FISHERIES STATISTICS

TOPIC 1 - INTRODUCTION : WHAT ARE FISHERIES STATISTICS

In this course we will be discussing some of the basic techniques used in collecting, presenting and analysing fisheries statistical data. But in this introductory topic, we will talk briefly about why we collect fisheries statistics, what types of statistics are collected by and for a fisheries statistical system, the types and levels of detail needed for some of these data and some possible types of statistics collections. Following this short introduction to the world of fisheries statistics, we begin the part of the course which is concerned with detailed studies of basic statistical methods which can be applied to fisheries data.

1.1 Components of a national fisheries statistical system

Fisheries statistics are essential to fisheries managers and scientists alike. A government fisheries department collects a wide range of types of fisheries data, from scientific to socio-economic data. We briefly examine the whole range of types of statistics which come under the control of a government fisheries department. Not every department, of course, will deal with all types. In each category of statistics, we mention whether we would normally expect to collect a census of the statistics or just a sample.

Domestic large-scale fishing

Census statistics on large-scale fishing are usually gathered by detailed catch reports and by landing data returns. Examples are pole-and-line, purse-seine and longline operations for tuna and trawling for prawns and fish. In the case of logsheet data, we may have to process the data by computer since the amount of detail is large.

Foreign large-scale fishing

Census statistics are collected under government-to-government access agreements. Detailed processing of the logsheets is carried out on computer at the South Pacific Commission (SPC), but some preliminary statistics should be recorded in-country.

Domestic small-scale commercial fishing

Sample or census logbook statistics are collected from fishing units and/or from landings. Examples are local deep-bottom fishing, trolling for pelagic species, and shell collecting for export.

Local artisanal and subsistence fishing

Sample surveys are conducted, usually by fisheries officers, to estimate catch and effort. Careful planning, recording and analysis of the samples is required. The estimates of non-commercial catch are often quite imprecise and some of the difficulties involved in making catch estimates are discussed in this course.

Market statistics

Economic data on market sales, costs, profits and number of operators for the commercial fish catch should be collected where possible.

Export statistics

Values and quantities of fish and fish products exported should be monitored.

Import statistics

Quantities of fresh, frozen and processed fish products imported should be known, especially with a view to supplanting some imports with local products.

Fish consumption statistics

The quantities and types of fish and fishery products consumed in a country are of considerable interest in planning for development of fisheries and fishery facilities, e.g. processing plants, and in defining the role of fish products in economic and nutritional terms. Fish consumption statistics may be obtained from household surveys, catch, import and export statistics.

Research and survey results

A government fisheries statistician should be familiar with the results of research and survey data on fisheries in the country and, where possible, should be given copies of the results to supplement routine data collections. Detailed research and survey programmes can help explain some basic observations on changes in the status of stocks which may have been noted in routine catch and effort statistics.

Aquaculture

Pond sizes, equipment, capital outlay, employment and production data are basic to monitoring the progress of aquaculture projects. A census of aquaculture data should be attempted.

Fishing vessels

Fisheries departments frequently are responsible for licensing commercial fishing vessels and keeping estimates of the numbers of non-commercial vessels involved in fishing. Even if the fisheries department is not responsible for licensing of vessels, the fisheries statistician should be familiar with current information on fishing vessels. In some cases, the sizes, numbers and types of boats used for fishing may have to be determined by household and village sample surveys.

Data on fishermen

Often the number of commercial fishermen is easy to determine because such fishermen usually have to be licensed. Alternately, we may get estimates of numbers from market sales. Determining the numbers of non-commercial fishermen, however, is more difficult, but fisheries departments frequently are responsible for sample estimates of numbers of people involved in fishing. In conjunction with other government departments, fisheries departments often carry out socio-economic studies of people involved in fishing so that the value of fishing in economic, employment and nutritional terms may be understood. Socio-economic studies usually are carried out by household surveys, e.g. the 1981 survey of artisanal fishing in South Tarawa (Anon 1982), the 1981/82 study of the status of women in fisheries activities in Fiji (Lal and Slatter 1982).

1.2 Why collect fisheries statistics

Before examining the problems of which statistics to collect and how to go about collecting them, we might ask the question - why do we collect fisheries statistics?

