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SOME EXPERIENCE WITH AN EXPERIMENTAL FISHERIES-ORIENTATED DATABASE

by

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SUMMARY

A fisheries-orientated database using the PASCAL/R programming language/database management system was recently used at the BIOMASS data workshop in Hamburg. PASCAL/R implements a "relational data model" and a description is given of some of the important steps in designing the Fisheries Database. A detailed description is given of the vessel description, vessel equipment description and acoustic survey data parts of the Fisheries Database, together with a general description of the trips, hauls, oceanography and bird data parts. Two ways of interactively addressing the database are described. Experience with the Fisheries Database at the BIOMASS data workshop showed that no major design flaws existed, that the system is easy to use, and can be used to represent other types of fisheries-related data. High-level systems such as PASCAL/R have an information retrieval function, rather than a data retrieval function, and they have reached a level of development which enables them to be used at workshops to provide interactive co-operative interpretation of data brought to the workshop by participants.

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INTRODUCTION

The development of the "Fisheries Database" at the University of Hamburg started with an attempt to represent in a database the various types of data from many different disciplines which would be collected by a proposed Antarctic marine research programme, particularly those types which are not available, or not exchanged, through existing data exchange systems. When substantial progress had been made, the "Fisheries Database" was demonstrated to participants in the Antarctic research programme "BIOMASS" [1] at the BIOMASS Data Workshop in Hamburg during May 1980 [2]. This paper describes the experience gained in using an interactive system to address a fisheries-orientated database to extract information according to specific queries established before and during the workshop.

The data for the workshop were provided by the participants (and the World Data Centre A) in a wide variety of physical and logical formats, but they were easily converted into the format required by the database management system. At the end of the workshop it would have been possible to have transmitted the contents of the database to a data centre in any format desired.

No attention was given to the problems of manipulating very large amounts of data: the interest is in interactive information retrieval (as opposed to data retrieval) at workshops.

The PASCAL/R SYSTEM

During the last twenty years, there has been a steady evolution in methods of data management. Broadly speaking, during the 1960s the problems in data management were restricted to considerations of data storage due to the expense and limited choice of the available software and hardware. During the 1970s, as hardware problems and costs lessened, a generalised solution to the problems of data storage and retrieval arose with the development of database management systems. In the 1980s, when data can be stored and retrieved efficiently, effort centres on even higher level "data handling", which can be termed information handling.

The development of database management systems occurred because many computer users were unsatisfied with the data storage and retrieval facilities offered by conventional filing systems. During this development phase, certain aspects became very important :

- users of a database management system should not be concerned with how and where their data are physically stored in the database,
- ideally, users want to retrieve data by specifying the properties of the data itself, not _via_ its physical address (for example, one wants to retrieve data about a certain vessel by giving its name, home port, owner or registration number and not by specifying "the data on file XYZ, block i and byte j"),
- a database management system should permit the data to be described in a way that reflects the "reality" of the data more closely. For example, a percentage may only have values from 0..100, so protecting the database from certain kinds of incorrect data entry,
- a database management system should allow users to gain access to the same data concurrently, without interference,
- a database management system should allow for changes in the

physical and logical structure of the data because the part of "reality" modelled by the database might change (for example, new kinds of equipment may be developed which have a bearing on fishing power; certain new licencing regulations may be promulgated; certain types of data may no longer be collected).

The PASCAL/R programming language/database management system was designed and developed at the University of Hamburg with these goals, and some others, in mind [3,4,5].

The PASCAL/R system is based upon the programming language PASCAL [10] which, at the time of the development of PASCAL/R, was the most advanced, well-structured yet simple, programming language available. The system has been operational for two years and is implemented at six sites in Europe and North America but, since it is primarily a research topic still undergoing development, it cannot be considered as generally available. The PASCAL/R system implements the so-called "relational data model" [6].

