	78	122,975	142,784	182	11,149	5	464	613		14						278,263	341,430
403 Shortraker	19	30,643	86,918		2,324											119,905	176,580
405 Silvergray	92	49,692	93,235	2,703	2,280	166	253	5,595	271	48		56	8			154,399	188,380
407 Copper	794	11,601	6,759	6,797	7,621	26,623	6,806	2,402	2,577	79	1,119	493	15			73,688	62,210
409 Dusky		15	23	11					14							62	110
410 Darkblotched		225						9								234	180
412 Splitnose			3													3	150
414 Greenstriped	3	556	800	20	3	475		3			15					1,874	1,620
417 Widow	11	154	696	7	119	275	3	29	29	6	9					1,338	520
418 Yellowtail	25	431	322	134	202	3,736	350	112	403	45		15				5,773	8,210
421 Rosethorn		1,353	1,037	0.5	122		1,049	0				7				3,570	6,400
423 Shortbelly		1														1	---
424 Quillback	5,648	73,338	42,496	48,733	74,238	137,114	4,990	10,733	10,547	815	3,518	817	25	22	78	413,113	383,870
426 Black	457	3,519	1,805	268	1,657	2,985	1,787	732	357	19	4	110	24	17		13,741	14,710
428 Vermilion	42	5,801	983	48	5,016	92	393	96	2	65		414				12,953	19,160
429 Blue		223			39	187	158									607	660
431 China	448	26,427	7,103	4,901	8,998	1,206	1,043	1,289	712	92		310	3	7		52,539	65,780
433 Tiger	149	5,572	1,628	2,876	2,590	647	181	185	191	25	24	140		3	7	14,217	16,970
435 Bocaccio	52	3,045	19,792	623	360	125	37	3,193	66	165		22	4			27,484	30,350
437 Canary	275	21,715	15,451	1,804	5,609	476	442	1,466	193	75	64	240	8	2	10	47,831	64,260
439 Redstripe		2,278	700	0.5	54	486	4	1	17		9					3,550	1,880
440 Yellowmouth		8,235	10,973		1,083											20,291	25,170
442 Yelloweye	22,856	163,677	174,703	29,703	82,740	11,115	12,794	34,866	10,046	6,668	705	2,497	165	43	442	553,019	580,600
446 Harlequin						8										8	---
450 Sharpchin			22			0.5										22	---
451 Shortspine		5,835	16,075		90	16	45									22,062	29,890
TOTAL	30,980	615,676	1,136,779	98,811	211,514	185,746	30,933	62,820	25,424	8,117	5,469	5,120	252	94	537	2,418,271	2,638,990

All species shown are in the genus *Sebastes* except 451 (Shortspine thornyhead) which is in *Sebastolobus*.
SG= Strait of Georgia, WCVI= West Coast Vancouver Island, QCI= Queen Charlotte Islands, NC= North Coast, CC= Central coast.
DMP = Dockside Monitoring Program, Options A, B, C, Inside

Table. 6.3. Rockfish catch (kg) by species, gear type, and management region from 1994 logbook data.

1994		Longline					Handline					Troll					Total
Code	Species	SG	WCVI	QCI	NC	CC	SG	WCVI	QCI	NC	CC	SG	WCVI	QCI	NC	CC	Coastwide
394	Rougheye		10,633	110,399		316											121,348
396	PO perch		835														835
401	Redbanded	89	52,901	133,163	42	309	15	4	61	4	0.4						186,588
403	Shortraker	5	3,552	35,203		206											38,967
405	Silvergray	50	61,600	62,610	976	1,455	5	1,611	178	68	10						128,564
407	Copper	117	16,228	3,948	4,591	5,025	26,976	3,799	526	3,745	568						65,523
409	Dusky																0
410	Darkblotched																0
412	Splitnose																0
414	Greenstriped		279	427		10	69										785
417	Widow		20	111	13	20	113										277
418	Yellowtail	68	798	744	267	477	1,727	571	9	116	2						4,778
421	Rosethorn		794	251	3	43	7										1,098
423	Shortbelly																0
424	Quillback	9,826	91,640	18,223	31,646	64,337	123,161	7,077	834	18,151	2,127						367,020
426	Black	101	1,115	387	334	375	1,727	1,914	137	2,369	34						8,494
428	Vermilion		5,354	143	69	547	75	636	14		26						6,863
429	Blue			38	24	8	308	202									580
431	China	618	27,283	1,670	3,021	2,756	128	1,244	148	2,551	29						39,447
433	Tiger	436	4,390	361	2,171	1,278	148	16	8	283	16						9,108
435	Bocaccio	39	9,347	10,025	876	70	16	726		97							21,196
437	Canary	764	69,599	22,863	1,806	5,702	368	2,273	137	498	137						104,148
439	Redstripe		1,628	279	5	15	43		16	20							2,005
440	Yellowmouth		4,873	6,873													11,746
442	Yelloweye	78,478	182,233	248,032	35,780	78,200	12,278	1,610	4,686	11,485	1,127						653,909
446	Harlequin																0
450	Sharpchin																0
451	Shortspine	2	458	1,714		17	36										2,227
	TOTAL	90,593	545,558	657,463	81,622	161,168	167,202	21,682	6,754	39,385	4,078						1,775,504

All species shown are in the genus *Sebastes* except 451 (Shortspine thornyhead) which is in *Sebastolobus*.

SG= Strait of Georgia, WCVI= West Coast Vancouver Island, QCI= Queen Charlotte Islands, NC= North Coast, CC= Central coast.