The uses of fisheries statistics may be classified as for (a) assessment, (b) monitoring, or (c) planning and management. Within each category we have scientific, economic and socio-economic fisheries statistics. In note form, we may summarise the uses of various types of fisheries statistics in the following way. Many of the ways in which fisheries statistics may be used will be seen in greater detail in following sections of the course.

1.2.1 Assessment

Scientific:

Data types: catch and effort, length frequency, species composition and catch rates, biological samples

Uses:
- assessment of current status of stocks
- potentials of new fishable stocks
- determination of biological parameters of populations, e.g. recruitment, reproduction, age structure

Economic:

Data types: landing data, market, import, export, consumption, vessel, gear, employment, foreign and local catch and effort statistics

Uses:
- to calculate values of catch, catch per unit effort, vessels and gear, import, export and domestic revenue
- to determine employment and occupational involvement in fisheries
- to calculate revenue and fees for foreign fisheries operations

Socio-economic:

Data types: national census, sample and household surveys

Uses:
- to determine employment and occupational importance of fishing to members of the population
- to assess the nutritional importance of fish and fishery products

1.2.2 Monitoring

Scientific:

Data types: time series of data types given in section 1.2.1 (Scientific: Data types)

Uses:
- changes in status of stocks
- effects on catch per unit effort due to interaction of different fisheries
- changes in biological parameters
- changes in fishing techniques and consequent effects on catches

Economic:

Data types: time series of data types given in section 1.2.1 (Economic: Data types)

Uses:
- to monitor changes in values of catch, catch per unit effort, vessel values, etc.
- to monitor employment and occupational involvement in fisheries
- to monitor returns in revenue from foreign fishing interests

Socio-economic:

Data types: time series or periodic updates of data types given in section 1.2.1 (Socio-economic: Data types)

Uses:
- to monitor changes in occupational importance of fishing
- to monitor changes in nutritional importance of fishery products

1.2.3 Planning and management

The end result of conclusions drawn from assessment and monitoring information is the input to planning and management of fisheries and fishing related enterprises.

Scientific:

Uses:
- regulation of fishing operations for conservation of stocks
- development of new fisheries and techniques

Economic:

Uses:
- planning of capital expenditure on vessels, ports, landing facilities, processing plants, etc.
- regulation of fishing operations for economic reasons
- calculation of access fee levels for foreign fishing

Socio-economic:

Uses:
- development of employment and occupational fishing projects
- regulation of fisheries based on social considerations

1.3 What fisheries data should be collected

In this section, we will discuss the form of data related specifically to fishing operations. Other forms of fisheries statistics listed in section 1.1, e.g. market, import, export, socio-economic and aquaculture statistics, are similar in their form and method of collection to many other types of non-fisheries related statistics, e.g. agricultural, income, educational. The collection and analysis of fisheries statistics not related to fishing operations are dealt with more generally in Topic 6 on sampling. The form and collection of data related to fishing operations, however, present features peculiar to fishing and to no other activity and an introduction to some of these features is now given.

In all fisheries a basic set of fisheries catch statistics is needed to satisfy the routine requirements of government fisheries departments in regard to research, stock assessment and economic management. The 1981 ICLARM/CSIRO Workshop on the Theory and Management of Tropical Multispecies Stocks (Pauly and Murphy 1982) identified the following requirements:

- Reliable catch by species and associated effort data.

- Length composition by species or, if appropriate, by groups of species. Where discarding of part of the catch at sea is known to occur, it will be necessary to sample discards for length composition as well as by species to enable conversion of length composition of landings to length composition of catch.

- Indices of abundance calculated from records of catch and effort and expressed in units of catch per unit of standardised fishing effort. Research vessels or selected commercial vessels may be used for this purpose.

- Related to these data requirements is the problem of obtaining satisfactory species identification. With the large number of species, special efforts are needed to provide field workers with easily used taxonomic aids.

- Age composition of selected species as a basis for using standard techniques of assessment and for calibrating length-structured models.

Except perhaps in the cases of large-scale foreign and domestic fisheries, even basic data requirements for many fisheries may be difficult to meet in the Pacific since:

- A large number of different species are caught.

