Dept. Fisheries and Oceans
Pacific Region

An Organizational View of Catch and Effort Data Requirements

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Acknowledgements

This report is the culmination of two years of research into the work performed by many dedicated staff in DFO involved in the very difficult task of estimating the harvest of our fish, a renewable resource that is sensitive to its ever changing habitat on the West Coast.

There were many contributors to this work, without whom this report would be the lesser document. ITSD is most grateful to Margaret Birch, Don Noakes, Bob Wowchuck, Dennis Chalmers, Leroy Hopwo and many others, as well as to the PSARC Data Committee members for their review and acceptance of this document, and to those who participated in the workshop in 1988 that initiated this exercise. It is, in effect, the combined thoughts and words of many.

As an indicator of its general and particular acceptance, the latest applications developments which are now on-line embody the spirit of this document, for they each reflect a more integrated approach to systems development. As ever, an ongoing commitment to the methodology advocated in this report will help DFO to manage more effectively it very valuable information resources.

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Purpose of Study

The rapid acquisition of **database management systems** and **micro-computers** in DFO has led to a proliferation of uncoordinated systems developments. The data in such systems is sometimes not comparable with regional data, raising concerns about the quality and accuracy of both datasets. This report attempts to develop a framework for the design of the overall information requirements for Catch and Effort Systems in the Region. **The goal of such a framework is to assure that subject area applications that collect and manage catch, landings, effort, and hails are built in an integrated manner, reducing data redundancy and duplication, while assuring a high degree of data quality.**

Scope of Study

This report covers only the catch and effort data and information requirements of the organization and relevant functions. A corporate model is proposed, and its impact upon future developments is assessed, with specific recommendations for each fishery from knowledgeable users.

The Fisheries Management Business Model

The business of fisheries management is to allocate a limited resource to a wide variety of competing user groups to achieve sustainable development. The **critical success factor for in-season fisheries management, then, is an accurate and timely estimate of the harvest by species and user group in an area.**

Catch and Effort Data Model

The fundamental information building blocks in this subject area are Catch, Effort, and Landings. The key measures are time, area, user (or gear counts), species and pieces. The primary current means for collecting these measurements are through three source documents - the **hail observations** kept by fishery officers, the **logbooks** completed by fishers, and the **landing slips** prepared by processing plants and vessels. The fundamental relationship between these documents is based upon the measurements recorded (i.e. time, area, species, user/gear). The comparison of these measurements is a key verification requirement in harvest monitoring today. **Standards must be established to assure correct cross-referencing between these data sources.** Data management policies should reflect this key business requirement.

Management Issues and Challenges

The primary issue facing DFO's catch and effort data management problems are, and continue to remain an organizational as well as a systems issue. There must be cross-organizational policies that direct the work in this area to providing high quality, accurate and timely data to management. These policies should cover definitive **management controls, cost/benefit standards, and the methods and means to improve the estimates, as well as ensuring that there are appropriate resources for implementation.**

Improving the estimates

To establish the validity of any one of these data sources, one or more of the others must also be collected as "corroborative evidence" within the same timeframe, at a similar level of detail, using the same measures. At least two of such building blocks across all fisheries are needed to obtain an accurate picture of the harvest (Figure 3.5). For instance, if logbooks were mandatory across all fisheries at this time, with full links to sales slips and hails, the catch leaving Canadian waters could be estimated more accurately. Detailed hail observations can also be used to verify landings if the original data (cfv number, date and time observed, area, target species and pieces) were saved in a corporate database.

Organizational Resources

Today, some areas have no ongoing obligation to harvest monitoring, due to the lack of resources to adequately perform this activity. **A consistent region wide management policy is needed clearly stating the importance and priority of harvest data.**

Management Controls in the Fishery

Management controls include five components. These are 1) a definable process with boundaries (harvesting), 2) a characteristic to measure (catch), 3) a measurement system (there are several), 4) a set of standards (differs by fishery), and 5) a regulator (management). A key mechanism of any management planning system is the feedback loop, which allows the 'regulator' to compare the 'measurement' against the 'standard'. Setting limits to harvesting through allocations or quotas is only useful if the feedback system(s) provide credible harvest information to compare actual fish caught against these allocations. The primary information source is ultimately the fisherman. **Regulatory changes must be instituted that make it costly to these users to misreport or omit to report catch and effort data in Canada.**

Cost/Benefit Standards

A fundamental principle of a control mechanism is that its cost should not exceed its benefit. When applied to this subject area, it appears that there has been no coordinated attempt to establish any criteria for evaluating the managerial and/or scientific "value" of each and every program from a cost/benefit viewpoint. This makes evaluating the relative priority of these programs difficult for managers. **A clear direction through policy statements from management is required in support of the 1990/91 regional priority to improve data management.**

Status of Current Systems

The key systems and applications that were reviewed in this study, were those that specifically collected, stored or used data from hails, sales slips, and log books.

Hails

While the report concentrates upon the key systems that are in a position developmentally to benefit from integration, a review of micro-based applications indicates that there are numerous local different databases that are used to collect this type of information. Few standards exist as to the composition or level of quality of the data contained in these databases. **A coast wide, carefully designed, statistically sound method for collecting harvest data would improve data quality.**

Sales Slips

The sales slip system is subject to extensive modifications in an attempt to satisfy many different, sometimes conflicting user needs. These modifications are rapidly becoming so complex, that estimating the costs of enhancements are difficult, and software quality assurance testing is becoming prohibitively costly in terms of contractor and staff support. **Some clear direction is required from senior management on the development strategy for this system.**

Logbooks

Logbooks are not mandatory for all fisheries coast wide. This makes enforcement of existing logbook programs difficult. Since this may become the primary source of catch and effort data with the GATT ruling, it is important that regulatory changes reflect the importance Canada places on this critical information. Note that while fisheries are not managed directly with logbook data, its importance to corroborate hails, as well as a fundamental data requirement in stock assessment programs, cannot be understated.

Logbook programs today are usually designed as part of a stock assessment program. **Their utility in the future as a management**

tool will require some changes to provide closer links with hail observations, and with sales slips in-season. The feasibility of various alternatives for improving the timeliness of the data should be investigated. Recent systems, like the Offshore Quota Management System may provide a base model for similar management tools.

Fisheries Executive Information Systems

Currently, there is no automated means for senior management to obtain catch and effort information. Summary hail data, available regionally now in the In-Season Catch Estimation System(ISCES), provides a convenient executive summary of openings and closings, catch and effort information coast wide for salmon. **Consideration should be given to include data for all fisheries in ISCES.** Other related data such as fishing plans, fishing conditions, public notices, and allocations could also be included. Graphical summaries would also be feasible, once the information was consolidated for the region.

Recommendations

It is recommended that the Regional EDP Committee, through various means :-

a) Support and encourage the development of new catch and effort systems in accordance with the Model.

b) Review all proposals and approve the development, enhancement or modification of systems concerned with catch and effort data (e.g. logbooks, landings, and sales slips).

c) Set standards for the use of region wide coding schema.

d) Oversee the development by a steering committee of an action plan to initiate the specific recommendations in this report, including setting of priorities with respect to Catch and Effort systems developments (see attached synopsis).

Salmon Fishery - Recommendations

The key areas of opportunity for improving existing systems to meet information resource delivery objectives are:-

1) to provide ready access to and linkages between key databases (Catchhis, Sales slips and Licensing and ISCMP, MRP, ISCES) by

   a. re-designing Commercial Catch Sales Slip and Remote Sales slip Entry systems to meet the user requests noted herein; as well, the errors inherent in the current system identified by Bjerring, Kopas[15] and others should be corrected; CCSS should be re-developed in Ingres database management system environment at considerable savings to DFO; Improved users on-line access this data using the Ingres ad-hoc query and report generators should be a high priority;

   b. providing access to all years of CCSS sales slip historical data (all species) on-line in batch mode using high-capacity disk or tape technology (e.g. write-once-read-many times [WORM]);

   c. providing universal, on-line access to MRP made transparently through the RIS Gateway (DFO-MENU), with a tutorial available for new and infrequent users;

   d. automating the regular in-season updates to MRP from the CCSS sales slip database,

   e. improving the turnaround of RSE originated sales slips by encouraging plants to speed up sales slip entry or assisting with technological research into tally station automation,

   f. expanding current ISCES hail data entry to include all areas and gears for salmonids immediately;

   g. re-designing ISCES in Ingres, and converting the current Fortran based system to SQL/C in Ingres (Figure 4.1.8 and Table 4.1.1), with modifications for multi-fisheries data entry and graphics output. This would make systems enhancements easier to manage.

h. linking Troll (ISCMP) and Net (SCD) fisheries catch estimation models into ISCES, and investigate the feasibility and utility of providing on-line access to Troll historical estimates if stored in Ingres;

2) to develop and implement statistically sound catch estimation practices for each Fishery (User/ Species/ Area/ Gear);

3) to improve the communications infrastructure to allow integrated fisheries management in-season (SPORT/ IFF/ COMMERCIAL) to meet the more sophisticated fishing plan strategies foreseeable in the future.

4) to improve the accuracy, integrity and completeness of the sales slip system by implementing the changes noted in memos by J Bjerring, L Lapi, and the recommendations of the PSARC Data sub-committee as part of the CCSS re-development project.

Sport Salmon Fishery - Recommendations

The Sport catch database in Ingres should be completed and computer access provided to DFO staff.

Consideration should be given to provide regional computer access to the creel survey database for DFO staff.

Consideration should be given to storing sport an recreational fishing data for non-salmonids in the Ingres database.

Indian Food Fishery - Recommendations

The Indian Food Fishery is a small but important portion of the total salmon fishery. These catches are a significant part of outstanding land claims involving millions of dollars in disputed land and rights.

A cost/benefit profile should be developed for use in evaluating whether the control systems which are in place now and any others which may be proposed in the future are viable.

Any control or monitoring system should be developed in close cooperation with the user group. It should provide accurate and timely objective data. The sampling methodology and estimation techniques should be rigorous, properly documented and archived with the observation data. An independent Scientific Authority should be established region-wide who will review and approve all catch and effort estimates.

All historical data should be evaluated and catalogued as to its accuracy and utility using the rating methodology applied by the Data Assessment division of Science Sector at IOS. (e.g. the Beaufort Sea Arctic Data Compilation and Appraisal Program)

Investigate the feasibility of implementing one local data capture system (e.g. like the ESSA system on the Fraser which has since been converted to hand-held PCs by Phil Neaves of ITSD) throughout the Region. This system should include a component to upload observation data to the Regional VAX on a timely basis, in the Ingres IFF system [14], which the Statistics Division maintains.

Herring Fishery - Recommendations

It is recommended that consideration be given to examining the technical and operational feasibility and costs involved to:-

1) provide on-line access for Fisheries Branch staff, fishery officers and biologists to :-

   a) the herring databases at PBS, specifically historical catch and effort data by fishery, year and area, in ad-hoc or pre-defined reports;

   b) a system for storing and accessing current and prior year quotas, hails, and openings and closings in an easy to use manner;

   c) historical herring original sales slip data from CCSS in a manner transparent to user (1966 - 1989);

   d) facilities for down-loading sub-sets of these data to PC's is also desired, so that PC's copies of datasets are managed only as copies and not as original datasets;

2) provide on-line access to current year herring data in Commercial Sales slip System in-season;

3) reconcile the data in the Sales Slip System with the herring catch historical data at PBS for years prior to 1987, before giving users access to these data;

4) conduct a feasibility study on implementing a coast-wide data collection program to assess the impact, size and extent of the non-roe herring catch, such as live sports bait.

Domestic Groundfish Fishery - User Needs and Recommendations

The Offshore Division would like sufficient time and resources provided to improve the turnaround in the current domestic quota reporting system in both the early hails and the logbook/sales slip catch finalization process.

Foreign Groundfish Fishery - Recommendations

A recent ITSD preliminary study prepared in cooperation with the Offshore Unit recommended the development of an Offshore catch and effort system with integrated quota management. This system will be implemented in two phases. Phase 1 consists of modules to enter catch and product data from the weekly telexes - HAILS - which is complete and in operation now. The second phase - due this fiscal - includes the management of quotas, the entry and reporting of set level catch and production from observer trip reports, and reports comparing the hail and observer data.

Shellfish Fishery - User Needs and Requirements

1. A region wide fishing LOG data collection and analysis system is needed for Z (abalone and geoduck) logs now, but flexible enough to allow its use for other species if quota management for these species is also established. See Exhibit 4.8.4 (sample of the Log Book) and Figure 4.8.4 (example of Z log table design in Ingres) below. This system should also be capable of importing the source validation slip information that is currently processed on contract. Verification against the sales slips processed in the Commercial Catch Saleslip System is important, and links with Licensing to obtain QUOTA information for comparison purposes is required.

2. A record of the Openings and Closures of the various fisheries, particularly the quotas fisheries. This would include a system similar to the herring and salmon information distribution mechanism (Oscar-Charlies) on a coast wide basis. A record of past management actions is also needed. Users indicated that a public information component would be desirable.

3. A HAIL data collection and reporting facility is required that is accessible by both field and regional staff.

4. A register of fishing plans for the coming year and a means of linking this data with HAIL, QUOTA and Opening/Closing and other management actions.

5. A common means of identifying the data which is used in all the shellfish databases at one level or another. These include species identification codes, quantity numbers like pieces, spatial resolution of statistical areas, shellfish beds, etc, fishing effort(CPUE), reporting periods, and gears used.

6. On-line access to biological databases at PBS in a user friendly way is requested by users in the field. (D. Noakes - "These data are used for assessment purposes and would be of little use to 'users in the field'".)

Recommendations

It is recommended that the shellfish management committee, in concert with the PSARC shellfish, agree upon the information requirements and user needs for an in-season management system, and submit the recommendations to the Fisheries Branch EDP committee and thence to the regional EDP committee.

Introduction

Purpose of Study

This study attempts to develop a framework for the design of the overall information requirements in a subject area defined by the business requirements and corporate mandate of the organization.

The subject area - Catch and Effort - was chosen because:-

a) it has been extensively reviewed for many years (Schnute [1], Gislason[2]) and has extensive references,

b) it is a key information requirement of the organization to know the harvesting rate of all species protected under the mandate of DFO;

c) no overall planning model or template has been put forward against which any existing or proposed data gathering function can be measured.

This planning framework is called functional and data modelling, and it is a necessary prelude to developing any integrated set of computer applications or manual procedures.

Rationale for Study

The rapid acquisition of **database management systems** and **micro-computers** in DFO has led to a proliferation of uncoordinated application developments, resulting in a loss of synergy in organizational systems, despite the short term efficiencies accruing to the local unit.

The **emergence of expert systems software** technology and high capacity **micro-based workstations** will further affect and diversify the analytical uses of this data.

A cross-organizational road map for data - the corporate data model - is a part of the solution, but education, training and "moral suasion" remain the chief strategies available to the data manager in assuring that data quality, timeliness and user access are at the forefront of the system developers' mind when designing or modifying applications.

Background

This study arises out of a series of workshops in 1987/88 on Catch and Effort. The participants strove to come to grips with the distinct needs and wishes of a diverse user group pursuing different mandates. Their goal was to develop a consensus on ways and means of identifying and measuring the harvesting activities on the West Coast, and the mechanisms required to collect, store and analyze these data.

The workshops proved that it was not possible to define the requirements at any level of universality. This was due in part the nature of the organization, which currently reflects the way various fisheries operate as well as the geography of the West Coast. This makes it difficult to foster a significant level of cooperation, with a few exceptions such as the herring fishery.

It was agreed by the participants that there are many problems facing DFO with respect to the quality and timeliness of the data currently collected, but that most of these problems could only be resolved one at a time. There arose, nevertheless, out of the last workshop in February 1988, a better general understanding of the data needs amongst the various groups.

Scope of Study

This study covers only the catch and effort data and information requirements of the organization and relevant functions. Information escapement and spawning, or other information are included in some section only where necessary to gain a complete understanding of the harvest monitoring activities of a fishery.

For the purposes of this project, and to define the scope of interest for the project, a definition of "Catch" and "Effort" is therefore important. These measurements, together with key references to area, species, gear, and user, are fundamental information for both in-season fisheries management and stock assessment as noted earlier.

No single definition of catch was found in the references cited, so it is herein defined as **catch or "the amount, in pieces or in weight, of fish caught as a result of harvesting efforts".**

Harvesting is a more all encompassing activity that includes both effort spent in catching wild stocks and the work required in gathering in a crop of artificially raised fish as occurs in aquaculture. Estimating the level of resource exploitation is done through a variety of models. The Harvest rate is defined as the Catch over the Total Stock [L. Hopwo] which is compared with the expected rate of stock depletion, and the Exploitation Rate

as the Catch over the Available Catch [ibid] is used as an indirect measure of the effectiveness of fishing effort.

Effort has been variously defined. Ricker defined "Fishing Effort" as **"The total fishing gear in use for a specified period of time"** (pp 3). Grohn [5] defined "Effort" as **"the expenditure of time and the quantity of equipment required to harvest fish"** (pp 108). Catch and effort are believed to be directly related and a key term in this subject area is "Catch per unit effort" which Ricker [16] defines as **"The catch of fish, either in numbers or weight taken by a defined unit of fishing effort"** (pp 2).

The DFO functional model [7], originally prepared by DMR, indicates that the function "Monitor Catch and Escapement" is a combined activity. This is true for salmon only, where a fishery officer performs many of the requisite tasks to obtain catch, effort and escapement data in the course of his/her duties. However, the functions relevant to observing the escapement and spawning activity of fish produce information used in stock assessment primarily, and are therefore not included in the scope of this report.

This report does not attempt to define the exact requirements for a 'universal' catch and effort system, but rather to propose a general model which all such systems should strive to emulate. Achieving this goal will help make dataset correlations, linkages and eventual integration workable in the future. However, it is not a complete remedy, and the knowledge and expertise of the data manager, biologist and statistician who are intimately involved in the collection, verification and analysis of this data, are still a necessary part of the corporate information resources.

Organization of Report

The report is divided up as follows:-

Section 1 is concerned with summarizing, in concise terms for managers, the impact of the proposed Model upon the Catch and Effort databases in the Region.

Section 2 contains a description of the analysis methodologies adopted in this report.

Section 3 describes the functions involved in collecting and using catch and Effort data (Figures 3.1 and 3.2), proposes a data model (Figure 3.4) as an organizational blueprint encompassing all catch and effort information. Section 3 particularly identifies the relationship between the various

data sources, and their impact on the data model. A conceptual framework for the integrated systems is summarized in the Systems Architecture (Figure 3.5).

Section 4 comprises the results of detailed reviews of in-season harvest monitoring activities which are summarized in a sub-section devoted to each species group (Salmon, Herring, Groundfish, Shellfish). Within each sub-section, each fishery (Commercial, Sport and Recreational, Native Food) is reviewed separately if warranted. All material was verified by at least one reviewer.

Section 2

Systems Analysis Methodologies

Data Modelling
ANALYSIS AND DESIGN Methodology

The terminology used in this report is based on two related methodologies:-

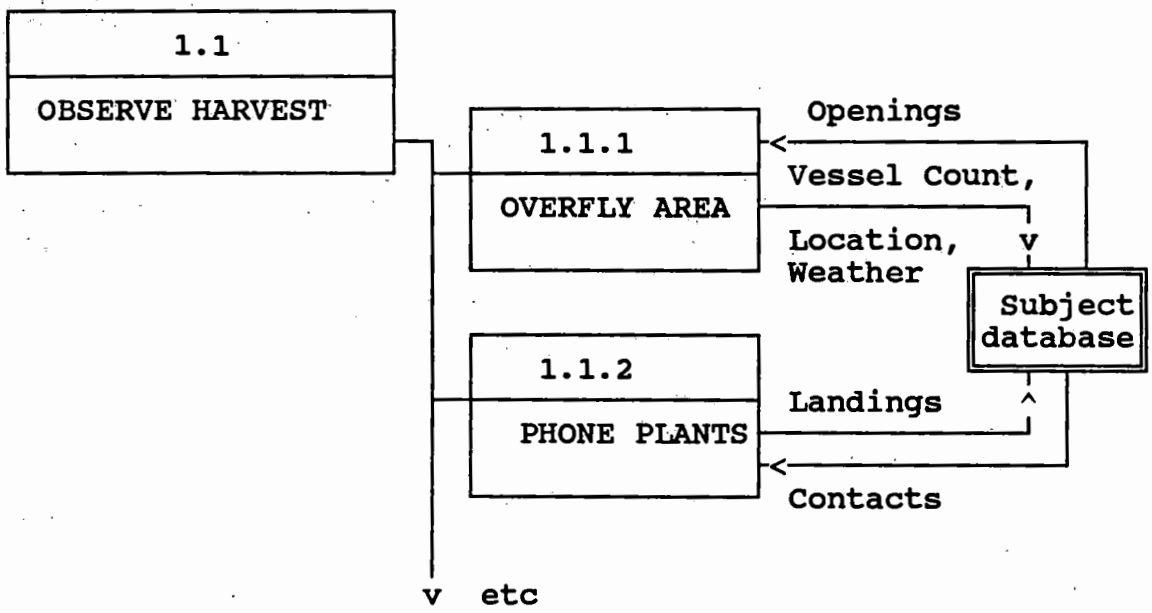
1. the Structured Systems Analysis (SSA) methodology for the identification and definition of functions carried out in the subject area. It is used by ITSD in Ottawa in systems development [18].

2. the Chen "Entity Relationship Diagrams (ERD)" methodology is used to represent the important relationships that link the data used in these functions [19].

Structured Systems Analysis is based on the examination of the work performed in an organization. The terms used are defined below:-

A Function is an activity, process, or task that results in information output from a given input. High level functions usually represent a collection of related functions. The level of detail, or functional decomposition, is represented by an hierarchic numbering system in the manner 1.0, 1.1.0, 1.1.1.0, etc as shown in Figure 2.1 below.

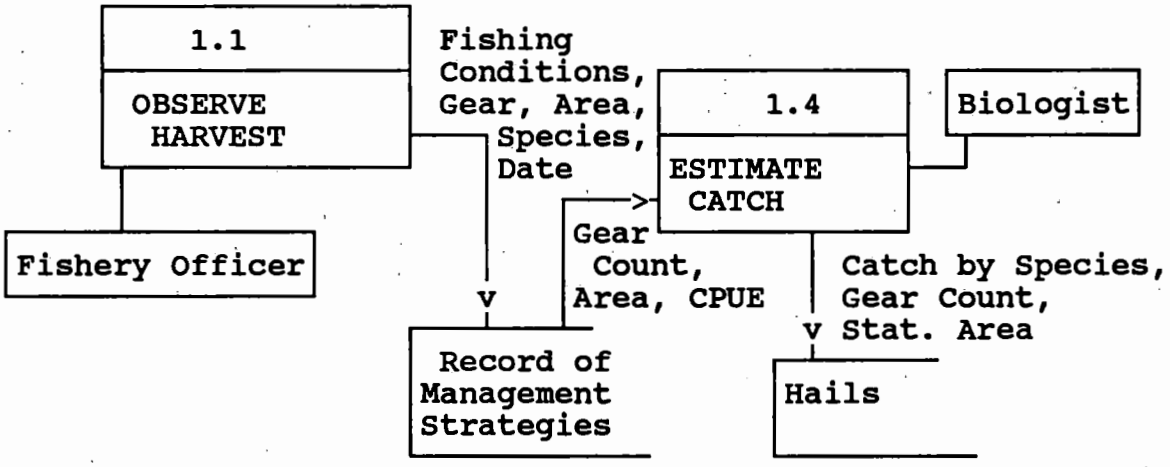
Figure 2.1 Example of a Function Chart
(with functions partially decomposed)



Data Flows are caused by information being passed between functions by any means (verbal, written, electronic). At high levels the information is usually very broadly descriptive in nature. As the level of analysis becomes more detailed, task specific data inputs and outputs can be identified and described. The information and data that is required to perform these functions are referred to as subject data. They are represented in a function chart as a subject database.

The actual flow of data between related functions is represented in a Data Flow Diagram(DFD) shown in Figure 2.2 below.

Figure 2.2 Example of a Data Flow Diagram (DFD)

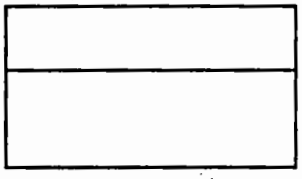


The example above depicts the movement of data and/or information between two functions - OBSERVE HARVEST and ESTIMATE CATCH. The Fishery Officer is responsible for the OBSERVE HARVEST function, and the Biologist is responsible for the ESTIMATE CATCH function. The Officer makes notes in the RMS on the fishing conditions and patterns, the gear count from overflights, the catch and species mix from interviews with fishers and site checks(in other words, this high level function actually consists of several related data gathering sub-functions or tasks). This information is synthesized and given to the biologist as an estimate of the total gear count in the area, a Catch per Unit Effort (CPUE) and the species mix. The biologist will review this information, compare it with information from plant interviews. An overall estimate of the catch by species for the opening is then recorded by the biologist in a hail database.

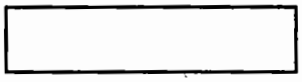
The example also serves to illustrate that a) most information/data passed between functions normally is 'filed' temporarily or permanently in a data source, sink or storage area, and b) that any level of abstraction (e.g. general information flows) or detail (a data processing program step) can be portrayed using this technique.

The chief advantage of the methodology is that it can describe any type of 'system', computerized or manual [23]. This allows the user and the analyst to concentrate on 'what' information is processed in a system, rather than on 'how' a computer or a person might perform the processing tasks. The symbols used in a DFD are defined below:-

Figure 2.3 Symbols used in a Data Flow Diagram



FUNCTION, task or activity

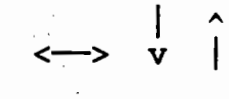


PERSON or AGENCY involved in a FUNCTION

DATA SOURCE, SINK or STORE

A Data Source or Sink may be a document, database, file, knowledge domain or verbal communication. A Source is an origin, while a Sink is a destination (report, card, verbal message). A Data Store is a place where related data is retained for future use (e.g. a database, card file, etc).

a line without an arrow means a PERSON or AGENT is responsible for performing the FUNCTION



DIRECTION of FLOW of Data or Information

Catch, Date

Catch & Effort Data Model

——————————> Information or Data passed to/from a FUNCTION, DATA SOURCE, SINK or STORE

Chen data analysis [19] is based upon the investigation of the information used in functions across the organization, and formalizes the symbolic language used in the analysis and design phases of systems development.

There are three levels of analysis and design [22]:

Conceptual Modelling	At this level, the analyst gathers information about the objects of interest to the organization, their general relationships to one another, and the business rules affecting them. (e.g. Customers receive Services, Fishers are Licenced to catch certain species of fish). The purpose is to ensure, at a corporate level that the objects one system collects are not duplicated elsewhere, that common standards for naming and identifying the same objects are maintained, and that business rules (security, confidentiality, data integrity, uniqueness, processing, etc) affecting critical objects in an organization are enforced in all systems which refer to that object. **Most of the analysis in the report is restricted to this modelling level.**
Logical Modelling	In logical modelling, the object is formalized by defining all the information that uniquely describes the object. A customer is described by their name, address, phone number, etc. Possible unique identifiers (keys) are catalogued at this time (customer number). The model should also reflect substantially all the data to be collected by one or more systems, with the exception of processing data (date, user-id, flags, etc) for a particular system. The model usually reflects a relational approach to file design.
Physical Design	At this level, the logical model is converted to a target file management system (e.g. dBASE, ORACLE, Ingres, RMS) and the internal record structure

(relational, hierarchic, or network) or the file structure and access paths (ISAM, Btree, Hash, etc).

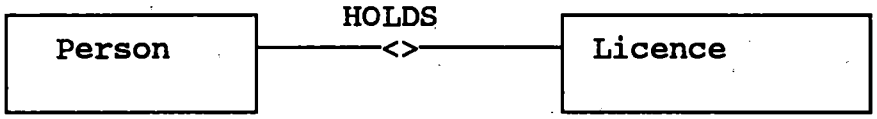
The terms used for describing data in Chen methodology are:-

An entity is an object of interest to the organization [19]. Any information collected can be classified as to the object of origin even when referenced in other objects. An object may be a memorandum, car, person, fisher, staff member, file, funding allocation, project, sport licence, or commercial troll logbook.

Figure 2.4 Examples of Objects or Entities

One object may be related to other objects - e.g. a licence is issued to a person. This is termed a relationship [19] and is depicted in Figure 2.5 below as the relationship "A Person HOLDS a Licence (to fish)".

Figure 2.5 Example of an Entity-Relationship



These relationships are usually the result of some function performed by the organization. The function may be the issuance of a licence to a qualified fisher the result of which is the relationship in Figure 2.5. Other examples of functions are:-

the registration of ownership of a commercial vessel for fishing (Person OWNS Vessel);

the approval of operating funds to an organization unit (Organization Unit ALLOCATED Budget);

the landing of fish as a result of harvesting activities (Person Catches Fish).

While any relationship is essentially binary in nature [20], a business rule may usually only enforce one of the directions of the relationship, while the other is used as a linkage or access path between entities. Thus, a function may require that only one of these directions is valid for the organization's purposes. For example, the ownership relationship could be described as a pair of relationships each satisfying a single business rule, as in Figure 2.6.

Figure 2.6 Business rules applicable to a relationship.

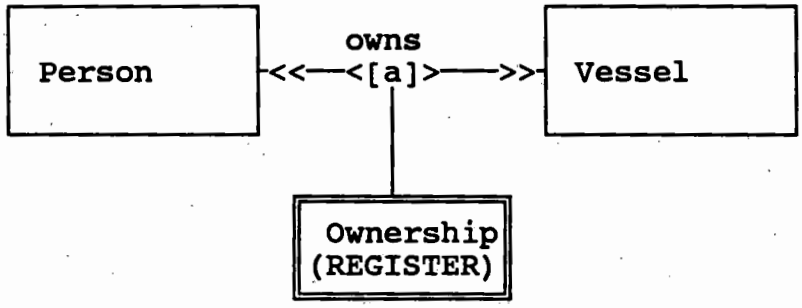
a (1) person owns one or more vessel(s)
person **<** **>>** **vessel**

a (1) vessel is owned by one or more person(s)
vessel **<** **>>** **person**

The combination would result in
vessel **<<** **>>** **person**

For clarity, an entity may also depicted in this report as a single or a double lined box. This is to distinguish between an static entity (single line box) that may be a candidate for a support file or table in a database and may change very little, and an entity representing an event or a transaction that is volatile (double line box) which is likely to be a file or table in a database which continuously grows or changes. The above ownership example may look like this in the logical design phase.

Figure 2.6a An example of a relationship defined by a Function (Vessel Registration)



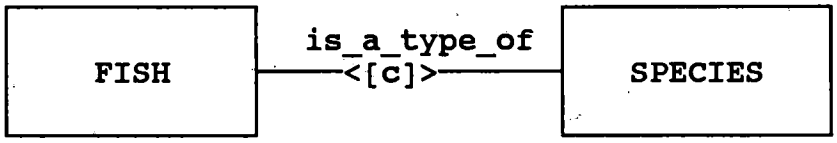
Note that this relationship now has been classified as '[a]', which means it is an Associative entity. Certain

entities and relationships can be categorized, to more clearly understand their impact upon the logical model.

An Associative entity [a] is one that normally arises as a result of an event (Figure 2.6a). This is a transaction which may be important to the organization or only to a particular system (e.g. commercial sales slips).

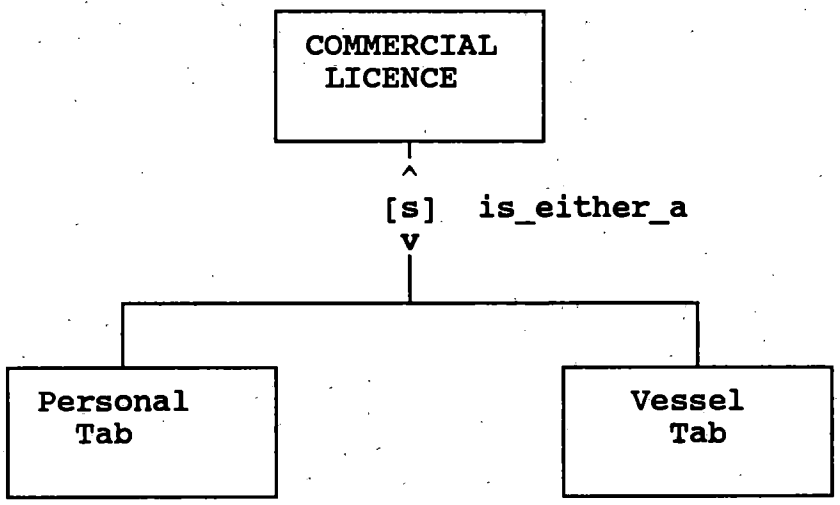
A Characteristic entity [s] is an object that is commonly represented as a particular table of codes (Figure 2.7) used throughout all systems (e.g. the Hart species codes, gear codes, statistical areas) to reduce file sizes and to minimize data entry and update overhead.

Figure 2.7 Characteristic Entity



An Entity Sub-type [s] means that a super-entity is represented by two or more similar types of entities, but they can be distinguished by at least one unique attribute (Figure 2.8). (e.g. A human is either a male or a female). Note that this entity sub-typing or super-typing is only used where the distinguishing information has an impact upon the way the entity is handled in a program or process.

Figure 2.8 Entity Sub-types



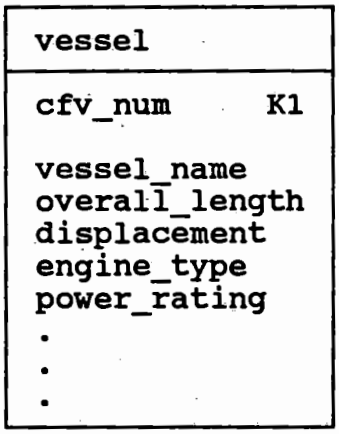
Data Elements

Each entity has a set of attributes [19] that describe it. Also called data elements or data descriptors, they contain information about the entity of interest to the organization.

a. The entity should contain at least one key attribute that uniquely identifies an instance of an entity [an actual record of a logbook (logbook serial number), issuance of a licence (licence number), a fisher (person number), or vessel registration(cfv number)]. The key must have no duplicates in the dataset (e.g. sales slip number in a year), and if so then additional 'qualifiers' should be used to ensure uniqueness (e.g. add the year to the above example if several annual datasets are to be combined).

b. There are usually other non-key attributes that describe an entity in more detail. For a commercial fishing vessel, the vessel name, overall length, displacement, engine type and power rating are important to DFO, and the key attribute uniquely identifying this information is the cfv number given by DFO to each vessel upon registration.

Figure 2.9 Entity attribution & keys

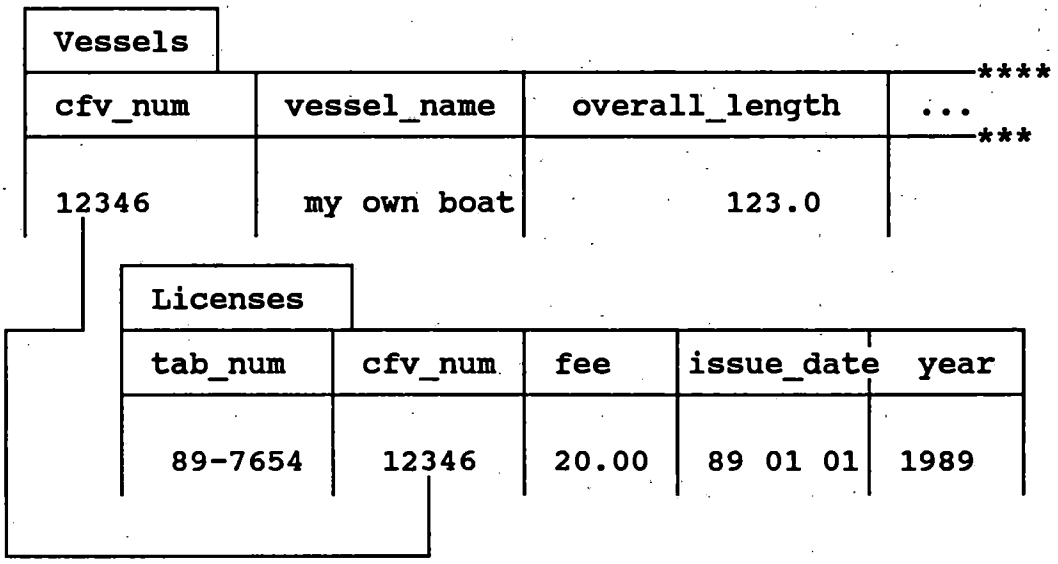


Other information representing relationships about the vessel may also be important to the organization. For example, DFO wants to keep track of the owners and operators of a fishing vessel. The result is a list of dates and person numbers associated with the cfv number representing these relationships over time (see Figure

2.8 below). These person numbers and vessel numbers are called foreign keys when they are recorded elsewhere than in their original file, because they are referenced in these files only by their unique key and not by the a long descriptive record (e.g. a person's name and address).

Such references are also called pointers, and their loss or absence may cause a system to fail due to a loss of referential integrity. If several systems refer to a commonly used entity, such as a commercial vessel (cfv number), and this file were not available or not kept up-to-date, then all these systems could fail on a crucial transaction which required the cfv number as a reference.

Figure 2.10 Example of a Pointer in a database table



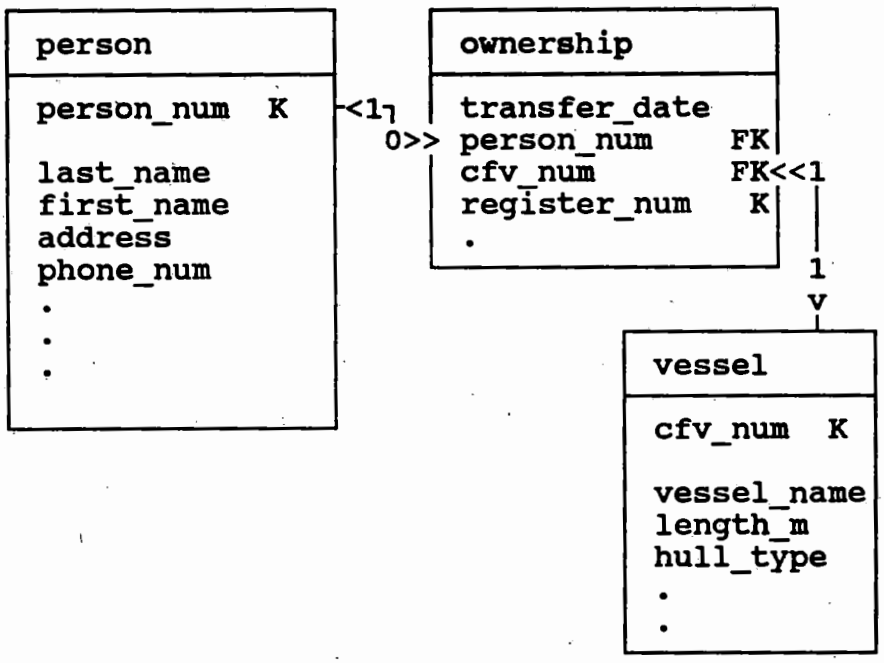
The basic rules for the development of te Entity-Attribute Diagram are:-

1. Each data element should also be a member of one entity or a relationship (excluding foreign keys).
2. Each relationship should contain at least two foreign keys.
3. Any entity which contains a set of attributes that repeat (such as the detail lines on a purchase requisition) should be split up into a "header" entity containing the non-repetitive data elements, and a "detail" entity which contains the repeating data.

Catch & Effort Data Model

In the previous example about vessel ownership from Figure 2.6a, further analysis reveals that additional attributes are needed in various reports and enquiries for each entity and relationship. The resulting logical data design is shown below. When the analysis is complete, all data elements required to fulfil the tasks within a system should have been identified.

Figure 2.11 Example of a Logical Data Model



The business rules that affect this relationship are:-

1. For each instance of a vessel there must be at least one registered owner.
2. For each instance of a ownership role, there must be a valid person.
3. A person may or may not be an owner.
4. A person may own many vessels.
5. A vessel may be owned by many persons.

Catch & Effort Data Model

This summary only serves to illustrate the methodologies used in this report. For a full understanding of Structured Systems analysis, refer to the cited sources [19-23].

Section 3

Corporate Data Model
Catch and Effort

Catch and Effort Data Model

Overview

This section will describe the proposed Data Model for Catch and Effort. The data model is designed to fulfil the information requirements of the functions identified in Table 3.1, which is at the end of this Section, by :-

a) defining the entities used commonly throughout most functions,
b) identifying the key relationships between important data elements, and
c) describing the business rules that affect these entities and relationships.

Before describing the Catch and Effort model, it is important to develop an understanding of the organizational context within which this model must operate.

Business Model of Fisheries

DFO's Mandates and Critical Success Factors (CSF).

A mandate is the equivalent of a mission statement defining the 'business' of the agency. Management develops programs or delivery systems which reflect this mandate. The 'organization' is designed to deliver these programs effectively and efficiently through objectives and plans. A well managed organization usually has a high degree of goal congruence, where each unit's subordinate goals assist in the achievement of the organizations prime objective.

A critical success factor is an underlying cause for the success of a organization in delivering its programs. The post office has significantly changed its ability to provide service by a) reducing the time it takes to deliver a letter, b) by measuring and promoting these time reductions to its public. The most important CSF for the Post Office is its perceived ability to serve the public.

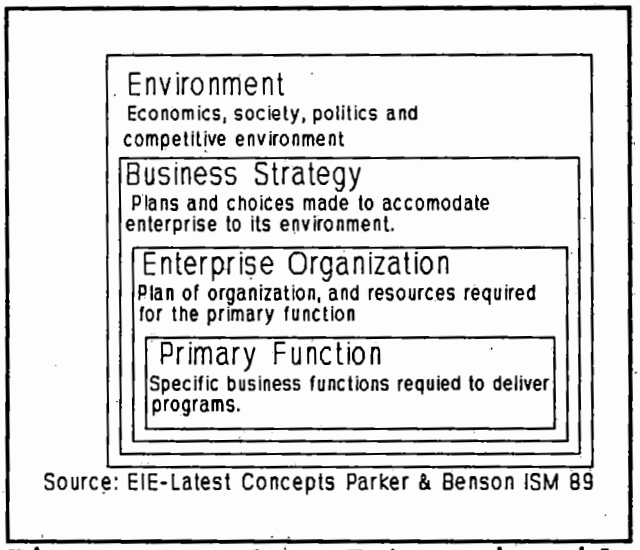
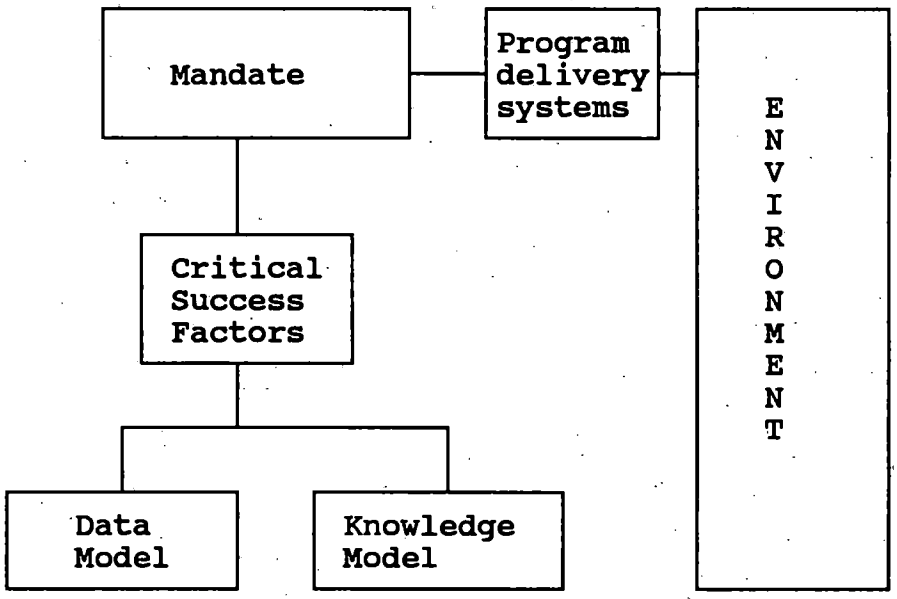


Figure 3.1 Enterprisewide Information Management Model

Catch & Effort Data Model

A critical success factor must also be an objective measure of an organization's ability to meet its mandate. An agency must be able to measure its success externally, rather than by self-imposed deliverables alone. For instance, the success of a good system is dependent upon client acceptance, even if it is delivered on time and within budget and is very efficient. Conversely, systems - computer or otherwise -which are requested by user groups but which provide no substantive added value to the organization should be discarded.

While an objective is a goal which the organization sets and strives to achieve, such goals should focused on changing the internal as well as the external environment to optimize these Critical Success Factors.