In the relational model, a relational database consists of a set of named relations. A relation is a set of elements, where each element has the same format, and can be visualised as a table consisting of rows and columns. Each row corresponds to one element and the columns determine the "format". Each column has a name and a set of permitted values associated with it. The number of elements in a relation (rows in the table) can vary when new elements are added to relations in the database or when elements are deleted. As an example, consider the relation "hauls" in the Fisheries Database. The elements of this relation consist of ten fields (a table with ten columns). The fields have the following names : vessel name, skippers name, date of haul, time begin, latitude start, longitude start, number of vessels operating co-operatively, nominal weight of catch, equipment class and comment. Each field has a set of values associated with it (time may only be between 00:00:00 and 24:00:00). If data from a new haul is to be added to the database, a new element is added to the relation "hauls".

The database management system maintains an additional property of the relation, namely, a so-called "key". The key distinguishes one or more fields, and makes sure that there are no two elements in a relation with the same values for those fields. In other words, the key constraint guarantees that every relation element can be identified uniquely by its key value.In the case of the "hauls" relation, the fields "vessel name", "date of haul" and "time begin" constitute a key, meaning that the name of the vessel, the date of the haul and the time the haul began uniquely identifies each haul.

The main difference between the relational model and most of the other data models implemented in database management systems is that no details of the physical or storage structure are seen by the user. As one consequence, the language used to retrieve and store data is fairly simple, because it uses only very few concepts, and it is unaffected by storage structure changes. In addition, it permits retrieval and alteration of data as sets, not only element by element.

The reasons for choosing this system as the basis for the prototype development of the Fisheries Database can be summarised as follows. For the fisheries side, PASCAL/R provides very advanced database technology, database methodology and database concepts in areas such as data description, data storage and data retrieval. For the designers and implementors of the PASCAL/R system, the Fisheries Database represents one of the first large scale applications of the system and thereby provides an opportunity to test and validate the concepts which have been developed.

GENERAL VIEW OF THE "FISHERIES DATABASE"

The general objective was to develop a database schema which accurately reflected the complexity of the fisheries research and commercial fisheries environments, whilst, at the same time, facilitating the retrieval of information. A database schema is the description of the data to be stored in the database. The schema also contains rules governing the data, and these rules are directed to the database management system for eventual enforcement.

In designing a schema for a relational database, the most important decisions concern the choice of data to be grouped together in a relation. In other words, the choice of the columns for each table. This decision is made difficult by the presence of identifying and dependent data items. The present theory of database design has certain guidelines, but no strict rules, for dealing with the logical properties of the data and these influence the way certain data may be distributed over a number of relations. One of the design goals is to preserve the logical properties of the data under "insert" and "delete" operations, through the optimum choice of columns, whilst at the same time trying to keep the number of relations small in order to assist in easy formulation of queries.

and research.

Whilst a unique description of a vessel is required, flexibility is necessary within the data structure. In practice, conflicts can emerge between different measuring systems. Should vessel "length" be length overall, between perpendiculars, along the waterline, or some other measurement ? Should hold capacity be measured in mass or volume units ? Can units all be metric, or must allowance be made for others ? These problems are avoided by describing an entity "vessel" with a fixed list of properties which all vessels hold in common, and associating with it an entity "vessel details" possessing the flexibility to describe the remaining characteristics of the vessel in any way (Table 1).

1. The "vessel" relation.

This consists of a unique, but not complete, description of the vessel. Name, port-of-registry and owner details are supplemented by vessel classification, length, beam and mean depth to provide a basic description. The vessel classification is based upon FAO vessel descriptions [9].

2. The "vessel-details" relation.

The flexibility necessary to represent any other item of the vessel description is provided by an additional relation, consisting of a detail name, detail value and detail unit, as well as vessel name (see Table 1).

3. The "licences" relation.

This relation possesses similar flexibility and can carry all the information on a vessels licence. Licence details, detail value and detail unit are stored with the licence number and vessel name. For example, licence detail - NUMBER OF TRAPS; detail value - 120; detail unit - UNITS.

B. Equipment data

Information on equipment carried aboard a vessel is required for registration and licencing by administrators, who need to know, for example, the power of the engine (kW or SHP ?), the type of fishing gear used and any limitation imposed on that gear (escape trap size, mesh size, number of fishing units). The scientific interest in effort analysis requires a thorough description of the range of fishing equipment aboard a vessel (Table 2), and research into gear performance requires a data structure which enables the smallest detail to be adequately recorded (Table 3).