- A wide variety of fishing techniques are used, often including several different techniques for the same species.

- The subsistence and artisanal catching sectors are extremely important and in some cases commercial fishing is almost negligible.

- Fishing is usually done by a large number of small fishing units.

- The requirements for trained manpower to collect statistics from remote atolls, islands and villages are often prohibitive.

- Small-scale fishing methods may vary considerably with time of day, phase of moon, season, food and money needs of the people involved, etc.

1.3.1 Catch data

Catch data, by species of fish, may be collected directly from the fishing units, e.g. individual vessels or fishermen, and/or in aggregated form as landings of fish.

Data collected directly from fishing units, e.g. on catch reports or logsheets, will be much more detailed than aggregated landing data. However, the accuracy of data reported directly from fishermen needs to be checked. Catch report forms must be well designed and accompanied by clear instructions on how to fill them in. In addition, fisheries officers must rely on fishermen being able to identify fish species accurately and to record weights, numbers, positions of catch, etc. carefully.

Fish landings are useful for estimating total catch and for cross-checking detailed logsheet data. In addition, species composition of the catch may be more accurately determined from landing data. For example, small yellowfin and bigeye tuna caught by purse-seiners are very difficult to tell apart and catch reports filled out on board fishing vessels often lump the two species as "yellowfin". On landing, however, greater care is taken to distinguish the species because they are sold for different prices.

The problem of which species to record as separate species and which to record as groups of species or as "other species" must be considered carefully. Species which are to be recorded separately must be able to be identified accurately and must make up a measurable fraction of the catch. In tropical fisheries, the diversity of species is often large and no small number of species dominates the catch. For example, Munro (1982) reported that in a trap fishery in Jamaica, 35 species each comprised at least 1.5 per cent of the catch by weight.

One approach to the species problem is to combine all species of one biological group, e.g. deep water snappers (*Etelis* spp.), parrotfish (*Scarus* spp.), groupers (*Epinephalus* spp.), when collecting routine catch data and then to estimate the species composition of the group from a subsample of the catch only. Alternately, we may collect catch data for one or a few indicator species in each group and total catch for the group as a whole. In general, catch totals for the group only will not be sufficient since any changes in species composition within the group will be missed. An example of a typical breakdown of species and species groups is shown in Table 1.1. The species are all caught in a deep-bottom dropline fishery and a trolling fishery operating in the same general area. We see that the group of miscellaneous and minor species constitutes only three per cent of the catch. Three species are recorded as individual species and all others are put into family or sub-family groups.

Special care must be taken to record the occurrence of species which may be only a minor component of one fishery but which are major or target species of other fisheries, e.g. yellowfin tuna in local troll fisheries and in large-scale tuna fisheries. Catch records of such species are very

important if we are trying to see whether the catches in the big fisheries are having any impact on catches in the smaller fisheries, i.e. if any interaction is occurring between the fisheries.

TABLE 1.1 : AN EXAMPLE OF FISH CATCH COMPOSITION RECORDS - DEEP BOTTOM DROPLINE AND SURFACE TROLL FISHERIES

Species/Group	Approximate Percentage of catch by weight
Etelis carbunculus (Deep-water red snapper)	12
Pristipomoides auricilla (Gold tailed jobfish)	4
Pristipomoides zonatus (Banded flower snapper)	14
F. Lutjanidae, s-F. Etelinae (Other deep-water snappers)	10
F. Lutjanidae, s-F. Lutjaninae : F. Lethrinidae (Shallow water snappers and emperors)	8
F. Serranidae (Groupers)	12
F. Carangidae : F. Scombridae : F. Thunnidae (Coastal pelagic species)	15
Ruvettus pretiosus (Oilfish)	7
F. Sphyraenidae : F. Scorpaenidae : F. Labridae : Unident. (Miscellaneous bony fish)	3
F. Carcharhinidae : F. Hexanchidae (Sharks)	15

Length-frequency distributions of the major species or of indicator species are of considerable value in monitoring the state of fish stocks. A sampling programme carried out at markets or landing sites or by research surveys is recommended. Provided sufficient samples are taken regularly, the size composition of stocks can be monitored for recruitment, change in sizes of fish taken and, in some cases, growth. Information on where the samples of fish were taken and what fishing gear was used must also be carefully recorded.