The underlying information requirements of DFO in the Pacific Region are thus defined as the data and knowledge required to know if one or more of these CSF's have been met or exceeded.

The problems facing DFO in the 80's were examined in detail in the Pearse Report [25] published in 1982. In part, the basis for the systems that have been built since 1982 find their source in this document. Moreover, the report first identified the **reasons why successful fisheries management policy work.** The report identified seven key areas [25, pp 5] - resource conservation, maximizing the benefits of resource use, economic development and

growth, social and cultural development, returns to the public, flexibility, and administrative simplicity. It is based upon these objectives that the critical success factors for DFO were defined by subsequent long range plans at the executive level.

CSF's and the Data Model

The DMR report [7] used the Pearse Report to identify 12 key success factors which were used as a basis for evaluating information critical to the kind of decisions made within DFO.

Some of these have been modified slightly to reflect the changing role of DFO. For instance, in order to reflect the concept of **sustainable development** [24], which is now a fundamental part of the Department's mandate, the word **"maximize"**, which was originally used in the Pearse and DMR reports, has been changed to **"optimize"** which implies a balancing of competing requirements over the long term to maintain sufficient freshwater and marine habitat for fish stocks to both regenerate and allow incremental improvements in harvests so as to satisfy a wide variety of user needs and desires.

There are a range of measurements that would indicate the "relative" success of DFO in each area. For instance, the ability to accurately measure the population of the resource - stocks - would ensure that management, through various strategies, could balance resource exploitation with resource regeneration. In the absence of an absolute measure of population, relative stock abundance, escapement, and catch and effort, as well as exploitation rates are all used as key indicators for this CSF. Underlying these measures, of course, are an intimate knowledge of the biological and environmental factors affecting the reproductive cycle, interaction and migration of all species.

A summary of these CSF's are outlined on the next page [7, pp 3-15].

Catch & Effort Data Model

	C S F	Information Requirement
1.	Optimize the use of the (fish) resource over time.	- Stock counts (catch, escapement, survival/mortality rates, optimum escapement); biological data; economic data.
2.	Protect aquatic habitat	- Inventory of quantity and quality of fish habitat; production capacity (actual and potential)
3.	Optimize the benefits of the use of the resource	- Net social benefits; long term maintenance of resource
4.	Fulfil commitments	- depends upon agreements
5.	Return on money spent (resources used/net social benefits)	- budgetary information; net social benefits
6.	Positive image with public and industry	- media coverage (positive or negative); fulfilment of commitments; ease of access to resource.
7.	Improve economic and social benefits to users	- Average incomes; spinoffs; opportunities; user satisfaction; lifestyle preferences
8.	Policy consistency (ability maintain intent of policies under changing conditions)	- credibility of department
9.	Flexibility (ability to respond rapidly to changing conditions)	- levels of authority; disaster prevention; response to new initiatives
10.	Motivation of employees	- employee turnover; productivity; grievances
11.	Priorities (ability to define and set with clarity)	- Enhancement of resource; improve management information base; manage change; deliver services efficiently, economically;
12.	Changes (ability to recognize, plan for and manage)	- International agreements, technology change; budgetary change; market changes; management changes

DFO, of course, has multiple mandates, and a critical activity of management is to maintain a balance between these mandates through priority setting and careful allocation of scarce organizational resources.

DFO must fulfil short term harvest allocation commitments that are often at odds with long term resource management goals. **Catch and Effort information is used to help managers balance short term commitments to industry, anglers and native interests.** Stock information on the other hand, is used to manage DFO's long term mandate to protect and enhance the fish resources.

The high level function chart summarises the broad organizational elements involved in the management process. It is not an organization chart, which is a means to deliver programs.

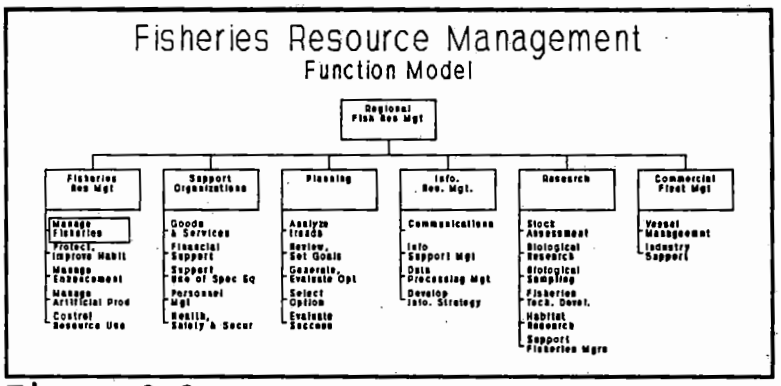


Figure 3.2

The processes relevant to Managing the Fishery (1.0) are all grouped under 1.0 "Fisheries Resource Management". The major ongoing planning and in-season management functions are all grouped under this heading. Catch and Effort information is required for one or more of these functions, so **a view of data that is predicated solely upon a particular organization unit's data requirement contains self-imposed limits**, thus reducing the utility of such data to the corporate level.

Within this functional area, the complexity of the fisheries analyzed is detailed in a chart at the end of this Section (Table 3.1). This analysis was conducted in cooperation with all staff involved, and covered both existing systems and future application areas. The functions have been grouped according to their similarities. The resulting key information groups that are common to most fisheries could then be consolidated. These common functions embrace areas such as openings and closings, hails, logbooks, and landings. These data sources should be viewed as corporate data, and treated accordingly.

The analysis of the individual fisheries in Section 4 contains recommendations on data and system design from the users' viewpoint. Most frequently cited areas of concern are access to

existing data, timeliness, and accuracy. Access is partly a technical issue, but it is mostly an organizational concern. Disparate systems development paradigms - micro versus mainframes, languages, poor documentation and lack of training - have resulted in applications data that cannot be correlated easily, if at all. For instance, logbook programs are developed to improve area and effort resolution of catch data, but no cross-reference is built into the saleslips or the logbook to verify either source document.

The Management Control Cycle

Management controls are systems that provide managers with feedback on the progress of management plans, and include five components. These are:-

1) a definable process with boundaries (harvesting),

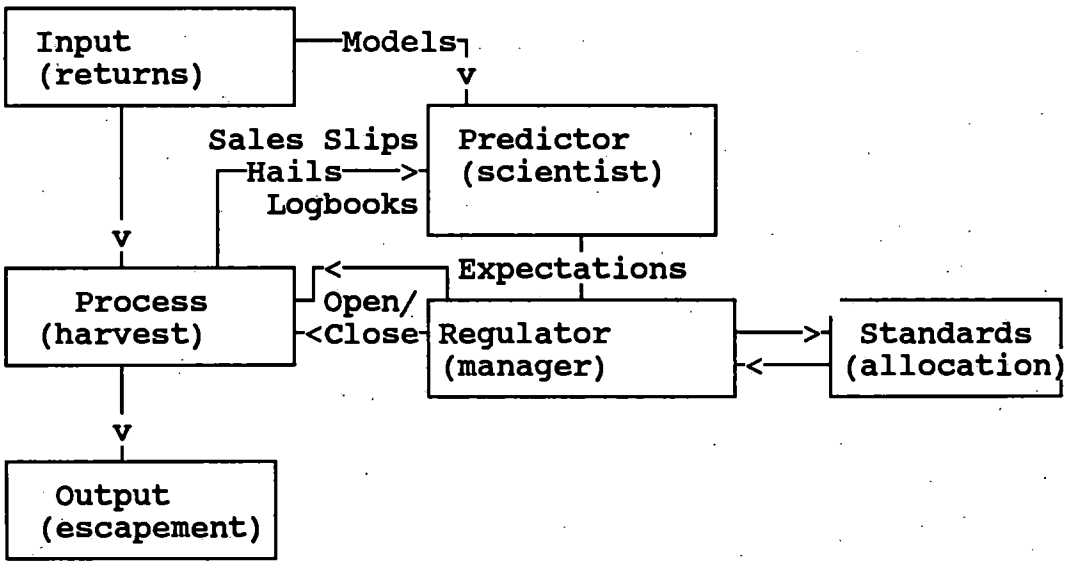
2) a characteristic to measure (catch),

3) a measurement system (several),

4) a set of standards (differs by fishery), and

5) a regulator (management).

A key mechanism of any management planning system is the feedback loop, which allows the 'regulator' to compare the 'measurement' against the 'standard'. For fisheries managers, this model might be summarised as follows:-



Setting allocations (TACs), or quotas on fisheries, is only useful if the feedback system(s) provide credible harvest information to measure "actual" against this "budget". **A fundamental principle of a control mechanism is that its cost should not exceed its benefit.** When applied to this subject area, it appears that **there has been no coordinated attempt to establish any criteria for evaluating the value of each and every program from a cost/benefit viewpoint.** This is partly because the true cost of a data collection program region wide cannot be easily estimated, since the task may be incorporated into others performed by staff, or parts have devolved to many different units over time. In other cases, the costs are known accurately, but the benefits - qualitative as well as quantitative - are not known. Indeed, the costs of losing or not collecting the data is often not known. This makes **evaluating the relative priority of these programs difficult for managers.** Nor is there any clear direction from management to correct this situation, despite a priority mandate to improve data management.

How does this affect the catch and effort information model? **Simply stated, if it is clear that the data sources need to be closely matched in order to gain a credible, accurate, and timely picture of the fisheries "feedback" to management, it logically follows that all programs involved in the collection, storage and management of this data be measured by the same criteria.**

The information model is the basic "architectural" standard used to reduce costs in data management. Establishment of similar criteria for measurements, procedurally and statistically sound collection methods, and scientifically verifiable estimation procedures would provide the basic building blocks. In addition, each program should identify the costs and particularly the benefits in quantitative terms to assist management in the evaluation process. A **value added approach to information management** might be used to evaluate developing independent versus inter-dependent systems.

Finally, **management needs to provide a framework for this evaluation process that is fair and equitable within the workplanning process.** This criteria, weighting and priorities should be defined by management to assist them in making these decisions. The cost/benefit methods used - such as data envelope analysis [23], activity price modelling [23], etc - should be developed by finance, with advice from planning and informatics.

Strategic Information Architecture.
Strategic Information Resources (SIR) are information holdings - data as well as knowledge - that are critical to managers and researchers in pursuing their various mandates. This approach was based upon:-

a) the Enterprise Data Model (Figure 3.3) and

b) the organizational realities of DFO (i.e. the organization chart).

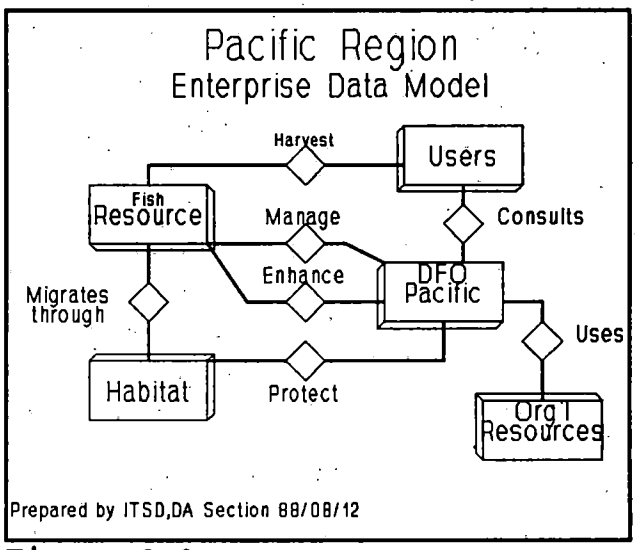


Figure 3.3

The functional framework first proposed by DMR (Figure 3.5) is based in part upon the broad functional requirements for program delivery. The work in this report seeks to flesh out a key information resource by describing the tasks carried out in collecting, analyzing and using this information, and building a matrix identifying these activities in detail in Table 3.1.

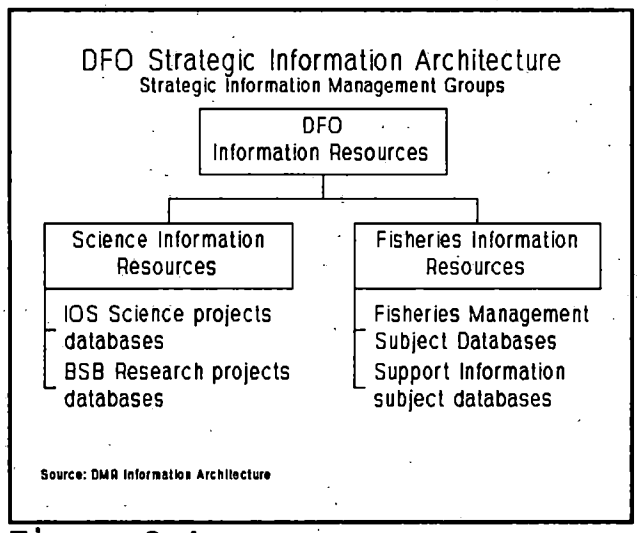


Figure 3.4

Originally, the Strategic Information Resource model was presented in the workshop (1988) and discussed as a framework for managing data as a key resource (FIgure 3.4). While partitioned along sectoral organization lines in part, it also prescribes information resource groups as a key mechanism for organizing the data management role.

These groups, however, can be also be segregated taxonomically. Data organized along these lines present a somewhat different picture of the organization's data. The level of potential data redundancy across systems is apparent immediately. The objective of data management is to reduce data redundancy, then this is a useful tool for assessing the level

and frequency of data redundancy. Ultimately, the organization saves the costs of maintaining diverse and incompatible systems.

The relevant information resources applicable to the catch and effort are within the boundaries of a large information resource - e.g. the Fish Resource - as a key data consolidation area (Figure 3.5). This resource information group contains, among others, key business entities "Harvesting Effort" and "Catch", and "Fish Products".

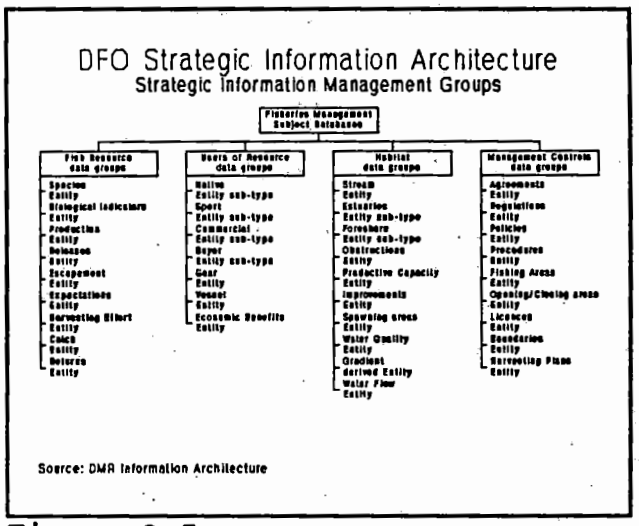


Figure 3.5

In addition, the data group "Users of the Resource" have extensive links with the Fish Resource information. Similarly, "Fishing Areas", "Licenses", "Harvesting Plans", "Boundaries", and "Opening and Closing" information from the Management Planning data group. It is these entities that comprise the "Catch and Effort" database and the scope of this report. Their relationships are illustrated in Figure 3.6 in more detail below.

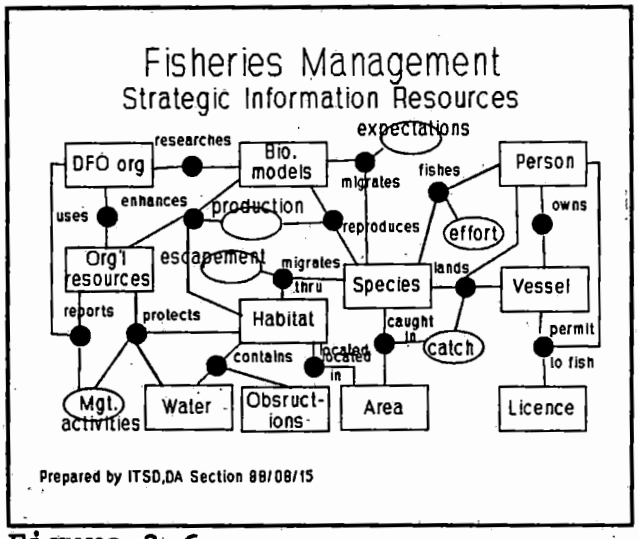


Figure 3.6

Key strategic relationships are really larger transient life cycle processes (i.e releases and returns, harvesting, spawning and escapement Figure 3.6). DFO is interested in tracking these processes and understanding them in more detail for each fishery and species. Such processes occur in the real world as events or transactions. In a database, these transactions are filed as records or "instances" of these relationships between entities. For example "species migrates through habitat" is an important process for DFO to monitor. However, there is no effective means of tracking fish through their migration cycle, except as a research excercise. Instead, this process or relationship of a

fish life cycle is monitored with a secondary measure like escapement, which is an estimate of the number of fish returning to spawn in the stream. Another indirect measure might be catch, if sufficient identifying information could be included (e.g. CWT) to make statistically valid estimates. These estimates might give one a picture of the results of migration - i.e. the returning population.

Figure 3.7 defines the scope of these entity relationships for Catch and Effort as a general model to review and modify for each system. These relationships can also be described in a structured way to define the data structures, and the business rules used to define its domain - or range of possible values. Common busines rules and relationships across systems can then be enforced uniformly. The key relationships for catch and effort are:-

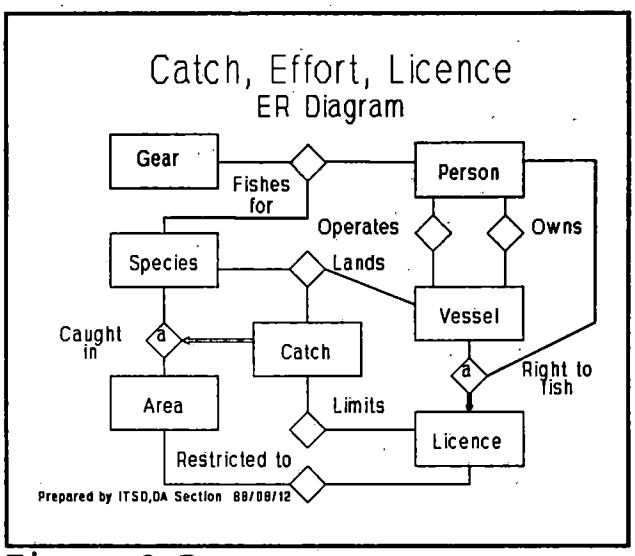


Figure 3.7

-Person operates Vessel
-Person owns Vessel
-Person 'is given' right to fish (Licence)
-Licence limits catch
-Licence restricted to Area
-Vessel lands Species (Fish) of catch with Gear
-Species (fish) caught (Catch) in an Area
-Fishery is opened/closed for an Area
-Catch Quota is allocated to a gear used on a Species in an Area

Business rules in this subject may vary from fishery to fishery. Some licences may have additional or less restrictions depending on the species. Some fisheries have no restrictions. Gear is an important entity that is regulated in some fisheries, not in others. Each fishery was examined in detail, and where sufficient information was found, the entity relationship model and the business rules were listed (e.g. see Figure 4.1.3 and Table 4.1.2).

A process - such as issuing a licence, observing harvest operations (hails), recording landings (sales slips) - affects one or more of these relationships, and thus the underlying data.

The references that represent the links between these relationships must be recorded correctly (e.g. species codes entered and checked against a code table). If errors in these references - called foreign keys - are made (e.g. statistical area codes and management area codes), then many more programs are required to check these links. If non-standard references are used, then more programs are needed to 'reconcile' these links. On the other hand, if the data model identifies clearly what these links must be, then the physical data design and programming of these processes can incorporate and verify these references, making future linkage feasible. Thus, information in the Licensing system is crucial in a catch and effort database, so references made to vessels must use cfv numbers, references to licences must use tabs, etc. However, mixing these references - as is done in the saleslip database reference to vessels and herring tabs in the same field, or adding special codes to this reference that do not appear in the Licencing database makes cross-database linkages very difficult.

DFO benefits from such data model analysis in the following ways:-

1) it calls for all system owners/managers with physical data belonging to a subject database to cooperate, for instance, in establishing data quality standards, coding schemes, and so forth.

2) it still allows the physical implementation of this 'architecture,' such as the location of the data, to be fully distributed (e.g. local data entry modules with updates to central database on a concurrent or non-concurrent basis).

3) it has the potential for DFO to achieve excellence in data management.

4) it also provides a framework for a more rigorous data acquisition and management strategy.

An understanding of the essential relationships within the data will help manage fish resources better. While individual data structures for each application will answer specific questions, they need to be a part of a comprehensive business model that will assure:

a) management obtain the required information in a timely manner,

b) that the underlying data is comprehensive, and of a high quality, and
c) that the models used are relevant to the management of the fishery (i.e. they answer critical questions).

These issues are addressed below.

Catch and Effort - A Business Model

The business justification for a Data Model for Catch and Effort is based upon the importance of the information to management in terms of the whether it fulfils a basic requirement of the DFO - to ensure sustainable development of the resource, manage the fishery to balance the competing needs of the users, with the fundamental issues of protection and enhancement of said resource.

The cardinal or critical success factor for in-season fisheries management is an accurate and timely estimate of the harvest by species and user group in an area. The timeliness is critical since the fishery must close before the allocations are exceeded. The accuracy of the estimate and the **quality of the underlying data** is important since any revision of these estimates at a later date has a downstream effect upon international as well as local resource allocation agreements. The quality of the harvest information is reflected in the means and methods of collecting, storing and using the original source data to prepare the estimates. Any one of these **data management principles has a direct bearing upon the credibility of Canadian fish harvest information.**

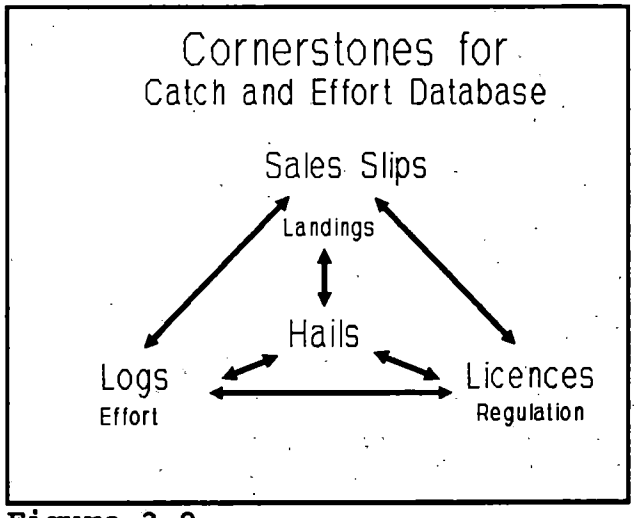


Figure 3.9

The proposed model identifies three key underpinnings to data quality. These are a) the source data or measurements, b) the inter-relationships between these sources to assure a high level of validity, and c) the process knowledge needed to use them. The fundamental building blocks in this subject area are Catch, Effort, and Landings. The key measures are time, area, user (or gear counts), species and pieces. The primary means for collecting these measurements are through three source documents - the hail observations kept by fishery officers, the logbooks completed by fishers, and the landing slips prepared by processing plants and vessels. **To**

establish the validity of any one of these data sources, one or more of the others must also be collected as "corroborative evidence" within the same timeframe, at a similar level of detail, and using the same measurements.

Without at least two of such building blocks across all fisheries, it is difficult to obtain an accurate picture of the harvest. This is, of course, not the case today. Indeed, some areas have **no ongoing commitment to harvest monitoring**, because of the low priority placed upon this activity in the absence of a consistent region wide management policy on the subject.

Hail observations

Some are copies or subsets of regional datasets, modified to the user's specific requirements. Others are original edited versions to include corrections to or added information which improves the accuracy of the original data set. Some are independent collections for the purposes of the local fishery and no more. Few are easily comparable by area, species, or user/gear. Some are documented, and more often no documentation is available. There is heavy reliance on local knowledge of the data by a staff member or contractor to interpret the data.

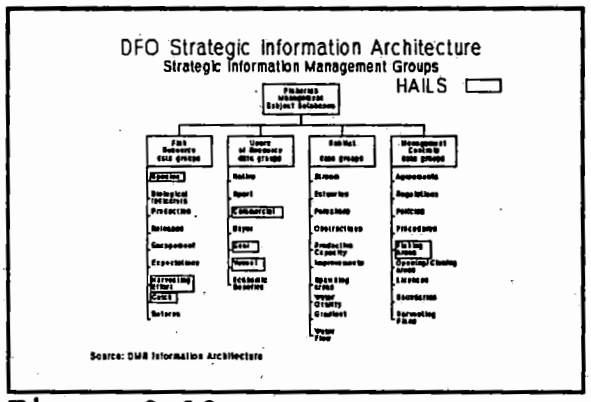


Figure 3.10

Logbooks

Logbooks programs have been implemented in some fisheries with varying degrees of success. The Foreign Observer program, one of the more comprehensive of such data collection activities, has proved successful because the data is collected by an independent contractor reporting to DFO. Others, especially if they are implemented voluntarily, are less reliable as data sources. Each program is tailored to the specific data needs of a research, conservation or post-season project. Mostly, these programs are designed to collect finer

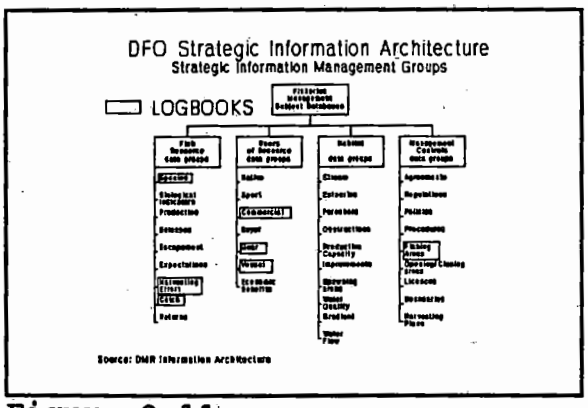


Figure 3.11

area resolution, or get better effort and gear data or species catch.

Sales Slips

The sales slip system is the only region wide standard reporting source of commercial fish "catch" for all species. It is required by regulation to be completed by any seller or buyer of fish. The slip essentially reports the landing of fish as to species, pieces and/or weight, and value, who purchased and who sold the fish. Some additional information such as days fished and areas covered are also included. This system is managed by the Statistics Division of Fisheries branch.

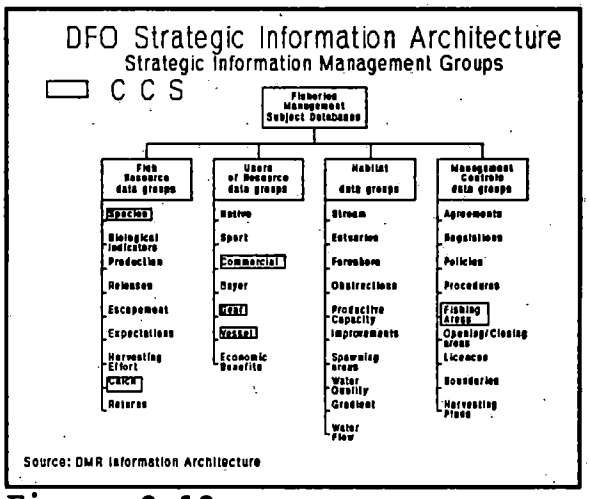


Figure 3.12

The current methods for cross-referencing this data to verify landings to catch, or hails to landings is a time consuming and often difficult task. The programs that collect this information are managed independently. The funding is often handled through several programs. Each program places varying levels of priority upon such funds. Priority setting is often done in isolation, and at an inappropriate level in the organization. This method of priority setting is dysfunctional and leads to goal sub-optimization, potentially resulting in the loss of continuity for key information sources. These programs need to be funded and coordinated by an appropraite level of management over a period of time to assure scientific or statistical validity. When urgent initiatives are funded to respond to sensitive issues, there is a need to are further detrimental side effects to ongoing programs. There is a need for a consistent direction in the management of key data sources.

Proposed Data Architecture

Figure 3.8 at the end of this Section represents a transformation of the conceptual designs discussed above into a physical database concerned with catch and effort information. This physical transformation of the entity relationship concepts into reality - the data architecture for Catch and Effort - provides a logical view of all catch and effort data if it were developed within Ingres.

Monitoring and harvest observations and the consequent data acquisition activities would result in the loading of tables dedicated to storing specific source data from logbooks, landings, sales slips, hails, openings and closings. These are entered and verified as received from a variety of external systems (microcomputers, other VAXes, or mainframes).

Support tables are required to validate and verify all source data and to provide the code descriptors for reporting purposes. Stable, well-designed, consistent and closely monitored, these support tables are the key strategic information resource needed to achieve integrated systems. Codes for species, gear, and area are the most critical in 'linking' datasets. The Atlantic provinces have had a common transfer format and 'code book' since 1982 using the STATAC file standards [3].

Pre-defined "views" or logical "flat files" are also required for users to access via Query-by-Forms. The views contain descriptions rather than codes, which makes the data understandable. Some rollups and summaries can be developed the same way, extracting data from a number of sources and creating a form of management summary.

Individual applications (i.e. the data entry and standard reporting programs for each source) will provide the more traditional access paths to the catch and effort data. In addition, the Ingres Utilities (QBF, RBF, Vigraph) will also allow access by users on an 'ad-hoc' basis. These skills can be acquired in a two day course provided by ITSD on a regular basis.

It should be noted that the logbook tables are shown separately. This is because much of the data collected by these observer programs are very specific to the fishery. However, PBS researchers have been using a sort of 'standard format' for some years. It is proposed that a relational equivalent of this standard be prepared by the research community with assistance of an ITSD data analyst, reviewed and agreed upon by the fisheries branch staff. This design would be made the model for the logbook data designs in the future. Forms and other collection methods could then be simplified somewhat.

Catch & Effort Data Model

The key data sources, LOGBOOKS, SALES SLIPS, and HAIL OBSERVATIONS are central to the integration strategy. Each refers to the vessel and thus the licensee, which provides the primary cross-reference between all sources. Date and time, areas fished, and gear used can also be verified across these sources, thus improving the total quality of this data. The corroborative nature of this verification process is the single most important feature of the integrated catch and effort systems. Indeed, it is this mechanism that is used in the groundfish fishery to validate catch. Figure 3.13 also graphically illustrates the linkages between various <u>systems</u> that use these data.

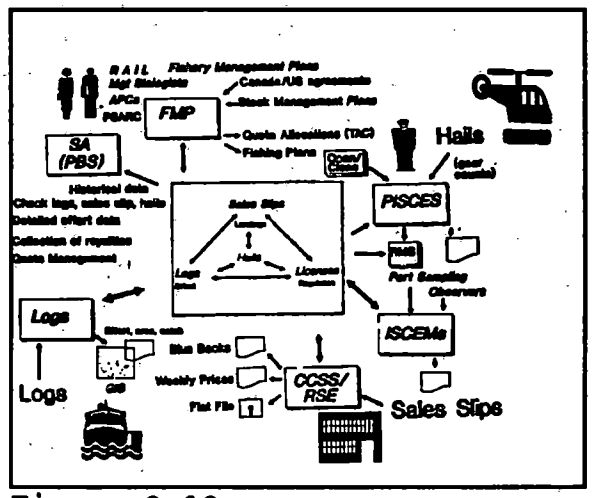


Figure 3.13

<u>Fishery Management Plans</u>:- Developed by consensus amongst DFO and users, these plans should be incorporated in a coast wide system accessible by all managers (Figure 3.14). Actual local openings and closings, and the resulting catch estimates could then be compared to these plans. Allocations and quotas are a key data requirement for this planning function. Managerial decisions could also be recorded here. Access to this information could be provided as necessary.

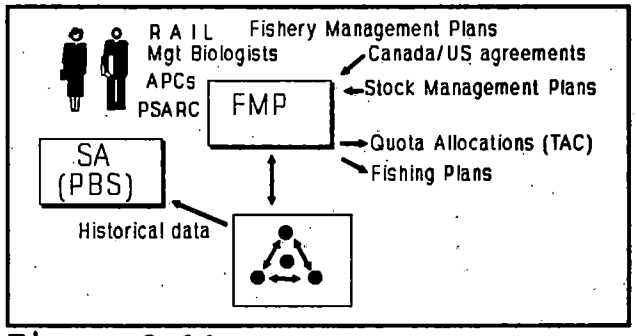


Figure 3.14

<u>PISCES</u>:- Pacific In-Season Catch Estimation Systems (Figure 3.15) records the final hail estimates, opening and closings. The original observations, though, which are recorded in the Record

of Management Strategies - in some areas - are the key data needed to verify fishing activity. These need to be recorded in a more accessible way, and provided coast wide on-line. Local fishing conditions also need to be uploaded for managers to be able to access easily. Key issues affecting the fishery need to be communicated both up- and down- line.

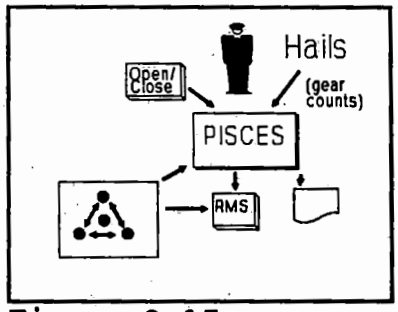


Figure 3.15

ISCEMs:- In-Season Catch Estimation Models (Figure 3.16), like the Troll model, would help to improve the quality of the estimation process. Developed for each fishery and providing local input from the management biologist and fishery officers, these models would use the hails, sales slips, logbooks to prepare a reliable and consistent catch estimate coast wide.

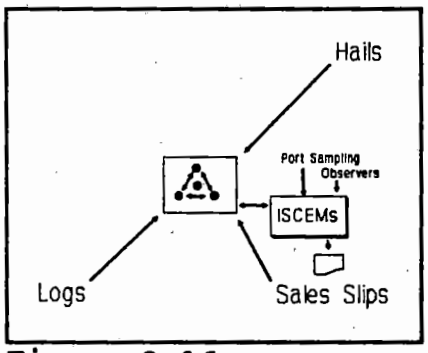


Figure 3.16

Commercial Sales Slips:- the sales slips, both manually and remotely entered(RSE), must be much more closely linked to the hail data in order to verify fishing activity as early as possible in the week (FIgure 3.17). When re-developed in Ingres, sales slips and detailed hail observations can be entered and verified in real-time, and an objective statistical method applied to estimate fishing effort, areas fished, and CPUE on a coastwide basis.

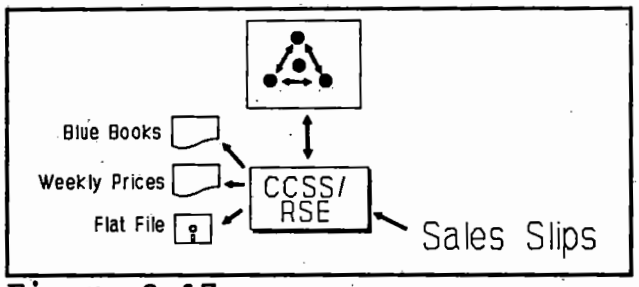


Figure 3.17

Catch & Effort Data Model

Logbooks:- These data will become more important as landings are redirected to US plants (Figure 3.18). Thus, hail observations will also have to be checked against the logs received from US bound fishermen to arrive at an estimate of catch. This procedure may initially be performed on a post-season basis to arrive at an estimate for use in models in-season. Eventually, technology may allow this process to occur in-season in a cost effective manner.

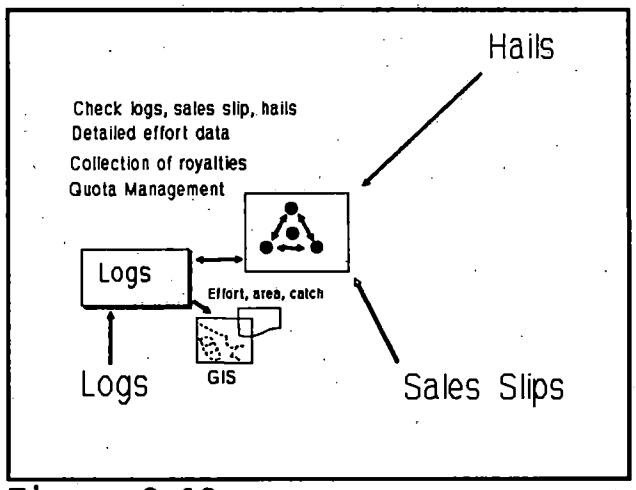


Figure 3.18

From a systems management viewpoint, integrating these related data sets in a comprehensive coast wide system by using existing hardware technology to provide the access paths to/from the database will

1) reduce the data storage overhead,
2) improve applications maintenance, and
3) increase the productivity of application development.

The advantage to research activities is better information. The on-line entry and verification of these data sources in a coordinated, integrated manner improves their quality and reliability, resulting in better source data for stock assessment models in the long run.

Finally, users gain greater reliability and quality in their information resources, and can take advantage of improved accessibility and utilization through the use of standard access programs, fourth generation languages and case tools, central data dictionaries and process/knowledge modelling.

Systems Architecture and User access:- Any systems architecture is driven by the existing technology architecture and the current applications used by the organization. DFO has already got in place a significant investment in these areas, which constrains the options available in the short term. However, in the long run, DFO should prepare plans which reflect the new data and process models (Figure 3.19).

Catch & Effort Data Model

The resulting application(s) that access these information resources will, of course, have to be flexible and graphics- and/or menu-driven, providing easy access to standard as well as ad-hoc reports, with the capability to "hook" into other systems. The ability to select and download data to micro-computers easily is also a key consideration. Ultimately, managers need to be able to access summaries of this information from the network of systems in as simple a manner as possible, and to communicate their decisions throughout the organization using this same network.

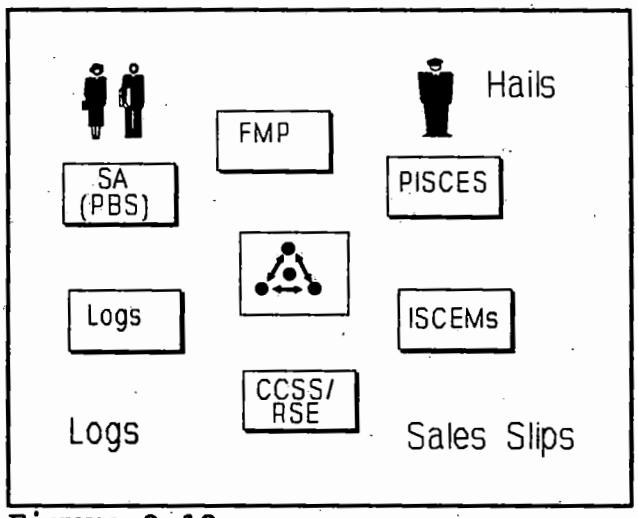


Figure 3.19

Recommendations

The body of this report contains a series of recommendations for each fishery. It is further recommended, that in order to coordinate the various efforts, a steering committee consisting of one representative from each fishery and a senior manager, together with a science advisor, a management biologist, and a senior systems analyst, be formed to manage this project. The steering committee's immediate task is to develop a preliminary study defining the scope and sub-system projects and the feasibility of specific strategies. User requirements analysis will be a key part of this phase prior to the development of each of the sub-system applications, when appropriate levels of funding have been provided.

Table 3.1 Source, Control and Use Matrix - DFO Manage Fishery Functions

Function	FISHERY							Data Sources							Data Stores						
	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks	Val.Slips	Hails	Surveys	Open/Close	Samples	MISC DATABASES						
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control R = Use	Commercial	Sport	IFF	Roe Herring	Offshore	FOP	Shelf'h										ISCMP	ISCES	RMS		
1.1.1 Estimate Stocks (Expectations)	R	R	R	R	R	R	R								U						
1.1.2 Allocate Resources	C	C	C	C	C	C	C								U						
1.1.2.1 Set T A C by User	S	S	S												U						
.2 by Area	S	S	S	S											U						
.3 by Species	S	S	S												U						
.4 Set Quota by Nation						S									U						
.5 Set Quota by User				S			S								U						
.6 Set Quota by Area, Species					S										U						
1.1.3 Set Fishing Plan	C	C	C	C	C	C	C								U						
1.1.3.1 Set Joint Venture/Co-op plan						S									U						
1.1.3.2 Set Area Fishing plans	S	S	S		S		S								U						
1.1.3.3 Open Fishery	S	S	S	S	S	S	S								R	U					

Catch & Effort Data Model

Function	FISHERY							Data Sources							Data Stores							
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks	Val.Slips	Hails	Surveys	Open/Close	Samples	MISC DATABASES	ISCMP	ISCES	RMS	Plan			
	Commercl	Sport	IF	Roe Fish	Offshore	FOP	Shelf'h															
1.1.4 Monitor Catch & Escapement																						
1.1.4.1 Observe Harvest																						
1.1.4.1.1 Hail Vessels																						U
1.1.4.1.1.1 Gillnet	S			S							U											U
.2 Seine	S			S							U											U
.3 Troll	S				S						U									U		
.4 Foreign Vessel						S					U											U
1.1.4.1.2 Interview																						
Plants	S			S			S				U											
Packers	S			S			S				U											
Fishers	S		S								U											
Anglers		S										U										U
Divers							S				U											
Foreign Vessels						S					U											
1.1.4.1.2.1 Logbook prepared by User	S					S			U													
1.1.4.1.2.2 Validate Catches by User							S		U													
1.1.4.1.3 Visiting sites																						

Catch & Effort Data Model

Function	FISHERY							Data Sources						Data Stores					
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks	Val.Slips	Hails	Surveys	Open/Close	MISC DATABASES				ISCMP	
	Commercl	Sport	IFF	Roe Fish	Offshore	FOP	Shellf'h							Samples	Plan	ISCES	RMS		
1.1.4.1.3 cont'd Shellfish sites							S												
Plants	S						S	U			U			U					
Packers	S							U						U					
Fishing sites		S	S																
Landing sites		S									U								
Foreign Vessels						S			U		U			U					
1.1.4.1.4 Overfly Areas	S				S	S													
1.1.4.1.5 Patrol Areas																			
1.1.4.1.5.1 Schedule patrols	S	S	S	S			S								U				
1.1.4.1.5.2 Set sea assignments						S													
1.1.4.2 Conduct Test Fisheries																			
1.1.4.2.1 Conduct a catch	S			S				U			U			U	U	U			U
1.1.4.2.2 Collect catch samples	S			S		S	S							U					
1.1.4.2.3 Perform site surveys																			
1.1.4.2.3.1 Dive survey				S															U
1.1.4.2.3.2 Surface survey				S															U
1.1.4.3 Estimate escapement	S														U				

Catch & Effort Data Model

Function	FISHERY							Data Sources							Data Stores						
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks	Val.Slips	Hails	Surveys	Open/Close	Samples	MISC DATABASES	ISCMP	ISCES	R M S	Plan		
	Commercl	Sport	IFF	Roe Fish	Offshore	FOP	Shelf'h														
1.1.4.3.1 Prepare BC-16	S																				U
1.1.4.4 Process Sales slips	S			S	S		S	U											U		U
1.1.4.4.1																					
.2																					
.3																					
.4																					
.5 Check Sales slips				C	C			U													U
1.1.4.5 Estimate Catch																					
1.1.4.5.1 Recording Harvest																					
1.1.4.5.1.1 Logbooks	C				C	C	C		U												U
.2 Hails/Observations	C	C	C	C	C	C	C				U										U
.3 Validation Slips							C			U											U
.4 Surveys		C										U									U
.5 Sales Slips	R			R	R	R	R														U

Catch & Effort Data Model

Function	FISHERY							Data Sources							Data Stores					
	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks	Val.Slips	Hails	Surveys	Open/Close	Samples	Plan	MISC DATABASES	ISCMP	ISCES	RMS	
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control	Commercial	Sport	IFF	Roe Fish	Offshore	FOP	Shellfish													
1.1.4.5.2 Estimate Harvest Rate																				
.1 CPUE	S	S	S	S			S	R	R	R	R	R								
.2 Cumulative Catch				S	S	S	S			R	R									
.3 Modelling	S							R			R									
.4 Sampling		S										R								
1.1.4.5.3 Calculate Total Catch	S	S	S	S	S	S	S	R	R	R	R	R								
.4 Record Harvest Est.	S																U			
.5 Report Harvest																				
Bulletin	S																			
Oscar/Charlies	S						S													
Market Report	S																			
1.1.5 Adjust Fishing Plan																				
1.1.5.1 Analyze harvest results	C	C	C	C	C	C	C													
.2 Compare catch to plan																				
by User Quota				C			C	R	R	R										
by Allocation (TAC)	C	C	C	C				R	R		R									
by National Quota						C					R									

Catch & Effort Data Model

Function	FISHERY							Data Sources						Data Stores						
1.1 MANAGE FISHERY 1.1.1 ESTIMATE STOCK 1.1.2 ALLOCATE RESOURCES 1.1.3 SET FISHING PLAN 1.1.4 MONITOR CATCH & ESCAPEMENT 1.1.5 ADJUST FISHING PLAN Legend: S = source U = Update C = control	Salmon			Herr	Groundf'h		Shlf	Sales Slip	Logbooks		Val.Slips	Hails	Surveys	MISC DATABASES			ISCMP	ISCES	R M S	
	Commercl	Sport	IF	Roe Fishy	Offshore	FOP	Shellf'h							Open/Close	Samples	Plan				
.3 Extend/Close Fishery	C	C	C	C	C	C	C						U		U			U		
.4 Convert Directed to Incid.					C			R	R		R		U							
.5 Adjust Quota by Nation						C					R		U							

Figure 3.8 Data Architecture - Catch & Effort

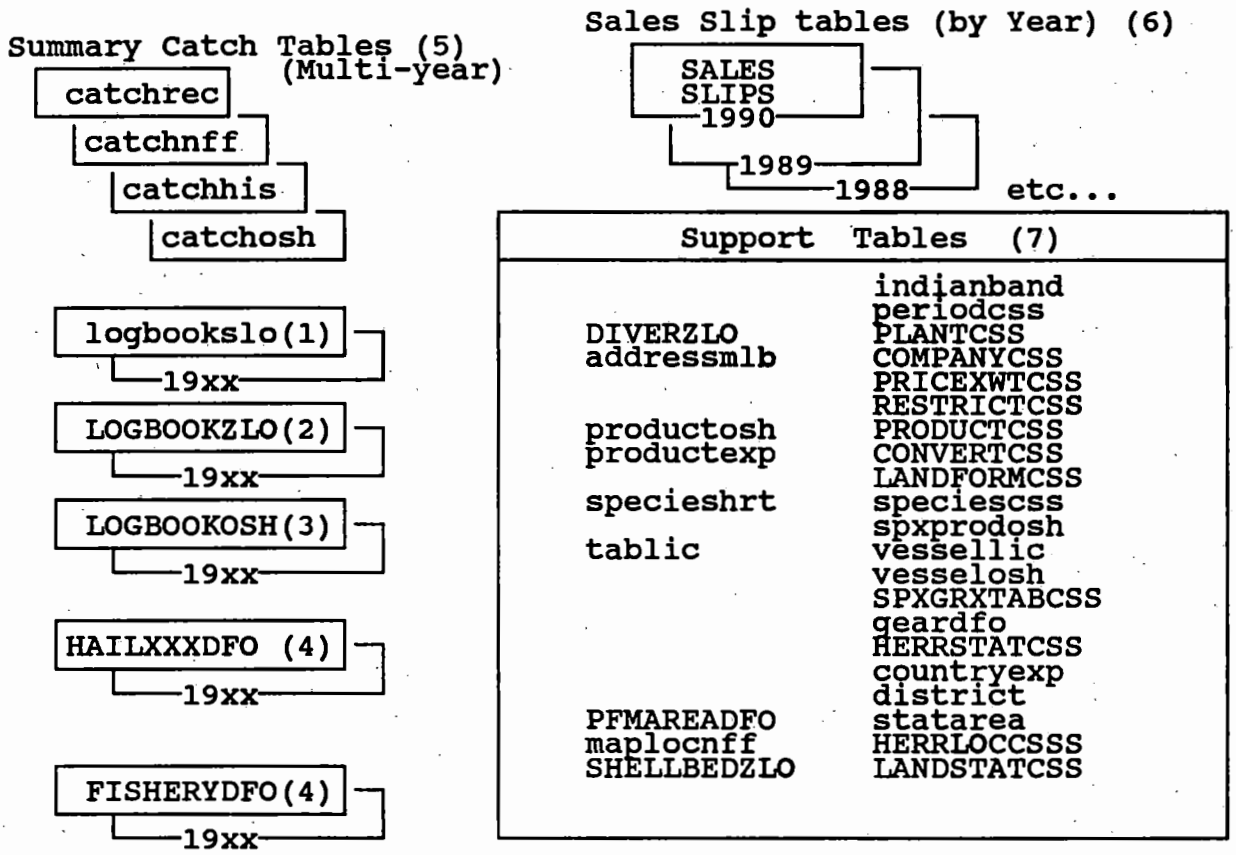


TABLE = PROPOSED
table = available in Ingres database REGION

Notes:
(1) See Figure 4.1.6
(2) See Figure 4.8.3
(3) See Figure 4.7.4
(4) See Figure 4.1.8 and Table 4.1.1
(5) See Figure 4.1.5 and 4.7.3 (CATCHOSH)
(6) See Figure 4.1.4
(7) This is a list of the support tables required for the transaction and summary tables. (See table 4.1.2 for descriptions)

Catch & Effort Data Model

Section 4

Data and Function Models
Analysis by Fishery

Catch & Effort Data Model

SALMON

4.1 - Commercial Salmon Fishery

Overview

The commercial salmon fishery targets on five salmonid species with some commercial value. The key target species are Sockeye, Coho, Pink, Chum, and Chinook. Steelhead is usually an incidental catch. Based upon the sales slips processed in 1988, an estimated catch of 81 million kilos of salmon were landed with a value of $256 million. The principal gears used in these fisheries are troll in the "HOOK and LINE" fishery, referred to in this report as the "TROLL" fishery, and seine and gillnet for the "NET" fishery. Approximately 4,600 vessels participated in these fisheries in 1989.