This is accomplished with a very flexible structure, where the description of equipment is divided between three relations - the equipment class, equipment description and equipment units. This sub-division is necessary to preserve the logical properties of these data.

1. The "equipments" relation.

A simple relation holding only the vessel name, a list of its equipment classes and corresponding equipment names, for example, class - ACOUSTIC; equipment name - ZB 50/4 (the unique name of an echosounder). The names of the equipment classes agree with the FAO gear categories for commercial gear [9], and also include most scientific gear.

2. The "descriptions" relation.

The description of the equipment is stored in an additional, flexible, relation. The vessel name, equipment name, the property of the equipment and the value of the property are held. For example, equipment name - ZB 50/4; equipment property - FREQUENCY; property value - 50.

3. The "units" relation.

This relation links the "equipments" and "descriptions" relations. It consists of the equipment class, and for each appropriate equipment name with equipment properties and values which possess units, the property name and the unit. For example, class - ACOUSTIC; property - FREQUENCY; unit - KHZ; that is, all acoustic frequencies have kilohertz units.

C. Trips data

Most activities of interest take place during the vessels trip : it may be a scientific trip where oceanographic stations are occupied, an echo-survey accomplished or bird sightings made. It may be a commercial trip aboard a factory vessel where hauls are made, products are prepared and transhipments made at sea. Alternatively, it may be a short trip where the catch is landed and its species composition determined at the jetty. It could as easily be a mixed commercial and scientific cruise, such as are becoming common in distant waters.

The trips relations make provision for the FAO effort measure descriptors A, B, C, D and E [9], and for the contents of a number of typical log-books. It is possible to distinguish the nationality of a nominal catch when catch is "owned" by one nation, landed in a second country, by a vessel registered in a third country, whilst the vessels usual home port is elsewhere. The landings part is based upon a number of typical landing forms.

D. Hauls data

A haul is a fishing activity occurring with any form of shipborne fishing gear described in ICES and FAO publications (e.g. [9]). In addition, provision is made for non-commercial net hauls with any net. This flexibility is achieved in a similar way to "vessels", that is, the basic description of a haul is supplemented by a flexible "details" entity to cope with the wide variety of details collected with haul data (e.g. towing speed, weather, acoustic information, sea state), and a "depth" entity to allow for nets which fish at multiple depths with or without opening/closing mechanisms.

Although most scientific and commercial log books differ in lay-out, they are very similar in content, which made the task of generalising the hauls data relatively easy.

E. Biological data

This data area is a conventional representation of the sampling procedures occurring in most fisheries (Figure 3). It is assumed that a haul is sampled, that the species composition of the sample is determined, and that a biological sample would be taken. Provision is made for bio-histograms (length frequency distribution by species, sex, and a chosen biological parameter, eg. maturity stage), bio-samples (stratified sampling for any combination of biological parameters) and for age/length keys.

Within the biological data "area", two entities exist which provide an indirect relationship to other "areas". They are the "hauls-sampled" relation linking the sample to the haul, and the "targets-sampled" relation which relates biological samples to the results of acoustic surveys.

F. Echo data

Three general types of data are produced during an acoustics survey : the raw acoustics data, consisting of the original echograms, integrams and recorded echosignals; net sample data, consisting of haul and biological data; and processed acoustics data, consisting of descriptions of acoustics targets or data summaries relating to their abundance. These data must be represented in the database, but there is one substantial problem which is fundamental to the design : the amount of raw data is very large and consists of digital or analogue data stored in computer-readable form, analogue data on graphs and pictorial data (echograms).

It has been estimated that a single survey of the Antarctic krill population would produce about 68 million digital samples [7]. Although possible, it is impracticable to store these data in a database for interactive access. Considering the likely costs of storing such data, and the fact that the benefit would be felt only by those few users interested in manipulating digital data, it seems preferable to store these data outside the database on some low-cost medium such as magnetic tape, but nevertheless to retain inside the database an index to the entire set of digital data available. It is not possible to store analogue data directly, so a similar indexing system must be used, in this case, to analogue and pictorial data stored on microfilm.