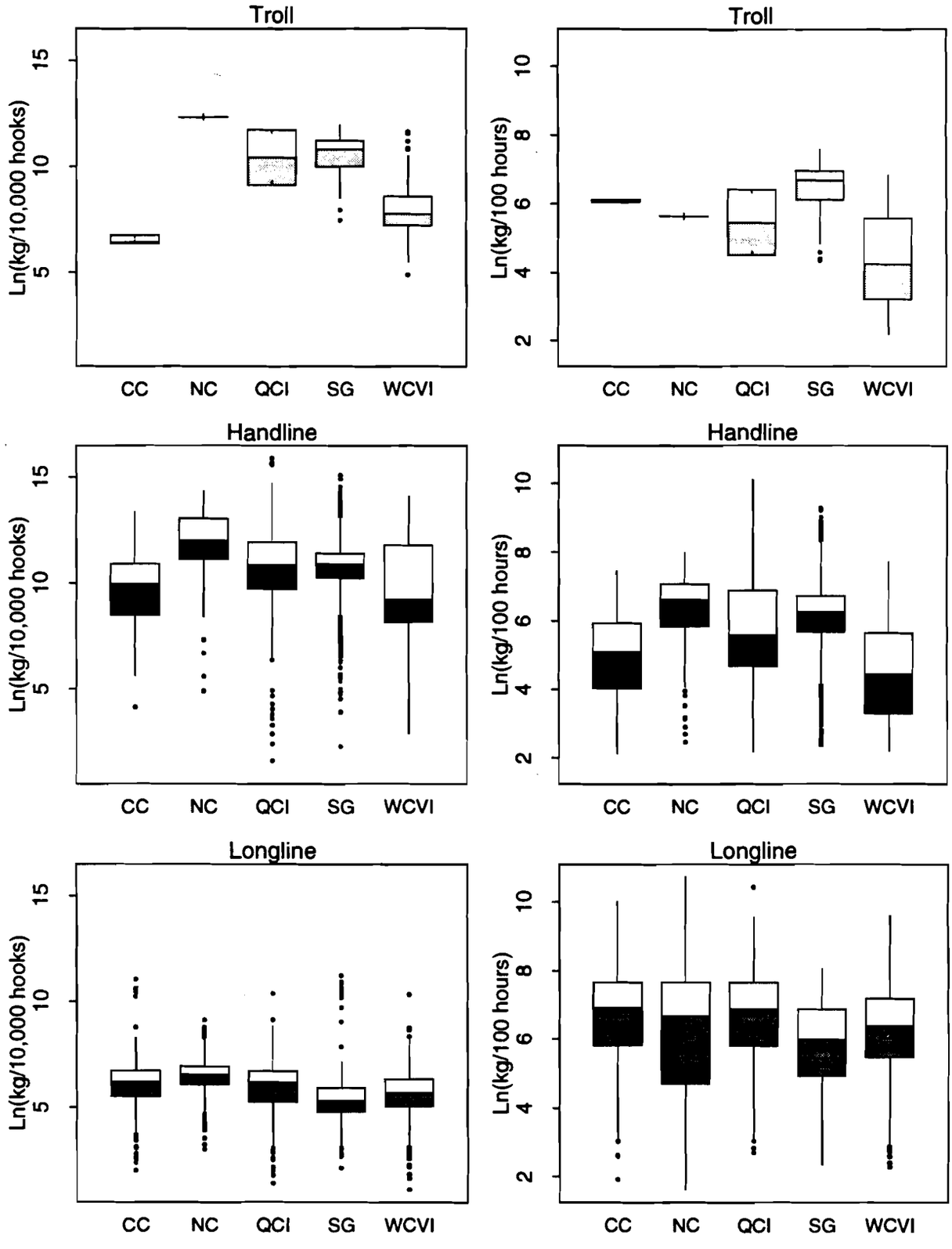


Fig. 6.2. Quillback rockfish 1995 catch per unit effort for troll, handline, and longline fishers in each management region.