1.3.2 Time and area details

The amount of detail required in specifying time and area of catch is important when designing a data collection system for fisheries statistics.

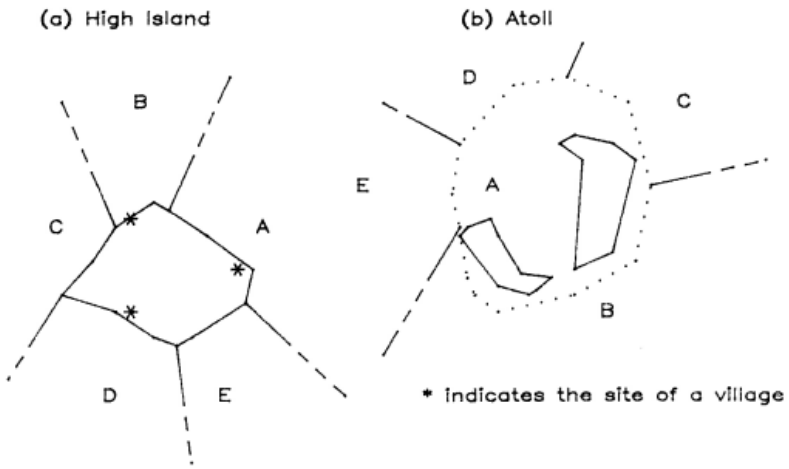
Time resolution is often straightforward because catch or landings are usually recorded by day or 1-2 day trip date. Greater precision on time of catch, e.g. hour of day or night, is more difficult to collect accurately.

With respect to area of catch, the amount of precision we need or can obtain is determined both by the type of fishery and by the precision with which the fishing boats are able to report catch. Thus, in inshore reef fisheries we may be interested in knowing the area fished to within a few kilometres accuracy whereas in pelagic fisheries we may be satisfied with several tens of kilometres accuracy.

In large-scale fisheries where vessels have good navigation instruments, fishing positions can readily be given in precise degrees and minutes. In such cases, computers can be used to produce graphic presentations of large amounts of detailed catch and effort data and to summarise the data in numeric form.

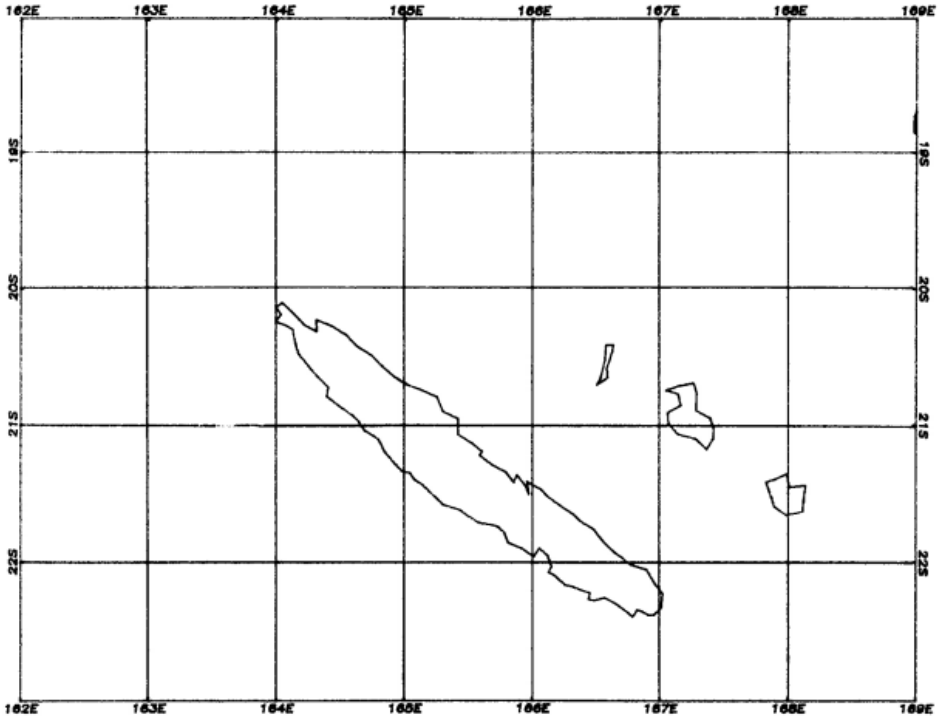
In practice, in small-scale fisheries, exact fishing positions usually cannot be obtained. However, a local system for describing approxiate areas should be set up. For example, the waters surrounding a high island may be divided into discrete areas which represent different possible fishing areas (Figure 1.1(a)); an atoll with lagoon may be divided into lagoon plus several offshore areas (Figure 1.1(b)). Particular note should be taken of recording fishing around fish aggregation devices (FADs).