The majority of users of acoustic survey data require information on the abundance of an organism or upon its distribution and behaviour. Consequently, the first major design decision was to leave the raw data outside the database, retaining contact with it through an index, so continuing with the development of the system suggested for digital data in 1979 [7].

The echo data "area" makes provision for survey data from schooling pelagic organisms. No design was produced for data derived from sideways-looking sonar, although in principle there is no semantic difference between down- or sidewards-looking acoustic data. No provision is made for single fish counting methods.

The design provides a unique description of an echo-integrator interval and the density parameter values measured in each depth channel within that interval. Whether the data come from a digital data logger or from an echogram, it provides a unique description of each aggregation encountered as well as its density and biomass parameters if quantitative data are available. Also, it permits the assignment of biological parameters to that aggregation *via* the intermediate entity "targets sampled", which links the aggregation to samples taken from a specific haul.

The echo integrator interval cannot be linked in this way, because the aggregations encompassed by any one interval may be attributed to a number of different haul samples. In this case, assigning species compositions and length/weight frequencies to geographical areas containing one or more integrator intervals must be done with a simple query.

1. The "cruises" relation.

A cruise is defined as occurring within a geographical area with North, South, East and West boundaries, between specified dates, and by a named vessel. In addition, the cruise has a name, and the investigation has a target species. Provision is made for a comment.

2. The "rawdata" relation.

This is an index to raw data held outside the database. Each raw data occurrence is identified by vessel and date, and its duration by time and position. The indices to the original sources are given together with a comment on the raw data.

3. The "abundance" relation

The echo-integrator interval is identified by vessel and date, and its duration by time, position and elapsed log values. In the event that more than one integrator is being used, an equipment name is recorded (which cross-references to the description of the vessels equipment). A comment can be made on each interval.

4. The "depth-abundance" relation.

Each unique echo-integrator INTERVAL possesses a number of depth channels "beneath" it. This relation describes them, no matter how many may exist for each interval. Each channel is identified by its interval and the equipment name, and then by a depth range. Within each depth channel are recorded the density and biomass parameters from each species observed. There is neither a limit to the number of species nor to the type and number of the density and biomass parameters.

5. The "aggregation" relation.

Each aggregation is identified by the vessel which observed it, the date and its position along the vessel track as fixed by time (begin and end) and position (begin and end). Because more than one sounder could be in use, the equipment name is recorded. The aggregation is classified (swarm, layer etc.) and, on the basis of sampling or "experience", identification will be made. Measurements of the depth, thickness, and horizontal dimensions are recorded. Horizontal dimension is measured because the precision obtained is better than that obtained by calculation from navigation and speed .

6. The "density" relation

If the data are available, density and biomass parameters of the aggregation can be stored. The values are associated with an aggregation on the basis of vessel, data, depth, equipment name and the time the aggregation began to be recorded. There is no limit to the number of equipments, or density and biomass parameters.

7. The "targets-sampled" relation.

This simply links an aggregation to a biological sample, through associating a unique description of the aggregation (vessel, date, depth, and time the aggregation began to record) with a unique sample number.

G. Oceanographic data

This section of the database was established to store data from the "Discovery" Investigations obtained from the World Data Centre A. The three entities describe the station position uniquely, provide the (now familiar) flexible details structure, and the structure for the station data. An intermediate entity (station-hauls) links the station with its biological net haul data, which is stored in the "hauls" area of the database.

H. Bird data

This design was based upon the International Antarctic Seabird Survey 10-minute card for recording observations made at sea. The seven relations describing the bird observations are directly linked to the rest of the database *via* the "trips" relation. Provision is made for the unique identification of the card, flexible recording of any details (present weather, ice cover etc), the count of the birds observed, the activity of those counted, general behaviour of birds observed but not counted, any associations observed between birds and other phenomena (animals, pollution etc) and the activity of the ship during the 10 minute observation period.