The fisheries are cyclical. This is because a salmonid life cycle usually ranges between two and five years. The salmon spawns in fresh water streams throughout BC, incubates and develops in fresh water for up to two years, before escaping downstream to the sea. Their long migration takes them up the West coast of the North America, often as far as Japan, before returning to spawn in the origin stream. A spawn-rear-escape-return cycle may be between two years (pink) and five years (chinook), depending upon a species and stock. The typical sockeye cycle is four or five years. Returning stocks are identified by their "brood" year, or the year their parents' spawned.

Fishery Management

Expected returns are summarized and these expectations are the basis for the resource allocation exercise. The expected recruitment is divided between escapement and harvesting. Escapement is an estimate of what is required for the renewal cycle (upstream escapement to spawn). The balance is available for harvesting. Estimating population levels, or stock assessment, is an important part of the process toward estimating recruitment. Stock assessment is an ongoing responsibility of the Biological Sciences Branch, Salmonid Section. These assessments are reviewed by oversight committees under the aegis of the Pacific Stock Assessment Review Committee (PSARC), and published in annual reports [4]. In addition, independent stock assessment reviews are conducted by Planning and Economics Branch, and by Fisheries Branch and the Divisions prior to establishing fishing plans and allocations. Salmon Enhancement Program also has a Stock Assessment Unit for enhanced stocks only.

Various agreements are in place to "ration" the catch among user groups (Sport, Commercial, Native) and then further detailed allocations are made to specific gears (Nets and Troll). The

catch allocation is then broken down by statistical areas, or geographic locations where the actual catch will be made. The allocation process is complex and beyond the scope of this study. Many representatives from industry and user groups as well as government agencies are involved in discussions through APC (Area Planning Committees) at the Area level and with the Salmon Coordinator. International agreements, which are monitored by the Pacific Salmon Commission (PSC), are also in place for pink and sockeye salmon species on the Fraser River. A database of catch and effort is also maintained by PSC in Ingres on a Micro-VAX (Figure 4.1.9).

Eventually a Fishing Plan consisting of dates and duration of openings in a management area or sub-area is prepared for each Area by gear and user group.

Harvest Monitoring

Monitoring the harvest is a key management control process to ensure that allocations are not exceeded by any one group and that stocks are not over-fished. The monitoring process may differ for TROLL and NET gears, and from area to area, due to the nature of the fisheries, so the descriptions below provide a general overview.

The primary source of data for in-season catch estimation are HAILS performed by fisheries officers and management biologists during a fishery. Each commercial fishery is handled differently. Some are sophisticated, such as the Troll Fishery, which relies upon the troll survey and a modelling program (In Season Catch Monitoring Program -ISCMP) to advise Senior Area Biologists and the Salmon Coordinator via Bulletins on the salmonid catch effort situation (D.Schutz).

Most HAILS are made by fishery officers a) interviewing boat skippers on the water, b) calling upon plants, or c) boarding packer boats. This observation data is written in notebooks and summarized in the Record of Management Strategies(RMS). HAILS from these sources are also stored in Lotus or Symphony spreadsheets on PC's (See Figure 4.1.1a).

A preliminary estimate may be calculated by using overflights to collect data on the number of vessels (gear count) in or near a fishing area multiplied by a catch per unit effort (CPUE) for the time of year, target stock and an estimate of the by-catch mix. Subsequent phoning to plants and vessel hails may indicate a different CPUE, and a correction is made. This phase of monitoring is grouped into a set of functions called OBSERVE HARVEST (see Figure 4.1.2). This estimate stands until early sales slips (landings) indicate whether further adjustments are needed. Information on fishing conditions and patterns is also

collected, and often has a lot to do with corrections and refinements in the catch estimate.

For Troll, a conference call is made by the Salmon Coordinator with each Division on the second day of the fishery to decide if the estimate of catch is under the allocated or planned catch. If it is over or close to the allocation, the fishery would be closed. If it is under, a recommendation may be made to extend the opening.

Subsequent checking is done of these final estimates (recorded in PISCES or elsewhere, Figure 4.1.1) against the sales slip data in the Commercial Catch Sales slip System to ensure that the differences between the estimated and the actual catch are reasonable. The Pacific Salmon Treaty between the US and Canada requires that the difference be no greater than 7%.

Data Sources

The key data sources of information for the in-season management of the fishery are the sales slips for landings and the hail observations. Recently (1989/90) mandatory logbooks have been instituted in the commercial troll salmon fishery for chinook. A system is being developed in Ingres to allow entry and enquiry of this data (see Figure 4.1.6). It is not likely to be useful for in-season management. However, it will provide better area and effort data. The relationship between hailed, logbook and landing data is summarized in the conceptual data model in Figure 4.1.3. The sales slip system conversion to Ingres will have to meet the High Level Logical data design summarized in Figure 4.1.4, which is based upon :-

a) the integration requirements noted in Figure 4.1.3,

b) the current availability of code and master tables in Ingres which are supporting the Sport, Recreational and Native Food historical data tables (Figure 4.1.5).

Recently, to account for salmon leaving BC unprocessed, Landing Summaries were introduced by Regulation to record information on outbound fish. These had to be landed at certain specified sites prior to being delivered directly to US processing plants. A subsequent ruling by GATT effectively disallowed this requirement. However, the incident shows that systems now in place or being considered in future should be designed to allow for, and provide corroborative links among multiple data sources.

Commercial Sales Slip System

The sales slip system is the only region wide standard reporting source of commercial fish "catch" for all species. It is required by regulation to be completed by any seller or buyer of

fish. The slip essentially reports the landing of fish as to species, pieces and/or weight, and value, who purchased and who sold the fish. Some additional information such as days fished and areas covered are also included. This system is managed by the Statistics Division of Fisheries branch.

However, the sales slip system has been subjected to extensive modifications in an attempt to satisfy many different, sometimes conflicting user needs. These modifications are rapidly becoming so complex, that estimating the costs of enhancements are difficult, and software quality assurance testing is becoming prohibitively costly in terms of contractor and staff support. On occasion, the ramifications of a change are unknown, and further changes are required to correct any problems that arise. Often, only key reports are updated to reflect changes, and others are only updated when a request is made, and the report fails. Users now prefer to get copies of the raw data, rather than rely on existing reports, and create their own datasets to prepare analyses. Users complain that there is no direct means of access to the database or reports.

The costs for the Sales Slip program are over $400,000 annually in Fisheries Branch and Management Services budgets. The cost to re-develop the computer programs and convert the data into Ingres, which would finally permit the integration of hails, logbooks and sales slips, are estimated at $200,000. The result is a net annual saving of $147,000 annually to the Region, or a payback in business terms of less than one fiscal year.

Problems and Challenges

The sales slip data may no longer be relied upon as the primary source of "catch" on the west coast. Rather, while it will remain the main source of data on fish landed and processed in Canada, Canadian fish landed in the US and foreign fish landed in Canada are not covered in the system. The GATT ruling will further impact the value and completeness of the sales slip as a "census" type of data source for all fisheries, and particularly salmon.

The key problem areas which limit the capability of various manual and computerized systems to meet in-season management information resource delivery objectives are:-

1) The lack of area resolution in commercial troll fisheries catch data.

2) The timeliness of corroborative data (i.e. sales slips)

3) the need for more timely and more accurate data affecting changes to the anticipated fishing conditions

(weather, stock migration and recruitment, expectations) as a result of changes in prior and current fishing patterns.

Recommendations

The key areas of opportunity for improving existing systems to meet information resource delivery objectives are:-

1) to provide ready access to and linkages between key databases (Catchhis, Sales slips and Licensing and ISCMP, MRP, ISCES) by

   a. re-designing Commercial Catch Sales Slip and Remote Sales slip Entry systems to meet the user requests noted herein; as well, the errors inherent in the current system identified by Bjerring, Kopas[15] and others should be corrected; CCSS should be re-developed in Ingres database management system environment at considerable savings to DFO; Improved users on-line access this data using the Ingres ad-hoc query and report generators should be a high priority;

   b. providing access to all years of CCSS sales slip historical data (all species) on-line in batch mode using high-capacity disk or tape technology (e.g. write-once-read-many times [WORM]);

   c. providing universal, on-line access to MRP made transparently through the RIS Gateway (DFO-MENU), with a tutorial available for new and infrequent users;

   d. automating the regular in-season updates to MRP from the CCSS sales slip database,

   e. improving the turnaround of RSE originated sales slips by encouraging plants to speed up sales slip entry or assisting with technological research into tally station automation,

   f. expanding current ISCES hail data entry to include all areas and gears for salmonids immediately;

   g. re-designing ISCES in Ingres, and converting the current Fortran based system to SQL/C in

Ingres (Figure 4.1.8 and Table 4.1.1), with modifications for multi-fisheries data entry and graphics output. This would make systems enhancements easier to manage.

h. linking Troll (ISCMP) and Net (SCD) fisheries catch estimation models into ISCES, and investigate the feasibility and utility of providing on-line access to Troll historical estimates if stored in Ingres;

2) to develop and implement statistically sound catch estimation practices for each Fishery (User/ Species/ Area/ Gear);

3) to improve the communications infrastructure to allow integrated fisheries management in-season (SPORT/ IFF/ COMMERCIAL) to meet the more sophisticated fishing plan strategies foreseeable in the future.

4) to improve the accuracy, integrity and completeness of the sales slip system by implementing the changes noted in memos by J Bjerring, L Lapi, and the recommendations of the PSARC Data sub-committee as part of the CCSS re-development project.

Interviewees: Brian Moore

Reviewed by: Dave Schutz, Margaret Birch, Brian Moore, Leroy Hopwo, Bob Wowchuck

Table 4.1.1 Functions in Commercial Fishery Catch and Effort

The functions that are primarily concerned with Catch and Effort Estimation are:-

1. Monitoring activities(1.1.4) include :-

VESSEL ENUMERATION and movement (overflights, DND radar counts, etc) to obtain an estimate of the gear in or near a fishery.

HAILING VESSELS during and after a fishery to obtain catch estimates by area, gear and species;

SITE VISITS TO PLANTS AND PACKER BOATS to collect sales slips and observe landings;

INTERVIEWING by phoning plants to obtain an estimate of landings daily;

VISIT FISHING SITES to CHECK NETS and estimate catch by area and species.

2. Catch estimation procedures, which include:-

PROCESSING SALES SLIPS

COMMERCIAL CATCH SALES SLIP SYSTEM - Regional data entry and reporting system.
REMOTE SALES SLIP ENTRY SYSTEM - is direct link to CCSS from the PLANTS using polling telecommunications techniques.

RECORDING CATCH IN THE Record of Management Strategies (RMS) by fisheries officers. Some of these books are automated on micro-computers, principally the North and Central Coasts.

ESTIMATING CATCH

TROLL FISHERY
In-Season Catch Monitoring Program (Exhibit 4.1.4) is used to estimate the effort and resulting catch in the Troll fleets coast wide. ISCMP Bulletins published weekly.

IN-SEASON - Weekly Hail Estimating process is performed by each Area management biologist and

the results are relayed to a Regional Salmon Fishery Coordinator who is responsible for overall management of the fishery in-season and recommends opening and closing strategy to the Areas.

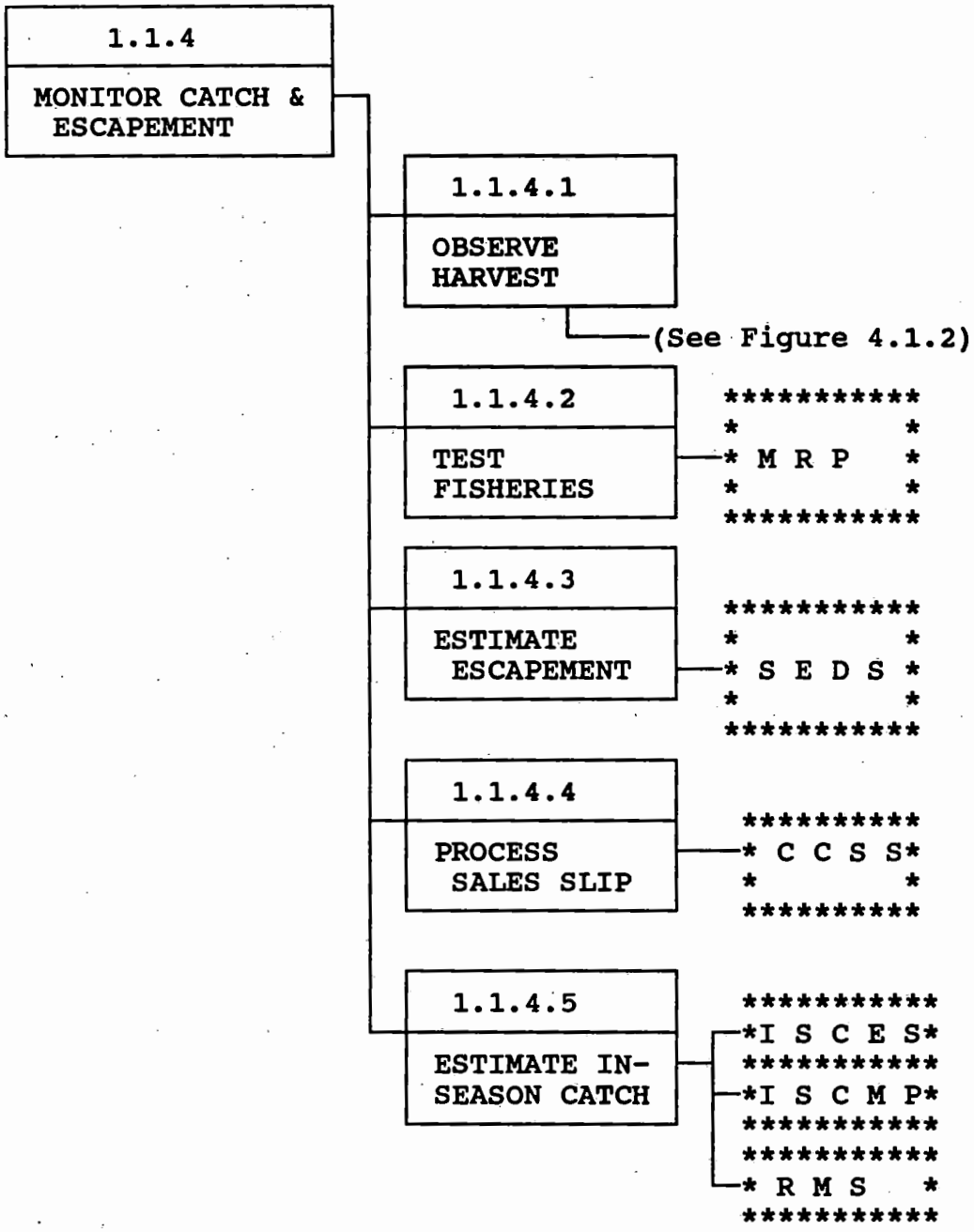
In-Season Catch Estimation System (ISCES) used by South Coast, Fraser River, North and Central Coast. The system currently only records openings, closings and extensions, and resulting "final" hails entered by each area for salmonids.

North Coast historical hail on VAX Regionally in Fortran.

South Coast have a micro-computer based model that uses inputs from hails, sales slips, and gear counts, day open, and estimates the in-season catch.

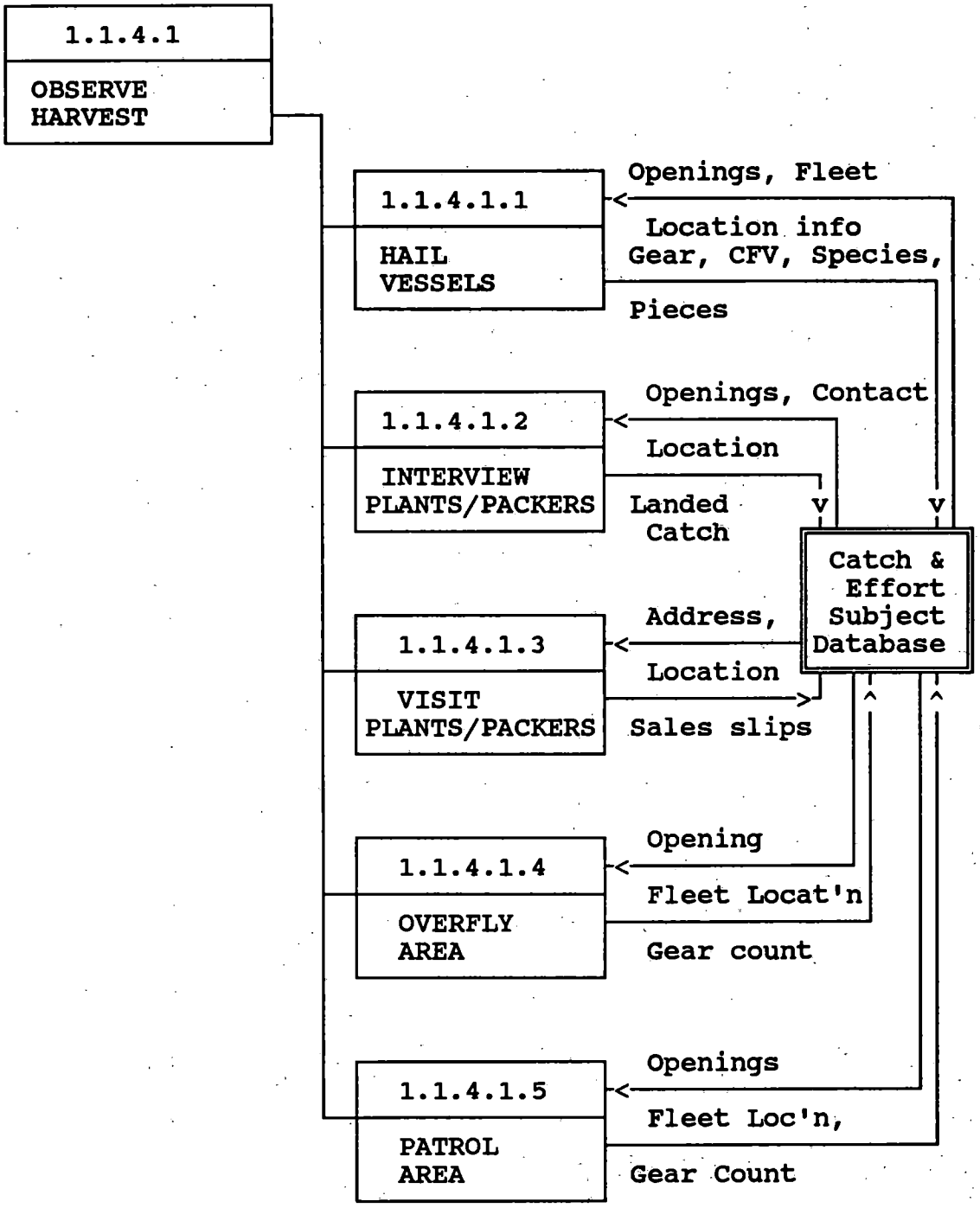
B-13 EXPORTS
Records B-13's completed by exporting and importing companies for all species landed at BC plants. Includes un-processed as well as processed fish products.

Figure 4.1.1a Function chart - Commercial Salmon Fishery



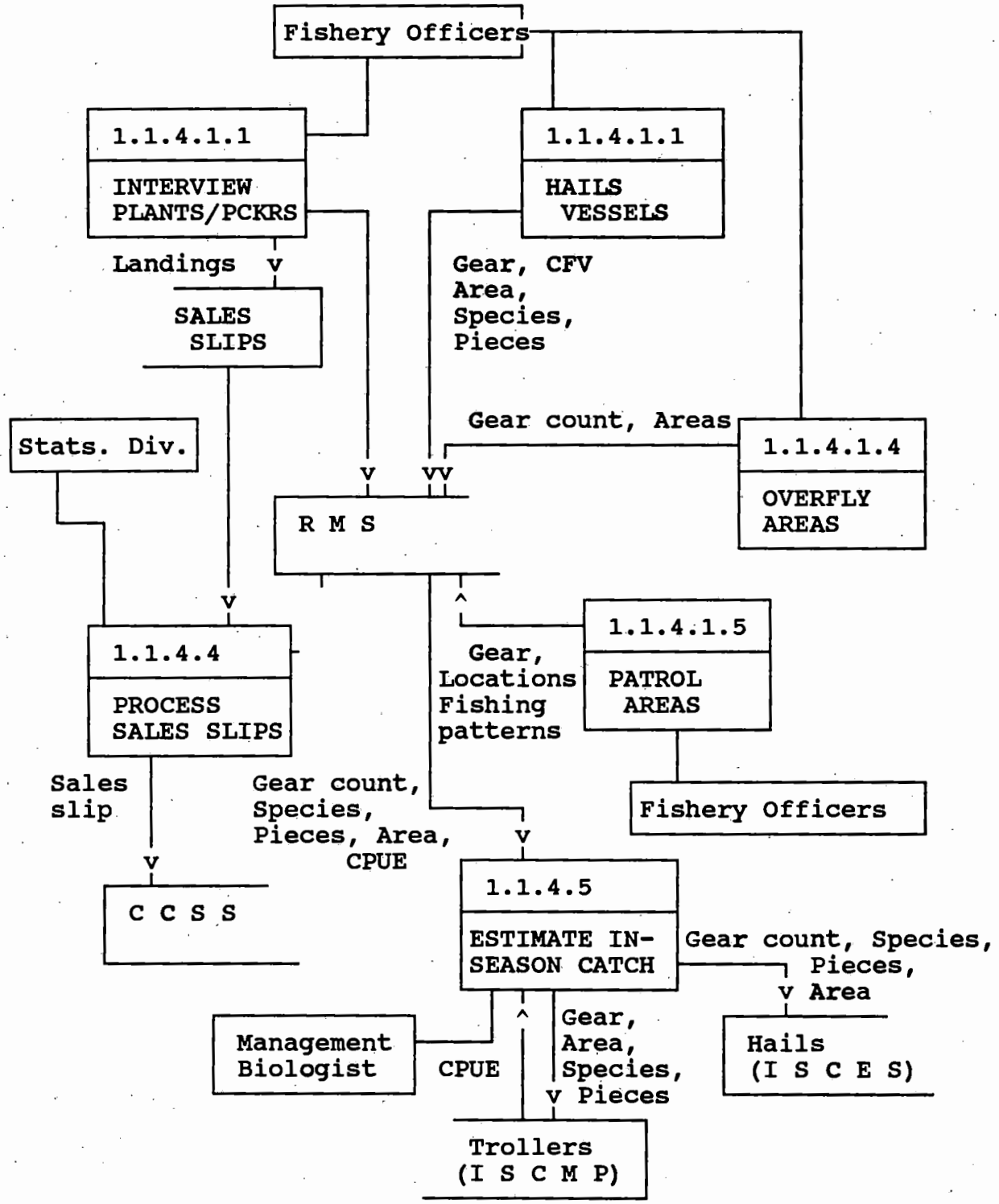
CCSS - COMMERCIAL CATCH SALES SLIP SYSTEM
ISCES- PACIFIC IN-SEASON CATCH ESTIMATION SYSTEM
ISCMP- IN-SEASON CATCH MONITORING PROGRAM (TROLL)
MRP - MARK RECOVERY PROGRAM
RMS - RECORD OF MANAGEMENT STRATEGIES
SEDS - SALMON ESCAPEMENT DATA SYSTEM

Figure 4.1.1b OBSERVE HARVEST (1.1.4.1)



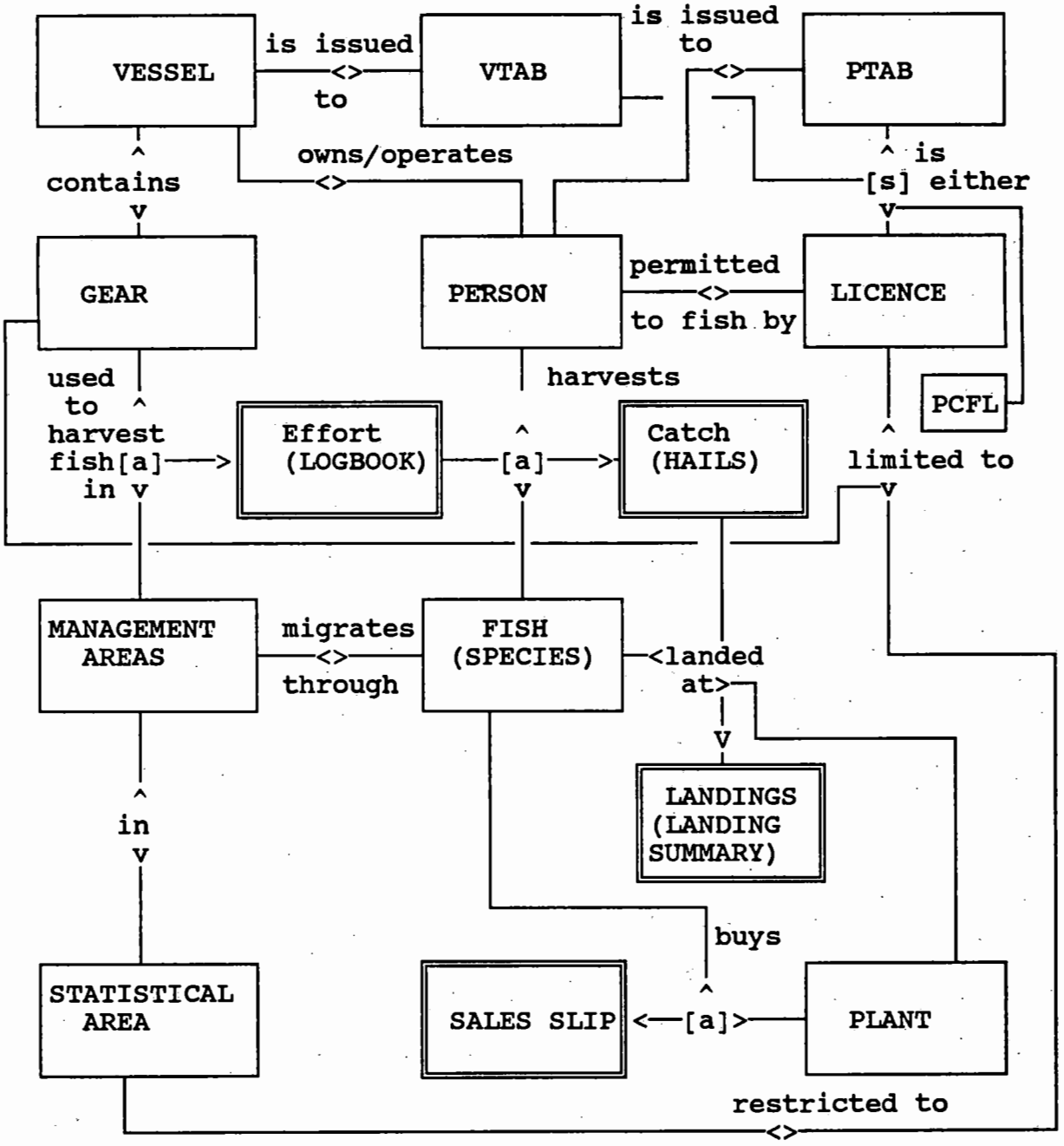
Catch & Effort Data Model

Figure 4.1.2 DFD - Commercial Salmon Catch and Effort



Catch & Effort Data Model

Figure 4.1.3 Commercial Salmon ER Data Model



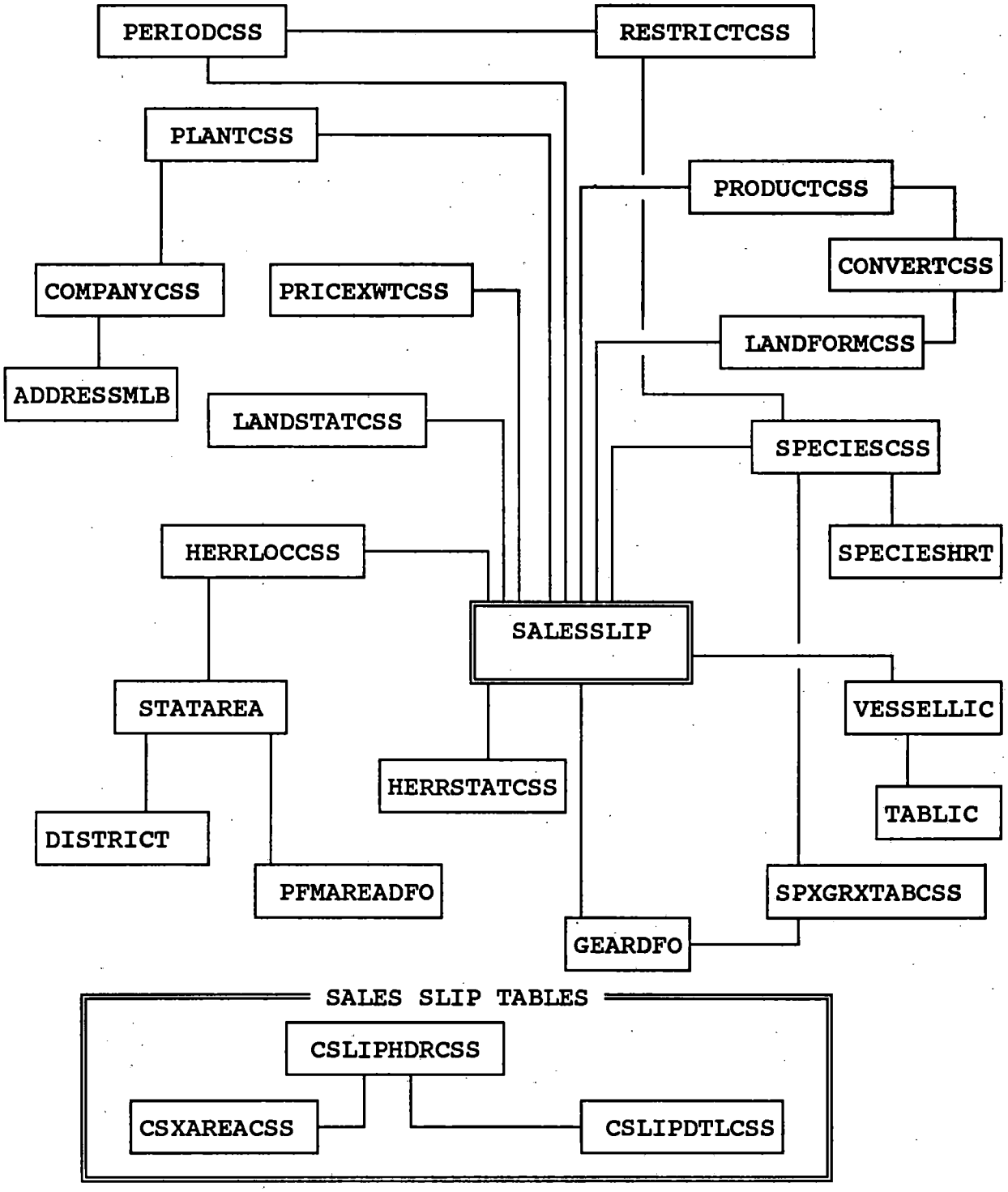
Catch & Effort Data Model

Table 4.1.2 Entity Relationships Catch and Effort - Salmon

	DOMINANT ENTITY	ENTITY RELATIONSHIP	MIN CARD.	MAX CARD.	SUBORDINATE ENTITY
1	PERSON	HARVESTS	0	M	FISH (CATCH)
1	VESSEL	CONTAINS	1	M	GEAR
1	GEAR	USED FOR HARVESTING IN	0	M	MANAGEMENT AREA (EFFORT)
1	EFFORT	HARVESTS	0	M	FISH
M	FISH	MIGRATES THROUGH	1	M	MANAGEMENT AREA
1	MANAGEMENT AREA	IN	1	1	STATISTICAL AREA
M	FISH	LANDED AT	1	M	PLANT
1	CATCH	LANDED AT	1	1	PLANT (LANDINGS)
1	PERSON	OWNS/OPERATES	0	M	VESSEL
1	PERSON	IS PERMITTED TO FISH BY	1	M	COMM. LICENCE
1	COMM. LICENCE	IS EITHER 1	1	1	VESSEL TAB
1	COMM. LICENCE	IS EITHER 2	1	1	PERSON TAB
1	COMM. LICENCE	IS EITHER 3	1	1	PERSONAL COMMERCIAL FISHING LICENCE (PCFL)
1	VESSEL TAB	IS ISSUED TO (may be permanently or temporarily transferred)	1	1	VESSEL
1	PERSON TAB	IS ISSUED TO	1	1	PERSON
1	COMM. LICENCE	IS LIMITED TO	1	1	GEAR
1	COMM. LICENCE	IS RESTRICTED TO	1	M	STATISTICAL AREA
1	PLANT	BUYS	1	M	FISH (SALESLIP)

Catch & Effort Data Model

Figure 4.1.4 COMMERCIAL SALES SLIP SYSTEM
(PROPOSED INGRES System)



(Note: the Commercial Saleslip system is currently in Adabas)

Table 4.1.3 CCSS Ingres Table Descriptions

Note: Table names used here are those proposed for an Ingres CCS System. (lower case table names = already available in Ingres)

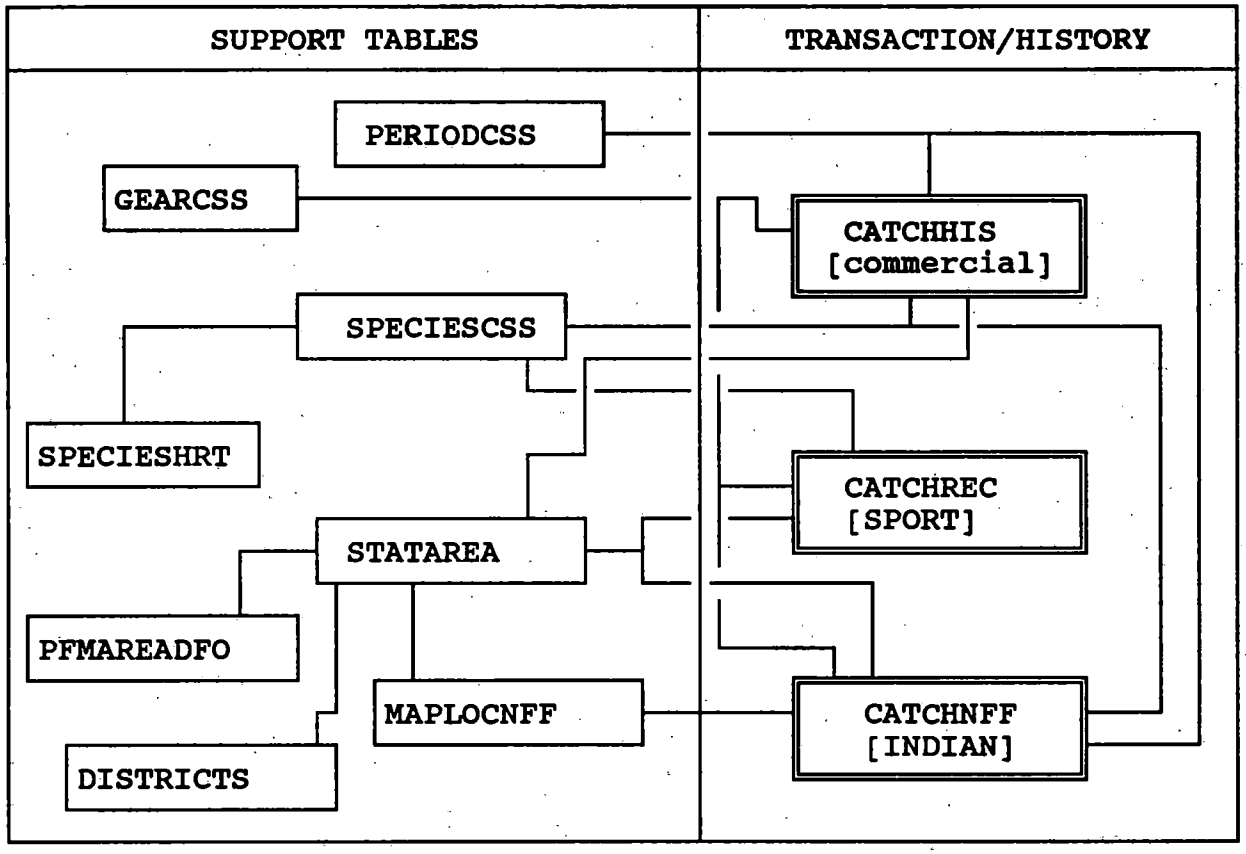
Table Name	Description
periodcss	Commercial fishing period code used in STATS
PLANTCSS	Plant name ad address, contact
COMPANYCSS	Buyers and sellers of fish, non-plant
addressmlb	Name, address, contact used in Mailing Label System
PRICEXWTCSS	Price Weight standards and defaults by species code and landed form
LANDSTATCSS	Landing status codes
HERRLOCCSS	Herring location codes
statarea	Statistical areas and stat division codes
districts	District codes
PFMAREADFO	Pacific Fisheries Management Area boundaries and codes
HERRSTATCSS	Cross-reference of Herring locations within Stats areas
gearcss	Statistics gear codes
GEARDFO	Gear codes use by other systems cross-referenced to gearcss, and DFO thesaurus
RESTRICTCSS	Area and gear restrictions on a fishery
PRODUCTCSS	Species to landed form cross-reference containing list of valid combinations
CONVERTCSS	landed form to rounded form weight conversions
LANDFORMCSS	landed form codes
speciescss	Statistics division species codes
specieshrt	Hart codes, latin name, common names
vessellic	Licensing - vessel registration table
tablic	Licensing - tabs on licenses for vessels and persons
SPXGRXTABCSS	Species(css), gear(css), tab(lic) cross-reference of valid combinations
SALESSLIP	
CSLIPHDRCSS	Sales slip - header record
CLIPDTLCSS	Sales Slip - landed species catch details
CSXAREACSS	Sales slip - areas, days fished details

(see Figure 4.1.5 below)

catchhis	Commercial Catch historical summary
catchrec	Sport Catch historical summary
catchnff	Native Food Fishery historical summary

Figure 4.1.5 CATCH STATISTICS TABLES IN INGRES

(CURRENT)

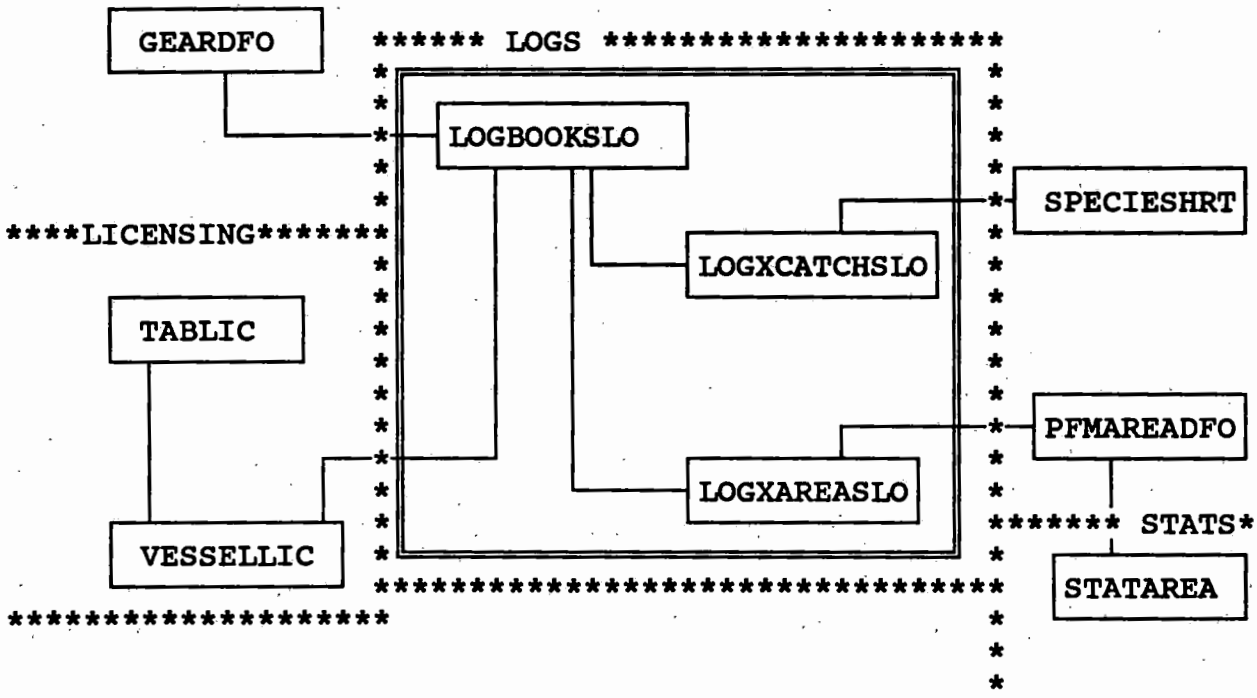


CATCHHIS CONTAINS PUBLISHED ANNUAL CATCH HISTORY (NON-SALMON) 1952 - 1988. (See Figure 4.1.9 for database schema) IT IS PROPOSED THAT THE SUMMARY OF CATCH FROM THE SALES SLIP SYSTEM REPLACE THIS TABLE IN THE NEAR FUTURE.