FIGURE 1.1 : EXAMPLES OF ZONE AREAS AROUND ISLANDS



If some navigation equipment is available to local vessels, a grid system may be set up, e.g. a 1/4x1/4 degree, or 1x1 degree grid system. Figure 1.2 shows a 1x1 degree grid system.

FIGURE 1.2 : EXAMPLE OF 1x1 DEGREE GRID FOR NEW CALEDONIA



In general, the smaller the areas defined, the better the catch and effort data may be monitored, but the greater the difficulty in collecting and processing the data.

1.3.3 Fishing units

The fishing unit is defined as the smallest discrete, complete unit necessary for a fishing activity. The fishing unit varies from fishery to fishery but always consists of the fishing gear, persons (crew or fishermen and fisherwomen) and often fishing vessel or vessels. In some fisheries, the unit is obvious, e.g. in tuna longline fishing the unit is the longline vessel, crew and fishing equipment. In smaller fisheries the unit is not so clear, e.g. in shellfish gathering the unit may be one or more people and their collecting equipment. A table of common Pacific fishing methods and the fishing unit for each method is given in Table 1.2.

Identification of fishing units is important when designing the collection of fisheries statistics and also in choosing the way in which to measure fishing effort.

TABLE 1.2 : FISHING UNITS FOR SOME COMMON PACIFIC FISHERIES

Type of Fishing	Fishing Unit
Tuna longline	Longline vessel, crew and gear
Tuna pole-and-line	Pole-and-line vessel, crew and gear
Tuna single purse-seine	Purse-seine vessel, crew, gear and helicopter for locating fish
Tuna group purse-seine	Net vessel, skiff, carrier vessel(s), crew and gear
Trolling	Canoe/motor vessel, crew and gear
Deep-bottom fishing	Canoe/motor vessel, crew and gear
Trap fisheries	Canoe/motor vessel, crew and traps
or	Crew and traps if shore-based
Spearfishing	Fishermen, spears and boat(s)
Gillnets, set nets, lift nets, beach seines	Fishermen, nets and boat(s)
Cast netting	Single fisherman and net
Shellfish collecting	Collectors, equipment and boat(s)

1.3.4 Fishing effort

Catch data alone tells us little of the state of a fishery. For example, if the total catch of all reef fish is 50 tonnes in one month but only 10 tonnes in the next month, we have no way of knowing whether the drop in catch was due to reduction in available fish or to a drop in the amount of fishing, for whatever reason, carried out in the second month.

If we are to monitor the changes occurring in fisheries, therefore, we must measure or estimate not only the catch but the amount of fishing carried out. We quantify the amount of fishing by choosing a measure called a unit of fishing effort, depending on the fishing gear, skill and time required to catch fish. We require, therefore, some method for measuring the amount of fishing effort used by each fishing unit to catch fish. Ideally, the measure chosen should be such that catch is proportional to effort expended under given conditions. For example, if two people fish with lines in the same area on the same day, and one uses one line and the other uses two lines, we expect the person with two lines to catch about twice as much fish as the other since he/she is using twice the fishing effort.

Fishing effort is measured in different ways for different types of fisheries. Table 1.3 gives the usual measures of effort for different fisheries. The recommended measures for each fishing method are marked with a (1). Often it is difficult to collect data for the best measure of effort in a fishery and instead a less ideal but more easily measured unit must be used. For example, in set net fisheries on a reef, we may easily find out the total number of sets but may less easily obtain data on the size of nets and on the actual catching time for each set.