INTERACTIVE QUERY SYSTEM

The PASCAL/R system provides two user interfaces for a database. One can be termed the "programming language interface". A programmer can write application programmes which address and manipulate the database by using the PASCAL/R programming language, which treats a database and its relations as ordinary variables. The programme QUERIE was written in PASCAL/R to allow persons without computer training to execute a limited number of queries [2]. The parameters of each query are fixed, but nevertheless, considerable flexibility exists, as the range of any parameter in a query can be selected interactively by the user. For example, a query may request the station positions and average depth of krill aggregations (choice of swarm, layer, super swarm, unclassified) within a square box of chosen side length, with the centre point a station where the chlorophyll maximum value lay in a chosen range between a chosen depth range, all within chosen date, time, and geographical ranges.

The second user interface provided by PASCAL/R is called the DIALOG system. DIALOG accepts queries formulated in a mathematical language, the relational calculus, and immediately returns the answer to the user at the terminal. This is a high level language which allows the user to specify the information needs with a limited number of commands. For example, "give the latitude, longitude and depth of all Euphausia superba aggregation type X, where the horizontal dimensions were greater than A and less than B, and the relative density is equal to D, and where the attributed sample contained females of maturity stage F and length greater than R millimeters (only if measurement name is anterior margin eye to tip of telson) and where greater than G individuals of bird species H,I,J were observed feeding at the surface, and where the observation vessel was not fishing, not dropping trash and the association "other vessels present" was false. The DIALOG system was used to address databases up to 20 mB in size, and the response time (depending upon the number and size of the relations involved and the other work being done by the computer) ranged from less than a second to ten minutes.

EXPERIENCE WITH THE FISHERIES DATABASE

The Fisheries database has had only one period of operational use, when it formed part of the background to the "BIOMASS" Data Workshop in May 1980. In order to evaluate the Fisheries Database as a proposed medium for co-operative international processing of data from the first BIOMASS experiment (FIBEX), the participants inadvertantly thoroughly tested the query facilities, both DIALOG and QUERIE.

It was apparent immediately that, after an introduction lasting five minutes, persons who had never worked with a computer before, and indeed never seen a visual display unit, could effectively use the 18 groups of queries incorporated into QUERIE. This was because, regardless of the complexity of the query, success depended only on responding to prompting by QUERIE. Those persons with a good background in programming were able to use DIALOG, which freed them from the established set of queries within QUERIE and gave an unrestricted opportunity for the development of their own queries. DIALOG can be used by persons with no computer training, but it would take some time to acquire enough skill to develop complex queries. These two systems permitted immediate interaction between the scientist and the data, so providing a very powerful means to extract information from the database. Naturally, the data itself could be retrieved, if needed, but it was clear that the main interest at the workshop was in the extraction of information from the data.

No major design flaws were detected in the database design during the BIOMASS data workshop, so it is probably fair to say that vessel, equipment, haul, trip, biological sampling, echosurvey, bird and oceanographic data can be effectively represented in an integrated database. On the other hand, some inadequacies in the present design became apparent during discussions, which in the main also provided the solutions.

For example, in the echo data, no provision was made for recording the vessels cruise track, which results in the loss of vital negative information. It is not enough to know, for example, the position of all aggregations observed : one must also know where they were not observed despite the presence of a ship.

The proper scientific name was used for species names. Although this does not waste storage space (character strings are stored only once, then internal codes are used in the relations), it led to errors in insertion, updating and retrieval. Spelling mistakes in original data made retrieval difficult, but not impossible, as it was easy enough to find the mis-spelt name with the HELP assistance facility. The use of a specific name for a target species made it impossible to use species groups as a target "species".

An interesting problem arose through the use of common names for catch compositions : this is legitimate, because it may take months to identify some species. If a catch is recorded as say, 12 tons of "krill", but the sample later shows it to be a mixture of three species of large euphausiids, some amphipod species and fish larvae, retrieval of the correct species composition of the catch in a query depends upon the use of <u>sample</u> composition data, not <u>catch</u> composition data. This could lead to errors.