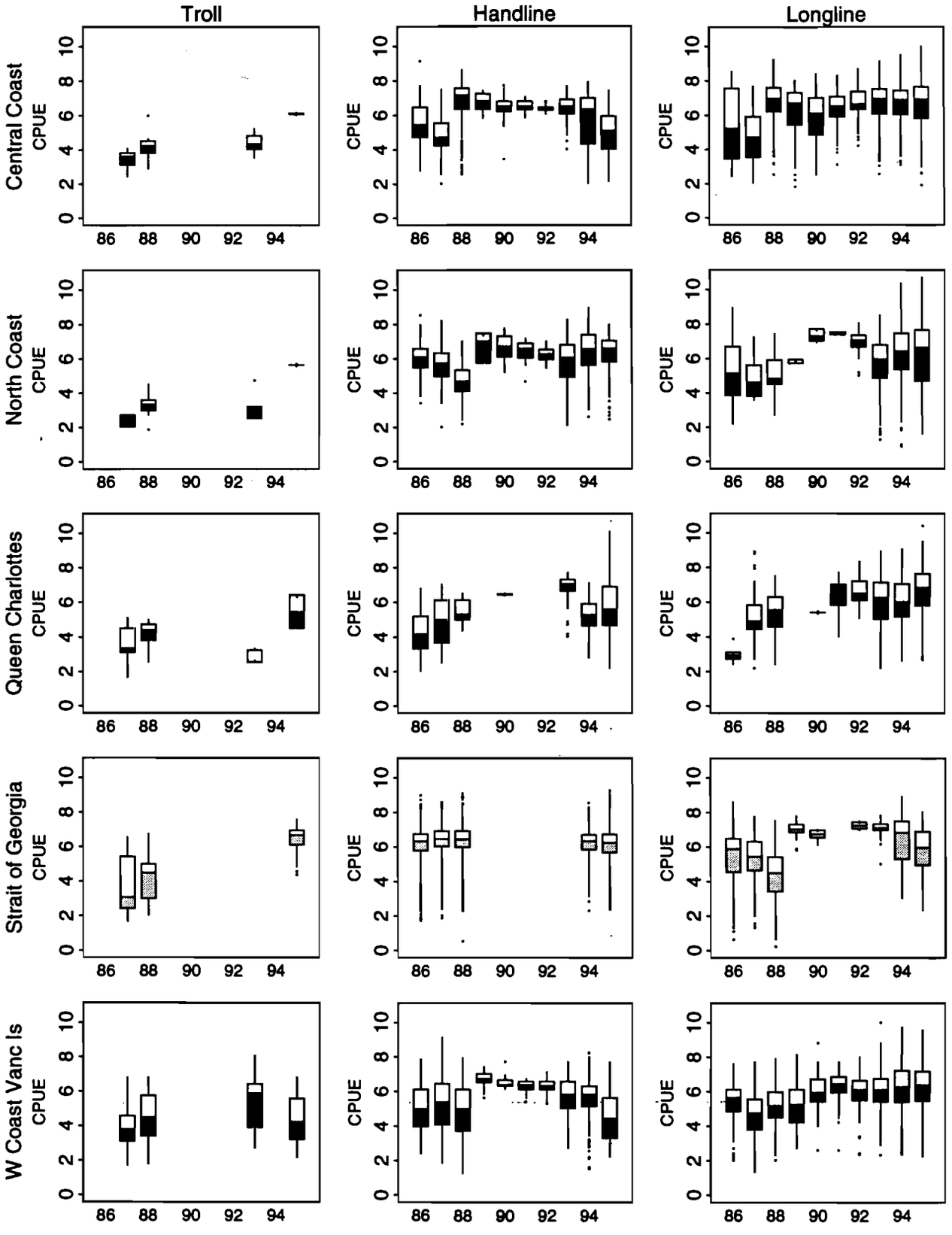


Fig. 6.3. Annual quillback rockfish CPUE, measured as kg/100 fishing hours and transformed with natural logarithms, for each gear type in the five management regions.

ACKNOWLEDGEMENTS

Rob Kronlund created the initial versions of the hook and line rockfish ACCESS database and wrote the PASCAL program to convert keypunched files suitable for importation to Microsoft ACCESS. Lynne Yamanaka was responsible for maintaining and enhancing the database thereafter. We are grateful to both Rob Kronlund and Lynne Yamanaka for useful comments on the manuscript.

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Appendix A1. Hook and Line Rockfish ZN Logbook Form, 1986-88.

SKIPPER _____ FISHING METHOD _____

VESSEL _____ CFV _____

CONFIDENTIAL

DATE (DAY-MO-YR)	STAT. AREA	LOCATION (NEAREST CHARTED LANDPOINT)	DEPTH (fm)	TIME SPENT FISHING * (HOURS)	NUMBER OF HOOKS	NUMBER OF FISH					REMARKS
						QUILL-BACK	COPPER	YELLOW-EYE (SNAPPER)	LING-COD	OTHER (SPECIFY)	

* ACTUAL TIME WITH FISHING GEAR IN THE WATER

MAIL TO: GROUNDFISH, PACIFIC BIOLOGICAL STATION, NANAIMO, B.C.

Appendix A2. Hook and Line Rockfish ZN Logbook Form, 1989-93.

Government of Canada Fisheries and Oceans / Gouvernement du Canada Pêches et Océans

ROCKFISH FISHING LOG

VESSEL NAME:_____ CFV NO. _____ CAPTAIN'S NAME:_____ GEAR TYPE:_____ TRIP NO._____ PAGE NO._____

GEAR	HOOK SIZE	HOOK TYPE	NO. OF HOOKS/SKATE	HOOK SPACING	BAIT USED
LONGLINE					

GEAR	HOOK SIZE	HOOK TYPE	NO. OF HOOKS/LINE	HOOK SPACING	BAIT USED
HANDLINE/TROLL					

CATCH DATA (ROUND WEIGHT IN POUNDS)

DATE D/M/Y	MGMT SUB-AREA	LORAN READING	DEPTH (FTMS)	NO. OF SKATES FISHED	TIME FISHED (HOURS)	PACIFIC OCEAN PERCH	YELLOW -MOUTH	ROUGH -EYE	CANARY	SILVER -GRAY	YELLOW -TAIL	YELLOW -EYE	QUILL -BACK	COPPER	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	LINGCOD

REMARKS (WEATHER, TAGS, DISCARDS, ETC.) _____

Appendix A3. Hook and Line Rockfish ZN Logbook Form, 1994-95.

HOOK AND LINE ROCKFISH LOG

PAGE#____

CFV#______________ VESSEL______________________________________ GEAR TYPE______________ TRIP#_____

CAPTAIN______________________________________ TARGET SPECIES______________________ BAIT__________

*****RECORD CATCH IN NUMBER OF FISH***** *****SHADED AREAS ARE OPTIONAL*****

DATE YR/MO/DA	WP# end	LOCATION	deg	min	sec	deg	min	sec	WP# end	TOTAL # HOOKS	DEPTH Min	Max	MGMT Area	SubA	TIME hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
DATE	WP#	LOCATION	deg	min	sec	deg	min	sec	WP#	# hooks	Min	Max	Area	SubA	hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
DATE	WP#	LOCATION	deg	min	sec	deg	min	sec	WP#	# hooks	Min	Max	Area	SubA	hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
DATE	WP#	LOCATION	deg	min	sec	deg	min	sec	WP#	# hooks	Min	Max	Area	SubA	hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
DATE	WP#	LOCATION	deg	min	sec	deg	min	sec	WP#	# hooks	Min	Max	Area	SubA	hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
DATE	WP#	LOCATION	deg	min	sec	deg	min	sec	WP#	# hooks	Min	Max	Area	SubA	hours
		latitude													
		longitude													
CATCH	YE	QB	CP												
PIECES															
TOTAL															
TOTAL WT LBS															
PRODUCT TYPE															
DATE UNLOADED (YR/MO/DA):						HAIL REPORT #:		Z	N	-	9		-		
BUYER/PROCESSOR(S):															

COMMENTS: weather conditions, sea state, amount of lost gear, reason for discarding fish, etc.