In practice, a unit of fishing effort can vary in effectiveness from fishing unit to unit and over time and area for the same unit. For example, 2000 longline hooks set for a standard period of time will vary in their success from time to time and from vessel to vessel. Several factors can cause variation in the effectiveness of a unit of fishing effort.

(i) Learning and technological changes:

In a new fishery, fishing skills and knowledge change rapidly over the first few years so that catches may improve with little apparent change in effort. The effective fishing effort is constantly changing as the fishermen become more skilful, but the measures of fishing effort, e.g. number of hours fished, number of sets made, will not show the changes.

The effectiveness of a unit of fishing effort may also change when new fishing gear or fish-finding equipment is introduced, e.g. a new type of net, a motor added to a canoe, better navigation and depth-sounding equipment, or when changes occur in the method of fishing, e.g. fishing at different depths from the usual, using a different type of bait, setting a purse-seine on different types of tuna schools.

(ii) Competition between units of gear:

Physical competition exists when the setting of additional units of gear directly interferes with the gears already fishing, e.g. heavy fishing of a school of fish may disperse the school. If many boats fish in an area, each boat may catch less per unit effort than if only a few boats fished.

(iii) Saturation of gears:

Some types of fishing gear cease to fish effectively once a certain amount of fish have been caught, e.g. set longlines, fish and crab traps.

TABLE 1.3 : FISHING EFFORT MEASURES

Type of Fishing	Gear Size/ Number	Bait	Vessel Size	Actual Catching Time	Searching Time	Changing Target Species	Skill	Within-fleet Communication
Deep sea handlines	** (1)	*		*** (1) (or no. of trips)		*		
Deep sea longlines	*** (1)	*		*** (1) (no. of sets)		*	*	
Reef, shore, gillnets, set nets	***			*** (1) (no. of sets)		*	*	
Traps, pots	*** (1)	*		*** (1) (no. of sets)		*		
Coastal pelagic - troll	*** (1)	*		*** (1)	*		*	
Oceanic - tuna purse-seine	**		*	*** (1) (no. of sets)	**	*	**	**
Oceanic - tuna pole-and-line	**	*	*	*** (1) (no. of days fished)	*	*	**	**
Oceanic - tuna and billfish longline	*** (1)	*	*	** (1) (no. of days fished)	*			*

Note: The preferred measure of fishing effort is marked by (1).

The degree of relative importance for each factor is shown by the number of asterisks (*). Three asterisks indicates that the factor is very important, two asterisks that the factor is moderately important and one asterisk that the factor is of low importance.

(iv) Co-operation between fishing units:

A single fishing unit may be much more successful when fishing in co-operation with other units or when receiving information from other fishermen. In some cases, we may have to redefine our fishing unit to account for co-operation, e.g. group purse-seiners.

(v) Expansion of fishing areas:

As a fishery expands to use new fishing grounds, the effectiveness of a fishing unit may be increased as previously untouched stock are fished.

(vi) Differences in skill between fishing units:

Fishing skill is hard to measure, but differences between fishing units cause some of the greatest differences in effectiveness of units of fishing effort. Adjustments may be made by comparing the long-term catches of different fishing units to the catches of a standard research or survey unit or to a particular unit of the local fishery. For example, if a particular fishing team or group of teams habitually catch one and a half times as much fish as other teams, each unit of effort from the successful teams is effectively equal to one and a half times similar units of effort from the other teams. Such adjustments to units of fishing effort are difficult to carry out, however, and a large amount of detailed data analysis is required.

Despite the care which must be taken in collecting fishing effort data and in using these data, fishing effort is still a very useful measure to have, both from the biological and socio-economic point of view.

1.3.5 Using catch and effort data

Catch and effort data are used by scientists, economists and planners as simple indicators of what is caught and how much effort is expended in fishing, and in calculations for stock assessment.

At the most basic level, if we know any two of the three statistics, catch, effort and catch per unit of effort, we may estimate the third statistic. If we know total catch and have a sample of catch with effort data, we may estimate total effort, provided the sample is representative of the whole. Conversely, if we know total effort and have a sample of catch with effort data, we may estimate the total catch. The values for total catch and effort derived from samples will only be estimates of the actual (unknown) values. If neither total catch nor total effort is known, however, both may still be estimated by sampling, but the estimates will be approximations only.