Redundancy exists at the moment because the oceanographic station is regarded as an entity in its own right. It is intended in future to redesign the schema to create an "activity occurring at a fixed place at sea" entity which reduces the redundancy involved in noting the date, time, and position of stations, hauls or other fixed-point observations.

From the scientific side, it was clear that multidisciplinary ecosystem studies involving several species at different trophic levels found the database (and its management system) particularly useful because of the ability to examine relationships between widely different very large data sets. The stepwise refinement of complex queries by trial and error was seen to be a very powerful aid to data evaluation.

Intensive discussion showed that it is possible to represent in the Fisheries Database any other type of fisheries or marine biology data in which the Workshop participants expressed an interest. Such interest was expressed in observations of krill swarms at the surface, planktological data, data from devices which record biological data continuously, vertical profiling devices, current meter data, provision for subsampling commercial catches, and providing facilities for net monitoring data.

Perhaps the principal value of the workshop was as a practical demonstration of the power of modern database management and query systems, and their value as support to international scientific workshops.

CONCLUSIONS

The BIOMASS data workshop used PASCAL/R but, despite the growing number of implementations, it will not be commercially supported in the forseeable future. The system will only be available as a research tool, and for future workshops.

Nevertheless, design effort which is put into such a research system need not be lost, because the database schemata which have been thoroughly evaluated at workshops can be translated into schemata applicable to commercially-available database management systems.

This important relationship between such workshops and present or future data centres has already been noted. In particular, workshops of this type will provide an opportunity to develop ideas on the evaluation and testing of database designs and data exchange formats, identifying and developing the needs of users, developing special data products, and data interpretation, all of which will be of great help to the establishment of the BIOMASS data centre [8]. Another important relationship is in the rapid exchange of data between data centre and workshop sessions. Efficiency would improve, and overheads would be reduced, if large amounts of data could be transferred very rapidly between the data centre and workshop computers, so preventing excessive and unnecessary storage of data at the workshop. Direct support for interactive data workshops will be an important function for future data centres, bearing in mind the normal delivery time of data tapes from national or world data centres and the inevitable delays caused by validation of the data. Perhaps the most important lesson to be learnt was that interactive data interpretation workshops can be organised now.

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VESSEL NAME : WALTHER H. PORT OF REG. : BREMERHAVEN

DETAILS:

NAME	UNIT	VALUE
GROSS REGISTERED TON	TON	2250
LENGTH BETWEEN PERPE	M/10	690
VOLUME HOLD CAPACITY	M3	89
WEIGHT HOLD CAPACITY	TON	82

Table 1. Vessel details.
(artificial data)

VESSEL NAME : WALTHER H.