MAIL TO: Department of Fisheries and Oceans, Offshore Division, Suite 418, 555 W. Hastings St., Vancouver, B.C. V6B 5G3

Fisheries and Oceans Pêches et Océans

Canada

Appendix A-3. cont'd.

Holders of the ZN license are required to give the following information for each trip (taken from DFO's Hook and Line Rockfish Instructions):

Header information at the top of each log sheet:

PAGE# - consecutive for each trip
CFV# and VESSEL Name
GEAR TYPE - type of fishing gear used on this trip
e.g., longline, handline, rod and reel, etc.
TRIP# - consecutive for the year
CAPTAIN's Name
TARGET SPECIES - fishing effort is directed for this species
e.g., yelloweye rockfish, live quillback rockfish, spiny dogfish, Pacific halibut, lingcod, etc.
BAIT - type of bait used in fishing
e.g., live herring, lures, squid, etc.

Fishing Information: **FOR LONGLINE GEAR** record for each string of gear or for each Management Subarea fished in a day. **FOR HANDLINE, ROD AND REEL, TROLL, AND OTHER LINE GEAR** record for each Management Subarea fished in a day.

Please note that shaded areas are optional and are not required information that must be provided.

DATE - Date (year, month, day) the gear was set for longline gear, date of fishing activity for other line gear.
WP# or end# - optional, this space is provided for identifying fishing gear.
LOCATION - Latitude/Longitude of **one end** of longline gear or **fishing spot** within each subarea for other line gear, recorded to the *nearest minute*. Locations may be determined from a chart. *Latitude/longitude seconds and other end of longline gear or fishing spot are optional.*
#HOOKS - The total number of hooks on all gear used in fishing at this location. If recording location for each string of longline gear, the #hooks used is the number of hooks on each string. If recording for more than one string of longline gear fished in a subarea, the #hooks used is the total number of hooks on all strings.
e.g., fished 3 strings of gear, each string had 1000 hooks, #hooks = 3000
fished 2 rods, each rod had 4 hooks, #hooks =8
DEPTH - Minimum depth fished and maximum depth fished. Record in fathoms.
e.g., 30, 50 for minimum depth of 30 fathoms and maximum depth of 50 fathoms
MGMT Area/Subarea - Pacific Fishery Management Area and Subarea fished.
e.g., 12, 5 for Management Area 12, Subarea 5
TIME - Total number of hours each string of longline gear soaked, total number of hours other line gear spent fishing.
e.g., five hour soak for one string = 5 hours, 2 hour soak for 3 strings = 6 hours, 8 hours of fishing with a rod and reel = 8 hours

Appendix A-3. cont'd.

Catch Information: RECORD CATCH IN <u>PIECES OF ROUND FISH</u>

PIECES - Record by species, the number of pieces of round fish kept. Species codes to be used are listed on this log book flap. OTHER catch, please indicate species or common name in the space provided.
e.g., QB 50, 50 pieces of quillback rockfish kept from this string of longline gear or day of fishing with rod and reel in this subarea.

TOTAL - Sum of fish pieces caught by species, this space may be used for recording a running total of fish onboard by fishing trip (optional).

Sale information: Recorded on the bottom of the last log sheet for the trip.

TOTAL WT LBS - Record in pounds (lbs), the estimated total round weight of each species of fish.

PRODUCT TYPE - optional, record the type of product for each species kept.
e.g., live, round fresh/iced, round frozen, H/OFF, etc.

DATE UNLOADED - Date (year/month/day) which the fish were taken out of the fishing vessel.

HAIL REPORT NUMBER - Hail number obtained from the DFO radio room.
e.g., ZN-94-0442

BUYER/PROCESSOR(S) - Company or companies purchasing the fish. If the processor is different from the buyer, also indicate the processor.

Comments: *This information is optional.*

Useful information to report are weather conditions, sea state, amounts of lost gear, reason for discarding fish, etc.
e.g., Weather was too bad to fish. Lost 200 hooks from the second string of gear set (June 24). Quillback rockfish were discarded if they were too small (<1 lb) or too big (>3 lb) for the market, 2 lingcod (10 lbs) were discarded because the area is closed.

Appendix B. Text File Format for Rockfish Main Logs, 1986-88.

MAIN LOGS	Columns		
Field Description	**1986**	**1987**	**1988**
Page number of log	1-4	1-4	1-4
Page letter of log (if required) e.g., 67a	5	5	5
Name of skipper: initial plus first 5 letters of last name	6-11	6-11	6-11
Canadian Fishing Vessel (CFV)	12-16	12-16	12-16
Fishing Method:1=trawl;3=longline; 6=troll;7=handline, jig, rod&reel; 8=trap	18	17	17
Lines: Handline vessels - # lines, longline vessels - # skates	—	18-20	18-20
Total number of hooks	—	21-26	21-26
Error code: A, C, D (see below)	17	27	27
Date: year-month-day	19-24	28-33	28-33
Minor statistical area	25-27	34-36	34-36
Subarea: statistical	—	—	37-38
Target species	28-30	37-39	39-41
Minimum depth (if range is specified)	31-33	40-42	42-44
Depth (if no range) or maximum depth	34-36	43-45	45-47
Units of depth: FM=fathoms; M=metres; FT=feet	37-38	46-47	48-49
Total catch (if specified)	39-43	48-52	—
Units of total catch: NO=number; PC=percent; KG or LB=weight	44-45	53-54	—
Time spent fishing (hours)	46-48	55-57	50-52
Units of species catch: NO=number; PC=percent, KG/LB=weight	49-50	58-59	53-54
Quillback catch	51-54	60-63	55-58
Copper catch	55-58	64-67	59-62
Yelloweye catch	59-62	68-71	63-66
Lingcod catch	63-66	72-75	67-70
Unspecified rockfish catch	67-70	76-79	71-74
Other species catch units #1	71-72	80-81	75-76
Other species code #1 (page in Hart)	73-75	82-84	77-79
Other species catch #1	76-79	85-88	80-83
Other species catch units #2	80-81	89-90	84-85
Other species code #2 (page in Hart)	82-84	91-93	86-88
Other species catch #2	85-88	94-97	89-92
Other species catch units #3	89-90	98-99	93-94
Other species code #3 (page in Hart)	91-93	100-102	95-97
Other species catch #3	94-97	103-106	98-101
Other species catch units #4	98-99	107-108	102-103
Other species code #4 (page in Hart)	100-102	109-111	104-106
Other species catch #4	103-106	112-115	107-110
Other species catch units #5	107-108	116-117	111-112
Other species code #5 (page in Hart)	109-111	118-120	113-115
Other species catch #5	112-115	121-124	116-119
Other species catch units #6	116-117	—	—
Other species code #6 (page in Hart)	118-120	—	—
Other species catch #6	121-124	—	—