For the purposes of stock assessment, catch per unit effort (CPUE) is commonly used as an index of abundance of fish stocks. CPUE is calculated by dividing catch by effort, perhaps after first standardising effort. Unfortunately, CPUE will not always be proportional to fish abundance. Some of the factors that influence the relationship between catch and effort are:

(i) Multispecies fisheries:

When more than one species is caught in a fishery, CPUE of any one species may not be a reliable measure of the abundance of that species. Where certain species are highly sought after and fishing practices target on the preferred species, CPUE may be a misleading indicator of abundance of all species.

(ii) Standardisation of effort:

Individual units of effort may need to be standardised. If the measure of effort is not a true measure of effective fishing effort due to varying skill among fishermen, changes in technology, etc., the measures of effort may have to be adjusted to make CPUE values comparable between times and areas.

(iii) Discards:

Undesirable species and undesirable specimens of the preferred species, e.g. small, very large or damaged fish, may be discarded after catching. Discards are rarely recorded in routine fisheries statistics. The regional longline and purse-seine tuna catch reports have columns for discards of tuna and other species but not all vessels fill in the columns. Observers aboard vessels have provided useful information on the extent of discards but such information is only a very small sample of the whole catch. The Deep Sea Fisheries Development Project at the SPC keeps careful records of fish discarded, especially where the species of fish discarded, e.g. oilfish (Ruvettus pretiosus) and some sharks, have potential as food species. In general, research and survey programmes are required to provide reliable information on discards.

(iv) Changes in catchability of fish:

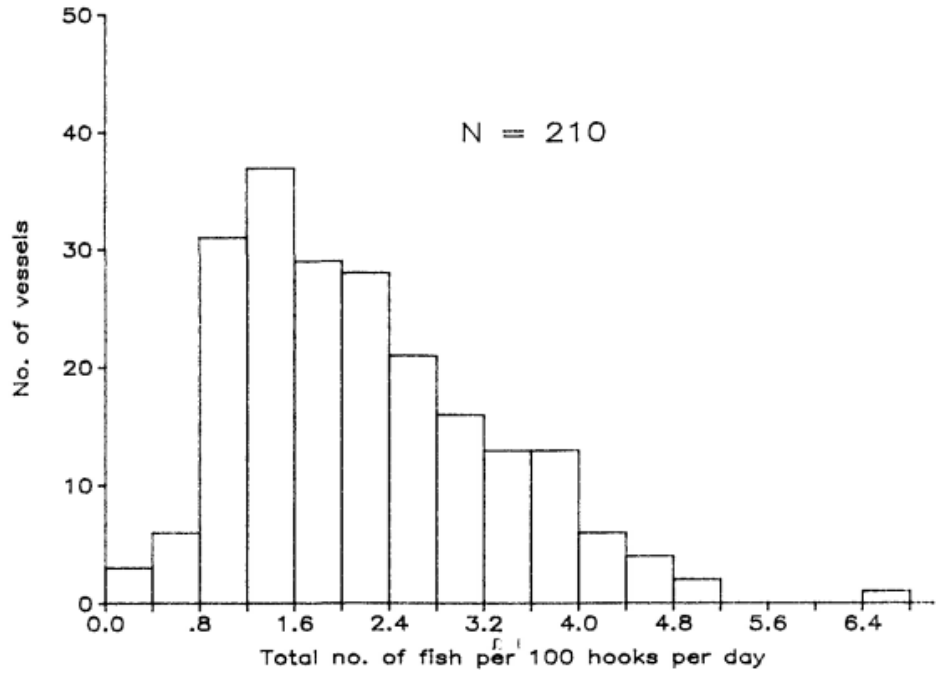
Changes in catchability of fish due to behavioural and physiological factors, e.g. schooling, reproduction, moulting in crustaceans, or to environmental factors, e.g. temperature, winds, moon phase, tides, may cause large fluctuations in CPUE. Such fluctuations, however, are not indicative of changes in abundance of the fish stock.