CATCHREC CONTAINS ANNUAL/MONTHLY CATCH STATISTICS (FROM VARIOUS SOURCES) 1951 - 1988. (See Figure 4.2.6 for database schema)

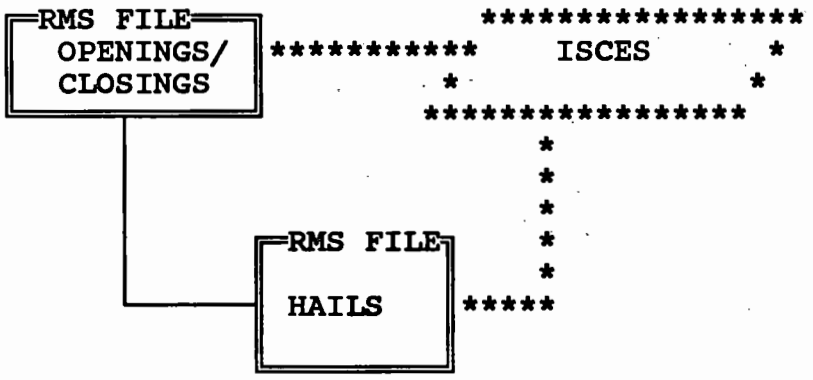
CATCHNFF CONTAINS ANNUAL/MONTHLY CATCH STATISTICS (FROM VARIOUS SOURCES) 1951 - 1988. (See Figure 4.3.6 for database schema)

Figure 4.1.6 SALMONID (CHINOOK) LOG BOOKS
(UNDER DEVELOPMENT)



NB: THIS SYSTEM ONLY REQUIRES THE ADDITION OF THE LOG (OR TRANSACTION) DATA, WITH NO ADDITIONAL SUPPORT TABLES NEEDED.

Figure 4.1.7 HAILS - (PISCES)



ISCES = IN-SEASON CATCH ESTIMATION SYSTEM CONTAINS FRASER RIVER, SOUTH COAST, NORTH & CENTRAL COAST DATA.

FORTRAN PROGRAM ALLOWS USER TO ADD, UPDATE, DELETE, OR READ HAILS BY YEAR AND AREA. PRINTS STANDARD REPORTS.

Note: A special version of this program also manages NORTH COAST historical hails. Recently, the data was loaded into Ingres to allow user to prepare ad-hoc reports easily. (AOF 1989/11/27)

Catch & Effort Data Model

Exhibit 4.1.1 Sample ISCES Report - Daily Catch Summary

_DUB0:[NEAVES]DAILY.RPT;2 1-AUG-1989 09:30 Page 1

1-AUG-89 09:30:36

1989 DAILY CATCH SUMMARY IN PIECES FOR AREA 001

OPENING PERIOD: 20
SN : JUL 16 18:00 - JUL 17 18:00, DURATION = 02 00:00 WITH 01 00:00 EXTENSION

GN : JUL 16 18:00 - JUL 17 18:00, DURATION = 02 00:00 WITH 01 00:00 EXTENSION
MESH: 0

DATE	BOATS	GR	SOCKEYE	COHO	PINK	CHUM	CHINOOK	JACKS	STLHD
JUL 17	0	GN	0	0	0	0	0	0	0
	19	SN	798	437	27740	76	285	0	0
JUL 18	0	GN	0	0	0	0	0	0	0
	22	SN	1273	1140	53960	361	1311	0	0
TFW		GN	0	0	0	0	0	0	0
TFW		SN	2071	1577	81700	437	1596	0	0
TFW	ALL NETS		2071	1577	81700	437	1596	0	0
TTD		GN	0	0	0	0	0	0	0
TTD		SN	2071	1577	81700	437	1596	0	0
TTD	ALL NETS		2071	1577	81700	437	1596	0	0

1989 DAILY CATCH SUMMARY IN PIECES FOR AREA 001

OPENING PERIOD: 21
SN : JUL 23 00:00 - JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTENSION

GN : JUL 23 00:00 - JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTENSION
MESH: 0

DATE	BOATS	GR	SOCKEYE	COHO	PINK	CHUM	CHINOOK	JACKS	STLHD
JUL 23	0	GN	0	0	0	0	0	0	0
	4	SN	399	42	1640	63	41	0	0
JUL 24	0	GN	0	0	0	0	0	0	0
	0	SN	0	0	0	0	0	0	0
TFW		GN	0	0	0	0	0	0	0
TFW		SN	399	42	1640	63	41	0	0
TFW	ALL NETS		399	42	1640	63	41	0	0
TTD		GN	0	0	0	0	0	0	0
TTD		SN	2470	1619	83340	500	1637	0	0
TTD	ALL NETS		2470	1619	83340	500	1637	0	0

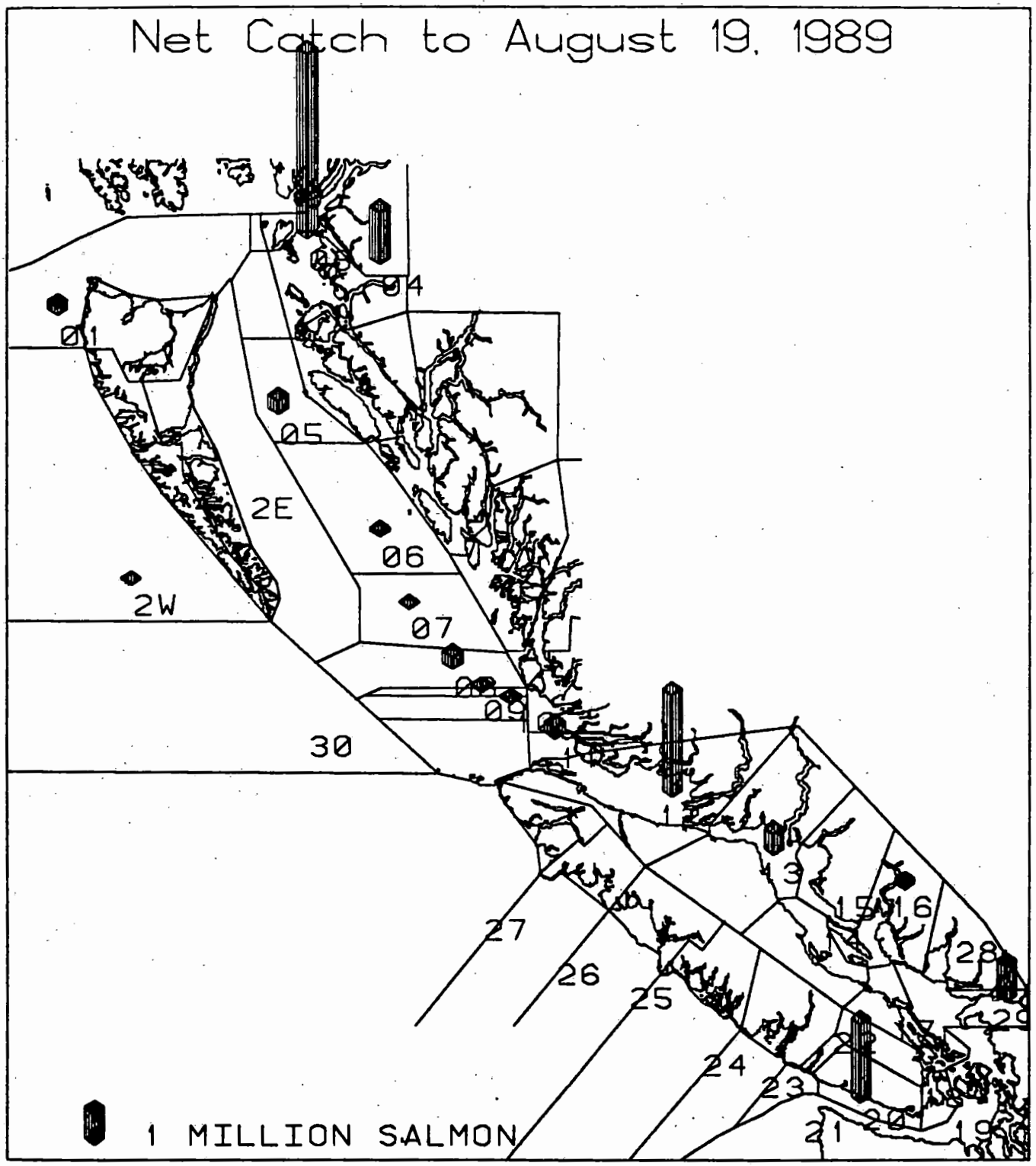
Exhibit 4.1.2 Sample ISCES Report - Unreported Openings

_DUB0:[NEAVES]UNREPORT.RPT;2 1-AUG-1989 09:30 Page 1

PISCES UNREPORTED 1989 OPENINGS AS OF 1-AUG-89 09:30:45

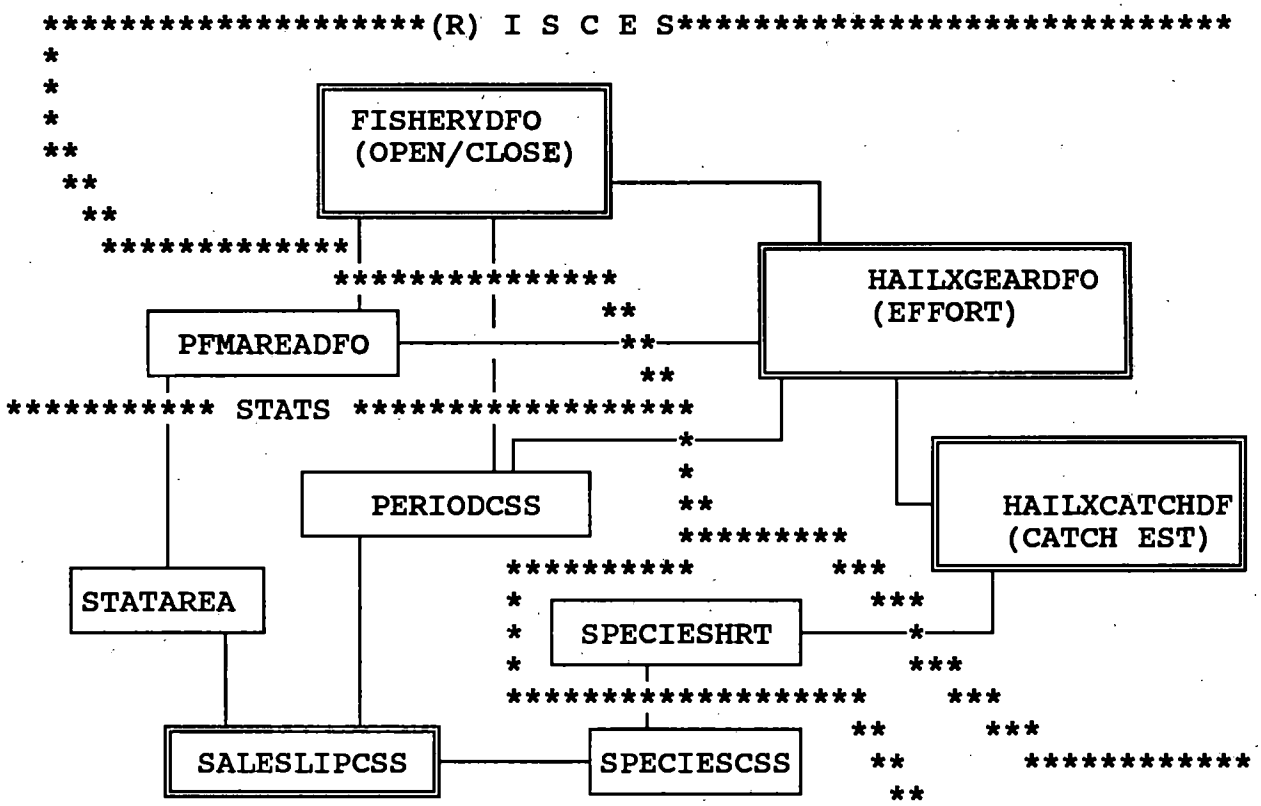
AREA	GEAR	ORIGINAL OPEN	CLOSE
NORTH COAST DIVISION:			
001	GN :	JUL 23 00:00 -	JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTEN
001	SN :	JUL 23 00:00 -	JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTEN
02W	GN :	JUL 23 00:00 -	JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTEN
02W	SN :	JUL 23 00:00 -	JUL 24 00:00, DURATION = 02 00:00 WITH 01 00:00 EXTEN
003	GN :	JUL 23 00:00 -	JUL 25 00:00, DURATION = 02 00:00
003	SN :	JUL 23 00:00 -	JUL 25 00:00, DURATION = 02 00:00
004	GN :	JUL 16 00:00 -	JUL 19 00:00, DURATION = 03 00:00
004	GN :	JUL 23 00:00 -	JUL 25 00:00, DURATION = 02 00:00
005	GN :	JUL 23 00:00 -	JUL 25 00:00, DURATION = 02 00:00
005	SN :	JUL 23 00:00 -	JUL 25 00:00, DURATION = 02 00:00
006	GN :	JUL 17 07:00 -	JUL 17 19:00, DURATION = 01 00:00 WITH 0 12:00 EXTEN
006	SN :	JUL 17 07:00 -	JUL 17 19:00, DURATION = 01 00:00 WITH 0 12:00 EXTEN
SOUTH COAST DIVISION:			
NO UNREPORTED OPENINGS			
FRASER RIVER DIVISION:			
029	GN :	JUL 03 08:00 -	JUL 04 08:00, DURATION = 01 00:00
029	GN :	JUL 10 08:00 -	JUL 12 08:00, DURATION = 02 00:00
029	GN :	JUL 17 08:00 -	JUL 18 08:00, DURATION = 01 00:00
029	GN :	JUL 30 08:00 -	AUG 01 08:00, DURATION = 02 00:00

Exhibit 4.1.3 Sample of PBGraphics Plot using ISCES Data



Catch & Effort Data Model

Figure 4.1.8 HAILS IN INGRES - (PROPOSED APPROACH)



Note:
The same reports are required (Exhibits 4.1.1, 4.1.2) with some additional reports for specific fisheries.

Data entry screens would also need to reflect the species specific to a fishery (e.g. shellfish may require columns for Abalone, geoducks, clams, and crabs, and a Misc column to enter a specific species).

Table 4.1.1 HAILS - Ingres Conceptual Data Design

	FISHERYDFO (fishery open/close)
FISHERY TYPE	(TROLL, COMMERCIAL, SPORT, SHELLFISH, ETC)
*GEAR CLASS	H/L, Net, etc
GEAR CODE	(SEE GEARCSS)
GEAR RESTRICTION	MESH SIZE, etc
*SPECIES CLASS	Species type
SPECIES CODE	(SEE SPECIESHRT) [TARGET SPECIES/GROUP]
PFMAREA CODE	(SEE PFMAREADFO)
PFMASUB CODE	(SEE PFMAREADFO)
PERIOD CODE	(SEE PERIODCSS)
OPENING DATE/TIME	S I DATE/TIME FORMAT
CLOSING DATE/TIME	"
EXTENSION DATE/TIME	"

*defines the Fishery

	HAILXGEARDFO (effort/area information)
HAIL NUMBER	(UNIQUE IDENTIFIER)
FISHERY TYPE	(LINK TO FISHERY DFO)
PERIOD CODE	(")
PFMAREA CODE	(")
PFMASUB CODE	(")
GEAR CODE	(")
GEAR COUNT	INTEGER

Catch & Effort Data Model

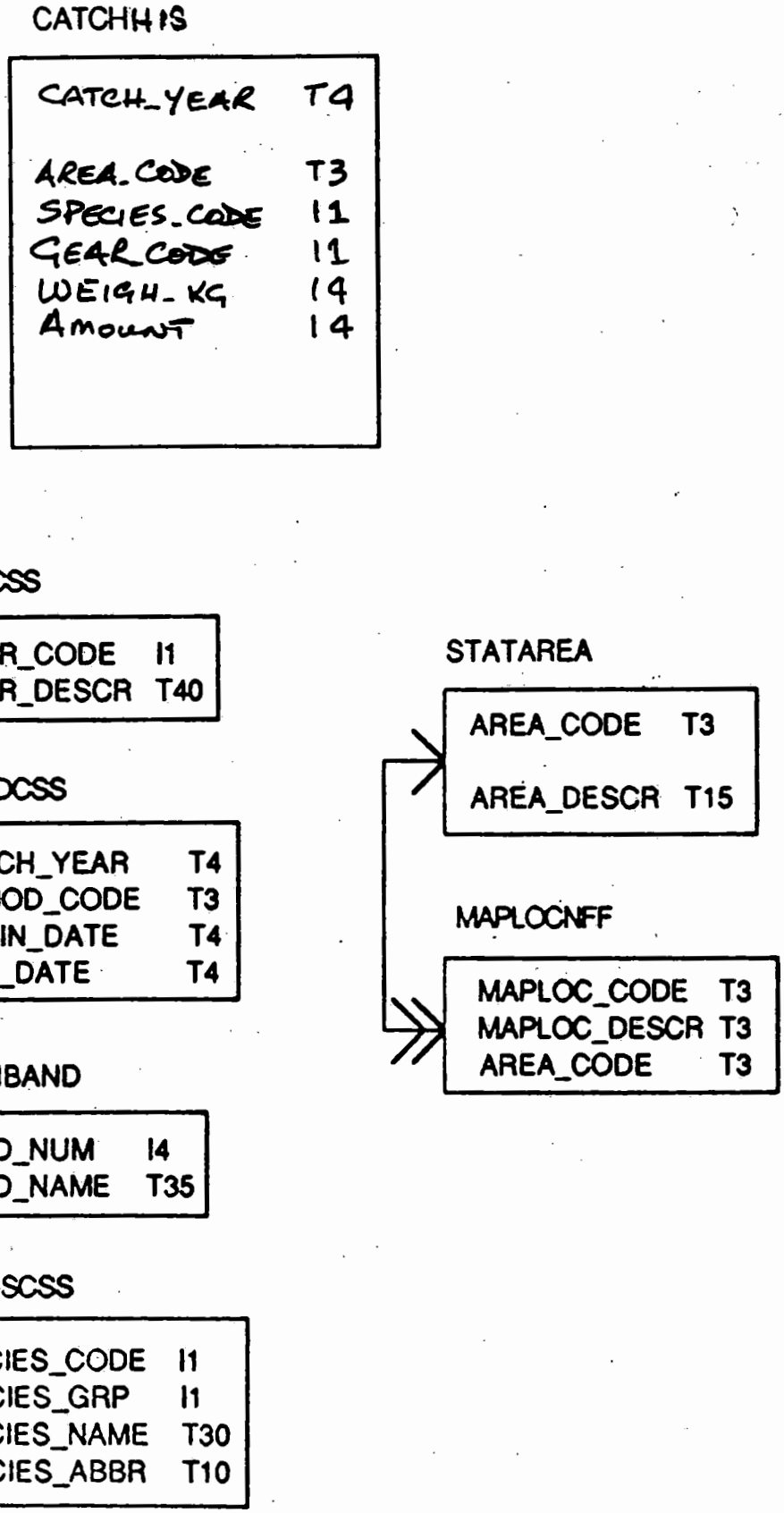
Table 4.1.2 (cont'd)

HAILXCATCHDFO (catch information)	
HAIL NUMBER	(LINK TO HAILXGEARDFO)
SPECIES CODE	(SEE SPECIESHRT)
CATCH PIECES	INTEGER

Note:
Data source and record update fields should also be considered in a physical design for audit trail purposes.

Catch & Effort Data Model

Figure 4.1.9 Historical Catch Database Schema in Ingres

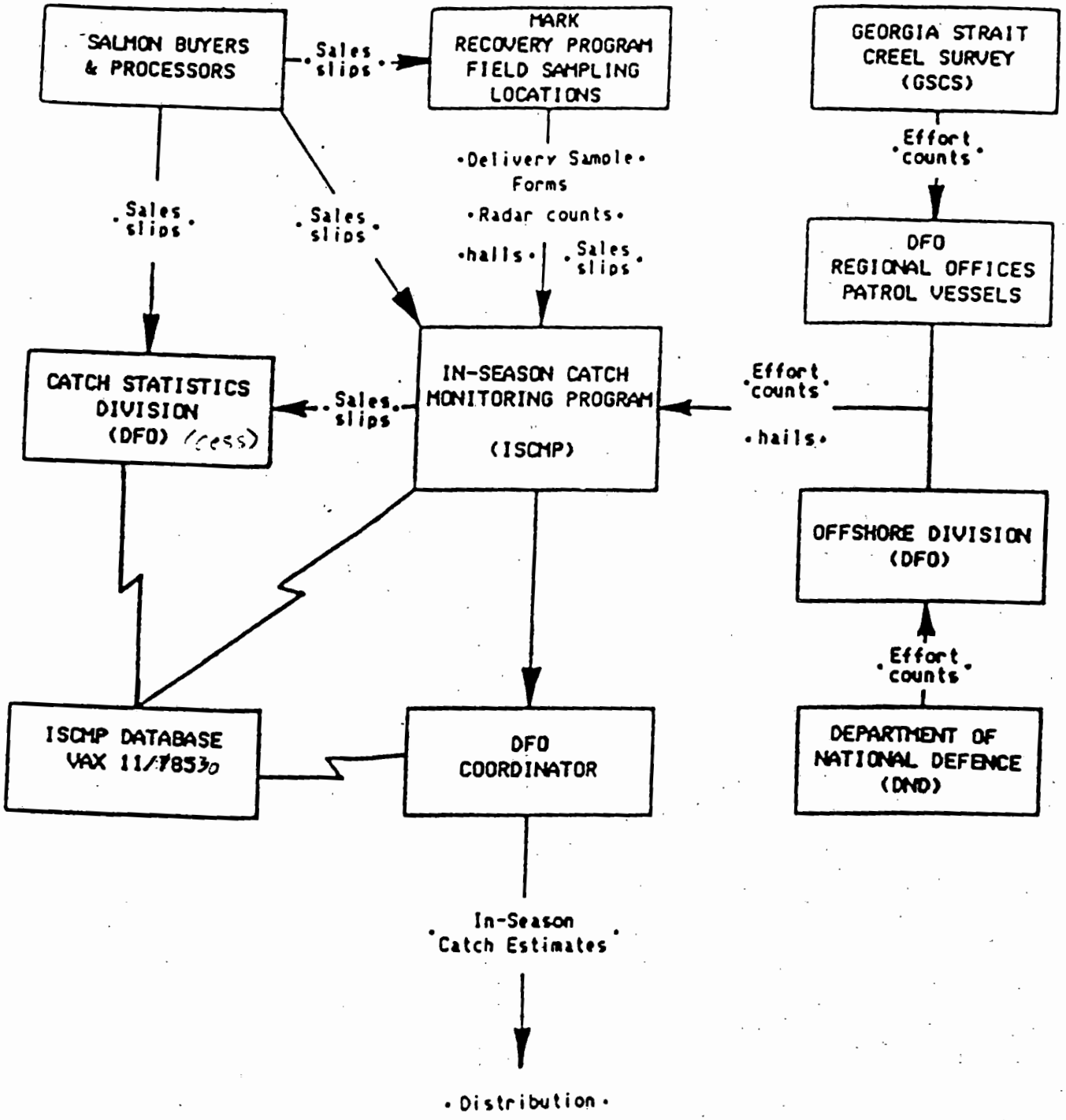


Catch & Effort Data Model

Exhibit 4.1.4 ISCMP System Architecture

Inseason Catch Monitoring Program (ISCMP)

General flow of data



4.2 - Salmon Sport Fishery

Overview

The salmon sport fishery is concentrated between Vancouver Island and the mainland. The target species are chinook and coho, but the full range of salmon species is caught. This fishery is a key tourist attraction during the summer and fall.

Catch estimation is performed by a number of groups both in-season and post_season, which are summarized in the Function Charts (Figures 4.2.1 and 4.2.2):-

1. The creel survey (Figure 4.2.3), which is limited to the Georgia Strait (conducted by LGL under contract in 1989) and Barkley Sound (conducted by JOT under contract), is supervised by Lorne Collicutt South Coast Division Data manager. The raw survey data resides in RMS (ASCII) files on tape and on the Regional VAX. Catch estimates are retained in dBASE files, and a series of FORTRAN programs are used to estimate catch on a monthly basis. The catch data is available from Lorne Collicutt upon request. A technical document will be published by the end of the summer.

2. The Tidal Diary Program (TDP) [13] and Visitors Sportfishing Survey (VSS) are conducted by the Statistics Division (Figure 4.2.4). The sample addresses generated for questionnaires are produced by the SPORT LICENCE SAMPLE system (Figure 4.2.5).

3. A national survey is also performed by Ottawa and the Statistics Division every five years.

The Sport Licensing Division is responsible for the issuance of some 300,000 annual Tidal Waters Sport Fishing Licenses.

As well, the Division is responsible for liaising with resort and charter operators and sport fishing associations on management strategies and policies. The Georgia Strait Model - managed by South Coast - is used to interpret these policies and estimate their effect upon catches.

While, Management Biologists in each Division monitor the Sport fishery in-season, the Sport Fishing Division is responsible for resource allocation and management of this fishery coast wide.

Catch & Effort Data Model

The management of the fishery is based upon long term objectives, with little in-season interference, due to the nature of the fishery (i.e. tourism). Management techniques include area/time closures, daily catch and size limits, and gear restrictions.

Recently, sales of tags(1988) and stamps (1989) have been used to track Chinook catches. Additionally, a recall of 1988/89 licences was conducted in 1989 by J O Thomas and Associates to provide data on catch success of individuals anglers, and to corroborate other data sources.

An historical database of sport catch is being developed by the Statistics Division (Figure 4.1.5 & 4.2.5) as a result of research done by L Bijsterveld into the status of recreational statistics in the Region [12]. **Nonetheless, the database has been designed to support all species, although the current dataset only includes salmonids.** Programs are complete, but data entry and verification will take additional time to resolve.

Note that the creel catch estimates are used by Lia Bijsterveld (Statistics Division) as the catch estimates for the afore-mentioned areas rolled up to annual estimates. Catch estimates for areas other than Georgia Strait and the North Coast are obtained from the TDP and VSS, or logbook programs and resort hails, etc. There may not be general agreement in DFO as to which of these estimates should be used for treaty purposes. A review is currently underway through a committee of DFO/SFAB representatives.

Problems and Challenges

A consistent sampling approach over a long time period is essential to gaining an understanding of the dynamics of the fishery[6].

The various sources of catch information show conflicting pictures of the annual sport catch.

A recent review of these programs does not appear to have resolved the problem of multiple data sources, although a DFO/SFAB committee is examining the whole issue of sports catch statistics.

Recommendations

The Sport catch database in Ingres should be completed and computer access provided to DFO staff.

Catch & Effort Data Model

Consideration should be given to provide regional computer access to the creel survey database for DFO staff.

Consideration should be given to storing sport an recreational fishing data for non-salmonids in the Ingres database.

Interviewees: Lia Bijsterveld, Bob Wowchuck, Vic Palermo
Reviewed by: Lia Bijsterveld, Lorne Collicutt, Margaret Birch, Bob Wowchuck

Figure 4.2.1 Function Chart - Sport Fishery Catch and Effort

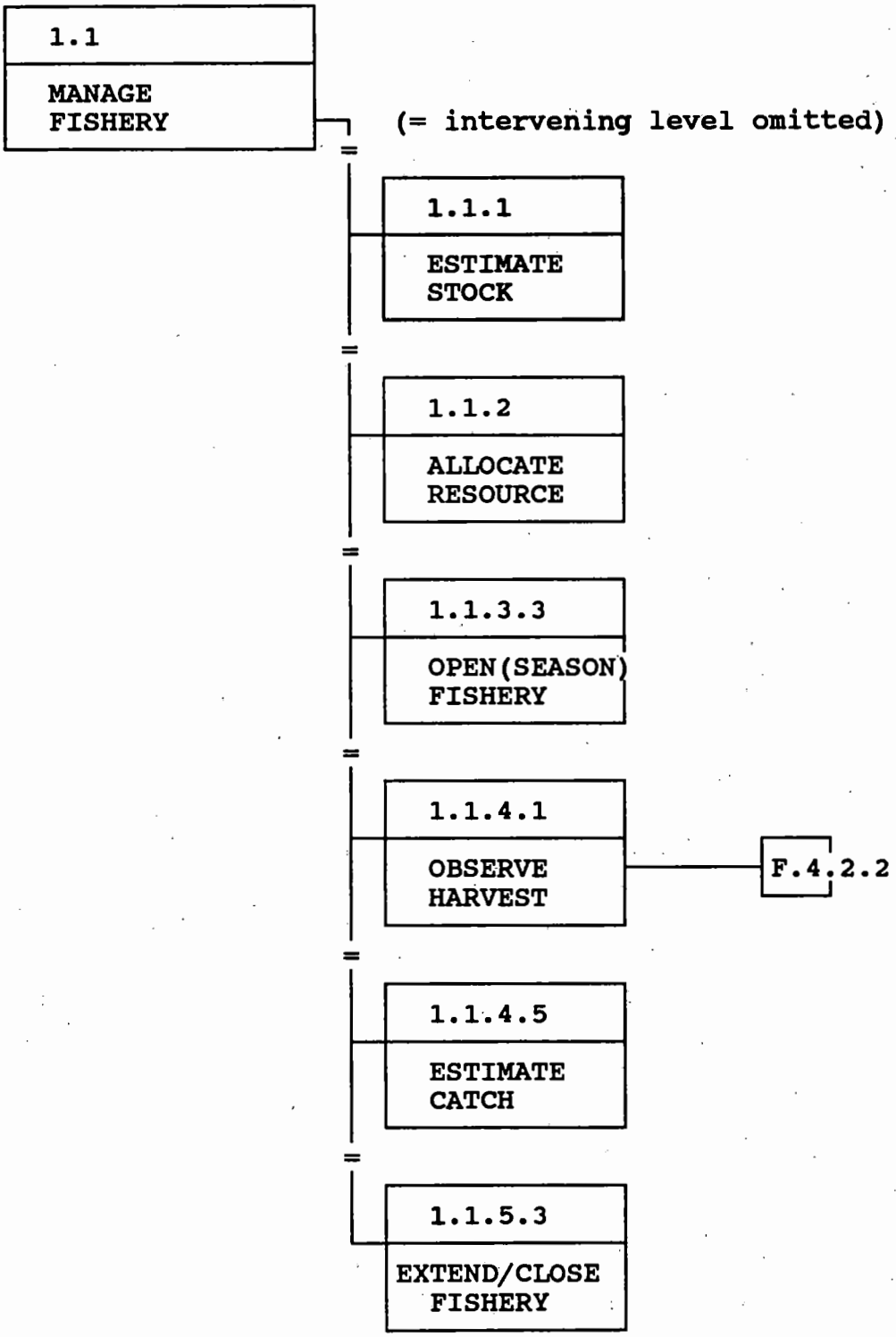


Figure 4.2.2 Function Chart for OBSERVE HARVEST activities

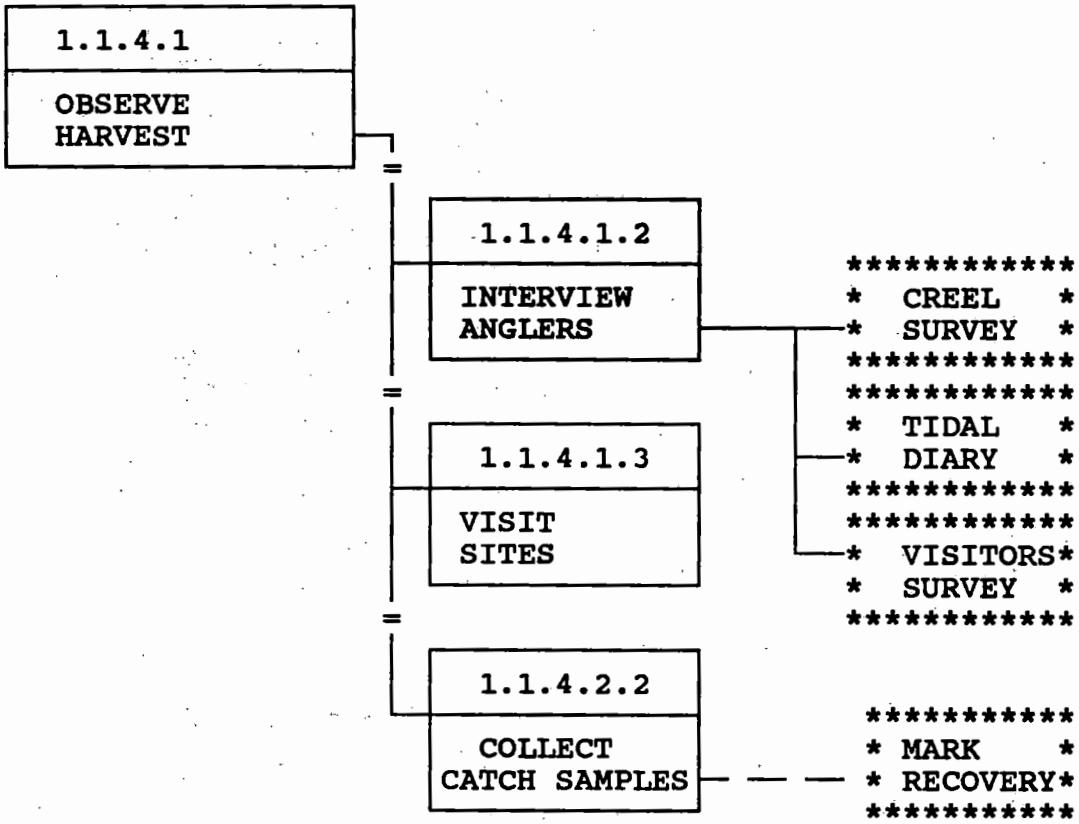


Figure 4.2.3 Data Flow Diagram - Sport in-season catch estimation

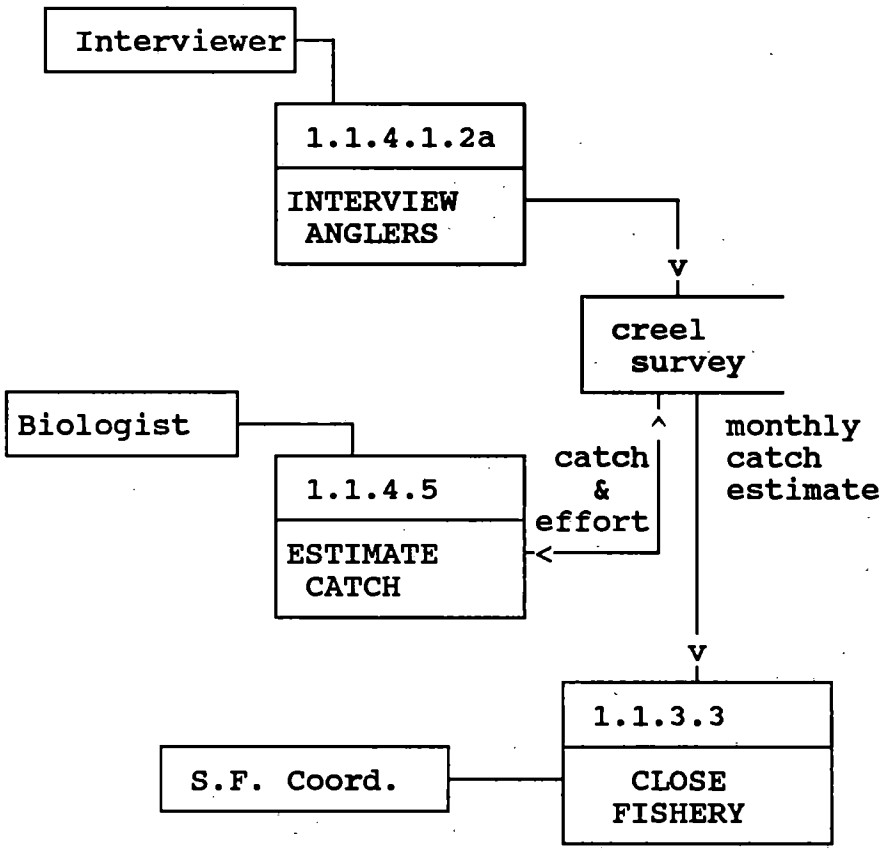
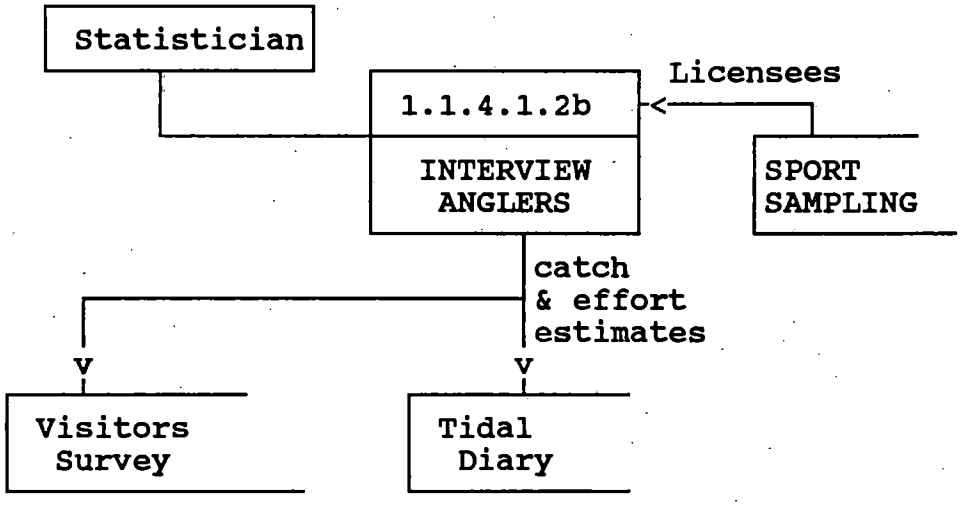
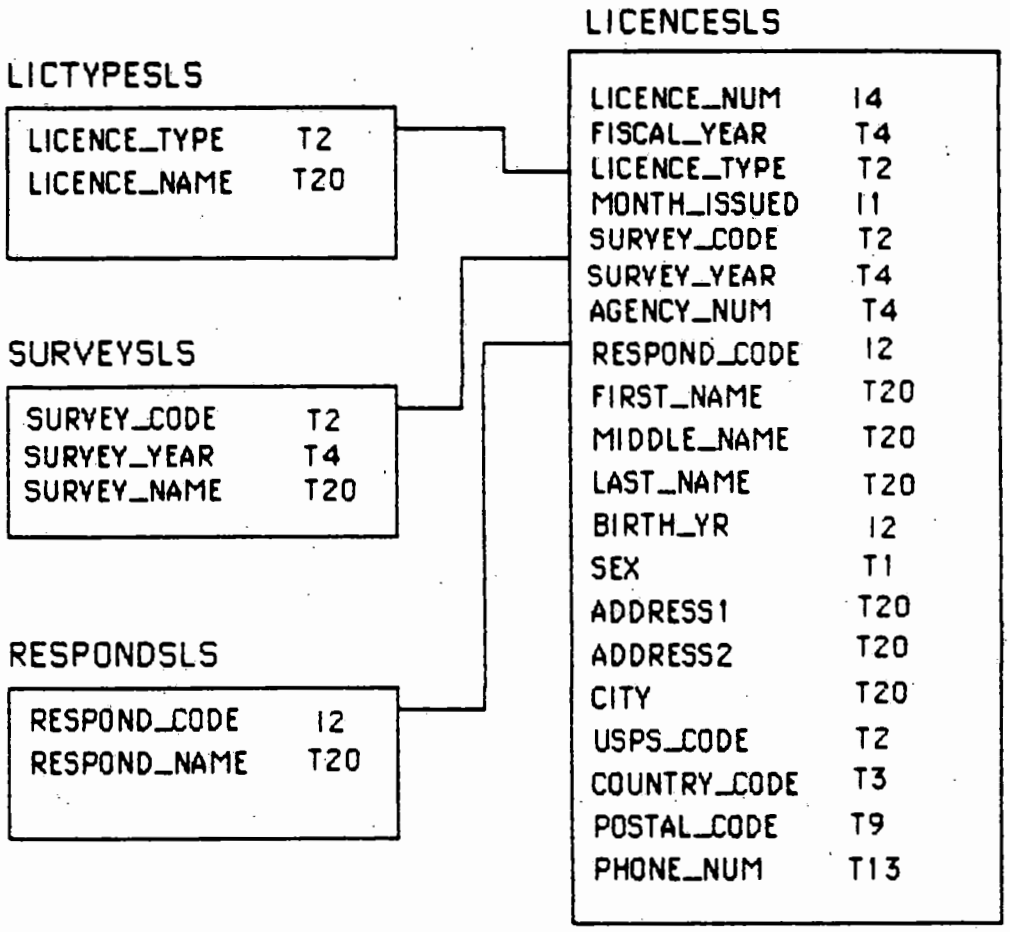


Figure 4.2.4 Sport post-season catch & effort estimation



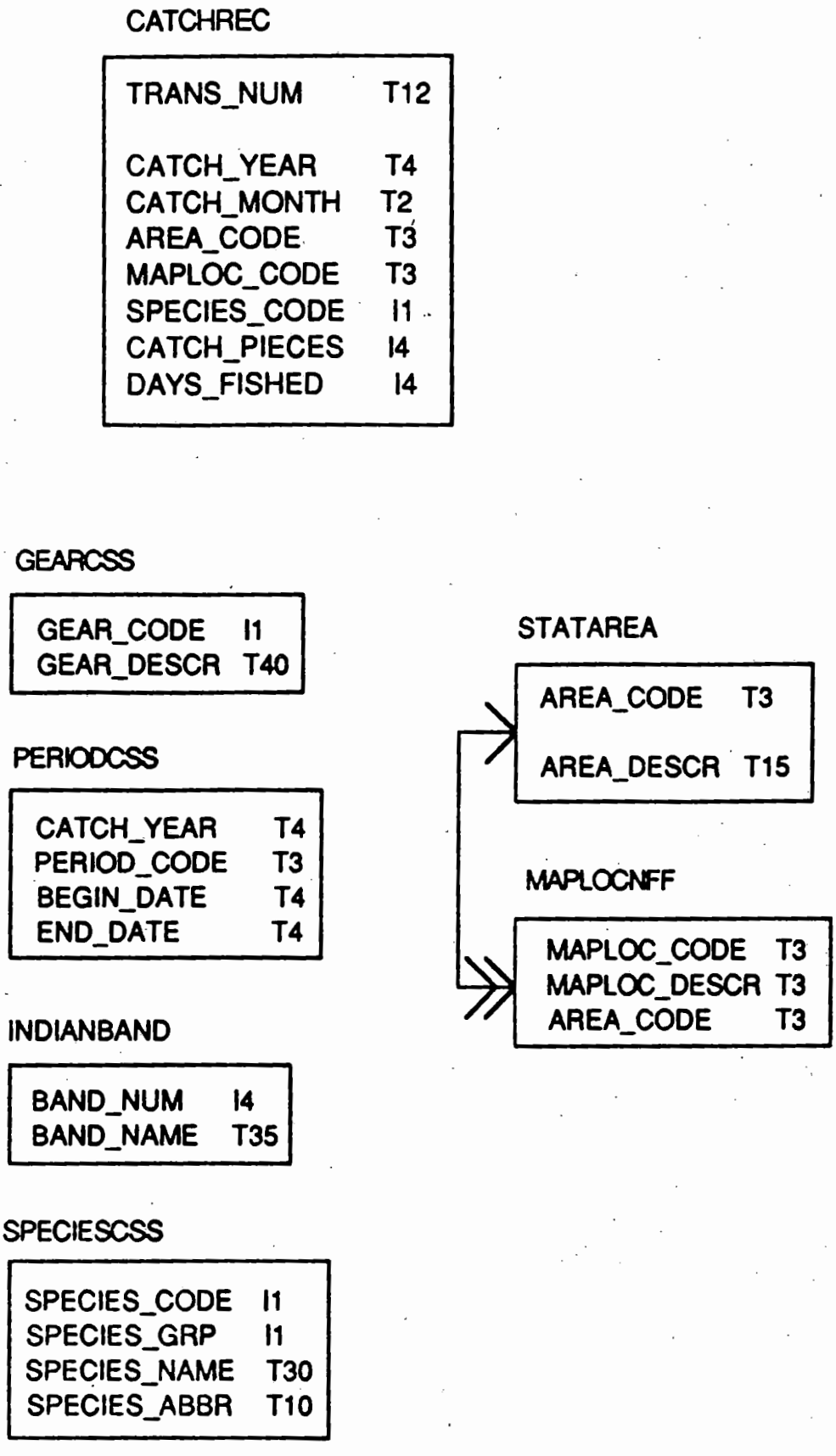
Catch & Effort Data Model

Figure 4.2.5 SPORT LICENCE SAMPLING
Ingres REGION database schema



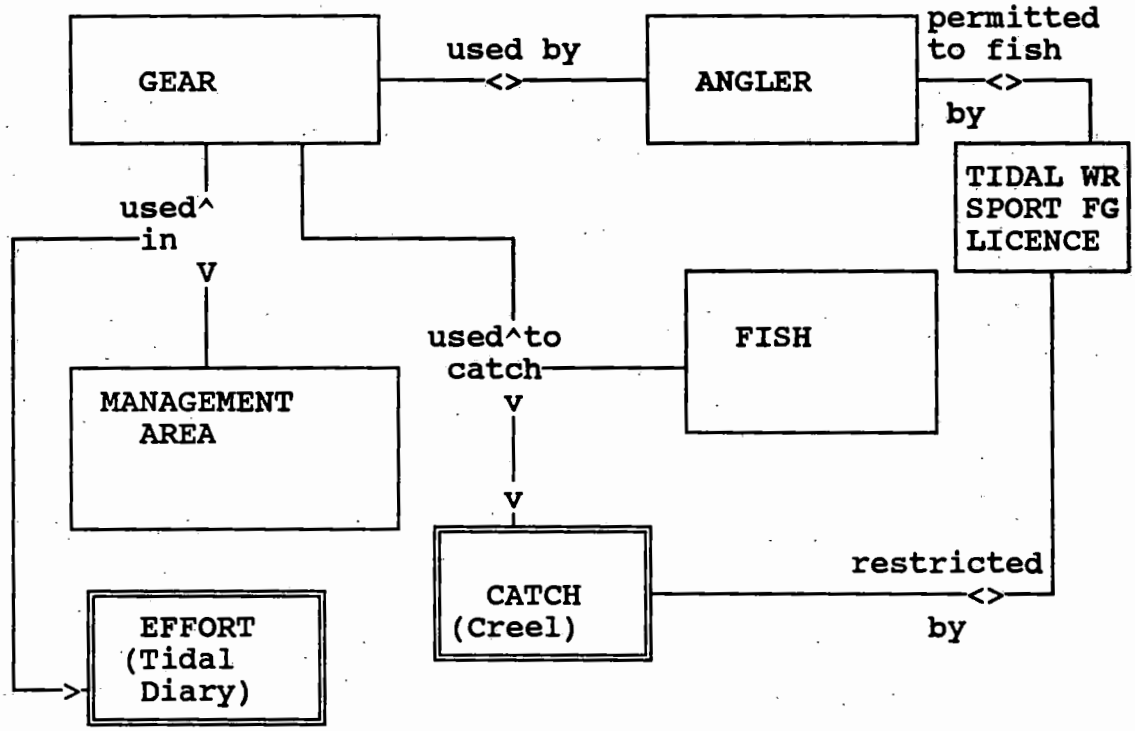
Catch & Effort Data Model

Figure 4.2.6 SPORT HISTORICAL CATCH
Ingres REGION database schema



Catch & Effort Data Model

Figure 4.2.7 Conceptual Data Model - Sport Catch and Effort



	DOMINANT ENTITY	ENTITY RELATIONSHIP	MIN CARD.	MAX CARD.	SUBORDINATE ENTITY
1	GEAR	USED TO CATCH	0	M	FISH (CATCH)
1	GEAR	USED BY	0	M	ANGLER
1	GEAR	USED IN	1	M	MANAGEMENT AREA (EFFORT)
1	PERSON	PERMITTED TO FISH BY	1	1	TIDAL WATER SPORT FISHING LICENCE (TWSFL)
1	CATCH	RESTRICTED BY	O	1	TWSFL

4.3 - Indian Food Fishery

The Fishery

The Indian Food fishery is estimated to be approximately 1 million pieces annually, compared with the Sport fishery at 1 million, and the Commercial fishery at 23 million pieces (1974-85 10 year average).