ERROR CODES:

A error in data (other than fishing time, fishing method, date, or species catch) e.g., depth units missing. This is a general error code; do not use for data errors which affect fishing effort or total catch calculations.

C data record cannot be used for fishing effort calculations; e.g., fishing time, fishing method, date missing or unclear, date reported as a range or fishing time as a total (Sep 7-10, total fishing time 30 hours.

D data record cannot be used for total catch calculations; e.g., species catch missing or unclear, unclear whether catch units are numbers or weight.

Appendix C. Format of ASCII Raw Data Files, 1989-95.

Information	1989-92	1993	1994	1995
Header Information				
CFV number	1-5	1-5	1-5	1-5
Captain code	6-10	6-10	6-10	6-10
Target species	11-13	11-13	11-13	11-13
Bait type	14	14	14	14
Gear type	15-16	15-16	15-16	15-16
Number of hooks/string	17-20	17-20	17-20	17-20
Number of strings/line	21-22	21-22	21-22	21-22
Fishing Information				
Date (YYMMDD)	23-28	23-28	23-28	23-28
Latitude (degrees, minutes)	29-32	29-32	29-32	29-32
Longitude (degrees, minutes)	33-37	33-37	33-37	33-37
Minimum depth (fathoms)	38-40	38-40	38-40	38-40
Maximum depth (fathoms)	41-43	41-43	41-43	41-43
Management area	44-46	44-46	44-46	44-46
Management subarea	47-48	47-48	47-48	47-48
Time fished	49-50	49-50	49-50	49-50
Catch Information				
YE pieces	51-53	51-53	51-53	51-54
QB pieces	54-56	54-56	54-56	55-58
CP pieces	57-59	57-59	57-59	59-62
Species 1 code	60-62	60-62	60-62	63-65
Number of pieces 1	63-65	63-65	63-65	66-69
Species 2 code	66-68	66-68	66-68	70-72
Number of pieces 2	69-71	69-71	69-71	73-76
Species 3 code	72-74	72-74	72-74	77-79
Number of pieces 3	75-77	75-77	75-77	80-83
Species 4 code	78-80	78-80	78-80	84-86
Number of pieces 4	81-83	81-83	81-83	87-90
Species 5 code	84-86	84-86	84-86	91-93
Number of pieces 5	87-89	87-89	87-89	94-97
Species 6 code	90-92	90-92	90-92	98-100
Number of pieces 6	93-95	93-95	93-95	101-104
Species 7 code	96-98	96-98	96-98	105-107
Number of pieces 7	99-101	99-101	99-101	108-111
Species 8 code	—	—	102-104	112-114
Number of pieces 8	—	—	105-107	115-118
Species 9 code	—	—	—	119-121
Number of pieces 9	—	—	—	122-125
Species 10 code	—	—	—	126-128
Number of pieces 10	—	—	—	129-132
Species 11 code	—	—	—	133-135
Number of pieces 11	—	—	—	136-139
Species 12 code	—	—	—	140-142
Number of pieces 12	—	—	—	143-146

Appendix C. cont'd.

Weight Information (total over a number of sets per fishing trip)				
YE round weight	102-106	102-106	108-112	147-152
QB round weight	107-110	107-110	113-116	153-158
CP round weight	111-114	111-114	117-120	159-164
Round weight 1	115-118	115-118	121-124	165-170
Round weight 2	119-122	119-122	125-128	171-176
Round weight 3	123-126	123-126	129-132	177-182
Round weight 4	127-130	127-130	133-136	183-188
Round weight 5	131-134	131-134	137-140	189-194
Round weight 6	135-138	135-138	141-144	195-200
Round weight 7	139-142	139-142	145-148	201-206
Round weight 8	—	—	149-152	207-212
Round weight 9	—	—	—	213-218
Round weight 10	—	—	—	219-224
Round weight 11	—	—	—	225-230
Round weight 12	—	—	—	231-236
Footer Information				
Date unloaded	143-148	143-148	153-158	237-242
Hail report number	149-154	149-154	159-164	243-250
Buyer/Processor code	155-159	155-159	165-169	251-255
Comment code	160-161	160-161	170-171	256-257
Error code	162	162	172	258