EQUIPMENT NAME : 1216/KRILL

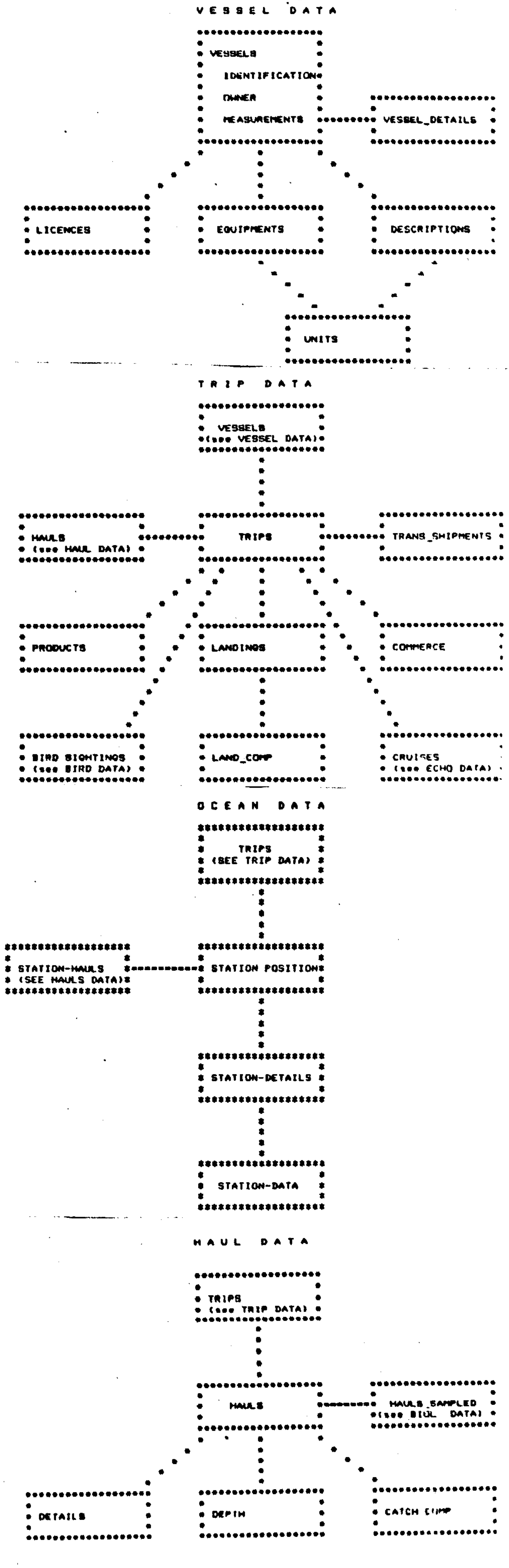
PROPERTY	UNIT	VALUE
DESIGNER		E.
DIA ROPE STREN 100MM	MM	24
DIA ROPE STREN 200MM	MM	18
DIA ROPE STREN DIAGO	MM	18
DIA ROPE STREN WING	MM	18
LEGS LENGTH	M	23
MESH MATERIAL		NYLON
OVERALL LENGTH	M	143
P1 BOT + TOP WIDTH	M	34.3
P1 LINER MESH SIZE	MM	40
P1 MESH SIZE	MM	200
P1 NO OF STRIPS		3
P1 SIDE WIDTH	M	24.3
P1 THREAD WEIGHT	G/KM	3180
P1 WIDTH	MESHS	400
P2 BOT + TOP WIDTH	M	11.8
P2 LINER MESH SIZE	MM	20
P2 MESH SIZE	MM	100
P2 NO OF STRIPS		3
P2 SIDE WIDTH	M	9.3
P2 THREAD WEIGHT	G/KM	3180
P2 WIDTH	MESHS	400
P3 BOT + TOP WIDTH	M	8.6
P3 LINER MESH SIZE	MM	12
P3 MESH SIZE	MM	50
P3 NO OF STRIPS		9
P3 SIDE WIDTH	M	8.6
P3 THREAD WEIGHT	G/KM	3036
P3 WIDTH	MESHS	400
P4 BOT + TOP WIDTH	M	7.0
P4 LINER MESH SIZE	MM	12
P4 MESH SIZE	MM	50
P4 NO OF STRIPS		5
P4 SIDE WIDTH	M	7 0
P4 THREAD WEIGHT	G/KM	3180
P4 WIDTH	MESHS	400
PART 1 LENGTH	M	44
PART 2 LENGTH	M	22
PART 3 LENGTH	M	30
PART 4 LENGTH	M	25
PARTS		4
WEIGHTS	KG	1400