The total resources invested in the estimation of the catch in this fishery are not available at this time.

There are at least 217 Indian Bands involved in the Fishery, and an indeterminate number of natives utilizing this resource.

Problems and Challenges

The following observations were made in a review of the systems used in the process of estimating catch and effort in this fishery:-

The estimation of catch and effort is unreliable on a region wide basis;

where data collection is done, the sampling technique used may differ from area to area;

the methodology in some areas changes over time, so datasets are not comparable;

the sampling period is not uniform - sampling may be done hourly, daily, weekly or annually;

the techniques used may be subjective and biassed;

original observation data may be discarded when the final estimate is completed, leaving the summarized data un-documented;

some areas have no ongoing data collection program in place;

the nature, location and participants of the fishery makes sampling difficult;

annual catch statistics estimates are slow to be sent from the field to RHQ for assembly into a regional catch estimate. Often the IFF estimates in the Record of Management Strategies are 'soft'. Their use as a source of Indian food catch estimates is unreliable because

corrections are made later, when new information is received by the field after the publication of the RMS's.

the user groups do not find the department statistics credible, since they offer differing information.

Recommendations

The Indian Food Fishery is a small but important portion of the total salmon fishery. These catches are a significant part of outstanding land claims involving millions of dollars in disputed land and rights.

A cost/benefit profile should be developed for use in evaluating whether the control systems which are in place now and any others which may be proposed in the future are viable.

Any control or monitoring system should be developed in close cooperation with the user group. It should provide accurate and timely objective data. The sampling methodology and estimation techniques should be rigorous, properly documented and archived with the observation data. An independent Scientific Authority should be established region-wide who will review and approve all catch and effort estimates.

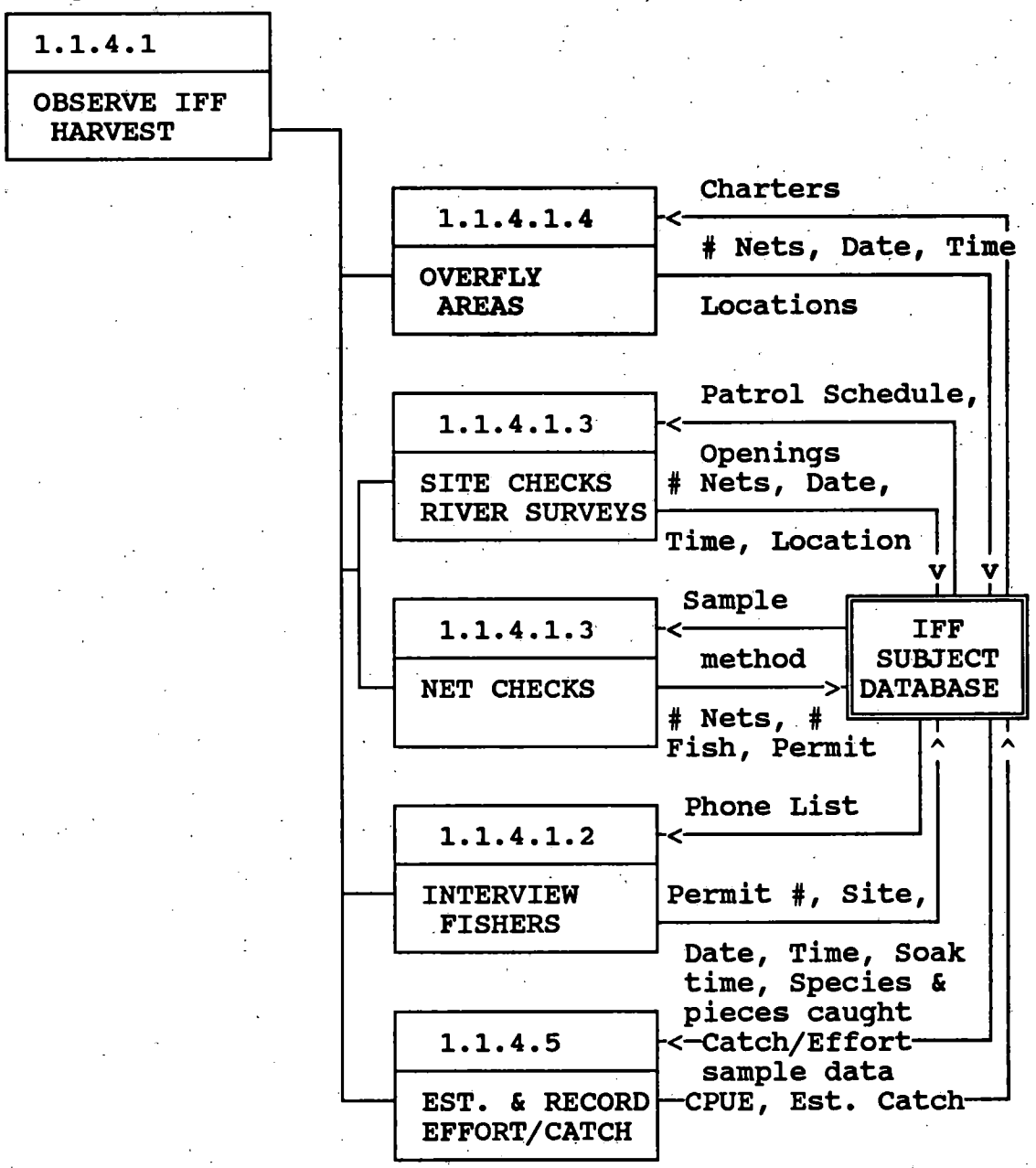
All historical data should be evaluated and catalogued as to its accuracy and utility using the rating methodology applied by the Data Assessment division of Science Sector at IOS. (e.g. the Beaufort Sea Arctic Data Compilation and Appraisal Program)

Investigate the feasibility of implementing one local data capture system (e.g. like the ESSA system on the Fraser which has since been converted to hand-held PCs by Phil Neaves of ITSD) throughout the Region. This system should include a component to upload observation data to the Regional VAX on a timely basis, in the Ingres IFF system [14], which the Statistics Division maintains.

Interviewees: Lia Bijsterveld
Reviewed by: Lia Bijsterveld, Leroy Hopwo

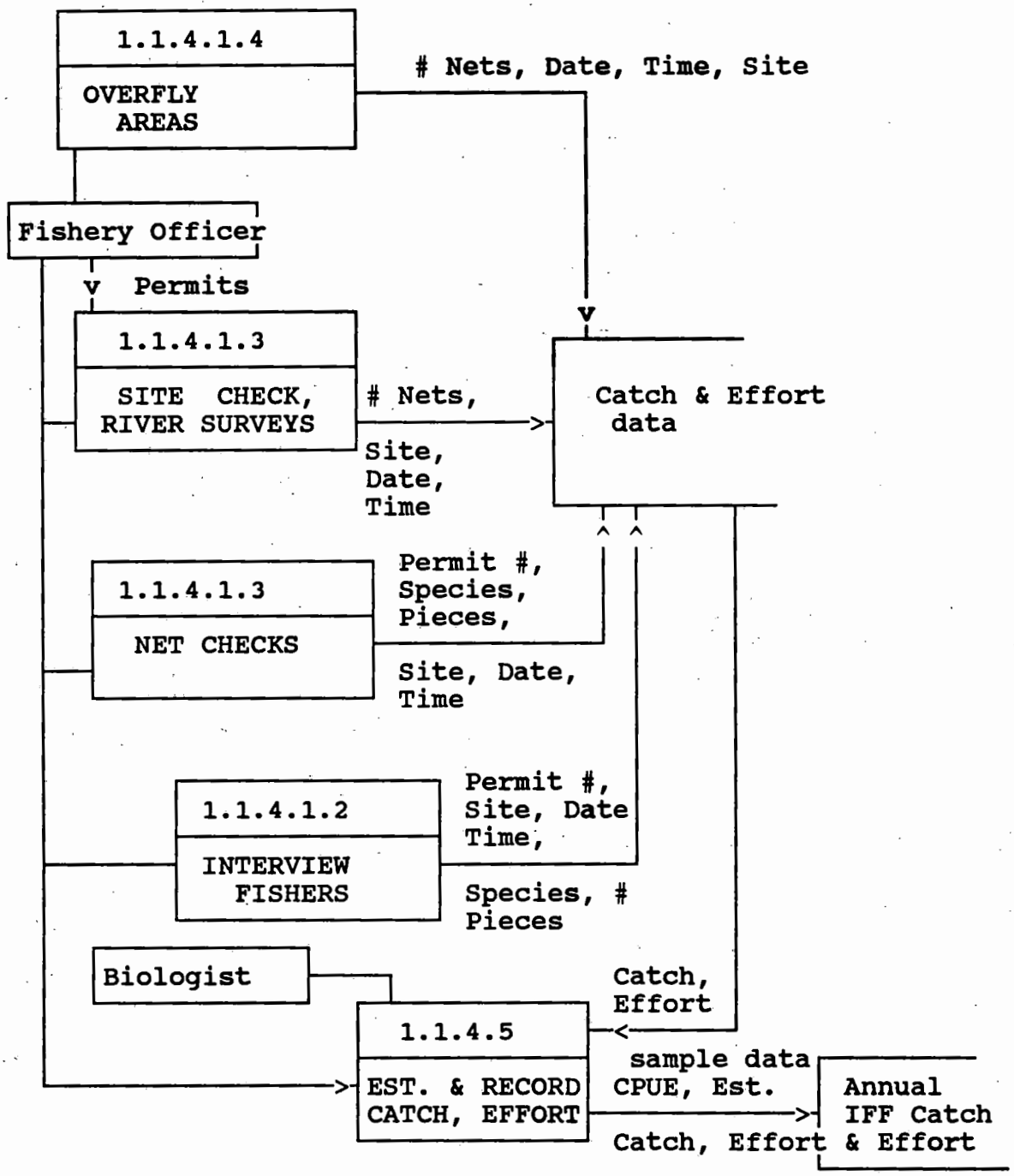
Catch & Effort Data Model

Figure 4.3.1 Function Chart - Indian Food Fishery



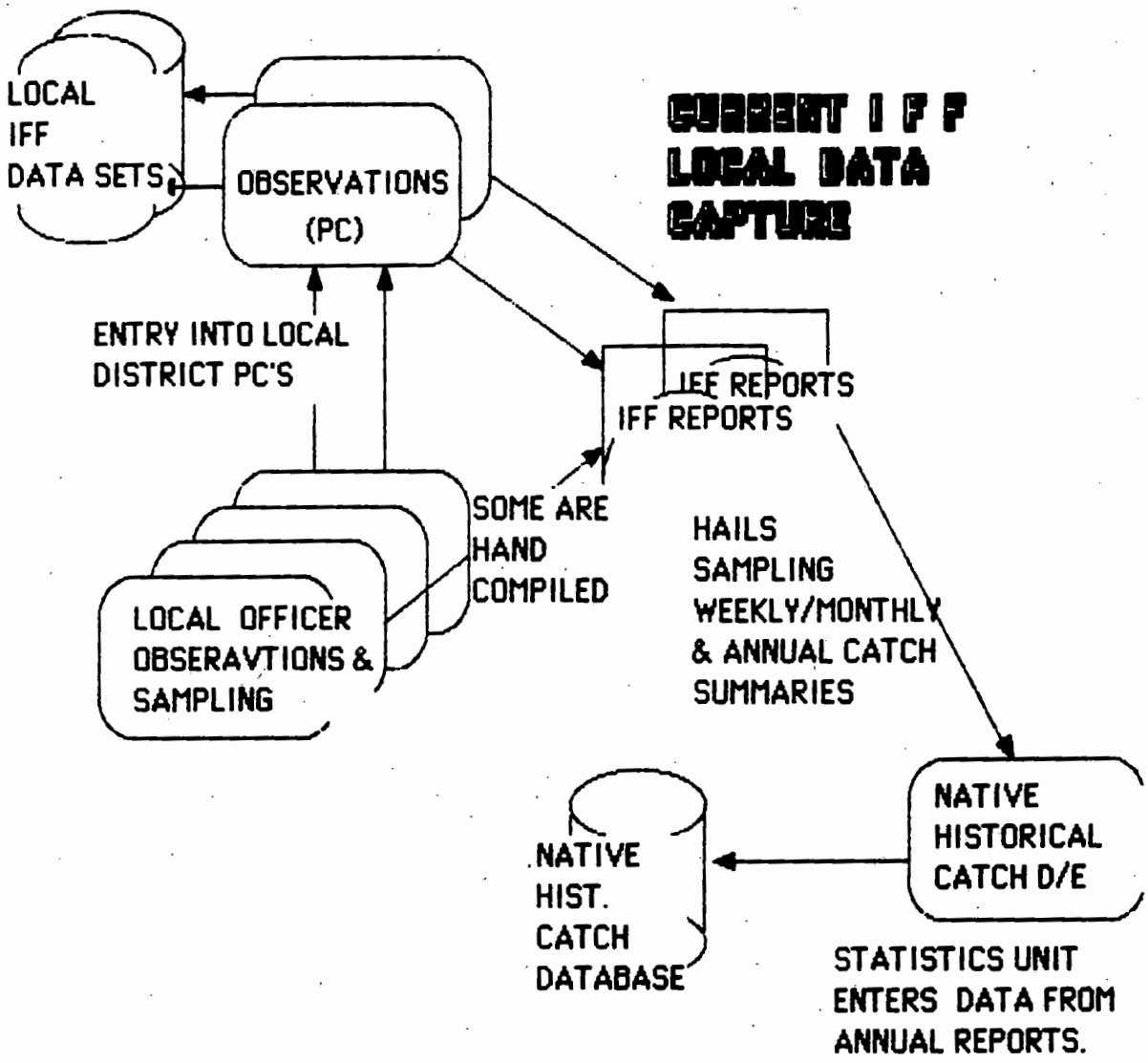
Catch & Effort Data Model

Figure 4.3.2 Data Flow Diagram - IFF



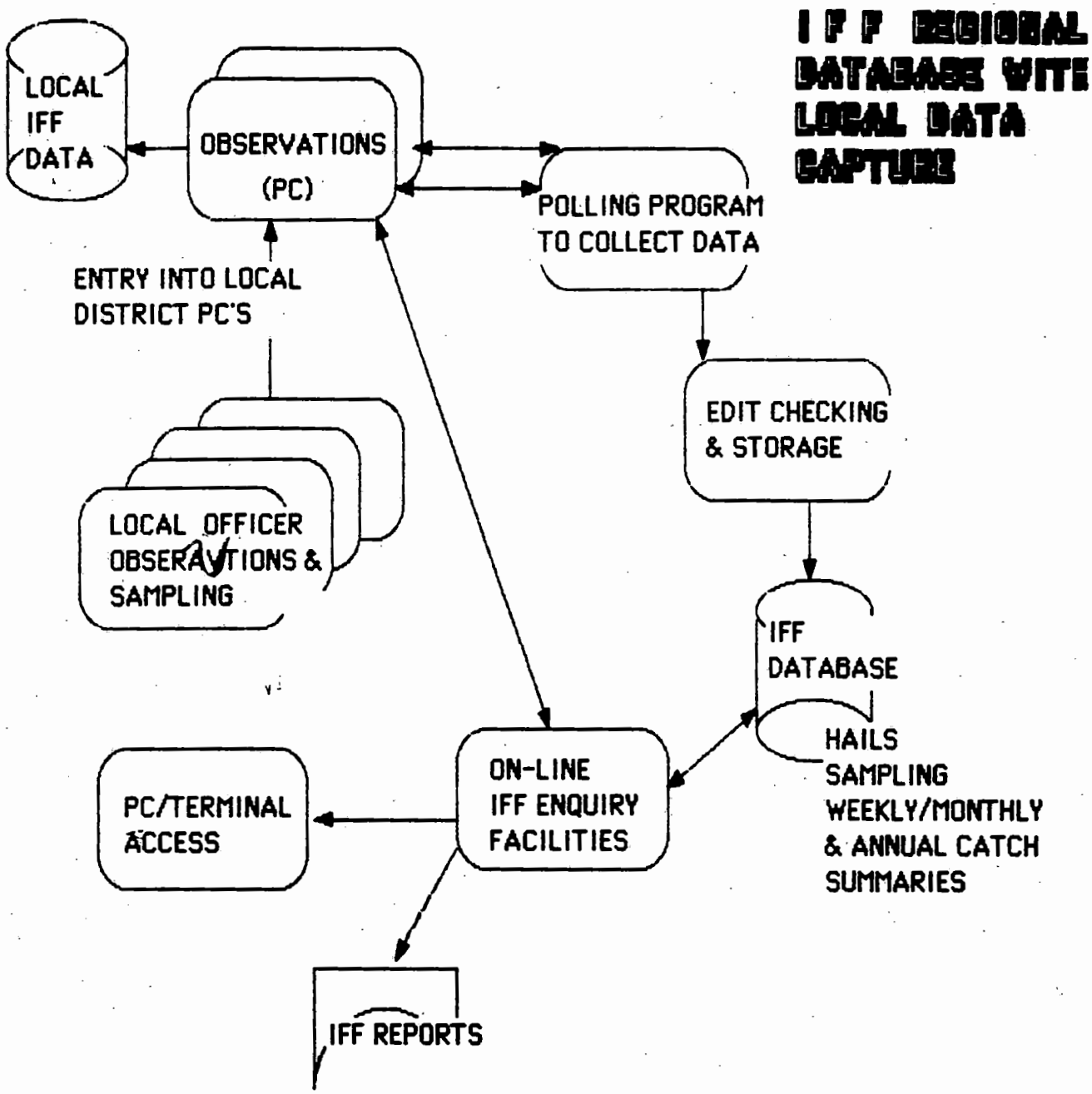
Catch & Effort Data Model

Figure 4.3.3 Current System Architecture IFF



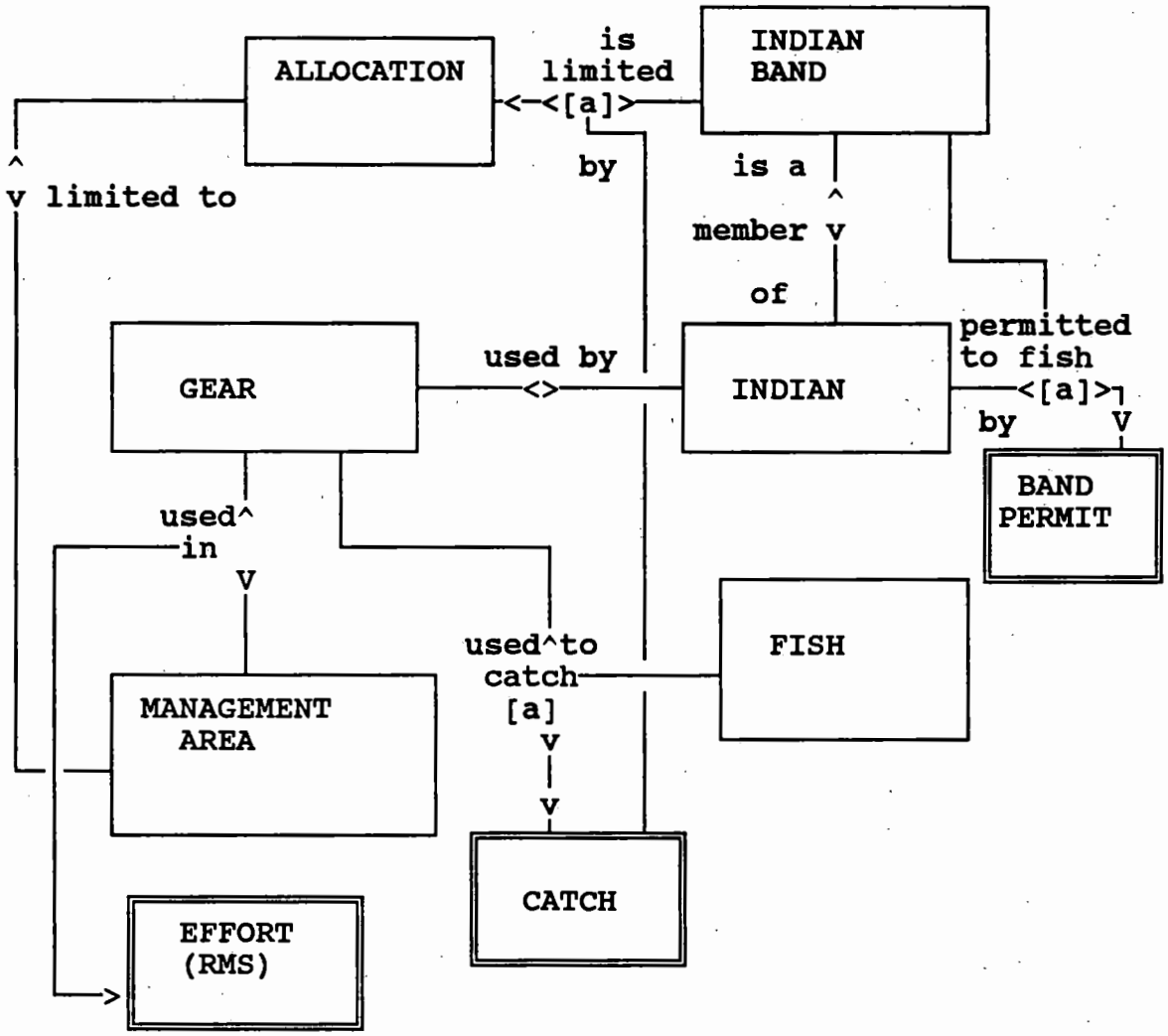
Catch & Effort Data Model

Figure 4.3.4 Proposed System Architecture IFF



Catch & Effort Data Model

Figure 4.3.5 Data Model for IFF



	DOMINANT ENTITY	ENTITY RELATIONSHIP	MIN CARD.	MAX	SUBORDINATE ENTITY
1	GEAR	USED TO CATCH	0	M	FISH (CATCH)
1	GEAR	USED BY	0	M	INDIAN
1	GEAR	USED IN	1	M	MANAGEMENT AREA (EFFORT)
1	INDIAN	PERMITTED TO FISH BY	1	1	INDIAN BAND (BAND PERMIT)
1	ALLOCATION	RESTRICTED TO	0	1	MANAGEMENT AREA
1	INDIAN BAND	IS LIMITED TO	0	M	CATCH (ALLOCATION)
1	INDIAN	IS A MEMBER OF	1	1	INDIAN BAND

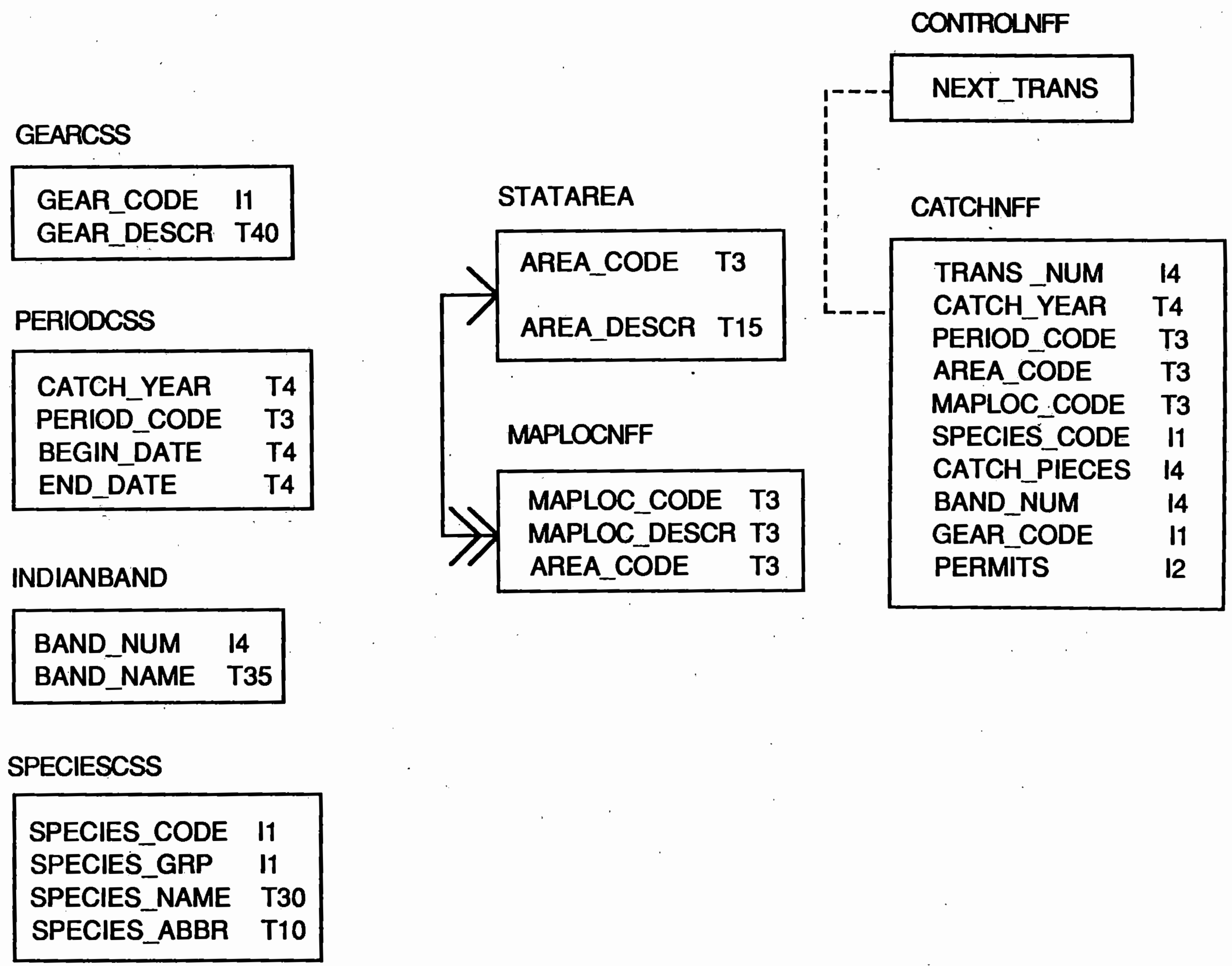


Figure 4.3.6 Current IFF Catch Data in INGRES

HERRING

4.4 - Herring Fishery

Overview

The Pacific Herring (Hart 096) is a commercially viable species on the West Coast. The main target commercial fisheries include Spawn on Kelp and Herring Roe. These products can only be harvested at a certain time each year, and special controls are in place to manage these fisheries to ensure stock survival, since they were all but decimated in the sixties.

Currently, with sophisticated stock assessment models, overfishing is no longer a concern, but rather the roe quality. The primary in-season stock management technique is time and area limited openings near key spawning areas along the coast. These main areas are southern Queen Charlotte Islands in Hecate Strait, near Prince Rupert, the Central Coast near Bella, the south and central west coast of Vancouver Island, and Georgia Strait (see attached maps of Herring Stock Assessment areas).

The fishery management process is includes the following activities:-

1. Estimating Stock Size:-
   The Stock Assessment Models prepared by PBS, and their considered opinion of the condition of the fishery as outlined in CMR FAS (e.g. 1988's Stock Assessment is contained in the CMR/FAS #1990 [9]). This stock assessment report is tabled and reviewed with all key personnel.

2. Setting a Fishing Plan:-
   Fishing plan drafts are drawn up by managers, reviewed by the Herring Industry Advisory Board (HIAB) , and must be approved by senior management. The individual area fisheries are executed by the local fishery officers, with support from the area management biologists.

3. Harvest Monitoring:-
   The fishery officers obtain copies of the current year herring licenses file from the Commercial Licensing Division and store this data as a file on portable PC's. The file is used in-season during the fishery to verify the licenses present in the fishery.

4. Openings/Closings:-
   An actual opening will be approved when the area fisheries branch staff feel that there is sufficient

roe yield and quality to satisfy the buyers of herring roe.

5. Catch Estimation:-
When an opening occurs, and the fishing gear is set, the fishery officers use patrol vessels and prescribed hail procedures to estimate catch depending on the gear used.

a) Gillnet. hails taken using a statistical sampling methodology, a CPUE (average tons per punt), and a gear count of the total number of vessels participating in the opening;

or

b) Seine. A running total of catch by vessel for seine during the opening.

As well, information such as fishing conditions and patterns are also used to estimate the total catch.

The Fishery is closed when the estimated catch is close to the maximum allowed catch. Openings have been as little as 5 minutes (one set) in some fisheries and several days in others.

The above noted functions are described in Table 4.4.1, and summarized in the Function Chart (Figure 4.4.1). Data flows are illustrated in Figure 4.4.2 (a & b).

Figure 4.4.3 shows the current system Architecture for Herring Fishery data which combines some degree of centralization - in the PBS databases - with some distributed processing occurring in the PC's, which are used in the Divisions and Districts.

Lap top micro-computers are used by fishery officers to monitor licence permits on the fishing grounds, and recording the results of test fisheries along the coast. Diver spawn data is entered onto PC's after each day's work, and verified by the data entry program. This data is sent to PBS on diskette, where it is combined and analyzed. As well, daily telex's are sent out via VAX/Mail to interested parties.

On a post-season basis, a committee chaired by D Chalmers reviews these copies and makes corrections. These sales slips are then updated in the Commercial Catch Sales Slip System(CCSS). Spawn and other biological sampling data is entered and stored in the herring section databases maintained at PBS (Table 4.4.3).

Catch & Effort Data Model

The Conceptual Data Model for Herring is quite similar to the corporate data model as noted in Figure 4.4.4. The business rules are summarized in Table 4.4.2.

Problems and Challenges

The management of this fishery is viewed as a model for in-season control of harvesting operations, and relaying information from the various fishing areas, the biologists, the fishery officers, and senior management and from industry is a key function that is the role of the Pacific Region Herring Coordinator.

While management of the fishery is well in hand, information access is an issue, particularly with respect to historical information on catch, quotas, and spawning. A great deal of this type of data is stored at PBS (Table 4.4.3). The Herring Section staff still have to analyze, interpret and prepare reports on request. Fisheries Branch staff then receive the resulting information by phone or in reports and memos, as opposed to obtaining the raw data.

Recently, some historical data has been loaded onto floppy disks and is being distributed amongst the users. Updating these 'floppy databases', however, becomes the responsibility of the end user.

Recommendations

It is recommended that consideration be given to examining the technical and operational feasibility and costs involved to:-

1) provide on-line access for Fisheries Branch staff, fishery officers and biologists to :-

a) the herring databases at PBS, specifically historical catch and effort data by fishery, year and area, in ad-hoc or pre-defined reports;

b) a system for storing and accessing current and prior year quotas, hails, and openings and closings in an easy to use manner;

c) historical herring original sales slip data from CCSS in a manner transparent to user (1966 - 1989);

d) facilities for down-loading sub-sets of these data to PC's is also desired, so that PC's copies of datasets are managed only as copies and not as original datasets;

2) provide on-line access to current year herring data in Commercial Saleslip System in-season;

3) reconcile the data in the Sales Slip System with the herring catch historical data at PBS for years prior to 1987, before giving users access to these data;

4) conduct a feasibility study on implementing a coast-wide data collection program to assess the impact, size and extent of the non-roe herring catch, such as live sports bait.

Interviewees: Lloyd Webb

Reviewed by: Lloyd Webb, T Calvin, D Chalmers

Table 4.4.1 Function Descriptions - Herring Fishery Management

1.1 MANAGE FISHERY
Ensure that estimated harvest is allocated to and caught by appropriate user groups by stock and area.

1.1.1 ESTIMATE STOCK (pre-season/post-season)
Estimate stock levels and recruitment to fishery. Use of Escapement Model and Age Model by PBS, Herring Section and documented in annual PSARC reports.

1.1.2 PLAN FISHERY OPENINGS BY LOCATION (pre-season)
Allocate fishing time by stock and area, and plan estimated fishing openings.

1.1.3.3 OPEN FISHERY IN LOCATION(S) (in-season)
Based upon biological advice, open a fishery in an area.

1.1.5.3 EXTEND/CLOSE FISHERY (in-season)
Based upon estimated CPUE rates, hailed catch and fishing time, close the fishery before quota is reached.

1.1.4.1 OBSERVE HARVEST (in-season)
Pre-season, estimate the allowable catch. In-season, ensure harvest targets are not exceeded.

1.1.4.2.3 PERFORM SURVEYS (in-season)
To estimate the fecundity and abundance of the herring stock.

1.1.4.2.3.1 SURFACE SURVEYS
Measure the spawning activity levels, density and area coverage in a herring location.

1.1.4.2.3.2 DIVE SURVEYS
Measure the spawning activity levels, density and area coverage in a herring location.

1.1.4.1.1 HAIL VESSELS/PERSONS (in-season)
Estimate the CPUE from the vessels/persons participating in the fishery during an opening in

a herring location. Hails for Gillnet (est. CPUE) are performed differently than hails for seine (to get a cumulative catch.

1.1.4.2 TEST FISHERIES (in-season)
Charter vessel to take catch to evaluate the catch size and quality before an opening.

1.1.4.2.2 COLLECT CATCH SAMPLES (in-season)
Obtain samples of fish from vessels and plants to evaluate roe quality of the herring catch.

1.1.4.5 ESTIMATE CATCH (in-season)
Estimate the total catch by herring location.

1.1.4.5.2.1 ESTIMATE HARVEST RATE - GILLNET
Based upon observation of the gear count (number of vessels available for fishing immediately prior to the opening), and an estimate of the gear harvest efficiency ratings, calculate a CPUE for the fishery - average tons per punt.

1.1.4.5.2.2 ESTIMATE HARVEST RATE - SEINE
Hail all vessels that are fishing during the opening, and use the cumulative catches to estimate the catch rate for the opening and the total catch.

1.1.4.5.3 CALCULATE CATCH (in-season)
Based upon the minutes/hours of actual fishing time, the CPUE or catch rate, vessel/person hails, and the stock strength, calculate the catch for the opening.