Appendix D. PASCAL Program to Re-Arrange ZN Logbook Data.

```
Program Norm95;
{*****************************************************************
 * Program    : Norm(alize)                DATE CREATED: 16-APR-96 *
 * Programmer: A.R. Kronlund               DATE REVISED:  1-OCT-96 *
 *                                                                 *
 * Purpose: Normalizes inshore rockfish logbook data before input  *
 *          to a relational database.                              *
 *                                                                 *
 * 20-May-96: Modified to add year into key field, e.g. 95xxxxx.   *
 *****************************************************************}
CONST
{ Hart codes for Yelloweye, Quillback, and Copper rockfishes. }
  YE = '442';
  QB = '424';
  CP = '407';

  nSpecies = 12;

  test = FALSE;

TYPE
  testRec = RECORD
    header: STRING[4];
    xList: ARRAY [1..3] of STRING[2];
    yList: ARRAY [1..3] of STRING[3];
  END;

  logRec95 = RECORD
    header  : STRING[50];
    species : ARRAY [1..nSpecies] of STRING[3];
    pieces  : ARRAY [1..nSpecies] of STRING[4];
    weights : ARRAY [1..nSpecies] of STRING[6];
    pieceYE, pieceQB, pieceCP : STRING[4];
    roundYE, roundQB, roundCP : STRING[6];
    footer  : STRING[22];
  END;

VAR
  i, j : INTEGER;
  fieldPos : INTEGER;
  inFile, outFile1, outFile2 : TEXT;

  iKey: LONGINT;

{ Record fields... }
  inRec1 : STRING[236];
  inRec2 : STRING[22];

  inTest: testRec;
  log95: logRec95;

BEGIN
{ Open the input file for read only... }

  IF ( test ) THEN
    Assign( inFile, 'test.txt' )
  ELSE
    Assign( inFile, '95rflogs.txt' );

  Reset( inFile );

{ Open the primary and secondary output files for write... }
  Assign( outFile1, 'set95.txt' );
  ReWrite( outFile1 );
  Assign( outFile2, 'cat95.txt' );
  ReWrite( outFile2 );

  iKey := 9500000;
  While NOT Eof( inFile ) DO
    BEGIN
      ReadLn( inFile, inRec1, inRec2 );
      iKey := iKey + 1;
      Writeln( 'Original file record number: ', iKey:7 );

      IF ( test ) THEN
          WITH inTest DO
          BEGIN
```

Appendix D. cont'd.

```
            header   := Copy( inRec1,  1, 4 );
            xList[1] := Copy( inRec1,  5, 2 );
            xList[2] := Copy( inRec1,  7, 2 );
            xList[3] := Copy( inRec1,  9, 2 );
            yList[1] := Copy( inRec1, 11, 3 );
            yList[2] := Copy( inRec1, 14, 3 );
            yList[3] := Copy( inRec1, 17, 3 );
          END
          ELSE

        WITH log95 DO
          BEGIN
            header  := Copy( inRec1,  1,50 );
            pieceYE := Copy( inRec1, 51, 4 );
            pieceQB := Copy( inRec1, 55, 4 );
            pieceCP := Copy( inRec1, 59, 4 );

            fieldPos := 63;
            FOR i := 1 to nSpecies DO
              BEGIN
                species[ i ] := Copy( inRec1, fieldPos, 3 );
                fieldPos := fieldPos + 3;
                pieces[ i ]  := Copy( inRec1, fieldPos, 4 );
                fieldPos := fieldPos + 4;
              END;

            roundYE := Copy( inRec1, 147, 6 );
            roundQB := Copy( inRec1, 153, 6 );
            roundCP := Copy( inRec1, 159, 6 );

            fieldPos := 165;
            FOR i := 1 to nSpecies DO
              BEGIN
                weights[ i ] := Copy( inRec1, fieldPos, 6 );
                fieldPos := fieldPos + 6;
              END;

            footer := Copy( inRec2, 1, 22 );
          END;

{ Write primary file output... }
{       WriteLn( outFile1, inRec1, inRec2 ); }
        Writeln( outFile1, log95.header,log95.footer,' ',iKey:7 );

{ Write secondary file output... }
      IF ( test ) THEN
        FOR i := 1 to 3 DO
          BEGIN
            WriteLn( outFile2, inTest.header,
                     inTest.xList[i], inTest.yList[i] );
          END

      ELSE

        WITH log95 DO
          BEGIN
            if (pieceYE <> '    ') and (pieceYE <> '   0')
             or (roundYE <> '      ') and (roundYE <> '     0') then
               WriteLn( outFile2, iKey:7,' ',YE,' ',pieceYE,' ',roundYE );
            if (pieceQB <> '    ') and (pieceQB <> '   0')
             or (roundQB <> '      ') and (roundQB <> '     0') then
               WriteLn( outFile2, iKey:7,' ',QB,' ',pieceQB,' ',roundQB );
            if (pieceCP <> '    ') and (pieceCP <> '   0')
             or (roundCP <> '      ') and (roundCP <> '     0') then
               WriteLn( outFile2, iKey:7,' ',CP,' ',pieceCP,' ',roundCP );
            FOR i := 1 to nSpecies DO
              if (pieces[i] <> '    ') and (pieces[i] <> '   0')
               or (weights[i] <> '      ') and (weights[i] <> '     0') then
                 WriteLn( outFile2, iKey:7,' ', species[i],' ',
                                    pieces[i],' ',weights[i] );
          END;

    END;      { While NOT Eof... }

  Close( inFile   );
  Close( outFile1 );
  Close( outFile2 );
END.
```

Appendix E. 01 SPECIES CODES: Information Table of Species Found in Logbook Database.