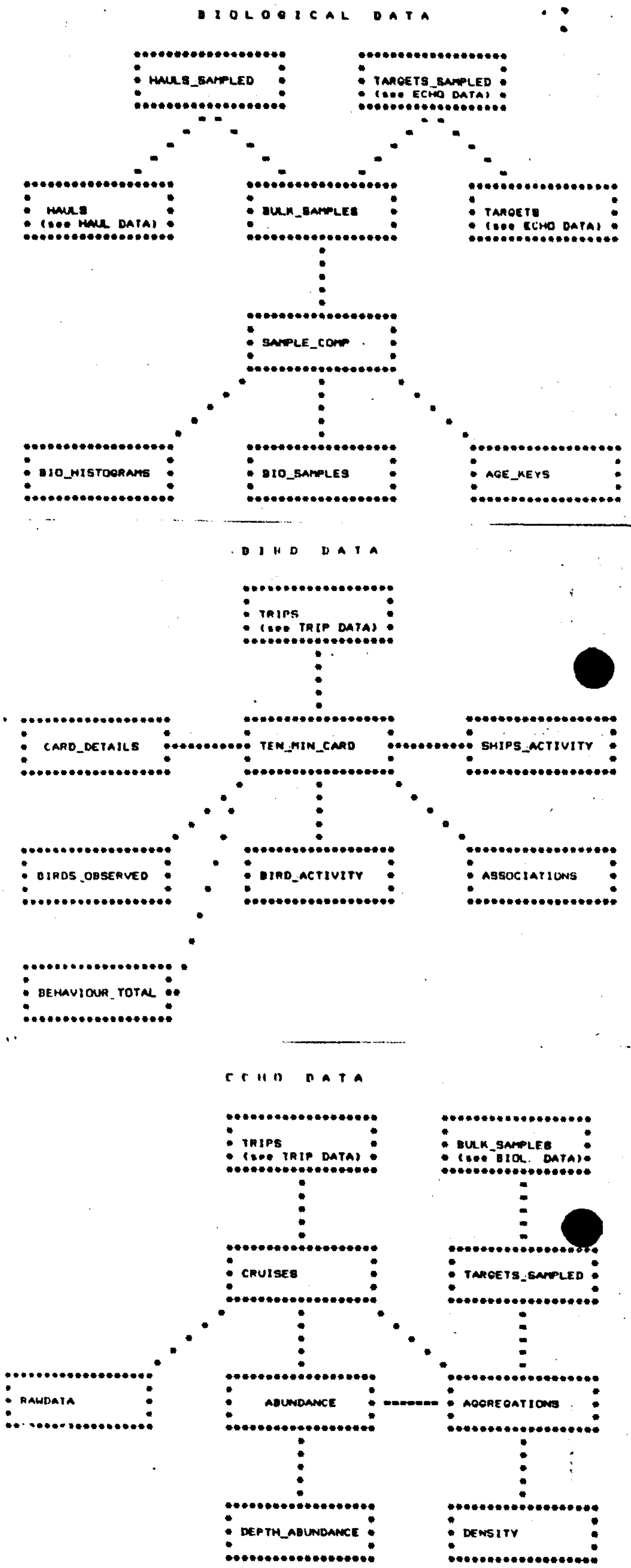
Table 3. Equipment properties,
units, values, (artificial data)

VESSEL NAME : WALTHER H.

EQUIPMENT NAME	EQUIPMENT CLASS
1216/KRILL	STERN_MIDW
COD END BARREL	BARREL
COD END LIFT WINCH	WINCH
DECCA NAVIGATOR	NAVIGATION
DIRCTION FINDER	NAVIGATION
ECHOSOUNDER 1	ACOUSTIC
ECHOSOUNDER 2	ACOUSTIC
ECHOSOUNDER 3	ACOUSTIC
FISH PROCESSING	FACTORY
FISHMEAL	FACTORY
FREEZER 1	REFRIGERAT
FREEZER 2	REFRIGERAT
FREEZER 3	REFRIGERAT
FREEZER 4	REFRIGERAT
HYDROGRAPHIC WINCH	WINCH
LOADING WINCH	WINCH
LORAN	NAVIGATION
MAIN ENGINE	PROPULSION
NET TO WATER WINCH	WINCH
NETSOUNDER	ACOUSTIC
NETSOUNDER WINCH	WINCH
PORT MULT. COND. WINCH	WINCH
PROPELLOR	PROPULSION
RADAR	NAVIGATION
SEC TRAWL WARP BARR	BARREL
SONAR	ACOUSTIC
STB. MULT. COND. WINCH	WINCH
STEVENLOG	SPEED_LOG
TRAWL WARP BARREL	BARREL
TRAWL WINCH	WINCH

Table 2 . Equipment names and equipment classes.
(artificial data)





Figures 1 & 2

Overall structure
of the database