Catch & Effort Data Model

Figure 4.4.1 Functions in Herring Fishery

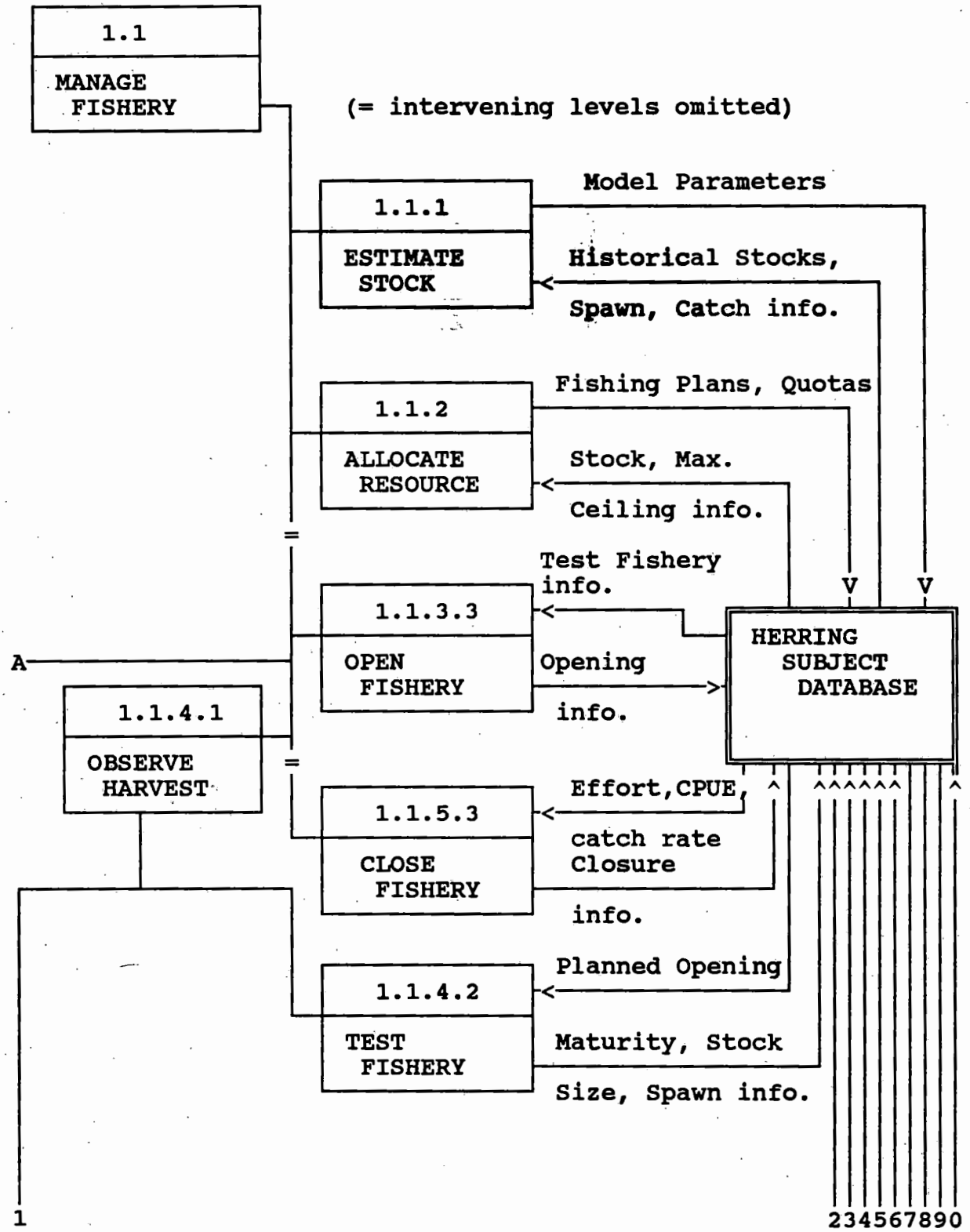


Figure 4.4.1 (cont'd)

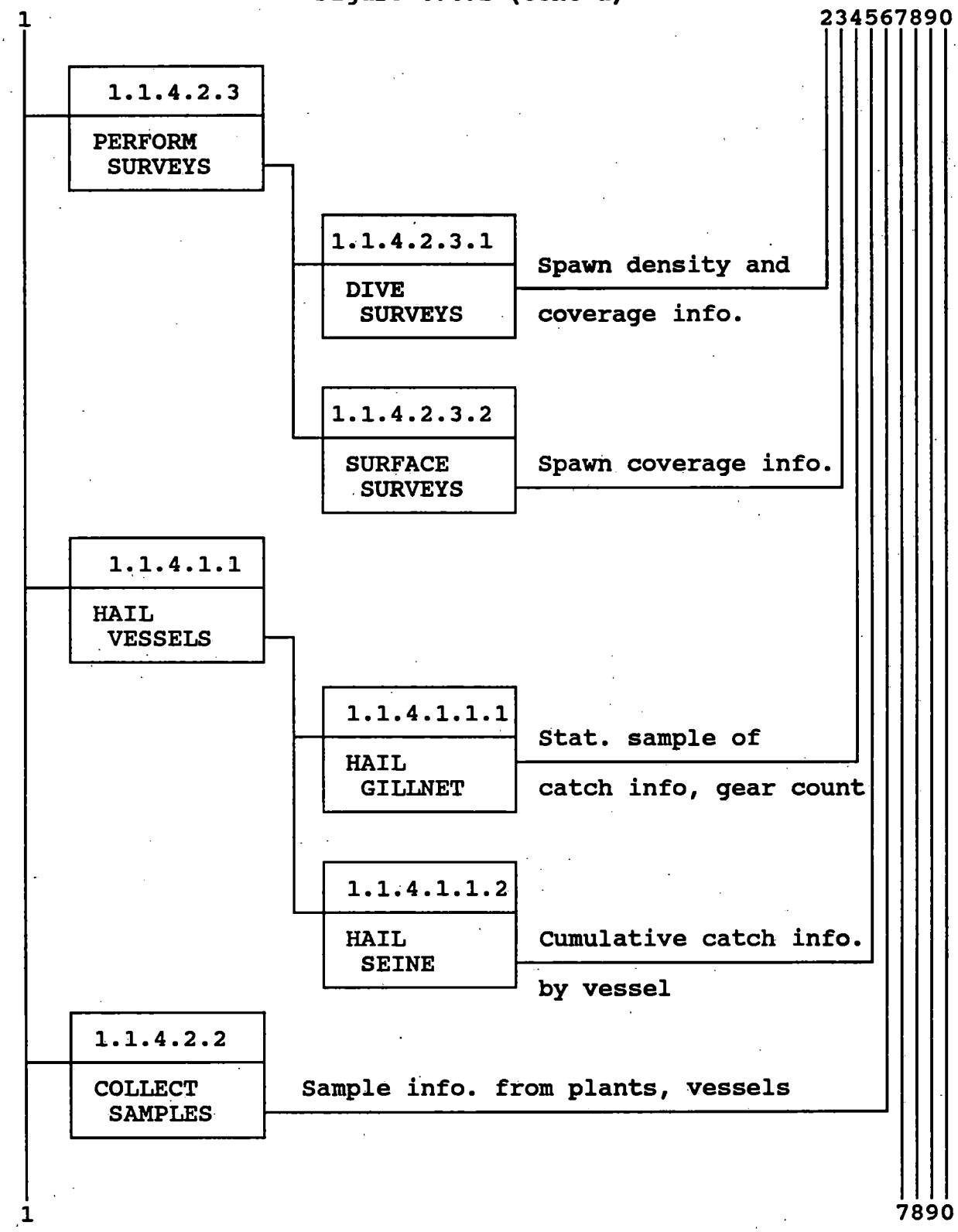


Figure 4.4.1 (cont'd)

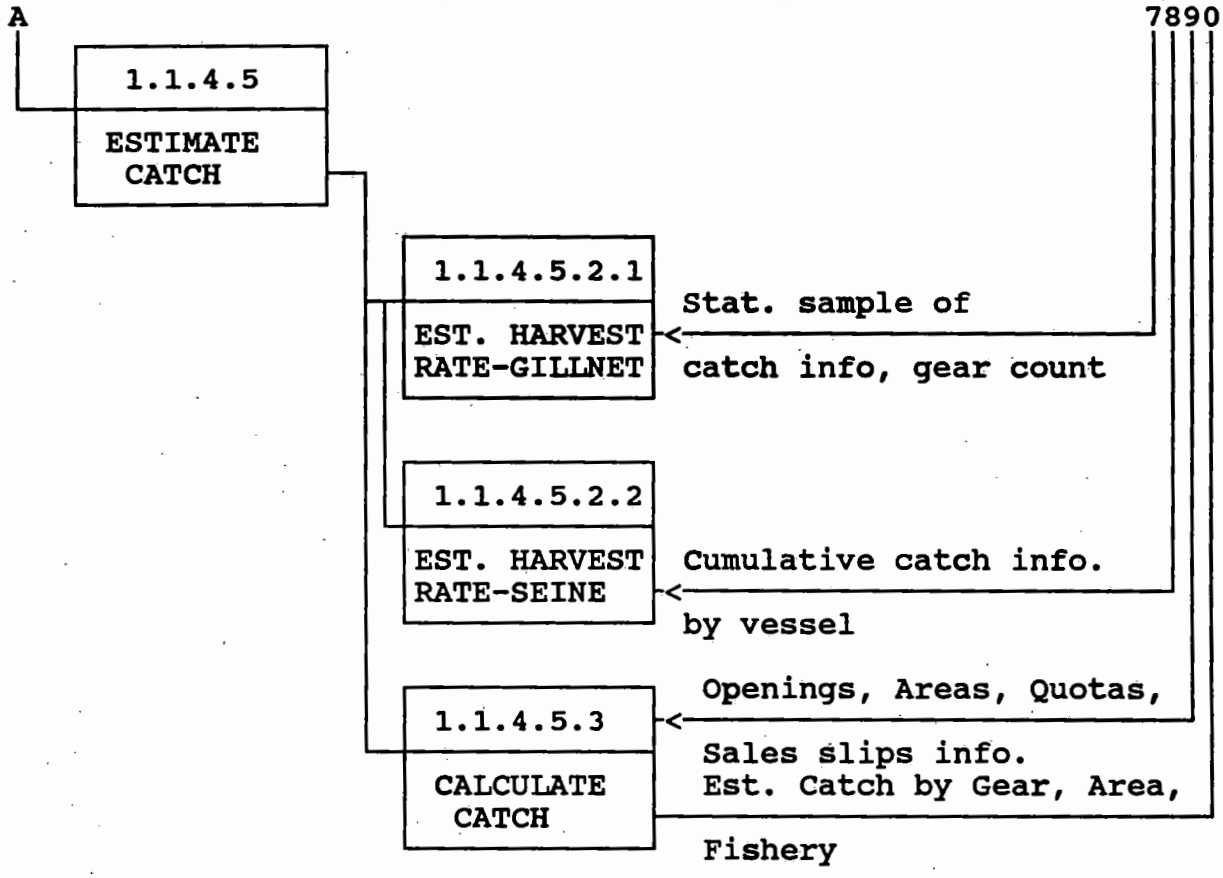
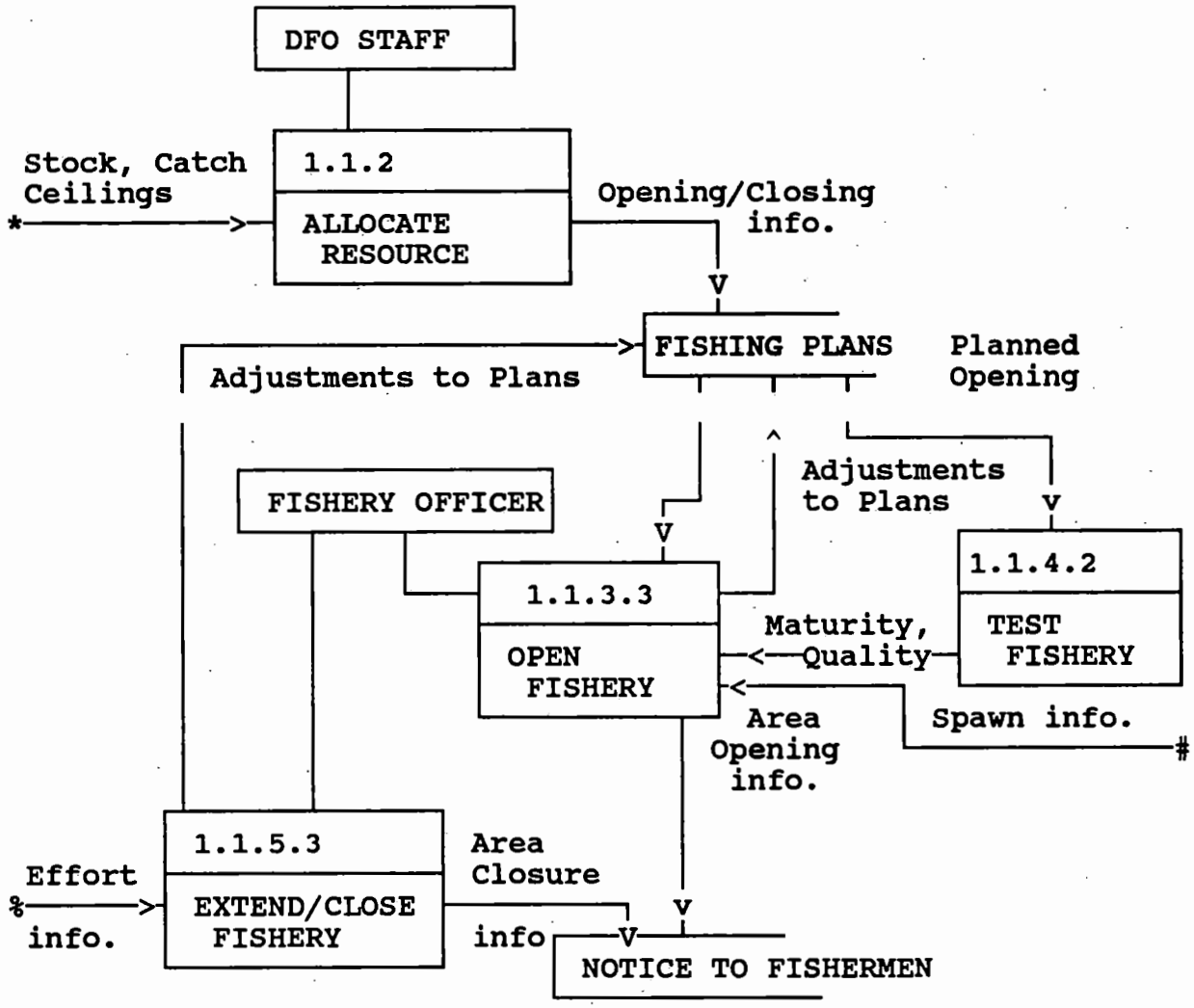
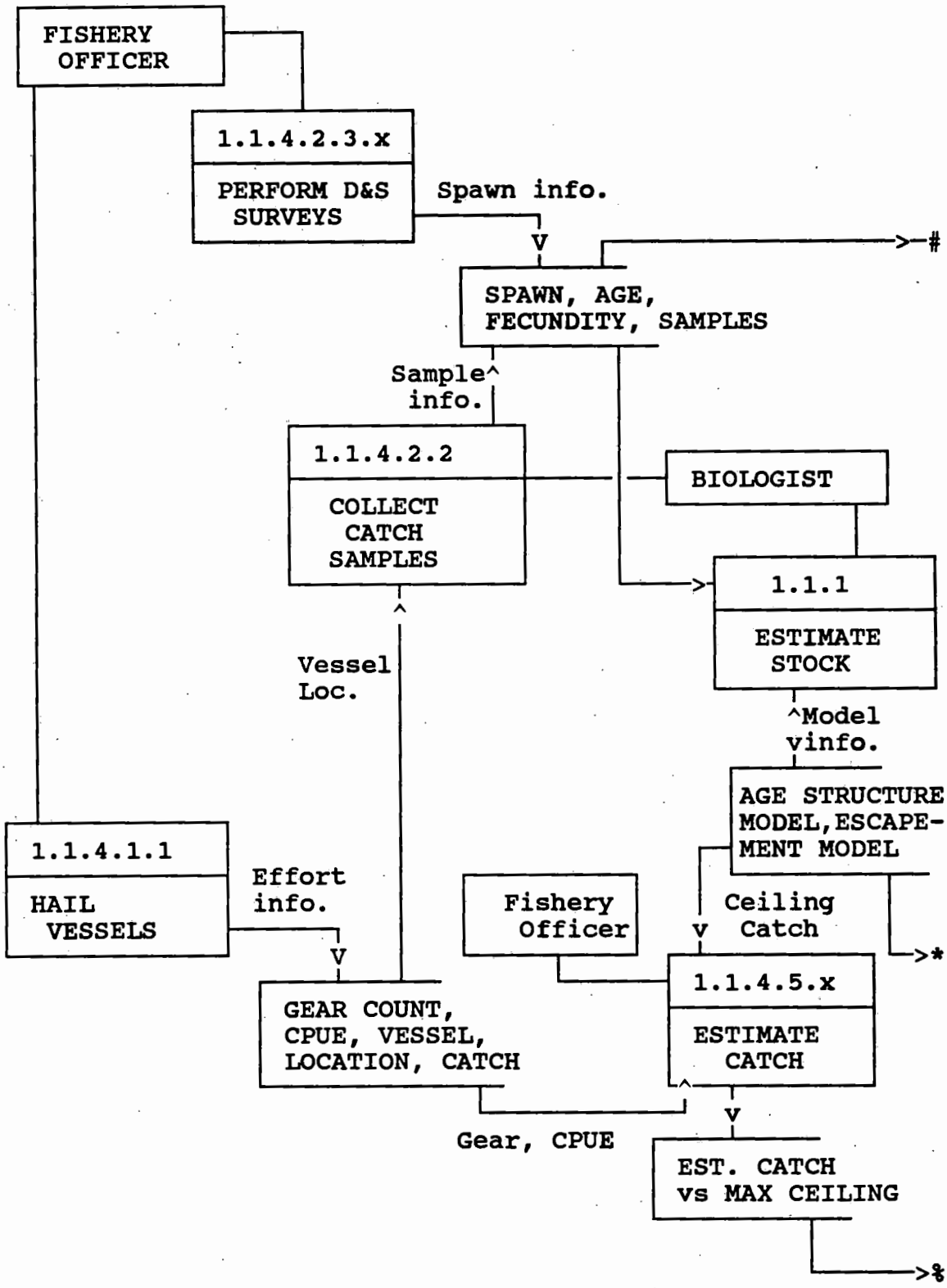


Figure 4.4.2a DFD - Herring



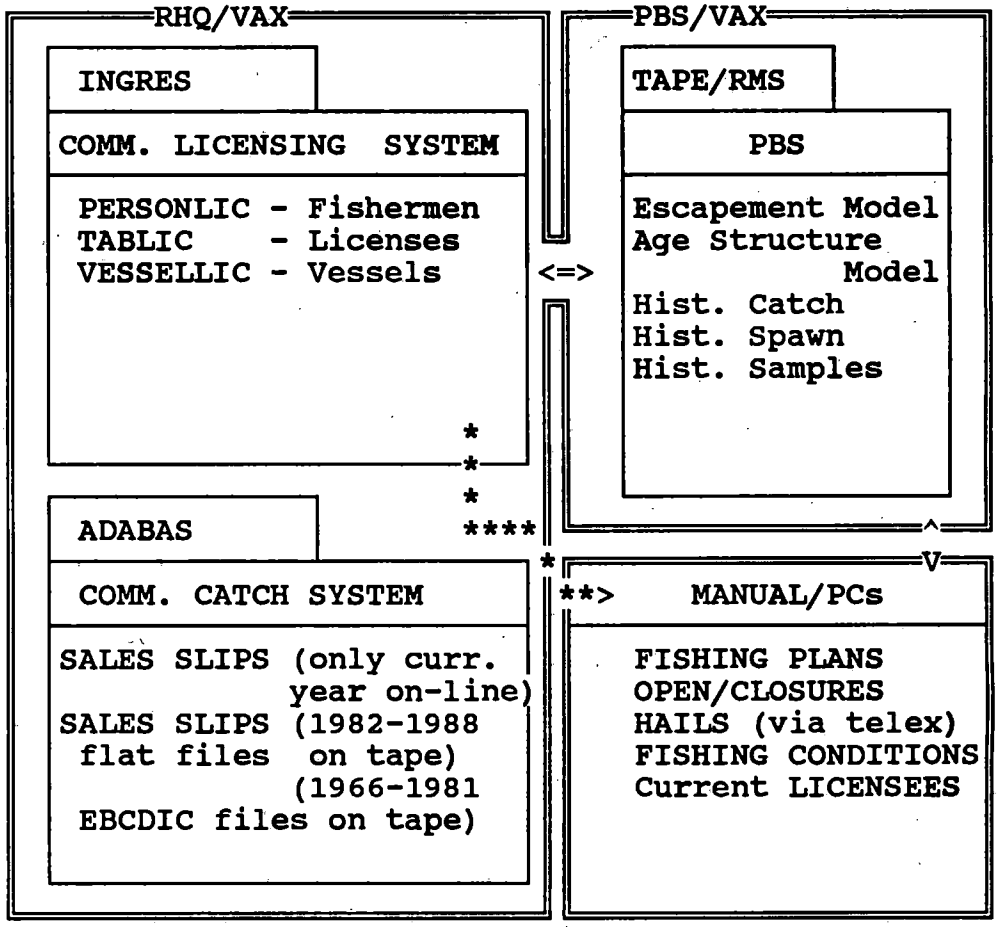
Catch & Effort Data Model

Figure 4.4.2b Herring Fishery Management DFD



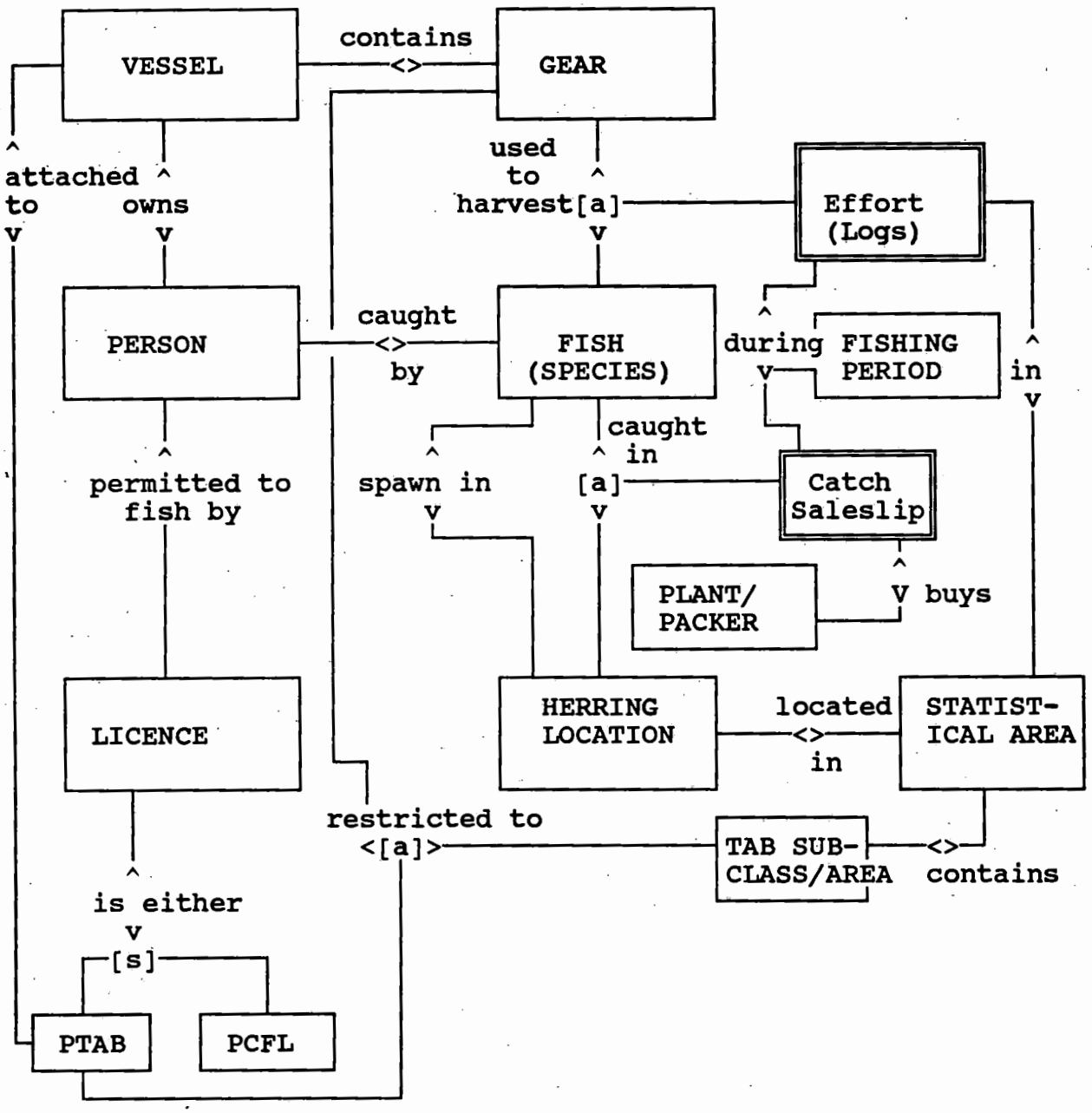
Catch & Effort Data Model

Figure 4.4.3 Current Architecture of Herring Fishery Information System



Catch & Effort Data Model

Figure 4.4.4 Herring Data Model



Symbols

<> relationship diamond lateral
^ relationship diamond vertical
v
[s] entity sub-type
[a] associative entity

Table 4.4.2 Entity Relationships Catch and Effort - Herring

	DOMINANT ENTITY	ENTITY RELATIONSHIP	MIN CARD.	MAX CARD.	SUBORDINATE ENTITY
1	FISH	ARE CAUGHT BY	0	1	PERSON
1	GEAR	USED TO HARVEST	0	M	FISH (EFFORT)
1	EFFORT	OCCURS DURING	1	M	FISHING PERIODS
1	EFFORT	OCCURS IN	1	M	STATISTICAL AREA
1	VESSEL	CONTAINS	1	M	GEAR
1	PERSON	OWNS/OPERATES	1	M	VESSEL
1	FISHER	IS PERMITTED TO FISH BY	1	M	COMM. LICENCE
1	COMM. LICENCE	IS EITHER 2	1	1	PERSON TAB
1	COMM. LICENCE	IS EITHER 3	1	1	PERSONAL COMMERCIAL FISHING LICENCE (PCFL)
1	PERSON TAB	IS ISSUED TO	1	1	PERSON
1	VESSEL TAB	IS ISSUED TO	1	1	VESSEL
1	PERSON TAB	IS ATTACHED TO	1	1	VESSEL
1	PERSON TAB	IS RESTRICTED TO	1	1	GEAR (TAB SUBCLASS)
			1	1	TAB AREA
1	TAB AREA	CONTAINS	1	M	STATISTICAL AREAS
M	FISH	ARE CAUGHT IN	1	1	HERRING LOCATION
1	HERRING LOCATION	IS LOCATED IN	1	1	STATISTICAL AREA
M	FISH	SPAWN IN	1	M	HERRING LOCATION
M	FISH	ARE CAUGHT DURING	1	M	FISHING PERIOD
1	PLANT/PACKER	BUYS	1	M	CATCH (SALESLIP)
1	CATCH	CAUGHT IN	1	M	HERRING LOCATION

Table 4.4.3 Herring Databases

Database : HERRING: BIOSAMPLING O. REGIONAL Code : 5131

Description : VAX(ONLINE/TAPE) -ORG:CATCH SAMPLING, RESEARCH CRUISE -MEASURE:WEIGHT, LENGTH, AGE, SCALES TAKEN, SEX, GONAD WEIGHT MATURITY -SAMPLE:1945-84 (MAJOR FISHERY- MARCH/APR./NOV. CHARTERS-MARCH/APR. CRUISES(BAIT PONDS) THROUGHOUT YR) BC COAST -APPL:STOCK ASSESSMENT, ID BIO TRENDS/CHANGES

Database : HERRING CATCH DATA O. LOCAL Code : 5132

Description : VAX(ON LINE) -ORG: LANDING STATS -MEASURE: WEIGHT, GEAR, TYPE OF HISTORY -SAMPLE: 1950-1967 REDUCTION FISHERY, 1970-1984 ROE AND FOOD FISHERY, DURING JULY 1-JUNE 30 BY STATS WEEK, IN BC (SECTIONS OF ROE HERRING FISHERIES) -APPLICATION: STOCK ASSESSMENT

Database : HERRING PERMITS (FOOD AND BAIT) Code : 5133

Description : VAX -ORG:COPIES OF LICENSES ISSUED -MEASURE:STAT AREA, LOCATION, APPLICATION, VESSEL & CFV NO, GEAR, START/END PERMIT, CATCH USAGE, LIMITED TONNAGE, PREVIOUS LIMIT, PREVIOUS UTILIZATION, LICENCE TYPE, IMPOUND LOCATION -SAMPLE:81-81, ANNUAL, S.COAST -APPLICATION:SUMMARY INFORMATION

Database : HERRING SPAWN DATA O. REGIONAL Code : 5134

Description : VAX(ONLINE/TAPE) -ORG: FISHERY OFFICER SPAWN REPORT -MEASURE: LENGTH & WIDTH OF SPAWN, NO. LAYERS, SUBSTRATE TYPE, PERCENT COVER, INTENSITY, START/END SPAWN -SAMPLE: 1950-1987 (JAN-JUNE, 1-3 DAYS PER SPAWN), BC-HERRING LOCATION CODES -APPLICATION: STOCK ASSESSMENT

GROUNDFISH

4.5 - Groundfish - Overview

Overview

Groundfish encompass all marine fishes that inhabit the continental shelf and slope areas of North America with the exception of salmon and herring. These fishes exhibit a wide variety of body forms and life history traits ranging from fast growing short-lived and sedentary species like Pacific Cod and lingcod, to very long-lived slow-growing and wide ranging species like rockfish and sablefish.

The groundfish fisheries occur along the continental slope and shelf, Hecate Strait, in certain areas of the Inside Passage, the Straits of Georgia and Juan de Fuca cited in CTR/FAS #1656 [11]. These fisheries are classified according to species groups, by gear types - trawl, hook and line, trap - and their commercial viability. However, these stocks are assessed and managed on a species by species basis, with advice from biologists summarized in annual PSARC reports [4]. Currently, target commercial species include rockfish, flatfish, Pacific cod, pollock, hake, and sablefish.

The groundfish (or demersal) Catch and Effort estimates are based upon information from several different sources.

Both the domestic and foreign fisheries are monitored by the Fishery officers.

The domestic fishery effort is monitored through mandatory logbook program, and little on-site monitoring is done. The domestic catch and effort estimates are based upon the sales slips as well as the mandatory vessel logs.

The foreign fishery has a directed program of observers on board, who are responsible for monitoring catch and production. The foreign fishery estimates are based upon the information gathered from this program, especially the mandatory vessel logs, foreign observer data and weekly catch reports telexed from the vessels in-season.

The next two sections review these monitoring programs separately.

There are certain species which are commercially viable [4]. Hake, pollock, sablefish, dover sole, english sole, dogfish, Pacific cod and Rockfish species, for example, are also subject to quota management.

As an indicator of the activity in these fisheries, the estimated catches for 1987 were [11]:-

Table 4.5.1 Groundfish Catch 1987

Groundfish Catch 1987*	Catch (metric tons)	Effort (hours)
BC fleet - Domestic Catch		
Trawl	60,518.48	42,915
Other gear	9,601.86	n/a
Foreign Fleet - includes activity of Canadian catcher boats		
Joint-Venture	49,298	
National	19,768	
Supplemental	2,371	

*Source (CTR/FAS # 1656)

4.6 - Domestic Groundfish

Overview

The domestic Groundfish fishery is conducted year round. Some 144 trawlers and approximately 2000 other vessels are active in the fishery. The dominant commercially viable species are limited by quota (see Exhibit 1). Annual quotas are determined by the Offshore unit, with biological advice from PBS Groundfish unit in the PSARC annual stock assessment reports [4].

Quota Monitoring

Quotas are managed by the Offshore unit through an ongoing weekly monitoring program, relying upon a combination of hails, sales slips, and log records. Vessel operators are required to call in on completion of a trip, and to identify their total rockfish catch by species under quota (hails). They are also obliged to complete a log of fishing activity as a requirement of their commercial licenses. Finally, upon landing their catches, vessel operators receive a saleslip from the plant or buyer. Copies of these documents are sent to DFO, and are eventually cross-referenced in the PBS groundfish databases, managed by the Groundfish Section (Rick Stanley). The hails are processed by the Offshore Unit to determine the status of coastwide species quotas and quarterly target catches.

Hail data

The hails are then transmitted to PBS where they are entered into a dBase IV program and summarized by species and area. This program is on a micro-computer, and will eventually be transferred to the Offshore Unit at RHQ for management. Since there is no area breakdown in the original hail data, the PBS Groundfish Section applies area distributions to hailed catches, based upon past logbook data and knowledge about the vessel/skipper. This information is then aggregated by species and area groups on a weekly basis, and faxed or mailed to the DFO Offshore Unit each Friday.

The quotas are reviewed weekly by Offshore, and if indications are that the fishery is likely to go over quota, the fishery is changed from a directed one to an incidental fishery. This means that a catch may contain the groundfish species but it cannot be the 'targeted' species. Offshore believes that there is at least a three week lag between the information they receive and the actual events on the fishing grounds. This is built into the current hail system due to the fact that a) hails from vessels are only received when it is returning from a trip, b) the delay in getting the hail data entered and processed, and c) quota vs catch report preparation and transmission.

In the PBS system, the data gathering process is designed toward developing progressively harder catch data as the season progresses.

Logbook data
Logbooks arrive about two to three weeks after a trip is finished. The logbooks are received from port samplers, as well as the Offshore Division. They are scrutinized and entered into the groundfish logbook database, a part of the Groundfish Catch Statistics data systems [10], and managed by the Groundfish Section. This data is then compared to the hails and saleslip data, and replaces either source as it is believed to be the most reliable in so far as area resolution is concerned. The groundfish database is limited to trawl and trap gears, but covers the whole coast. Logs records are also reviewed by Offshore for trip limit compliance, and to amend the rockfish quarterly quota status. It may take up to 3 or 4 months to obtain sufficient information from all sources to assess the catch in an area for a species.

Sales slips data
Sales slips usually arrive about three to six weeks after a landing. Copies of sales slips containing groundfish catches are reviewed by PBS regularly, where they are validated by research staff, and any changes - principally to 'areas fished' - are noted therein. A copy is returned to the Statistics Division for entry of such corrections into the Commercial Catch Saleslip System. Logbook observations are altered according to data in saleslips with the merged form of log data and sales slip data becoming "hard" data. Sales slips are also reviewed by Offshore for trip limit compliance and to amend the rockfish quarterly quota status.

Problems and Challenges
The domestic groundfish catch estimation process relies heavily upon the hails received from vessels to manage quotas in-season.

The PBS Groundfish Section provides a valuable service in-season and post-season to verify the hailed catches.

The Commercial Catch Saleslip System in Adabas is also validated by PBS, so that the data is more likely to be accurate in terms of area, species and gear resolution.

The Offshore Division would like to have faster access to the weekly hails, and earlier than presently provided. Some alternatives are:-

Catch & Effort Data Model

1. The hails are faxed to PBS for entry into a PC file in dbase IV. The plan is to let the Offshore Division could the raw hails directly into this system themselves given the appropriate resources. PBS are willing to hand the system over at any time. The report prepared manually by PBS which compares the compiled catch from the dbase files against the quotas could be incorporated into the PC based system if the quotas were also stored therein.

2. Alternatively, Offshore Division currently has a quota management system for Foreign fisheries being developed in the Ingres. The 'hails' part of this system is already in operation. In a similar manner, a domestic quota management sub-system could be added to this system. The scientific review process could be included in a special module, where log and hail data can be compared on-line and edited by PBS via terminal or PC. Quota reports would then be available on-line.

3. Other alternatives should also be investigated.

The logbooks and saleslip forms are slow to arrive at DFO and get processed. Offshore are considering various means to improve turnaround, but lack the resources to implement them.

The Offshore Division currently has on-line access to the PBS database, but staff have insufficient time and resources in-season to become familiar with the system or the user's manual in order to utilize this database fully.

User Needs and Recommendations

The Offshore Division would like sufficient time and resources provided to improve the turnaround in the current domestic quota reporting system in both the early hails and the logbook/saleslip catch finalization process.

Exhibit 4.6.1
Domestic Groundfish Quotas 1989

ESTIMATED DOMESTIC TRAWL CATCHES (t) OF QUOTA GROUNDFISH TO June 23/89

	QUOTA (t)	ESTIMATED CATCH (t) From logbks	Logs + hails[a]	
Canary rockfish				
Areas 121 to 125-6, 126, 127-1, 127-2 [3C, 3D]	600	204	336	56%
Areas 107-2 to 111, 127-3, 127-4, 130-1, 130-2 [5A, 5B[3]]	425	147	291	*68%
Areas 101-4 to 107-1, 130-3 [5B, 5C, 5D][4]	300	51	51	
Areas 101-1, 142 [5E-south]	500	1	1	
Areas 101-2, 101-3 [5E-north]	Nil	4	4	
Coastwide total[5]	1,575[5]	403	679	(43
Pacific ocean perch				
Areas 121 to 125 [3C][1]	150	147	153	**
Areas 126 to 127-2 [3D][2]	400	376	498	**
Areas 107-2 to 111, 127-3, 127-4, 130-1, 130-2 [5A,5B[3]]	850	268	569	*67%
Areas 101-4 to 107-1, 130-3 [5B, 5C,5D][4]	3,000	890	946	
Areas 101-1, 142 [5E-south]	400	284	284	
Areas 101-2, 101-3 [5E-north]	Nil	917	1196	
Coastwide total[6]	4,650[6]	1818	2297	149
Redstripe rockfish				
Areas 121 to 124-3, 125-6 [3C]	Nil	67	71	
Areas 124-4, 125-1 to 125-5, 126, 127-1, 127-2 [3D]	Nil	186	225	
Areas 107-2 to 111, 127-3, 127-4, 130-1, 130-2 [5A, 5B]	Nil	164	242	
Areas 101-4 to 107-1, 130-3 [5C, 5D]	Nil	140	140	
Areas 101-1, 142 [5E-south]	Nil	47	47	
Areas 101-2, 101-3 [5E-north]	Nil	104	104	
Rougheye rockfish				
Areas 101-1, 142 [5E-south]	250	92	92	
Areas 101-2, 101-3 [5E-north]	Nil	292	306	
Coastwide [4B, 3C, 3D, 5A, 5B, 5C, 5D]	Nil	94	110	
Silvergray rockfish				
Areas 121 to 125-6, 126, 127-1, 127-2 [3C, 3D]	500	351	458	* 92%
Areas 107-2 to 111, 127-3, 127-4, 130-1, 130-2 [5A, 5B][3]	850	271	368	
Areas 101-4 to 107-1, 130-3 [5B, 5C, 5D][4]	650	490	495	* 76%
Areas 101-1, 142 [5E-south]	250	59	59	
Areas 101-2, 101-3 [5E-north]	Nil	126	126	

Table 4.6.1 Function Descriptions - Groundfish Domestic Catch and Effort

ESTIMATE STOCKS 1.1.1
Annual estimate of stocks by species and area is prepared by PBS Groundfish Section

ALLOCATE RESOURCE 1.1.2.1
Annual quotas are established by the Offshore Division for each species and area. These fisheries include DIRECTED and INCIDENTAL FISHERIES.

CHANGE FISHERY TO INCIDENTAL 1.1.2.6
When 60% of a quota is exceeded, the fishery is changed from a directed to an incidental fishery. The incidental quota is adjusted as fishing conditions change.

MONITOR CATCH 1.1.4

OBSERVE HARVEST 1.1.4.1
Observe the harvesting activities of the fleet.

INTERVIEW FISHERS 1.1.4.1.2
The vessels are required to report in their catches as they return from a trip.

PREPARE LOGBOOKS 1.1.4.1.2.1
Vessel operators are required to complete a logbook of fishing activity during the trip.

CHECK SALES SLIPS 1.1.4.4.5
Statistics receive the sales slips of landed catches and forward a copy to PBS Groundfish Section for validation of Areas, Species and Gear'.

RECORD HAILS 1.1.4.5.2

Hails from the INTERVIEW FISHERS function are entered into a dBase IV file on a PC (at PBS).

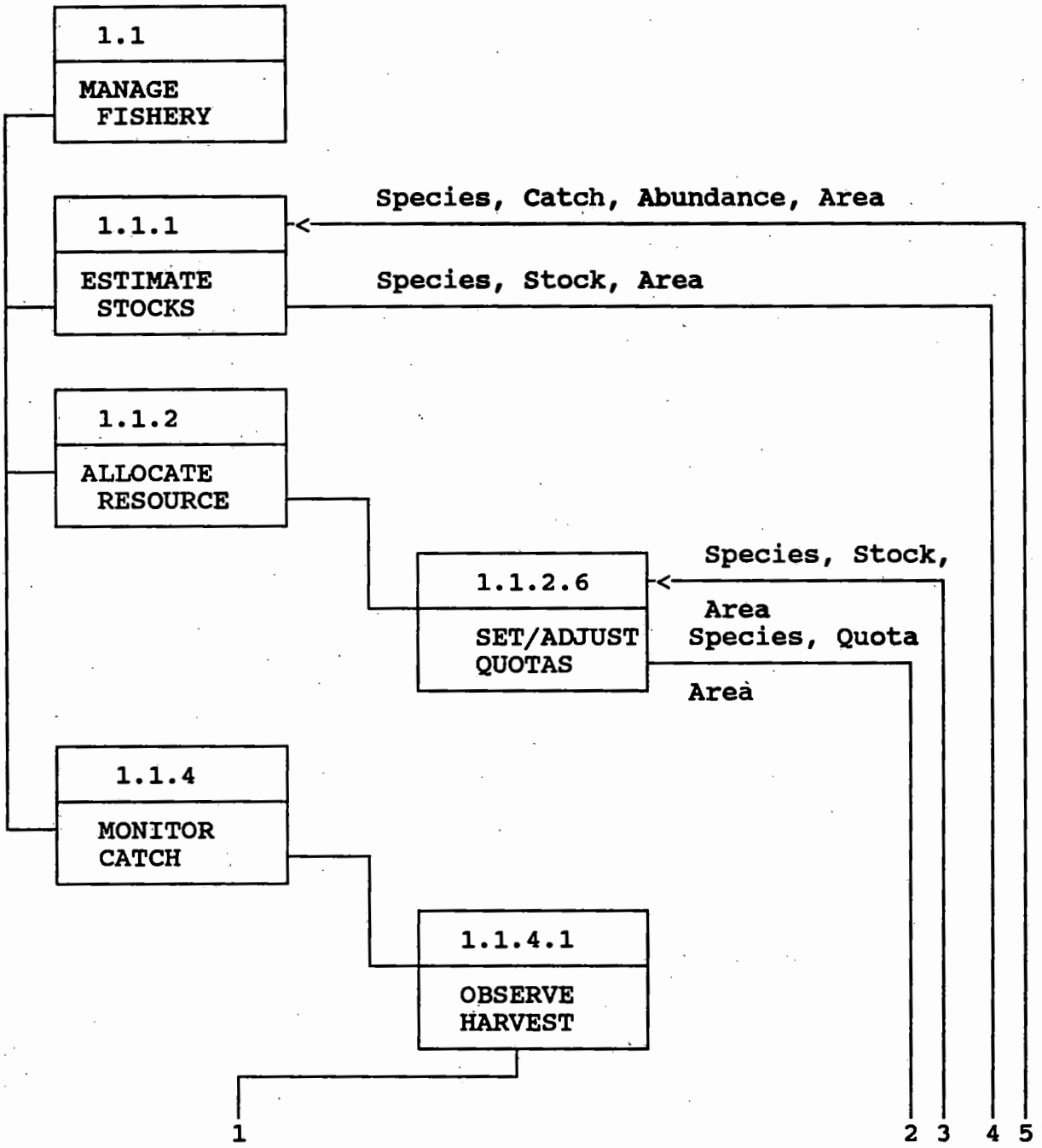
RECORD LOGBOOKS 1.1.4.5.1
Logbooks are received from the fishers and sent to PBS for entry into the logbook pro-gram.

MERGE LOGS and SALES SLIPS 1.1.5.1.5
Saleslip data - catch and effort data only - is merged with the logbook data in the PBS groundfish database. (Sales slips are also corrected by PBS Groundfish Section before being entered into the Commercial Catch Sales Slip System)

PREPARE QUOTA VS CATCH 1.1.4.5.2.5
PBS produces a report weekly indicating the estimated catch versus the allowed quota.

MONITOR QUOTAS 1.1.5.2
OFFSHORE monitors quarterly quotas using logbooks (from vessels), sales slips (from Statistics Division) and hails (from PBS).