SPECIES	TAXONOMY	COMMON_NAME	ABBREV
15	Unknown fish	Unknown fish	
24	Sebastolobus sp.	Thornyheads (Idiots)	ID
27	Hexanchus griseus	Sixgill shark	
38	Apristurus brunneus	Brown cat shark	
44	Squalus acanthius	Spiny dogfish	DF
48	Etmopterus (Genus)	Green-eye sharks	
51	Rajidae (Family)	Skates	
56	Raja binoculata	Big skate	
58	Bathyraja interrupta	Sandpaper skate	
66	Hydrolagus colliei	Spotted ratfish	
92	Squid spp.	Squid	
96	Clupea pallasi	Pacific herring	
97	Octopus spp.	Octopus	
106	Oncorhynchus sp.	Pacific salmon	SA
107	Oncorhynchus (Genus)	Pacific salmon and native trout	
124	Oncorhynchus tshawytscha	Chinook salmon	
222	Gadus macrocephalus	Pacific cod	
225	Merluccius productus	Pacific hake	
226	Microgadus proximus	Pacific tomcod	
228	Theragra chalcogramma	Walleye pollock	
303	Brachyistius frenatus	Kelp perch	
324	Stichaeidae (Family)	Pricklebacks	
351	Anarrhichthys ocellatus	Wolf eel	
388	Scorpaenidae (Family)	Scorpionfish	
394	Sebastes aleutianus	Rougheye rockfish	RE
396	Sebastes alutus	Pacific ocean perch	POP
398	Sebastes auriculatus	Brown rockfish	BW
400	Sebastes aurora	Aurora rockfish	AU
401	Sebastes babcocki	Redbanded rockfish	RB
403	Sebastes borealis	Shortraker rockfish	SR
405	Sebastes brevispinus	Silvergray rockfish	SG
407	Sebastes caurinus	Copper rockfish	CP
409	Sebastes ciliatus	Dusky rockfish	DK
410	Sebastes crameri	Darkblotched rockfish	DB
412	Sebastes diploproa	Splitnose rockfish	SN
414	Sebastes elongatus	Greenstriped rockfish	GS
417	Sebastes entomelas	Widow rockfish	WI
418	Sebastes flavidus	Yellowtail rockfish	YT
420	Sebastes goodei	Chilipepper rockfish	CL
421	Sebastes helvomaculatus	Rosethorn rockfish	RT

Appendix E. cont'd.

423	Sebastes jordani	Shortbelly rockfish	SB
424	Sebastes maliger	Quillback rockfish	QB
426	Sebastes melanops	Black rockfish	BK
428	Sebastes miniatus	Vermilion rockfish	VR
429	Sebastes mystinus	Blue rockfish	BL
431	Sebastes nebulosus	China rockfish	CH
433	Sebastes nigrocinctus	Tiger rockfish	TG
435	Sebastes paucispinus	Bocaccio rockfish	BO
437	Sebastes pinniger	Canary rockfish	CN
439	Sebastes proriger	Redstripe rockfish	RS
440	Sebastes reedi	Yellowmouth rockfish	YM
442	Sebastes ruberrimus	Yelloweye rockfish	YE
444	Sebastes saxicola	Stripetail rockfish	ST
446	Sebastes variegatus	Harlequin rockfish	HQ
450	Sebastes zacentrus	Sharpchin rockfish	SC
451	Sebastolobus alascanus	Shortspine thornyhead	SID
455	Anoplopoma fimbria	Sablefish	SB
458	Erilepis zonifer	Skilfish	
459	Hexagrammidae (Family)	Greenlings	
461	Hexagrammus decagrammus	Kelp greenling	KG
467	Ophiodon elongatus	Lingcod	LC
471	Zaniolepis latipinnis	Longspine combfish	
472	Cottidae (Family)	Sculpins	
502	Hemileridotus hemilepidotus	Red Irish lord	
504	Hemilepidotus spinosus	Brown Irish lord	
528	Oligocottus sp.	Unidentified sculpin	
540	Scorpaenichthys marmoratus	Cabezon	CB
595	Bothidae (Family)	Lefteye flounders	
597	Pleuronectiformes (Order)	Flatfish	
599	Pleuronectidae (Family)	Righteye flounders	
602	Atheresthes stomias	Arrowtooth flounder	
607	Eopsetta jordani	Petrale sole	
614	Hippoglossus stenolepis	Pacific halibut	HA
619	Pleuronectes isolepis	Butter sole	
621	Pleuronectes bilineatus	Rock sole	
628	Pleuronectes vetulus	English sole	
631	Platichthys stellatus	Starry flounder	
633	Pleuronichthys coenosus	C-O sole	
935	Octopus spp.	Octopus	
960	Crab spp.	Crab	
999	Unknown species	Unknown species	

Appendix F. BASIC Programs to Pad Average Weight Tables with Zeroes.

AREAWTS.BAS: Use QuickBasic for DOS (text files must be comma-delimited)

```
DIM a, b, area(50), spp(55) AS INTEGER
DIM c, d, e, totwt(50, 55), totpc(50, 55), areawt(50, 55) AS DOUBLE
REM area95.txt = vector of management areas fished in 1995
OPEN "area95.txt" FOR INPUT AS #1
DO
  numarea = numarea + 1
  INPUT #1, area(numarea)
LOOP UNTIL EOF(1)
CLOSE #1
REM spp95.txt = vector of species caught in 1995
OPEN "spp95.txt" FOR INPUT AS #1
DO
  numspp = numspp + 1
  INPUT #1, spp(numspp)
LOOP UNTIL EOF(1)
CLOSE #1

REM wt_are95.txt = array with length = numarea,
REM       width = 5 (area, species, total weight, total pieces, area weights)
OPEN "wt_are95.txt" FOR INPUT AS #1
DO
INPUT #1, a, b, c, d, e
FOR x = 1 TO numarea
    FOR y = 1 TO numspp
        IF area(x) = a AND spp(y) = b THEN
        totwt(x, y) = c: totpc(x, y) = d: areawt(x, y) = e: GOTO 1000
    END IF
    NEXT y
NEXT x
1000 LOOP UNTIL EOF(1)
CLOSE #1

OPEN "wtarea95.txt" FOR OUTPUT AS #1
FOR x = 1 TO numarea
    FOR y = 1 TO numspp
        WRITE #1, area(x), spp(y), totwt(x, y), totpc(x, y), areawt(x, y)
    NEXT y
NEXT x
END
```