Take one further general observation at this point, and this is that the frequency distribution of CPUE in many fisheries is skewed to the right. A few fishing units have high CPUEs, but the majority have relatively low CPUEs. A typical example is the set of 210 longline boats which fished in one country over a three-month period (Figure 1.3). The CPUE (total number of fish per day fished) for the boats is skewed to the right. We will look at the presentation of such data as these CPUE data in more detail in Topic 3.

1.3.6 Length frequency

The uses of length frequency data are beyond the scope of the present course, but it is important to know that good length frequency data are being increasingly used for stock assessment purposes in tropical fisheries. Workshop papers in the book on tropical multispecies fisheries edited by Pauly and Murphy (1982) may be referred to for further details.

FIGURE 1.3 : FREQUENCY DISTRIBUTION OF CPUE FOR LONGLINE VESSELS



1.4 Collecting fisheries catch and effort statistics

Collecting accurate and reliable fisheries catch and effort data is often difficult due to the problems mentioned in section 1.3. We just briefly mention here the nature of data collection in large- and small-scale fisheries. The collection of other fisheries statistics, such as market statistics and socio-economic data, is treated in Topic 6.

1.4.1 Large-scale domestic and foreign fisheries data

A census or total collection of large-scale domestic and foreign fisheries data should be attempted. A census rather than a sample is possible since large-scale fishing is conducted by large, well-organised fishing units, capable of catching large quantities of fish and of keeping accurate records of such catches.

Large-scale domestic operations are commercial concerns which are usually licensed under government regulations and should be required to provide complete catch and effort returns. Good examples are seen in the region, e.g. the Papua New Guinea prawn fisheries, the Fiji pole-and-line tuna fishery and the Tonga longline tuna fishery.

With respect to foreign fishing operations, the foreign affairs department of each country is responsible for agreements ensuring that fishing vessels provide catch and effort data. Fisheries access agreements usually include regulations on the type of catch reports to be used and how these are to be returned to the country fished. In practice, some vessels may fail to comply with the regulations and we must rely on surveillance and law enforcement authorities to provide us with information on the extent of the problem.

1.4.2 Small-scale fisheries

By their very nature, small-scale fisheries present great difficulties with respect to data collection. In many Pacific countries, the subsistence and artisanal fisheries catches are of greater magnitude than commercial catches. A census of fish catch and effort in non-commercial fisheries requires a prohibitive amount of work. Estimates of total catch and effort, however, may be made with a regular sampling programme and/or by short-term, intensive surveys.

The methods for designing sampling programmes are discussed in Topic 6. Such methods apply equally well to catch and effort estimates as to socio-economic statistics estimates, except that great care must be taken in considering all the possible sources of bias and variability affecting the sampling scheme. For example, how may we best sample sporadic or irregular types of artisanal fishing activity, or night fishing, or fisheries directed to spawning runs on certain lunar periods?

Apart from sampling, another useful method of collecting highly specific data on fishing catch and effort is by the use of fisheries surveys. Fisheries surveys are systematic fishing activities designed to collect data on what types of fish are available and on what quantities of fish may be caught by certain gear types. Fisheries surveys may be carried out once only or they may be repeated at regular or irregular intervals as the need arises. In particular, exploratory surveys are often used to test catches in new fishing areas and/or using new types of fishing gear. The Deep Sea Fisheries Development Project of the South Pacific Commission is an example of a very successful programme of exploratory surveys in the Pacific region. In this programme, the results from surveys in each country are published with full details of the methods used and the results obtained. A typical example is a report by Taumaia and Preston (1984). Intensive fisheries surveys may be of considerable importance to stock assessment and economic studies since the sampling methods usually are well documented and the results are available for future comparisons. By contrast, units of effort and identification of catch from routine data collection are often non-standardised and make comparison from year to year and area to area very difficult.

1.5 How do we present and analyse the data we have collected

Most of the remaining topics in this course will be concerned with simple but useful methods for processing, summarising and analysing the data collected. In Topic 2 are introduced some basic statistical concepts and terms which will be necessary for future work. Topic 3 covers frequency distributions, and Topic 4 deals with statistics which may be used to summarise and describe data. In Topic 5 we will look at some methods for analysing the relationship between different statistics such as catch against time. Topic 6 is devoted to the common methods of sampling as a means of obtaining estimates of statistics when we cannot get a complete collection of data.