Figure 4.6.1 Function Chart for the Domestic Groundfish Fishery



Catch & Effort Data Model

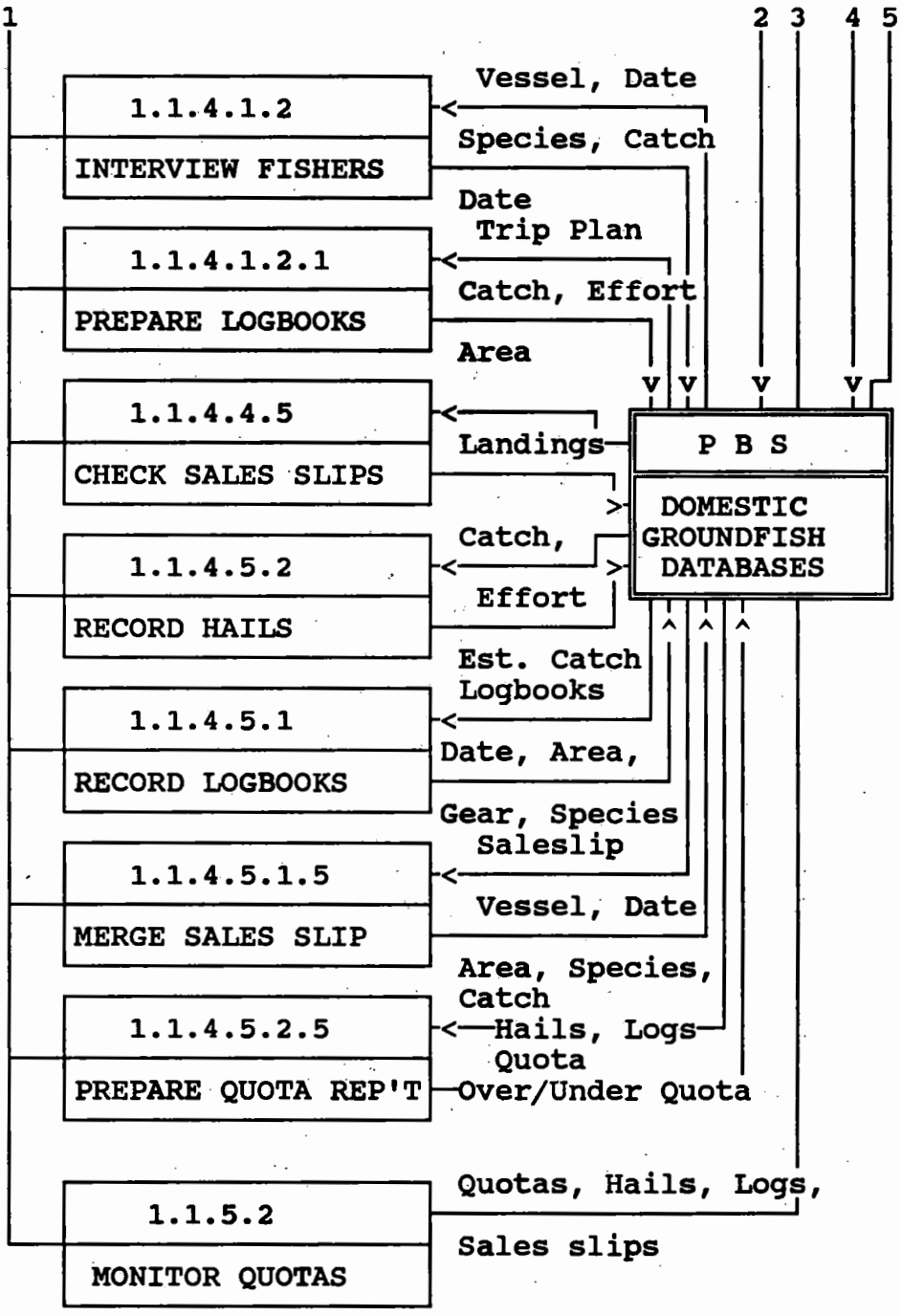


Figure 4.6.2 DFD Domestic Groundfish

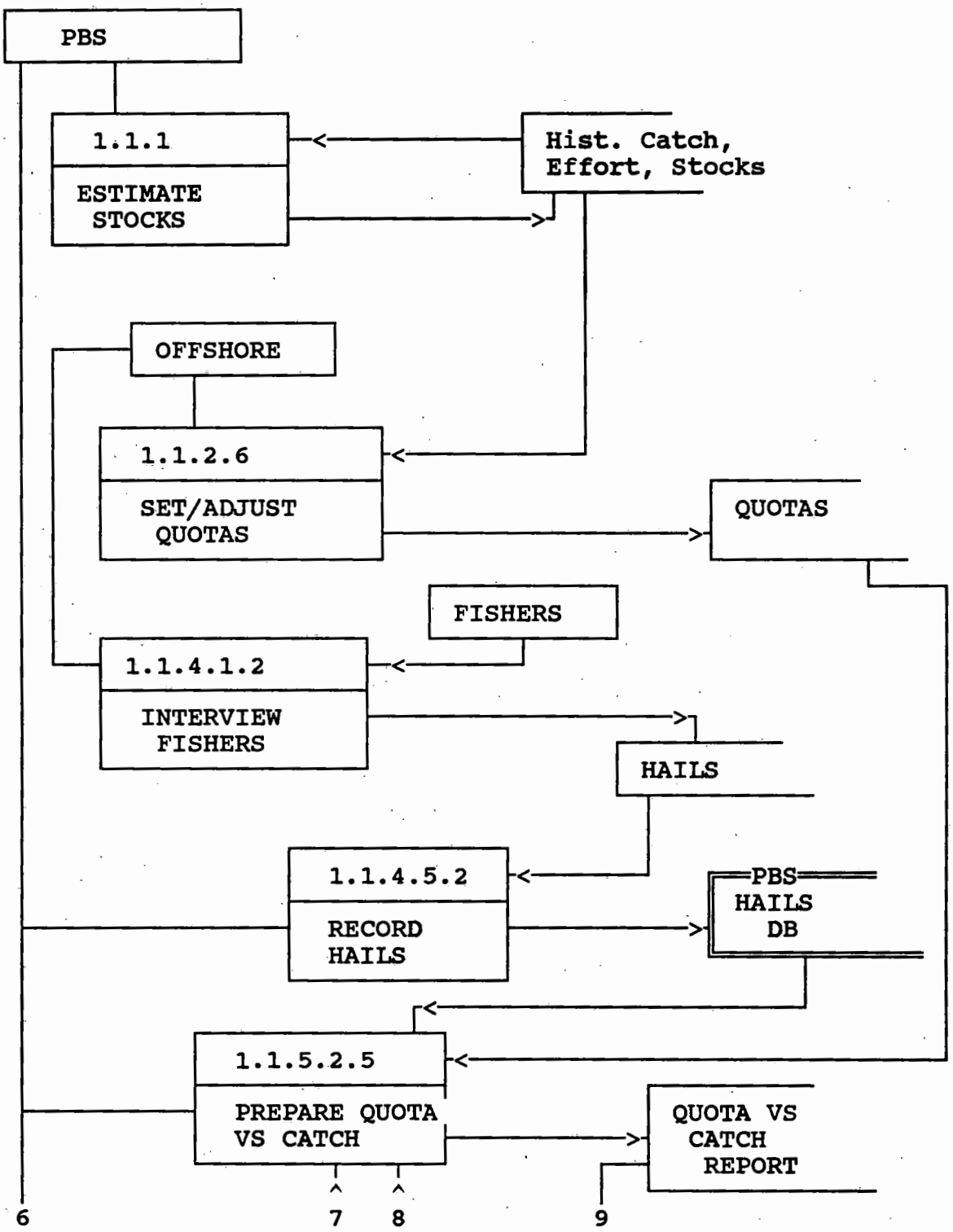
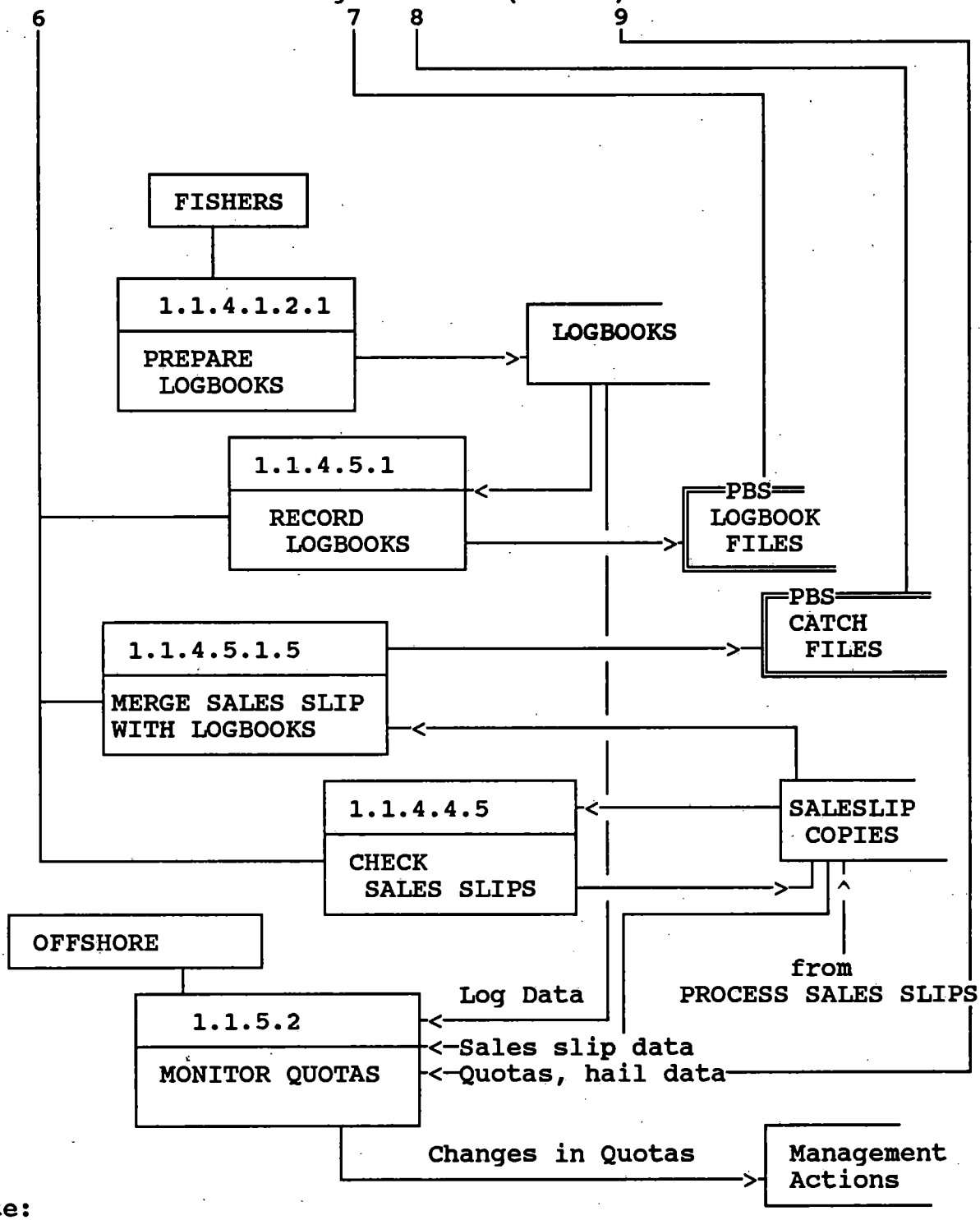


Figure 4.6.2 (cont'd)



Note:
++ Usually sales slip data is merged to existing logbook data as received (R. Stanley)

Catch & Effort Data Model

Figure 4.6.3 Domestic Groundfish Conceptual Data Model

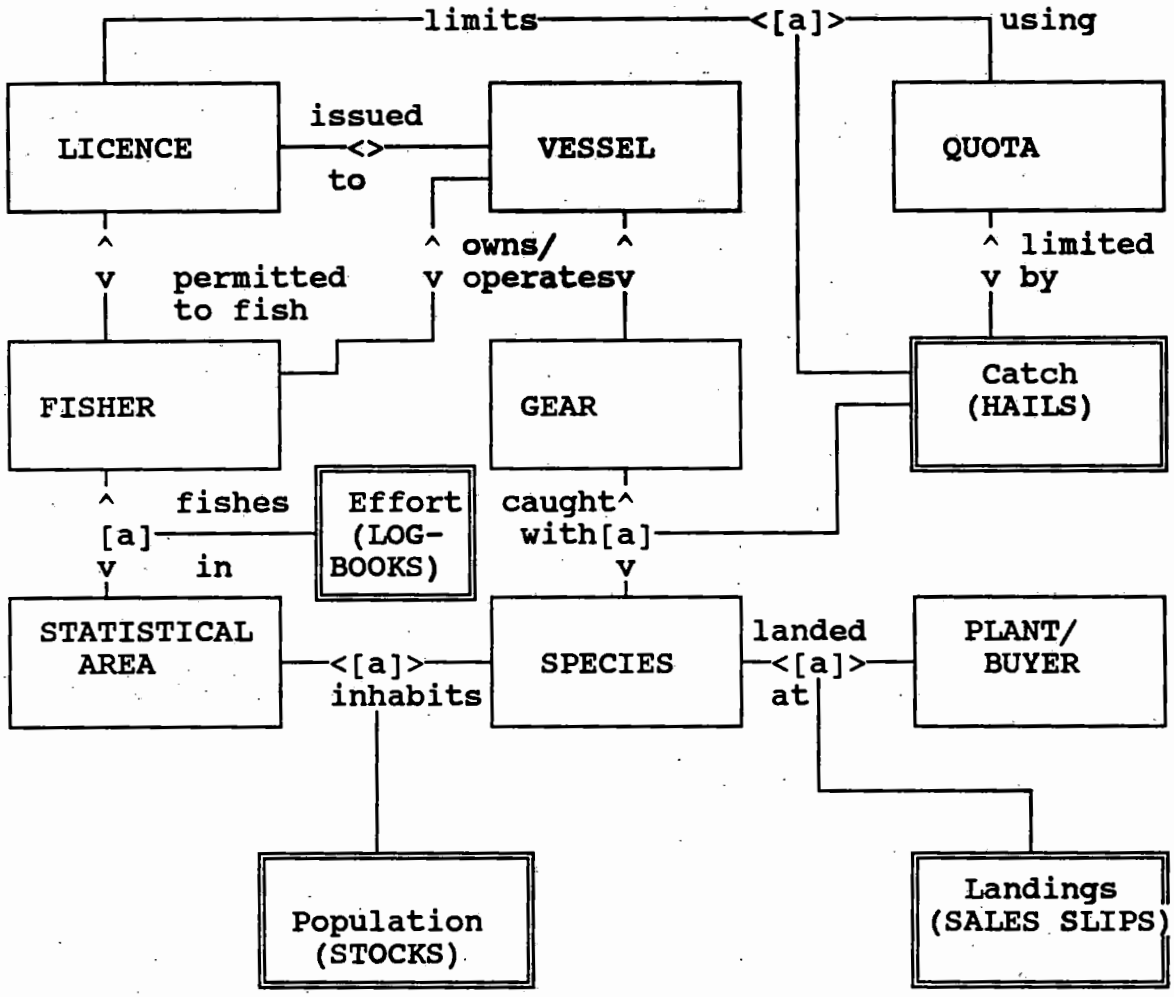


Table 4.6.2 Domestic Groundfish Databases at PBS
(Report on databases in RIM Repository)

Database	Code	Db_descr
BIOLOGICAL DATA ON F LATFISH	5135	VAX (DFO ONLINE/TAPE) -ORG: RESEARCH CRUISES
-MEASURE: SPECIES, WEIGHT, LENGTH, SEX, AGE, MATURITY, STOMACHS, AREA FISHED, DEPTH, DATE, GEAR -SAMPLE: 1980-1987, ANNUALLY, BC COAST -APPLICATION: N/A -CONTACT: J. FARGO, GROUNDFISH		
BIOLOGICAL DATA ON P ACIFIC COD	5136	VAX (ONLINE/TAPE/HARD COPY) -ORG: CATCH SAMPLES, RESEARCH CRUISE
-MEASURE: AGE, LENGTH -SAMPLE: 1956-1987 (IRREGULAR, THROUGHOUT THE YEAR), IN INTERNATIONAL AREA FOR GROUND FISH -APPLICATION: STOCK ASSESSMENT -CONTACT: R.FOUCHER; FRB(PBS)		
CATCH STATISTICS ON GROUNDFISH	5137	TAPE -ORG: CATCH SAMPLING, RESEARCH CRUISE
-MEASURE: SPECIES, LENGTH, AGE, SEX, GEAR -SAMPLE: 1977-1984 LINGCOD, 1983-1984 ROCKFISH, VARIED (2-4 TIMES/YR), ON BC COAST -APPLICATION: STOCK ASSESSMENT		
FOREIGN CATCH STATIS TICS	5138	IBM PC -ORG:FOREIGN FISHING LOGBOOKS
-MEASURE:DATE, SPECIES, CATCH BY PRODUCT FORM, BREAKDOWN OF DISCARDS BY SPECIES, AMOUNT OF DISCARD. -SAMPLE: 1977-1987, WEEKLY DURING HAKE FISHERY (JUNE-OCT) -APPLICATION:IN-SEASON MGT (QUOTA), DETERMINE FOREIGN LICENSE FEES, DETERMINE QUOTAS		
GROUNDFISH CATCH STA TISTICS	5139	VAX (ONLINE/TAPE/HARDCOPY) -ORG:LANDING STATS, VESSEL LOGBOOKS
-MEASURE: DATE, VESSEL(NAME, CLASS, GEAR), FISHING AREA, DAYS FISHED, NO. DRAGS, TRAWL TIME, FISHING DEPTH, TOTAL CATCH, SPECIES SAMPLE:1954-84, THROUGHOUT YEAR, MAJOR/MINOR STAT AREAS -APPL:STOCK ASSESSMENT, FLEET USAGE		
GROUNDFISH STOCK ASS ESSMENT	5140	VAX (ONLINE/TAPE BACKUP) -ORG: GROUNDFISH, STOCK ANALYSIS
-MEASURE: NONE -SAMPLE:1979-87 -APPLICATION: N/A -CONTACT: J. FARGO		

GROUNDFISH DATABASES CONT'D

OCEANOGRAPHIC DATA 5141 VAX(PBS) [ONLINE, TAPE, HARDCOPY] -ORG:BC SHORE STATION REC, NATIONAL OCEANOGRAPHIC & ATMOSPHERIC ASSOCIATION, NATIONAL MARINE FISHERIES SERVICE -MEASURE:TEMP, SALINITY, SEA LEVEL, EKMAN TRANSPORT -SAMPLE: 1930'S-NOW, MONTHLY, BC COAST -APPL:TO RESEARCH STAFF FISHERIES INVESTIGATION

ROCKFISH BIOLOGICAL 5142 TAPE/HARD COPY -ORG: CATCH DATA SAMPLING, RESEARCH CRUISE -MEASURE: NO. PIECES, DAYS FISHED, LENGTH, AGE, SPECIES, MATURITY, WEIGHT, SEX SAMPLE: 1963-1984, BC COAST STAT GROUNDFISH AREA - APPLICATION: STOCK ASSESSMENT

SABLE, DOG, HAKE, PO 5144 (SABLEFISH, DOGFISH, HAKE AND LLOCK:BIO DATA POLLOCK; BIOLOGICAL DATA) VAX -ORG:LANDING STATS, VESSEL & OBSERVER LOGBOOK, CATCH SAMPLING, CRUISE -MEASURE:SPECIES, GEAR, WEIGHT, NO. PIECES, LENGTH, AGE, SEX, NO. EGGS, DAYS FISHED, DEPTH, SET COMPLETED, HRS SOAKED, TEMP, PARASITES, MATURITY /BC

SABLEFISH CATCHES 5143 IBM PC -ORG: HAIL INFO AND SALES SLIPS
-MEASURE: VESSEL NAME, GEAR, ESTIMATED CATCH, SALES SLIP CATCH, NO. TRAPS CARRIED, NO. TRAPS FISHED, NO. TRAPS LOST, COMPANY -SAMPLE: 1981-1987, CANADIAN PACIFIC COAST -APPLICATION: IN-SEASON MGT, COMPARE CATCHES TO QUOTAS, IMPROVE MGT

4.7 - Foreign Groundfish

The foreign groundfish fishery is a directed quota fishery for Pacific Hake. This fishery is monitored closely through the Foreign Observer Program and the management and enforcement personnel in the Offshore Unit at RHQ.

The fleet is approximately 22 foreign registered vessels, fishing a small area of the continental shelf off the west coast of Vancouver Island (Area 5), as illustrated in Exhibit 1 below. These vessels are high capacity factory ships that harvest and convert the fish to a range of products for human and animal consumption and other commercial uses. Daily harvesting can range from 40 to 450 metric tons. These vessels use the catch from Canadian or joint venture "catcher boats" to maintain production capacity.

The fishery is managed to a quota by nation for certain target species (currently Hake). Each country is given a joint-venture allocation, which is the fish caught by Canadian "catcher" vessels and transferred to the factory vessel. They are also given a National allocation, which factory vessels are allowed to catch for themselves. National and joint-venture allocations are set by DFO and enforced by the Offshore Unit.

The Foreign Observer program is a National Program to monitor catch and by-catch harvesting by foreign nations. In the Pacific Region, observers are contracted by the foreign vessel owners to remain aboard the ship during each trip and monitor the operations closely. The resulting Trip Report is forwarded to DFO for analysis and compared with catch and production data telexed to Offshore weekly by the ship's captain.

The Trip report contains a wide range of data on catch production, operations and biological sampling programs that are performed during a sea assignment. Catches are estimated on a set by set basis by the observer, and summarized weekly. Biological samples are taken from selected sets and certain measurements, which may include sex, length, maturity, age, and stomach contents, as well as tag data are recorded.

Problems and Challenges
This program is one of the most structured approaches to catch and effort estimation available. The methodology is rigorous, performed by an independent party(a contractor), and has audit controls built into it.

Catch & Effort Data Model

A dBase III system developed in 1986 for all offshore fisheries was discontinued due to its complexity and slowness. The current system at Offshore is on Lotus spreadsheets and is cumbersome to use for monitoring the fishery to quota by nation. A contractor currently uses key-to-tape systems to produce catch, production and biological sampling files using a flat file system. These files are entered from the Trip Report, and maintained and accessed at PBS (by Mark Saunders). These data are not currently available on-line, but are used in post-season assessment of the fishery and for biological research studies.

Recommendations

A recent ITSD preliminary study prepared in cooperation with the Offshore Unit recommended the development of an Offshore catch and effort system with integrated quota management. This system will be implemented in two phases. Phase 1 consists of modules to enter catch and product data from the weekly telexes - HAILS - which is complete and in operation now. The second phase - due this fiscal - includes the management of quotas, the entry and reporting of set level catch and production from observer trip reports, and reports comparing the hail and observer data.

Interviewees: Mark Saunders, Devona Adams, Gary Buechler

Reviewed by: Mark Saunders, Devona Adams, Terry Calvin, Rick Stanley

Exhibit 4.7.1 Foreign and Domestic Groundfish Fishing Zones

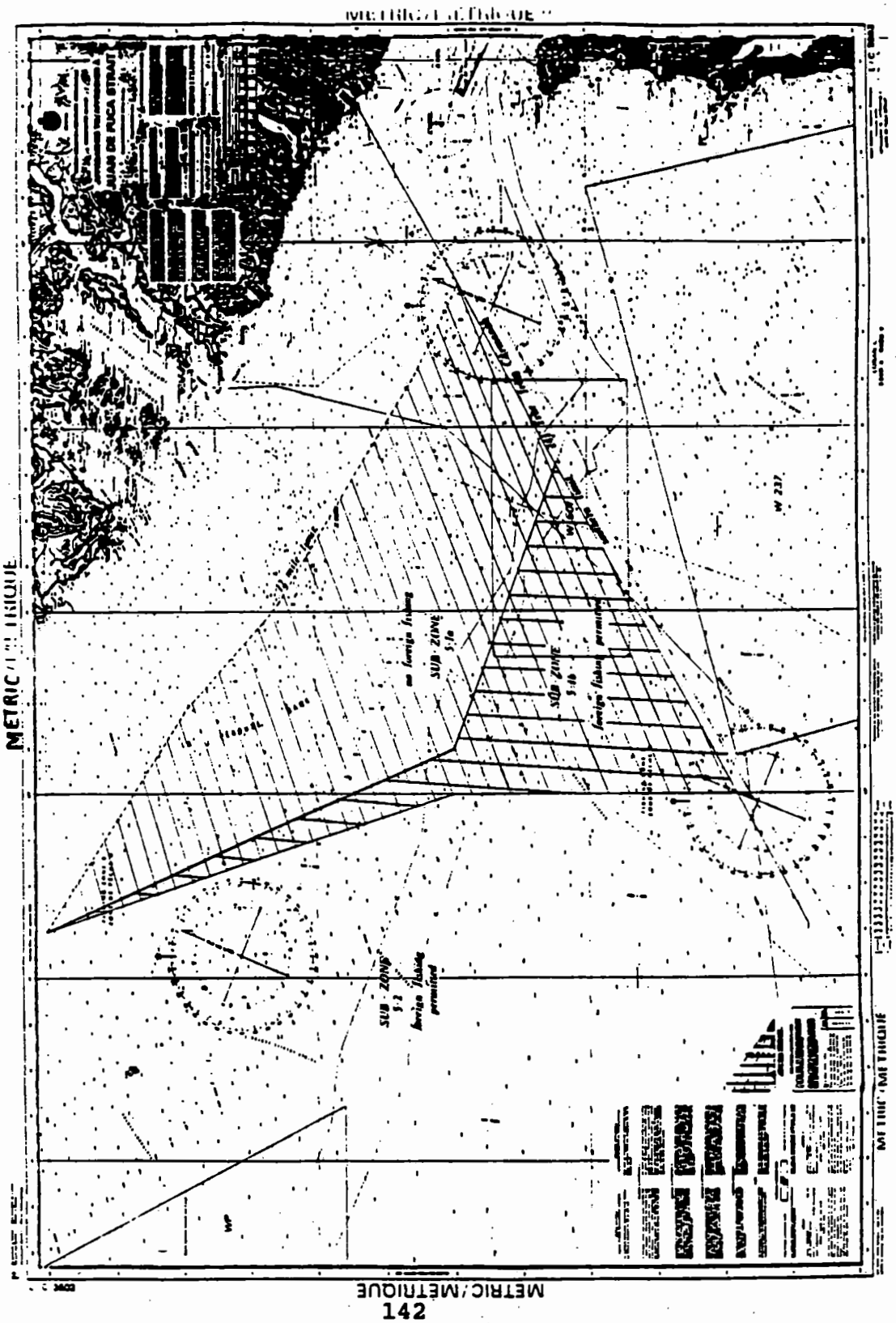
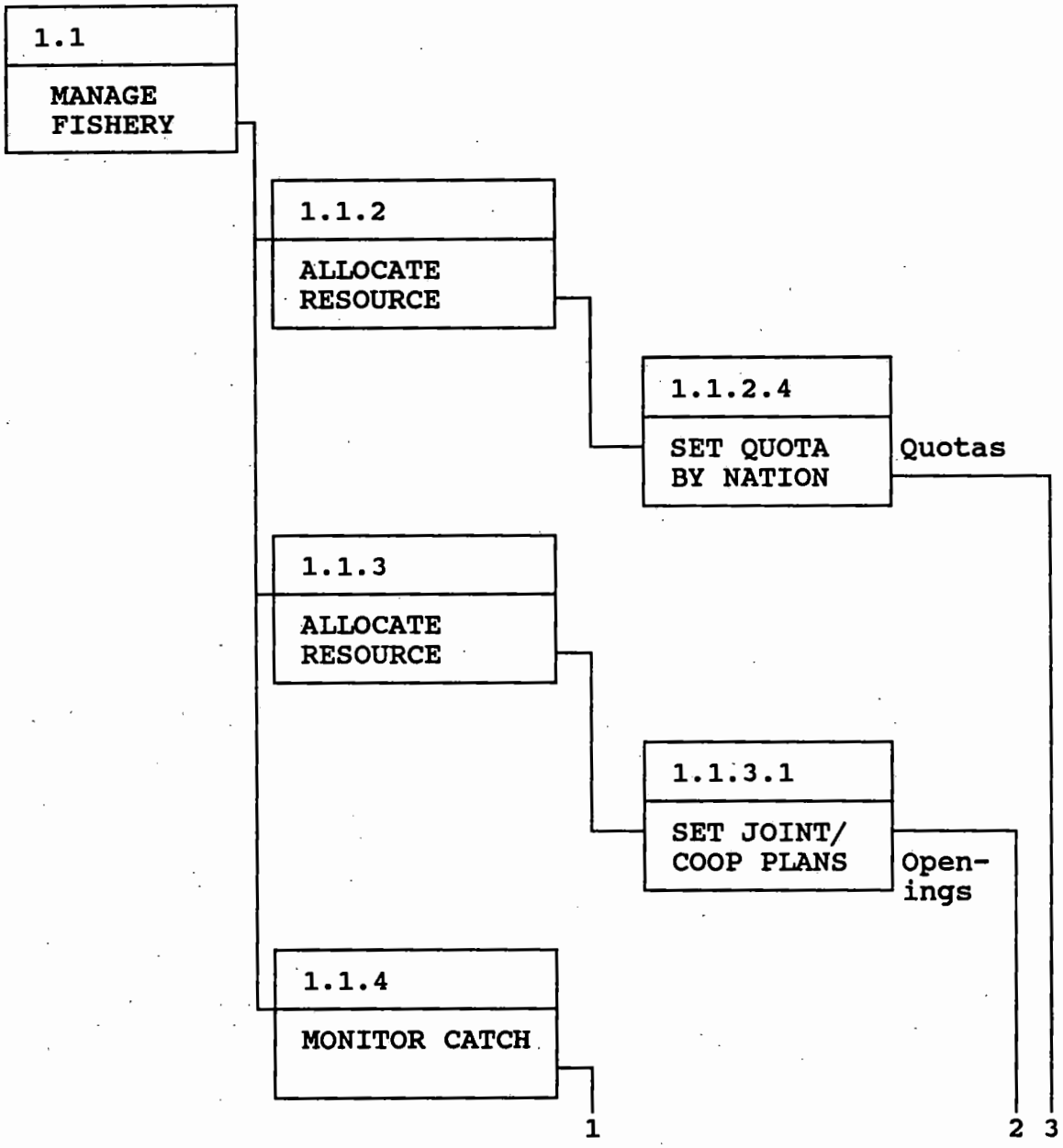


Figure 4.7.1 Function Chart Foreign Groundfish Fishery
Catch and Effort Monitoring



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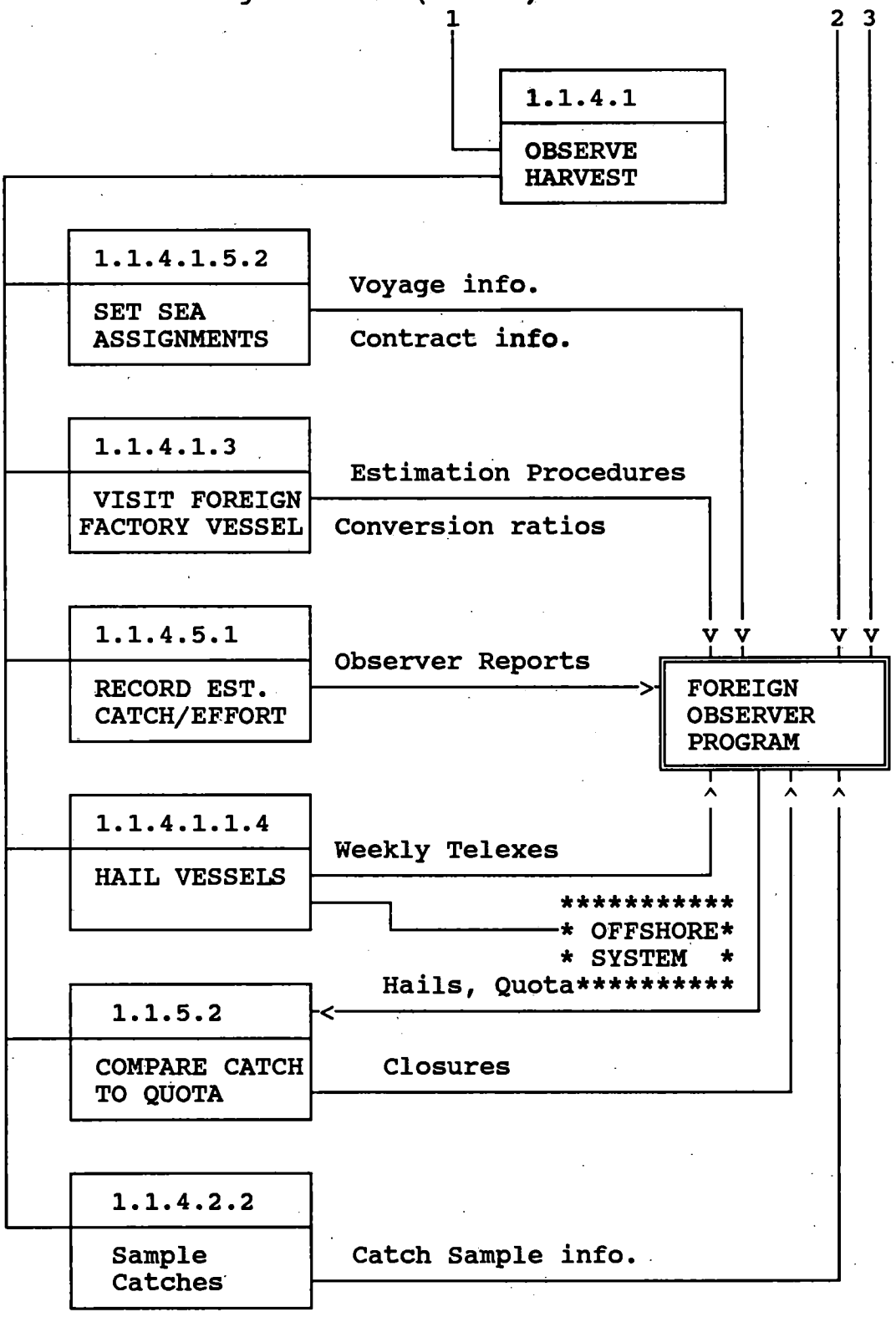
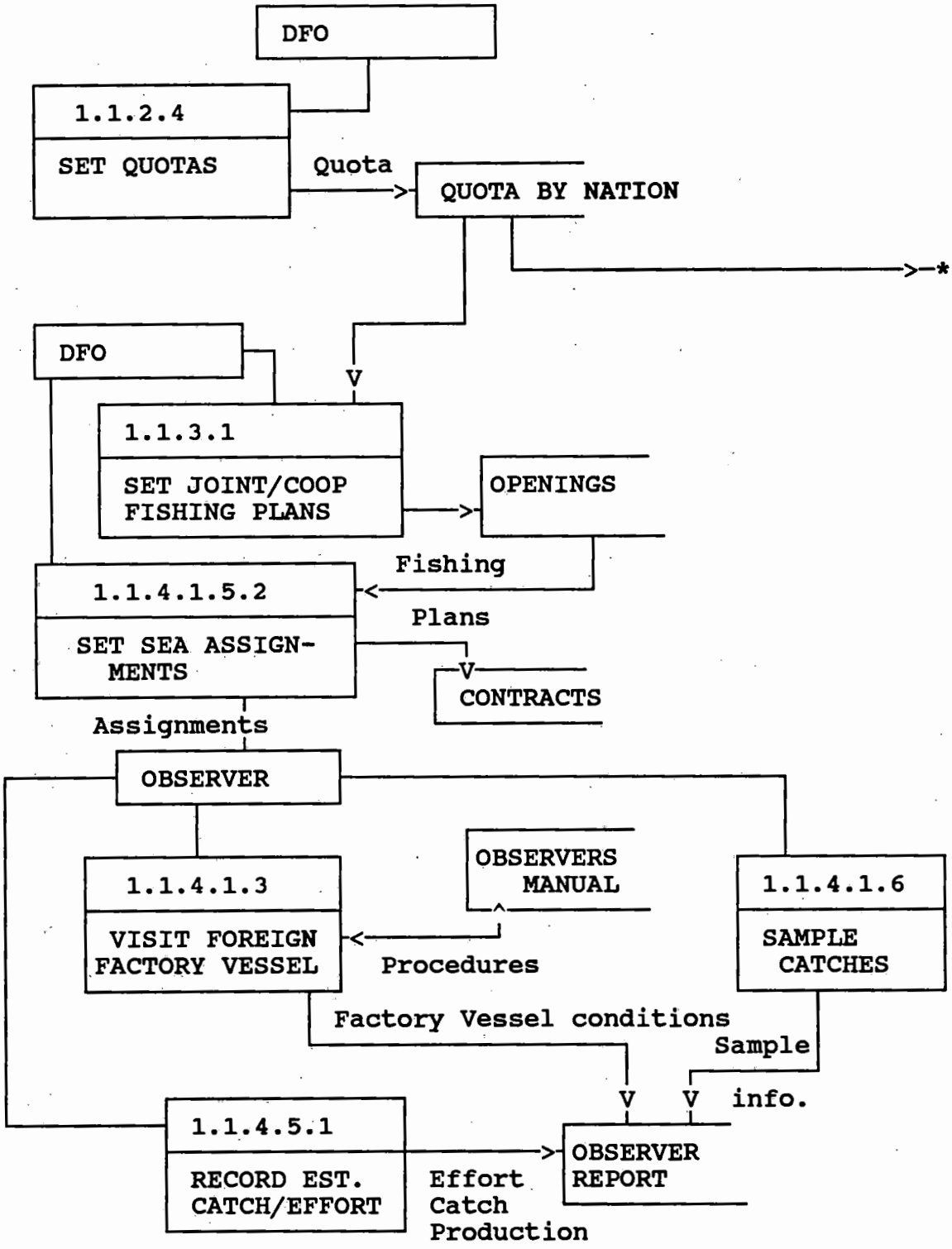


Figure 4.7.2 Data Flow Diagram Foreign Groundfish Fishery Catch and Effort Monitoring



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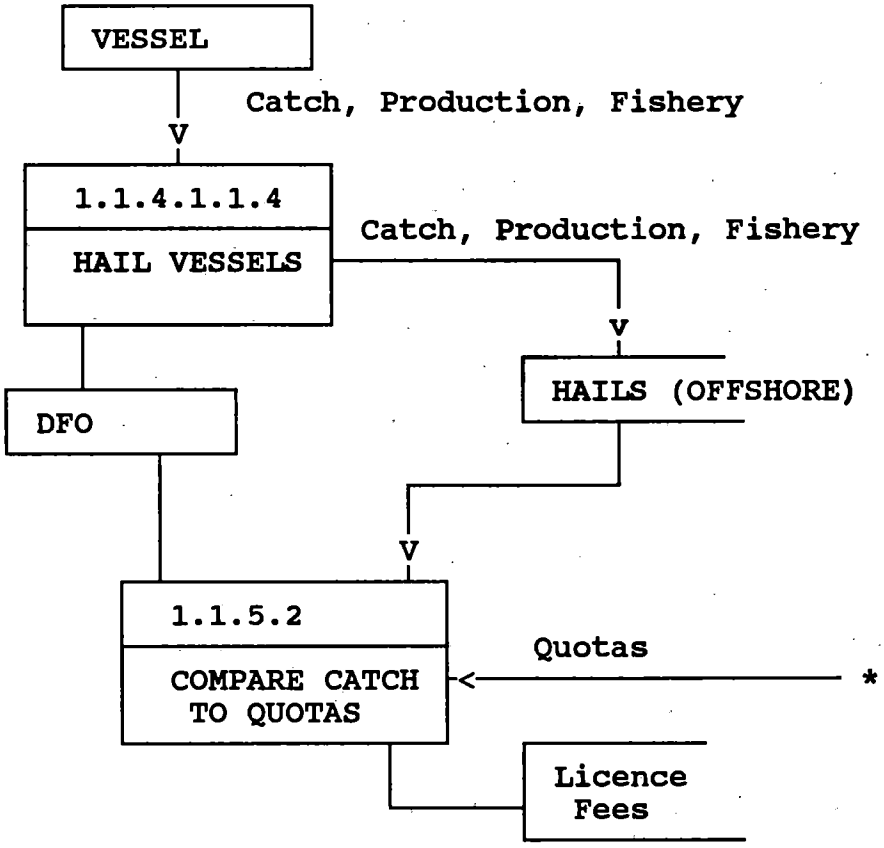
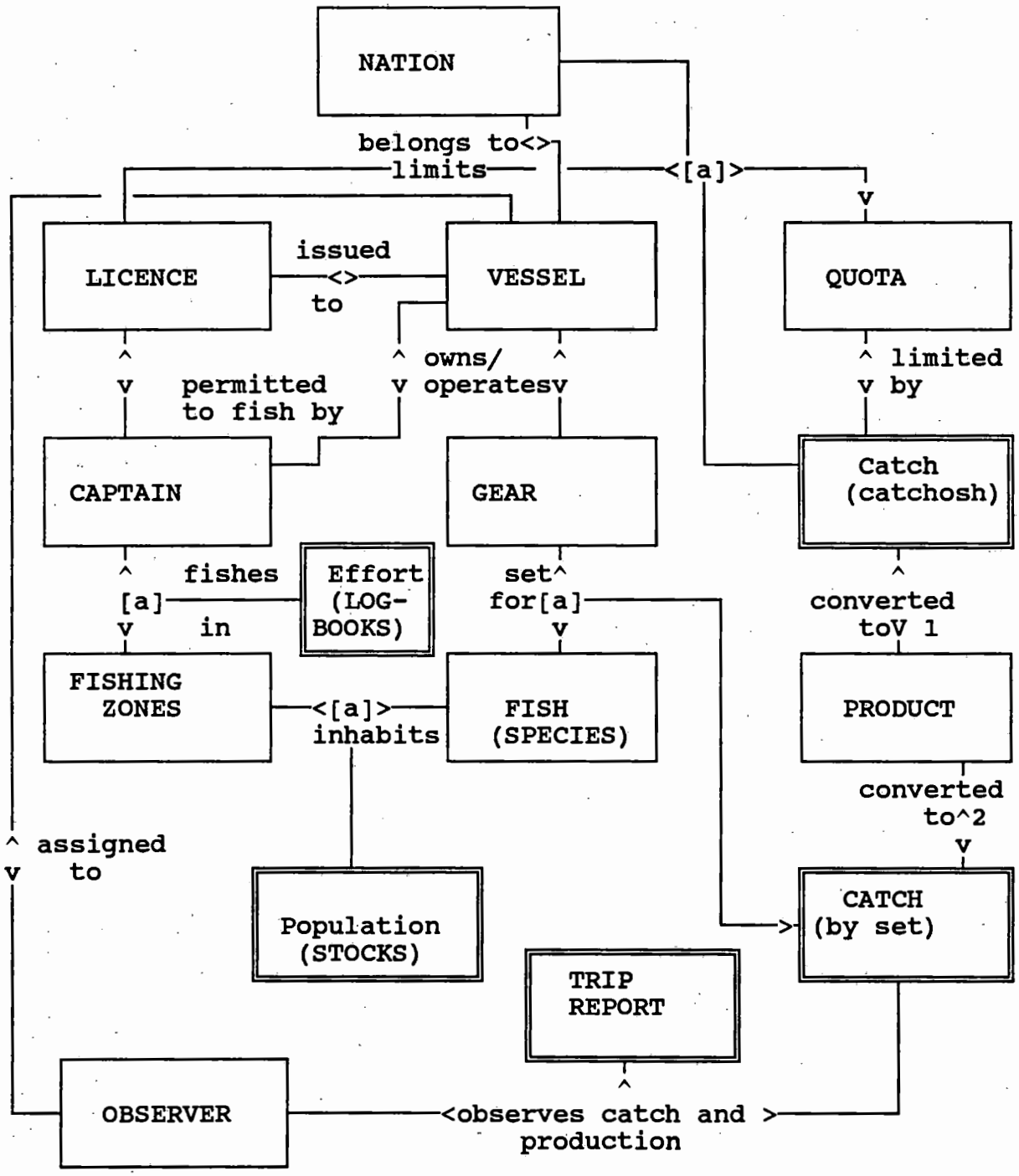


Catch & Effort Data Model

Figure 4.7.3 Conceptual Data Model - Foreign Observer Program



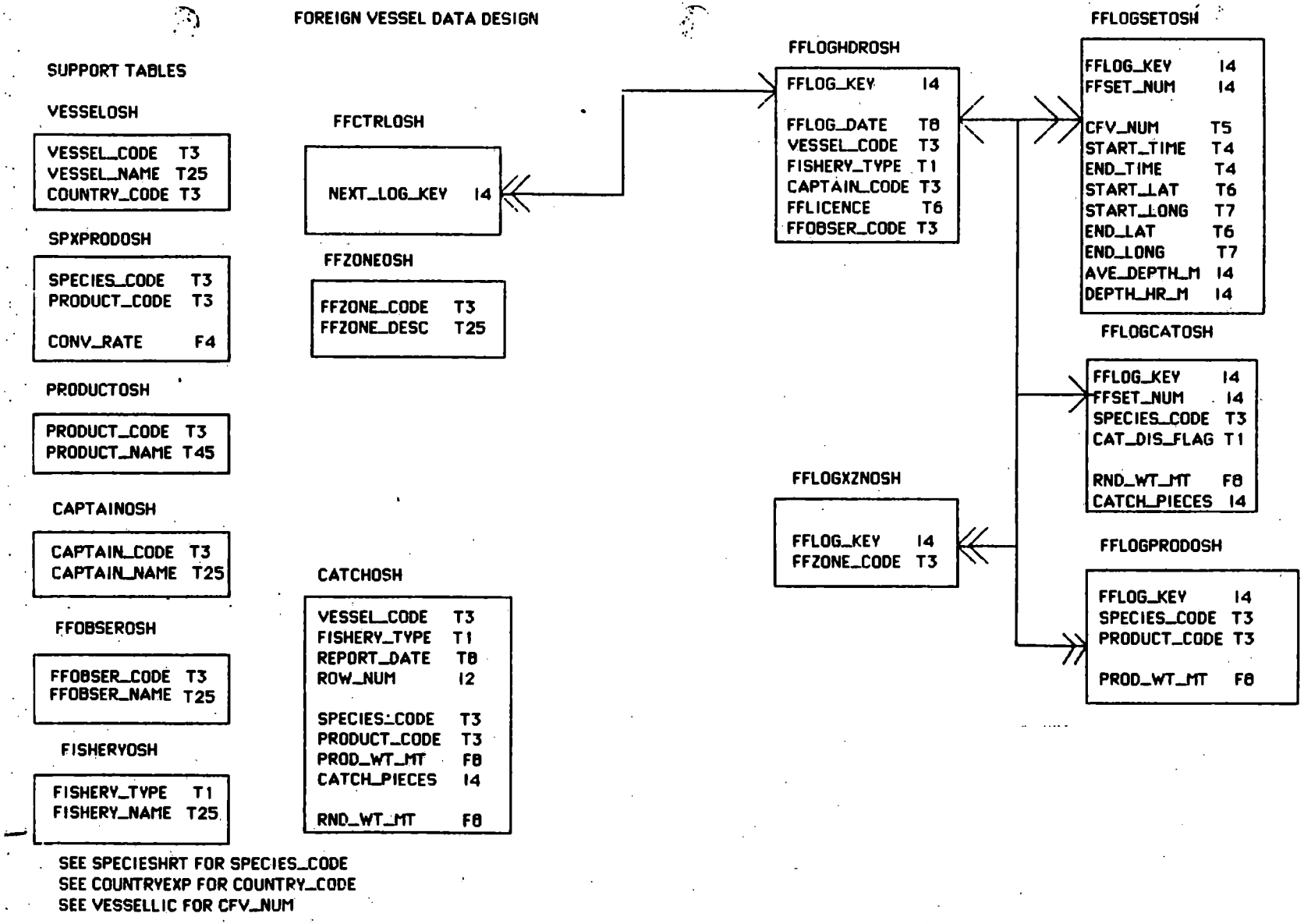


Figure 4.7.4 Logical Data Design - Foreign Observer Program

SHELLFISH

4.8 - Shellfish Fisheries

Overview

The shellfish fishery is highly fragmented, due to the diverse species that are caught and sold. The fishery exploits three major species groups namely crustaceans, echinoderms and molluscs.

The province is responsible for the management of cultured oysters on designated oyster leases. The province has assumed the responsibility of oyster stocks on crown land. The culture of other marine stocks such as clams, mussels, scallops, abalone, etc is under the authority of the federal government (per D Noakes).

The fishery is also segmented into commercial, recreational and native food harvesting of wild stocks. A wide range of gear is used in the different fisheries, from a bucket and rake to spears in diving. Fishing activity is normally along the coastal foreshore and shallow bays.

A range of target species such as geoducks, clams, abalone, shrimp, sea urchin, sea cucumber and crabs are commercially viable. Fishing commercially for these species is regulated and licenses are required. The total commercial shellfish fishery was valued at $34 million in 1988(Statistics Division). There are approximately 3,000 commercial licenses issued annually for these fisheries. For 1989, commercial licenses were issued in the following categories:-

Limited Entry Licenses (C, E, G and S licenses)				
Schedule II	500			
Abalone	26			
Geoduck or Horseclam	55			
Shrimp Trawl	249			
				830
Unlimited Licenses (Z licenses mostly)				
- with a vessel				
Octopus	212	clams	496	
Green Sea Urchin	121	Goose Barnacle	94	
Weathervane Scallop	6			
Red Sea Urchin	170	2,150		
Sea Cucumber	215			
Squid Species	53	-----		
Euphausiid	32	Total licenses all categories		
Shrimp	698	in 1989 = 2,980		
Pink or Spiny Scallop	39			
- without a vessel				
Mussel	14			

In the recreational fishery approximately 74,000 licences are issued annually (F Dickson), but there are no reporting requirements.

These fisheries are small compared to the salmon fishery in terms of value, and few resources are available to adequately monitor harvesting effort.

Fisheries Management

Management strategies used in the conservation and protection of these fisheries include size limits, weight limits or quotas, or area closures. Area closures are used in managing conservation related issues associated with shellfish contamination, product quality or market supply. Area closure is also used when quota allocations are filled or exceeded.

Monitoring the Fishery

The observation of fishing activity is summarized in Figure 4.8.1 below. The observation functions result in the collection of catch and effort information, which is used to manage the fishery. This flow of information is represented in the data flow diagram in Figure 4.8.2.