TRIPWTS.BAS: Use VAX Basic in PBSFOG (text files must be fixed-width as in lines 100 & 120)

```
100 map (arecord) trp$=7,sp1$=5,pc$=10,wt$=20,twt$=20
120 map (brecord) sp2$=3
130 dim spp(55),totwt(2000,55),totpc(2000,55),tripwt(2000,55)
135 rem Trip must be declared as an integer to retain 7 significant digits
140 dim trip%(2000)
155 rem Set number of trips for each year
160 numtrip=1899
170 for i=1 to numtrip
180 trip%(i)=9500000+i
190 next i
195 rem spp95.dat = vector of species caught in 1995
200 open "spp95.dat" as file #1%, organization sequential variable, map
brecord
210 on error go to 530
220 get #1%
230 numspp=numspp+1
```

Appendix F. cont'd.

```
240 spp(numspp)=val(sp2$)
250 go to 220
260 close #1%
265 rem wt_trp95.txt = array with length = numtrip,
266 rem       width = 5 (trip, species, total pieces, total weight, trip weights)
270 open "wt_trp95.dat" as file #2%, organization sequential variable,&
    map arecord
280 on error go to 540
290 get #2%
300 trp=val(trp$)
310 sp1=val(sp1$)
320 pc=val(pc$)
330 wt=val(wt$)
340 twt=val(twt$)
360 for x=1 to numtrip
370 for y=1 to numspp
380 if trip%(x) = trp and spp(y)=sp1 then totpc(x,y)=pc
390 if trip%(x) = trp and spp(y)=sp1 then totwt(x,y)=wt
400 if trip%(x) = trp and spp(y)=sp1 then tripwt(x,y)=twt
420 next y
430 next x
440 go to 290
450 close #2%
455 rem Output as a fixed-width text file
460 open "wttrip95.txt" for output as file #3%
465 margin #3%, 132%
470 for x=1 to numtrip
480 for y=1 to numspp
490 print #3% using "#######", trip%(x);
492 print #3% using "#####", spp(y);
494 print #3% using "##########", totpc(x,y);
495 print #3% using "##########.##########", totwt(x,y);
496 print #3% using "##########.##########", tripwt(x,y);
500 next y
510 next x
520 go to 550
525 resume 260
530 if (err=11) and (erl=220) then resume 260
535 resume 450
540 if (err=11) and (erl=290) then resume 450
550 close #1%, #2%, #3%
560 end
```

Note: TRIPWTS.BAS can be run in the BASIC compiler on PBSFOG or made into an executable file to be run on PBSSAM as follows:

1)	DOS> SETHOST PBSSAM	Log onto PBSSAM
2)	SAM> s2t WT_TRP95.TXT	Convert stream file to sequential (also for SPP95.TXT)
3)	SAM> SET HOST PBSFOG	Log onto PBSFOG
4)	SAM> edt TRIPWTS.BAS	Edit program: Change lines 160,180,200,270,460
5)	FOG> BASIC TRIPWTS	Compile the BASIC program
6)	FOG> LINK TRIPWTS.OBJ	Create an executable file
7)	FOG> DEL TRIPWTS.OBJ;*	Delete the OBJ file
8)	FOG> LO	Logoff
9)	SAM> VEST TRIPWTS.EXE	Create an executable file for PBSSAM
10)	SAM> SQL TRIPWTS.COM	Run a batch command file in long queue; command file contains the single line $RUN TRIPWTS_TV

Appendix G. Sequence of Queries to Follow for Each Additional Year of Data.

1) Make Trip ID 19YY (**02 TRIP ID NUMBER 19YY**); insert the field INDEX as a counter
2) Make Trip Table 19YY (**03 TRIP 19YY**)
3) Make Set Table 19YY (**03 SET 19YY**)
4) Make Catch per Trip Table 19YY (**03 CATCH PER TRIP 19YY**)
5) Make Catch per Set Table 19YY (**03 CATCH PER SET 19YY**)

   Note: Make sure there are no zeroes in "pieces" field or in "weight" field of **02 CATCH 19YY**.
6) Average Weight per Trip 19YY
   - Export data to a delimited text file.
   - Convert to fixed-width file using MINITAB:

     WRITE 'WT_TRPYY.DAT' C1-C5;
     FORMAT (I7,I5,I10,F20.10,F20.10).
   - Export file of all species for the year.
   - Copy text files to VAX drive, log onto VAX and transform using "s2t".
   - Adjust program TRIPWTS.BAS and run in VAX BASIC as outlined in Appendix F.
   - Import WTTRIPYY.TXT to **01 SPP TRIP WEIGHT 19YY**.
7) Allocate Weights to Area 19YY
8) Average Weight per Area 19YY
   - Export area weight data to a delimited text file.
   - Export file of all species for the year.
   - Export file of all management areas for year.
   - Run AREAWTS.BAS in QBASIC as outlined in Appendix F.
   - Import WTAREAYY.TXT to **01 SPP AREA WEIGHT 19YY**.
9) Make Species Average Weight 19YY (**01 SPP AVG WEIGHT 19YY**)
10) Temp Wts - 19YY,
    - Create **TEMP WTS -ALL YEARS**, starting with 1994 and appending subsequent years.
11) Revise Species Average Weight 1994-YY (**01 SPP AVG WEIGHT 1994-YY**)
12) AREAS 19YY
13) Establish relationships (see Fig. 5.5.2)
14) Calculate Weight per Set 19YY
    - Put into **TEMP WTS - TRIP, AREA, SPP** table (will take a few minutes)
15) Revise Catch per Set Table 19YY (**03 CATCH PER SET 19YY**)