Some licenced fisheries require logbooks be kept by the fisherperson as a condition of licence. A Fishing Activity logbook is kept by fishery officers or ship's masters on patrols on a coast wide basis. The Fishing Activity log has a record of each vessel sighted with the vessel name, commercial fishing vessel (cfv) number, date and time, and statistical area of fishing activity. This information is compared on a post-season basis to the fisher (harvest) logs, validation slips and to sales slips where appropriate.

Sales slips are also required for commercial shellfish transactions, when sales are made to the plants, local restaurants, or private individuals. Not all transactions are, however, recorded and estimates on catch from this source are believed to be biassed.

In some areas, fishery officers conduct site checks on shellfish beds, where time is available.

Hails are conducted by the North Coast on certain fisheries, and regionally on a weekly basis, through phone interviews and plant checks.

In the North Coast, a record of management activities, similar to the RMS, has been maintained on paper for the last two years for shellfish. This contains information on phone calls made, local

fishing conditions, and changes in season openings and closures.

Quota Fisheries

In the case of abalone and geoduck, an individual licence quota limit is applied.

In-season management of the geoduck individual quota fishery is based on verified landings at plants. The verification or "validation" process is contracted out and paid for by the fishers. DFO receives a weekly hard-copy report of the validated catches compared to the quotas. See Figure 4.8.2

In-season management of the abalone individual quota fishery also relies on validation slips. Catches can only be landed at designated plants. The slips are prepared by the local fishery officer at the plant where the catch is landed. The officer signs off that the weight is correct, then forwards the slip to the Division offices where they are recorded and later compared with the individual's quota. The diving fishery harvest logs prepared by the fishers are also compared to the validation slips.

Data Model

The Shellfish data model is found in Figure 4.8.3, and indicates some similarities with the corporate data model. The nature of the fishery requires some unique data to be collected, mostly due to the nature of the fishing techniques and the small areas - mostly intertidal - where the fishery are located. Catches are in pieces or weight. Licensing and quota regulations affect the design of any shellfish catch and effort system.

Problems and Challenges

Hail estimating procedures are not fully documented in all cases, and are inconsistent. No region wide system is in place to record in-season catch and effort estimates for shellfish fisheries.

Access to current year sales slip data is required for in-season management.

On-line access to any hail and historical sales slip data is requested by management biologists and fisheries officers, but opinion is divided on this issue on the basis that such information is not directly associated with fishery management, but to stock assessment.

User Needs and Requirements

1. A region wide fishing LOG data collection and analysis system is needed for Z (abalone and geoduck) logs now, but flexible enough to allow its use for other species if quota management for these species is also established. See Exhibit 4.8.4 (sample of the Log Book) and Figure 4.8.4 (example of Z log table design in Ingres) below. This system should also be capable of importing the source validation slip information that is currently processed on contract. Verification against the sales slips processed in the Commercial Catch Saleslip System is important, and links with Licensing to obtain QUOTA information for comparison purposes is required.

2. A record of the Openings and Closures of the various fisheries, particularly the quotas fisheries. This would include a system similar to the herring and salmon information distribution mechanism (Oscar-Charlies) on a coast wide basis. A record of past management actions is also needed. Users indicated that a public information component would be desirable.

3. A HAIL data collection and reporting facility is required that is accessible by both field and regional staff.

4. A register of fishing plans for the coming year and a means of linking this data with HAIL, QUOTA and Opening/Closing and other management actions.

5. A common means of identifying the data which is used in all the shellfish databases at one level or another. These include species identification codes, quantity numbers like pieces, spatial resolution of statistical areas, shellfish beds, etc, fishing effort(CPUE), reporting periods, and gears used.

6. On-line access to biological databases at PBS in a user friendly way is requested by users in the field. (D. Noakes - "These data are used for assessment purposes and would be of little use to 'users in the field'".)

Recommendations

It is recommended that the shellfish management committee, in concert with the PSARC shellfish, agree upon the information requirements and user needs for an in-season management system, and submit the recommendations to the Fisheries Branch EDP committee and thence to the regional EDP committee.

Catch & Effort Data Model

Interviewees: Frances Dickson

Reviewed by: Frances Dickson, Rick Harbo, Don Noakes

Figure 4.8.1 Function Chart - Shellfish Fishery
Catch and Effort Monitoring Process

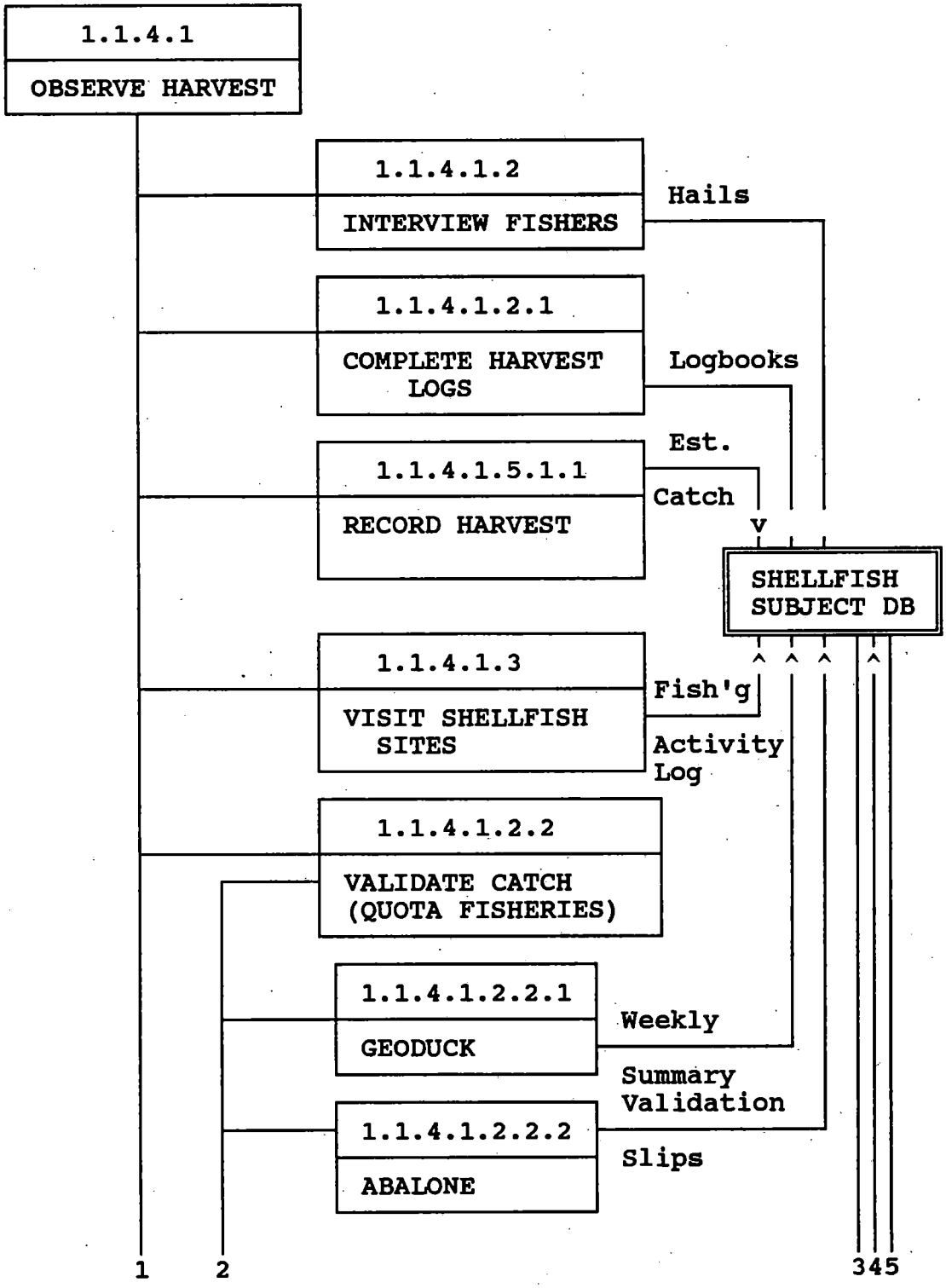


Figure 4.8.1 (cont'd)

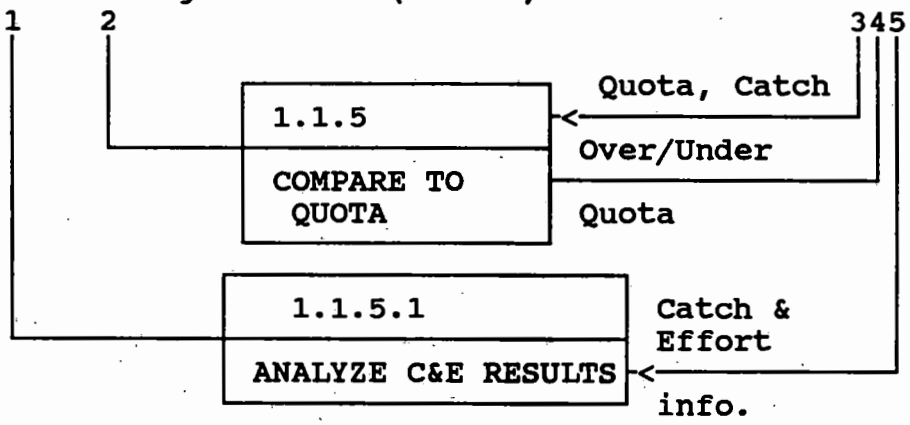


Table 4.8.1 SHELLFISH HARVEST OBSERVATION FUNCTION DESCRIPTIONS

1.1.4.1 OBSERVE HARVEST
FUNCTIONS CARRIED OUT TO MONITOR THE HARVEST OF VARIOUS SHELLFISH SPECIES.

1.1.4.1.2 INTERVIEW FISHERS/PLANTS
PHONE CALLS MADE WEEKLY BY FISHERY OFFICERS AND BIOLOGISTS TO PROCESSORS, PLANTS AND FISHERS TO OBTAIN ESTIMATES OF CATCH BY AREA AND SPECIES.

1.1.4.1.2.1 COMPLETE HARVEST LOGS
RECORD OF CATCH AND EFFORT MADE BY FISHERS AND DIVERS IN VOLUNTARY AND MANDATORY LOGS, WHICH ARE RETURNED TO DFO FOR ANALYSIS ON A POST-SEASON BASIS.

1.1.4.5.1 RECORD HARVEST
RECORD THE ESTIMATES OF CATCH AND EFFORT BY FISHERY, GEAR AND AREA ON A WEEKLY BASIS. (MANAGEMENT BIOLOGISTS)

1.1.4.1.3 SITE CHECKS
FISHERY OFFICERS CHECK HARVESTING ACTIVITY AT THE BEDS AND OTHER FISHING LOCATIONS. NOTE ACTIVITY IN THE FISHING ACTIVITY LOG BOOK, AND IN RMS.

1.1.4.1.2.2 VALIDATE CATCH
VARIOUS MEANS ARE USED TO CHECK ON THE VALIDITY OF THE OBSERVED CATCH.

1.1.4.1.2.2.1 VALIDATE GEODUCK CATCH
EXTERNAL CONTRACTOR PREPARES A VALIDATION SLIP FOR EACH LANDING FOR QUOTA FISHERIES, RECORDS CUMULATIVE CATCH AND ISSUES A WEEKLY REPORT TO LICENSEES (FISHERS) AND DFO COMPARING CATCH TO ANNUAL QUOTA BY FISHER/VESSEL.

1.1.4.1.2.2.2 VALIDATE ABALONE CATCH
NORTH COAST FISHERY OFFICERS CHECK THE ABALONE CATCH BY WEIGHT AT PLANT AND SEND SLIPS INTO THE DIVISION OFFICE FOR RECORDING.

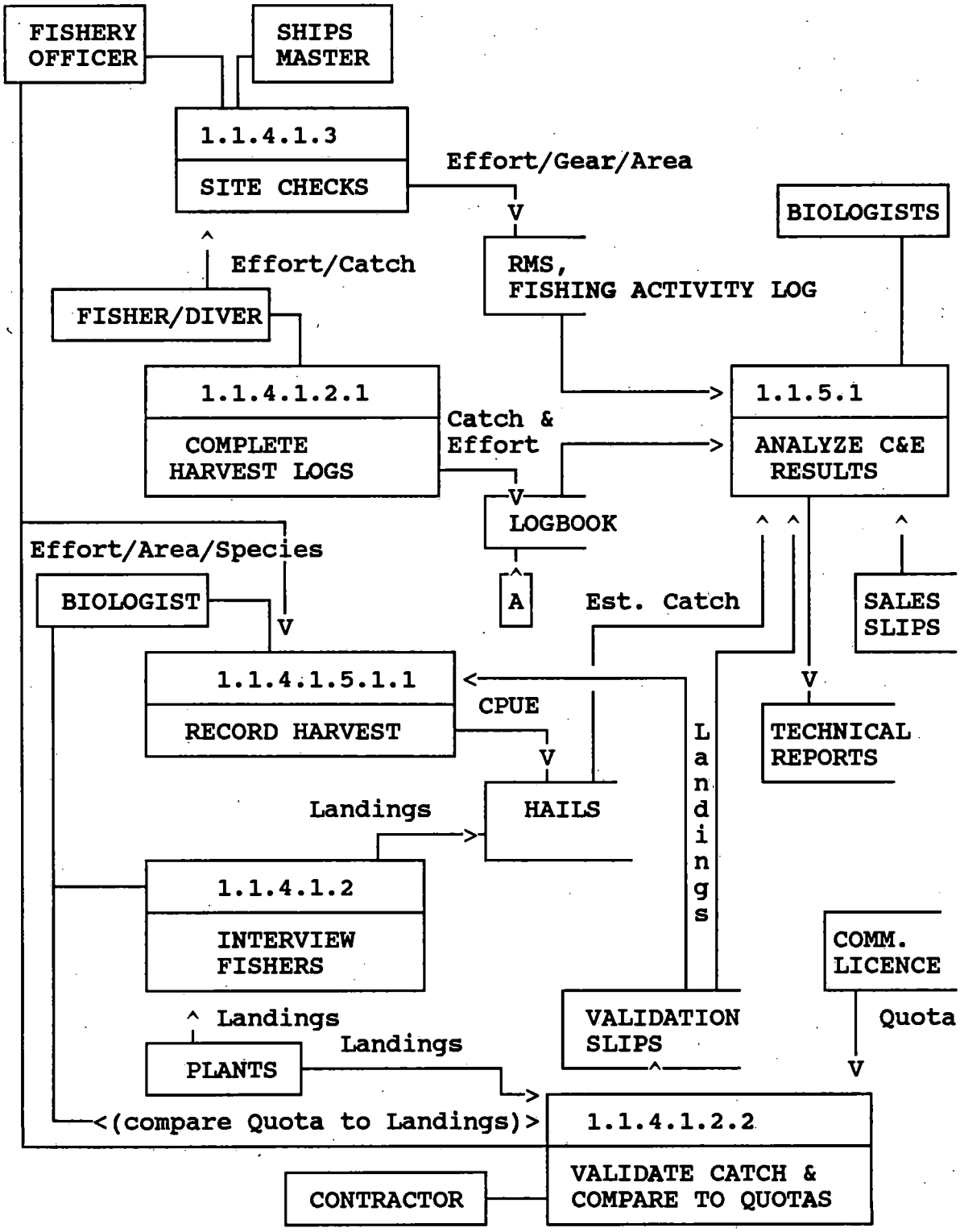
1.1.4.1.6 ANALYZE CATCH AND EFFORT RESULTS
BIOLOGISTS USE INFORMATION GATHERED FROM ABOVE FUNCTIONS AND CROSS-CHECK CATCH AND EFFORT DATA FROM THE DIFFERENT SOURCES ON A POST-SEASON BASIS.

1.1.5 COMPARE VALIDATED CATCHES TO QUOTA

MANAGEMENT BIOLOGISTS, NORTH AND SOUTH COAST DIVISIONS, CHECK THE VALIDATED CATCH DATA BY LICENSEE AGAINST THE INDIVIDUAL QUOTAS AND INFORM LICENSEE IF OVER QUOTA.

Catch & Effort Data Model

Figure 4.8.2 Data Flow Diagram - Shellfish Catch & Effort

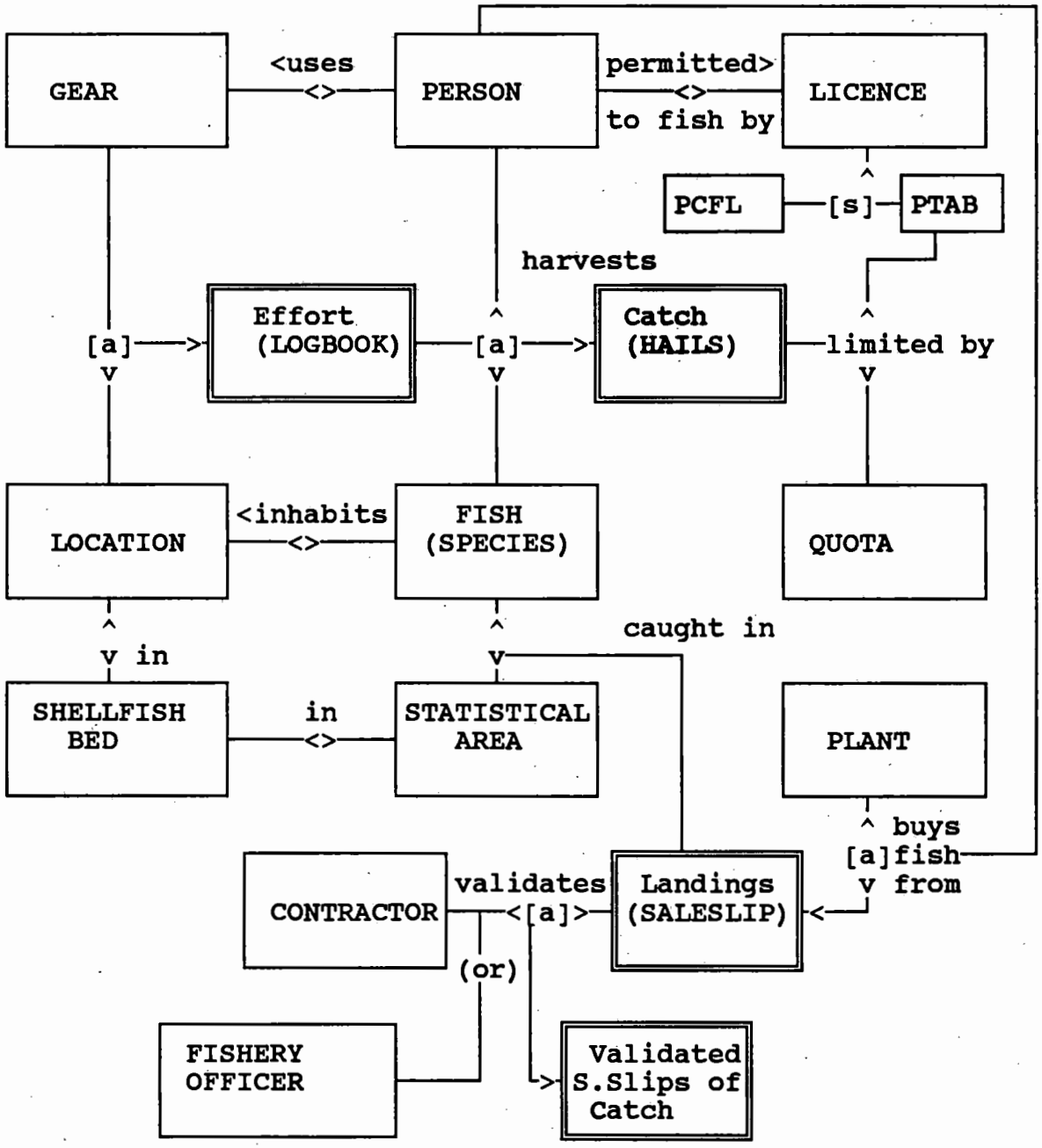


Catch & Effort Data Model

The Diving Fisheries Harvest Logs are recorded in a database at PBS.

Catch & Effort Data Model

Figure 4.8.3 Shellfish Data Model



Legend

Entity or object of interest to DFO

Source document or entity representing an event

Catch & Effort Data Model

<[s]>	Entity sub-type (e.g. fisher is either male or female)
<[a]>	Associative Entity (e.g. source document like forms, logbooks) shown as a double box entity

Notes:

Commercial Sales Slips and Validation Slips for the Abalone and Geoduck quota fisheries are redundant documents recording landed catch sold to a plant. This is required by the fishers and DFO to assure all parties that the landed catch is correct since it is the basis upon which a fisher's quota is set and their total annual catch is limited to the quota only.

Table 4.8.2 Entity Relationships Catch and Effort - Shellfish

	DOMINANT ENTITY	ENTITY RELATIONSHIP	MIN CARD.	MAX CARD.	SUBORDINATE ENTITY
1	PERSON	HARVESTS	0	M	FISH (CATCH)
1	GEAR	USED FOR HARVESTING IN	0	M	LOCATION (EFFORT)
1	EFFORT	HARVESTS	0	M	FISH
M	FISH	INHABITS	1	M	LOCATION
1	SHELLFISH BED	IN	1	1	LOCATION
1	SHELLFISH BED	IN	1	M	STATISTICAL AREA
M	CATCH	LIMITED BY	1	1	QUOTA [ABALONE]
M	FISH	CAUGHT IN	1	M	STATISTICAL AREA
1	FISHER	IS PERMITTED TO FISH BY	1	M	COMM. LICENCE
1	COMM. LICENCE	IS EITHER 2	1	1	PERSON TAB
1	COMM. LICENCE	IS EITHER 3	1	1	PERSONAL COMMERCIAL FISHING LICENCE (PCFL)
1	PERSON TAB	IS ISSUED TO	1	1	PERSON
1	PERSON TAB	IS LIMITED BY	1	1	QUOTA [ABALONE, GEODUCK]
1	PLANT	BUYS FISH FROM	1	M	PERSON(SALE-SLIP)
1	CONTRACTOR	VALIDATES	1	M	LANDINGS (VALIDATION SLIPS) [GEODUCK]
1	FISHERY OFFICER	VALIDATES	1	M	LANDINGS [ABALONE]

REGIONAL DIVING FISHERY LOG SYSTEM

The proposed log system would be built in Ingres to provide all users with a uniform access to critical catch and effort data. North coast biologists and statisticians can enter, update and report on the data using standard Ingres interfaces [Report-by-Forms(RBF) and Query-by-Forms(QBF)].

This system would directly benefit from regional integration in the following ways:-

a) it would be linked with Licensing on-line (the vessellic, personlic, tablic, and pcfllic tables) to verify licenses;

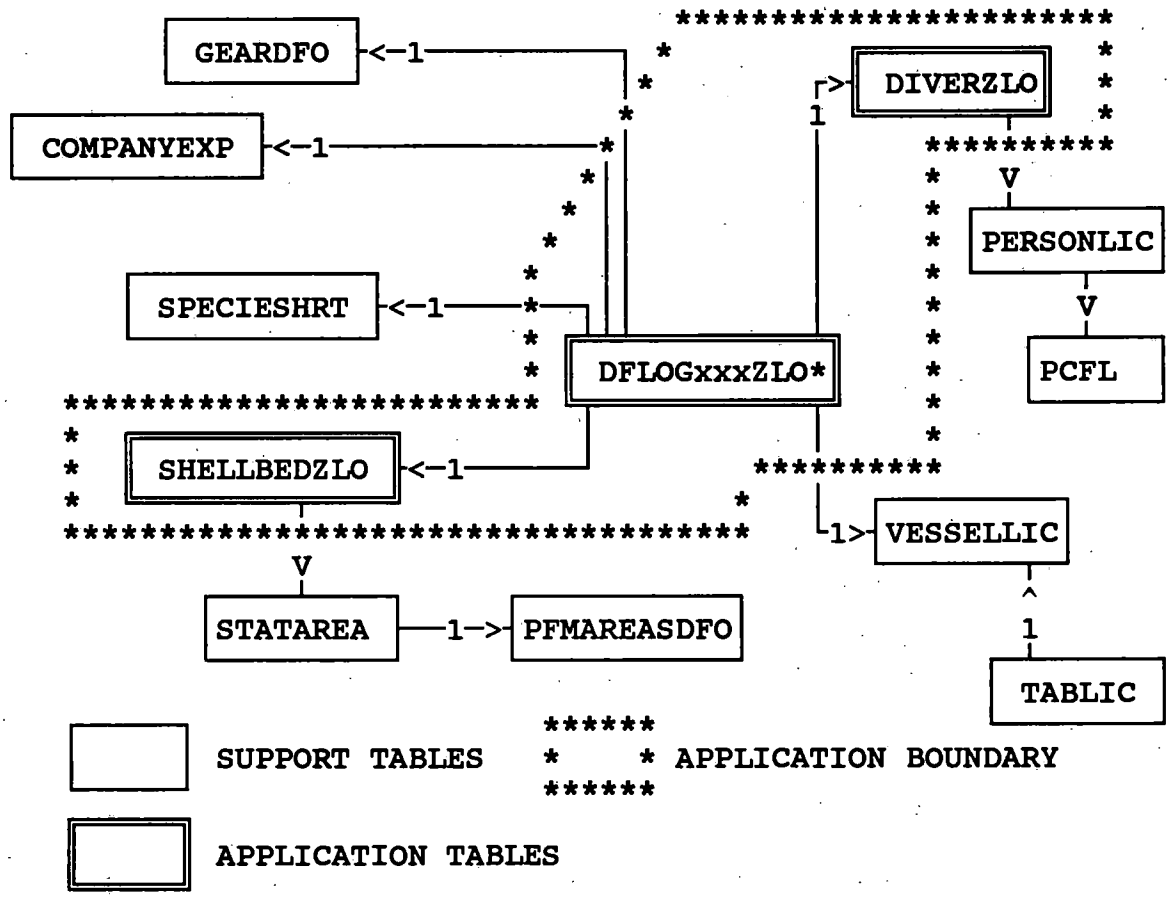
b) it would perform data verification on corporate codes such as buyers (companyexp in export), species (specieshrt), gear (geardfo), and statistical areas and sub-areas (statareas) eliminating the need for duplicate code tables;

c) the support tables for divers (diverzlo) could be compared to the person table in Licensing;

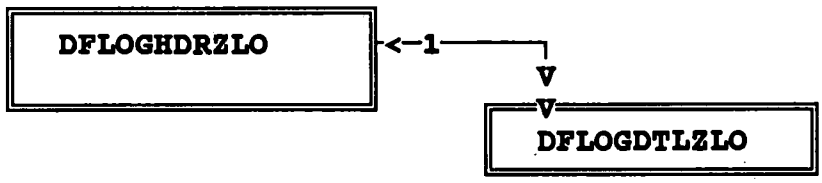
d) the shellfish bed codes 'owned' by this system would also be useful to other users involved in shellfish data collection and analysis;

e) it would provide the capability for cross-checks with sales slips on-line, since the sales slip data for the current and prior year are maintained in the Commercial Catch Saleslip system, which is located on the same computer.

Figure 4.8.4 ER Diagram - Shellfish Diving Fishery Logs



(* DIVING LOG HEADER AND DETAIL TABLES, SEE Figure 4.8.4 and Table 4.8.2 below)



All 2 log species by diver and geoduck fishery for the 1990 season → note a couple of minor changes from 88/89.

Vessel _____ Skipper _____

CFV [1][2][3][4][5] Year [1][9][6][7]

Are weights in kilograms [64] or pounds [64]

Are you using cages [64] pails [64] totes [64] other [64]

DIVING FISHERY

HARVEST LOG

Licence Tab # [60][61][62][63]

Average wt/cage, pail, tote, etc [56][57][58][59]

FOR OFFICE USE ONLY

Check species fished: only ONE SPECIES/SHEET [51][52][53]

Abalone ☐ Green Sea Urchin ☐ Sea Cucumber ☐

Geoduck ☐ Red Sea Urchin ☐ Octopus ☐

Horse Clam ☐ Pink and Spiny Scallop ☐

Other (specify) _____

Month	Day	Location (attach map)	Statistical Area	Sub Area	Bed Code	Diver Name	Diver Code	Depth (ft) Max	Depth (ft) Min	Diver Minutes	# cages, Pails, Totes	Total Number of Pieces	Total Landings (lb) or (kg)	Company Sold To	Company Code
10 11	12 13		14 15 16	17 18	19 20		23 24 25 26	27 28 29	30 31 32	33 34 35	36 37 38	39 40 41 42	43 44 45 46 47		48 49 50

Mail ABALONE logs to: Shellfish Biologists, DFO North Coast Division, 202-417 2nd. Ave. W., Prince Rupert, BC V8J 1G8

Mail ALL OTHER SPECIES logs to: Stock Assessment, DFO South Coast Division, 3225 Stephenson Pt. Road, Nanaimo, BC V9T 1K3

Exhibit 4.8.4 Diving Fishery Log (Sample form)

Table 4.8.2 Entity/Attribute Descriptions (Shellfish DIVING FISHERY LOGS)

ENTITY NAME	ATTRIBUTE NAME	DATA TYPE	ACCESS KEY	DESCRIPTION
DFLOGHDRZLO (diving fishery log header record)	LOG_TYPE	A1	K1	TYPE OF LOG BOOK
	LOG_YEAR	N2	K2	YEAR ISSUED
	LOG_NUM	N5	K3	UNIQUE TO YEAR/TYPE
	SPECIES_CODE	A3		HART CODE
	GEAR_CODE	A2	+	
	CONTAIN_TYPE	A1	(or container type e.g. cage, bag, pail, tote)	
	CATCH_AVG_WT	N4		FOR USE WITH CONTAIN_TYPE
	WEIGHT_TYPE	A1		LBS OR KG
DFLOGDTLZLO (diving fishery log detail record)	LOG_TYPE	A1	K1	KEY BACK TO HEADER
	LOG_YEAR	N2	K2	
	LOG_NUM	N5	K3	
	LOG_MON	N2		MONTH FISHING OCCURRED
	LOG_DAY	N2		DAY FISHING OCCURRED
	BED_CODE	N4		LOCATION OF ACTIVITY
	DIVER_CODE	N3		DIVER INVOLVED
	DIVING_MINS	N3		MINUTES UNDER-WATER
	GEAR_QTY	N3		AMOUNT OF GEAR USED
	DEPTH_MAX_FT	N3	DIVER MAXIMUM DEPTH IN FEET	
	DEPTH_MIN_FT	N3	DIVER MINIMUM DEPTH IN FEET	
	CONTAINER_QTY	N3		NUMBER OF CONTAINERS
	CATCH_PIECES	N4	PIECES CAUGHT	
	CATCH_WT_KG	N5	WEIGHT OF CATCH IN KILOGRAMS	
	COM_CODE	N3	COMPANY CODE *	
SHELLBEDZLO (shellfish bed codes)	BED_CODE	N4	K1	UNIQUE IDENTIFIER
	BED_NAME	A10	DESCRIPTION OF LOCATION	
	PFMAREA_CODE	N3	MANAGEMENT AREA CODE	

	PFMASUB_CODE	N3	MANAGEMENT SUB-AREA CODE

**

DIVERZLO	DIVER_CODE	N4	K1DIVER NUMBER - UNIQUE
(diver	DIVER_NAME	A20	NAME OF DIVER
codes)	PERSON_NUM	N5	UNIQUE IDENTIFIER IN

COMMERCIAL LICENSING SYSTEM ***

LEGEND:

ENTITY NAME	the candidate table name and description of the entity.
ATTRIBUTE NAME	the candidate column name
DATA TYPE	Ann = alpha-numeric data Nnn = numeric only data where nn = column or field width
ACCESS KEY	Knn = attribute [column(s) or field(s)] required to find a unique instance of a record
DESCRIPTION	description of the attribute

NOTES:

+	GEARS -	DFO STANDARD CODES RECOMMENDED REGION WIDE FOR ALL GEARS (geardfo)
*	COMPANY	USE OF THE COMPANY TABLE IN EXPORT OR CCSS RECOMMENDED
**	AREAS	PACIFIC FISHERIES MANAGEMENT AREA/SUB-AREA CODES AS DESCRIBED BY REGULATION NOW DFO STANDARD (pfmareadfo)
***	PERSON	LINK TO COMMERCIAL LICENSING SYSTEM USING THE PERMANENT NUMBER (person_num) ASSIGNED TO EACH INDIVIDUAL ISSUED A PCFL.

Appendices

Appendix A - Bibliography

[References in the report are noted as (Ref #1) etc]

Reference: 1
Author: Jon Schnute
Title: Report on data requirements for West Coast Fisheries
Type: Memo
Publisher: PBS
Year_publish: 1977
Abstract: Review of the state of catch, effort and bio-sampling data on computers in 1977, the availability of and access to this data, the characteristics of the fisheries at the time, and recommendations.

Reference: 2
Author: G S Gislason
Title: Recommendations for changes in the PR/F&MS data system with regard to the commercial fishery
Type: Report
Publisher: DFO/SEP
Year_publish: 1978
Abstract: The paper makes six recommendations to improve the quality of the data in the commercial catch data system.

Reference: 3
Author: STATAC Working Committee
Title: Some legal considerations for regulating collection of fisheries statistics
Type: Report
Publisher: STATISTICS AND ANALYSIS, ECONOMIC DEVELOPMENT DIRECTORATE, OTTAWA
Year_publish: 1982
Abstract: Analysis of the Fisheries Act's usefulness in ensuring compliance in reporting catch and other data from the fishing community. Reviews options using Statistics Act, Provincial legislation, etc.

Reference: 4
Author: Stocker, R. Harbo, B. Riddell, Schweigert, and A. Tyler (editors)
Title: Pacific Stock Assessment Review Committee (PSARC)

Annual Report for 1987 CMR/FAS No 1988
Type: Canadian Manuscript Report of Fisheries and Aquatic Sciences (CMR/FAS)
Publisher: DFO
Year_publish: June 1988
Abstract: Report on Proceedings of PSARC and sub-committees in 1987

Reference: 5
Author: Susan Grohn
Title: Fisheries and Oceans Thesaurus
Type: Report
Publisher: Fisheries and Oceans, Ottawa
Year_publish: 1978
Abstract: Dictionary of Department Technical Words and Phrases and structured catalog of key corporate entities (gears, areas, fisheries, species, effort)

Reference: 6
Author: Neilsen, L A and D L Johnson (editors)
Title: Fisheries Techniques
Type: Book ISBN 0-913235-00-8
Publisher: The American Fisheries Society
Year_publish: 1983
Abstract: Sport Fishery sampling techniques Ch 21

Reference: 7
Author: DMR & Associates
Title: Business Systems and Information Architecture
Type: Report
Publisher: DFO
Year_publish: 1985
Abstract: Data and Functional architecture for DFO - Pacific

Reference: 8
Author: Lamb, A and P Edgell
Title: Coastal Fishes of the Pacific Northwest
Type: Book
Publisher: Harbour Publishing
Year_publish: 1986
Abstract: Description of coastal fishes inhabiting the Pacific Northwest.

Reference: 9

Catch & Effort Data Model

Author: Haist V, J F Scweingert, D Fournier
Title: Stock Assessments for BC Herring in 1987 and Forecasts of the Potential Catch in 1988 CTR/FAS No 1990
Type: Canadian Technical Report, Fisheries and Aquatic Sciences (CTR/FAS)
Publisher: DFO
Year_publish: 1988
Abstract: Herring Stock abundance in BC waters was assessed for 1987 and forecasts were made for 1988 using two analytical methods (1) the escapement model, and (2) the age structure model.

Reference: 10
Author: Leaman J E, J M Hamer
Title: User's Guide to the Groundfish Catch Statistics Data System of the Fisheries Research Branch, Pacific Region CTR/FAS No 1395
Type: Canadian Technical Report, Fisheries and Aquatic Sciences (CTR/FAS)
Publisher: Fisheries and Oceans
Year_publish: 1985
Abstract: Data system contains information on species catch, effort, fishing area, depth, and gear by vessel landing.

Reference: 11
Author: Rutherford K L
Title: Catch and Effort Statistics of the Canadian Groundfish Fishery on the Pacific Coast in 1987, CTR/FAS # 1656
Type: Canadian Technical Report, Fisheries and Aquatic Sciences (CTR/FAS)
Publisher: DFO
Year_publish: 1988
Abstract: Catch and Effort Statistics for the Canadian Fishery (excluding Halibut) on the Pacific Coast in 1987.

Reference: 12
Author: Lia Bijsterveld
Title: Recreational Statistics Database
Type: Report
Publisher: FSB
Year_publish: 1985
Abstract: Summary of the status of various recreational statistics databases

Reference: 13
Author: K W Brickley
Title: Recreational Data Systems Study of BC Tidal Sport Fishery
Type: Report
Publisher: DFO Ottawa
Year_publish: 1979
Abstract: Recommendations with respect to Survey Procedures in the Tidal Diary program

Reference: 14
Author: Lia Bijsterveld
Title: Native Food Fishery Database
Type: Report
Publisher: Statistics
Year_publish: 1985
Abstract: Summary of the status of various native food fishery statistics databases

Reference: 15
Author: Paul Kopas
Title: On the origin of error by means of faulty sales slips, and the application of computer systems in fisheries management
Type: Report
Publisher: Statistics Division
Year_publish: 1983
Abstract: Recommends a vessel embossed card, remote sale slip data entry from plants, and close linkages to Commercial Licensing for quota management

Reference: 16
Author: W E Ricker
Title: Computation and Interpretation of Biological Statistics of Fish Populations No 191
Type: Bulletin
Publisher: Fisheries Research Board of Canada, Environment Canada, Fisheries and Marine Service, Ottawa
Year_publish: 1975
Abstract: The book deals with the general field of biological statistics of fish populations. (Note: this bulletin contains definitions of terms for catch and effort used throughout this report. see page 2,3)

Catch & Effort Data Model

Reference: 17
Author: Dodson, E, and P Dodson
Title: Evolution, Process and Product
Type: Book
Publisher: Wadsworth Publishing Coy
Year_publish: 1985
Abstract: A summary of evolutionary processes and species categorization.

Reference: 18
Author: DFO, ITS Directorate
Title: Systems Development and Support Methodology
Type: Manual
Publisher: DFO, Ottawa
Year_publish: 1986
Abstract: National standard for systems analysis and documentation

Reference: 19
Author: Chen, P P
Title: The Entity-Relationship MOdel - Toward a Unified View of Data
Type: Article pp 9-36
Publisher: ACM Transaction on Database Systems, Vol 1
Year_publish: March 1976
Abstract: First proposal of a relational paradigm for data analysis and design

Reference: 20
Author: Nijssen, G M
Title: An architecture for knowledge base software
Type: paper
Publisher: Nijssen, G M to the Australian Computer Processing Society
Year_publish: July 1981
Abstract: Proposal of the fundamental binary relationship between all objects are definable only at the attribute level.

Reference: 21
Author: Martin, James
Title: An End User's Guide to Data Base
Type: Book (ISBN 0-13-277129-2)
Publisher: Prentice-Hall
Year_publish: 1981
Abstract: Simple illustrated description of the data base concepts, schemas and sub-schemas

Reference: 22

Catch & Effort Data Model

Author: several
Title: Database Management
Type: Manuals
Publisher: Auerbach Publishers
Year_publish: 1979-86
Abstract:

Auerbach Information Management Series, Database Management
Article # 23-02-01 "Systems Development in a data base environment"
Article # 23-01-08 "Gathering and recording information for data base design"

Article # 23-01-04 "Principles of data structure design"

Auerbach Information Management Series, Systems Development Management
Article # 35-05-03 "Software Design Using SADT(TM)" (the technique described is based upon SSA).

Reference: 23
Author: see below
Title: Information Systems Management Vol 6 No 4 Fall 1989
Type: Periodical
Publisher: Auerbach Publishers
Year_publish: 1989
Abstract: #1 : Enterprisewide Information Economics: Latest Concepts
#2 : Determining Economic Feasibility: Four Cost/Benefit Analysis Methods

Reference: 24
Author: Hon. Tom Siddon
Title: An Address by the Hon Tom SIddon to the Mining Association of BC in Vancouver
Type: Speech
Publisher: D F O
Year_publish: February 24, 1989
Abstract: The speech espouses the concept of sustainable development as a balancing of priorities between environmental protection and economic growth in Canadian fisheries.

Catch & Effort Data Model

Reference: 25
Author: Peter H Pearse
Title: Turning the Tide, a new policy for Canada's Pacific Fisheries
Type: Royal Commission Report
Publisher: Gov't of Canada
Year_publish: Sept. 1982
Abstract: The report analyzes the problems of the Pacific Fishery in the 1970's, and proposes a series of measures to correct the problems identified.

(references # 1 and #2 and #12 through #15 may be obtained from the Chief of the Statistics Division,DFO)

Appendix B - Glossary of Terms

Abalone	a species of mollusc
Adabas	a database management system
Angler	a sport fisherman
Attribute	a unit of information describing a characteristic of an entity
Biologist	a person concerned with the study of human and animal processes
Buyer	a company or a person who purchases fish
Catch	a unit of fish harvested by a resource user
Chinook	a species of fish of the salmonid family
Chum	a species of fish of the salmonid family
Clam	a species of shellfish
Coho	a species of fish of the salmonid family
Coordinator	a person performing a communication function to ensure the success of a function
Crab	a species of shellfish
Crustacean	a name for all species with a carapace
Cutthroat trout	a species of fish related to salmonids
Database	a collection of related tables (files)
Database management	system a set of software (programs) which control the creation and maintenance of and access to one or more related tables (files)
Demersal	a group of bottom feeding species
Dolly Varden	a species of trout
Echinoderm	a family of invertebrates
Effort	the quantity of equipment and resources used to harvest fish
Entity	a unique object of interest to the organization
File	a set of records reflecting an entity occurrence
Fisher	a person who fishes
Fishery Officer	a member of the Dept of Fisheries and Oceans whose mandate is to enforce regulations to protect and enhance the resource.
Flatfish	a group of species with the distinctive characteristic of swimming sideways with both eyes on the 'top' of the head instead of either side.
Gear	an equipment designed to catch fish
Geoduck	a species of clam
Groundfish	a group of related species who live primarily at or near the sea bottom
Hail	a unit of information about the condition of the catch made by a fisher
Hake	a species of demersal groundfish
Herring	a species of fish

In-season	the period of time during which fishing activity is highest
Ingres	a relational database management system
Landing	a catch or catches off-loaded from a vessel at a prescribed landing site
Licence	a permit to harvest fish, there are three types issued by DFO - Commercial licence, a Personal Commercial Fishing Licence, and a Tidal Waters Sport Fishing Licence.
Lingcod	a species of groundfish
Logbook	a record of the harvesting performed by a fisher
Mollusc	a family name for clams, barnacles, etc
Observer	a person assigned by DFO to oversee the fishing activity of a foreign vessel
Oyster	a species of mollusc
Pacific Cod	a species of groundfish
Pelagic	a characteristic of certain fish that inhabit and migrate through the ocean at a maximum depth below sea level of 100 fathoms.
Pink	a species of salmon
Plant	a factory dedicated to packing and processing fish for resale
Pollock	a species of groundfish
Record of Management Strategies	a written summary of the fishing conditions, management actions, and harvesting activity during a season
Rockfish	a group of species of groundfish
Sales slip	a document recording the sale of fish to a plant, packer, restaurant or cold storage company.
Sablefish	a species of groundfish
Salmon	a group of fish of the salmonid family
Salmonid	see above
Scallop	a species of shellfish
Sea cucumber	a species of tubular worms (echinoderm)
Sea urchin	a species of invertebrates (echinoderm)
Shellfish	a group of related species
Shrimp	a species of shellfish
Sockeye	a salmon species
Steelhead	a sea run trout
Stock	a unit of fish population within a habitat
Table	a set of rows (tuples) representing entity occurrences in a relational database
Vessel	a boat

Appendix C - Distribution

Distribution	Addressed to	Received Comments
All Sections		
M Romaine	*	v
J Bjerring		
B Moore		v
S Somji		
M L Jung		
T Calvin		v
Salmon - Commercial		
D Schutz	*	v
M Birch		v
V Palermo		
L Bijsterveld		v
L Lapi		
L Hopwo		v
K Petrie		v
Salmon - Sport		
R Wowchuk	*	v
L Bijsterveld		v
L Lapi		
Salmon - IFF		
W Duncan	*	
L Bijsterveld		v
L Lapi		
Herring		
L Webb	*	v
V Haist		
Groundfish		
E Zyblut	*	
G Beuchler		
D Adams		v
B Ackerman		
R Stanley		v
M Saunders		v
Shellfish		
F Dickson	*	v
S Farlinger		v
R Harbo		v
D Noakes		v

Catch & Effort Data Model

Note:
In addition this report was reviewed by the PSARC Data Committee November 9th 1989. Their general and specific comments are, for the most part, incorporated into this document.

Appendix D - Index

Notes