United Arab Emirates

Environment Agency Abu Dhabi (EAD)

Implementation of a National Fisheries Information System

(UAE-NFIS)

Training on basic statistics

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Preface

A major task of most countries is the improvement of their data collection programmes relating to agricultural statistics, including fisheries and forestry. The advantage of sample-based fisheries statistical systems is that they can make large-scale data collection programmes more affordable when sharp limitations exist with regards to human resources and availability of operational funds. The Environment Agency of Abu Dhabi (EAD) has long recognized these needs and over the past period it has intended to make use of training materials and methodological/operational guidelines with the view of assisting national staff in their efforts to improve their performance in their field and office functions and responsibilities. This document was prepared as a training component of the UAE National Information System.

Data collection on catch, fishing effort, first-sale prices and average fish size is a key factor for basic fisheries statistical studies. This means that a statistical system that operates on a regular basis is not an end in itself but a valuable source of information and data that serves a wide variety of purposes. Consequently a regular fisheries statistical programme is judged with two criteria: (i) whether it operates in a cost-effective manner (and this concerns its developers and operators) and, (ii) whether its results are of good utility when diffused to their intended audience. This training course concerns the first criterion and its objective is to provide system developers and operators with the theoretical basis for improving the methodological and operational aspects of their systems.

The document presents application aspects of fisheries sampling programmes. The operational concepts included here are adaptable to most situations encountered in the fisheries in UAE and are expected to assist the national experts in enhancing the operational aspects of their fisheries statistical programme.

Emphasis has been placed on the understanding of the applicability aspects of different data collection schemes and several practical examples are illustrated with the aid of computer simulators. Consequently the statistical methodology used here is limited to this objective; users may consult the References given in the last section for an in-depth study.

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1. GENERAL ESTIMATION PROCESS

1.1 Generic formula

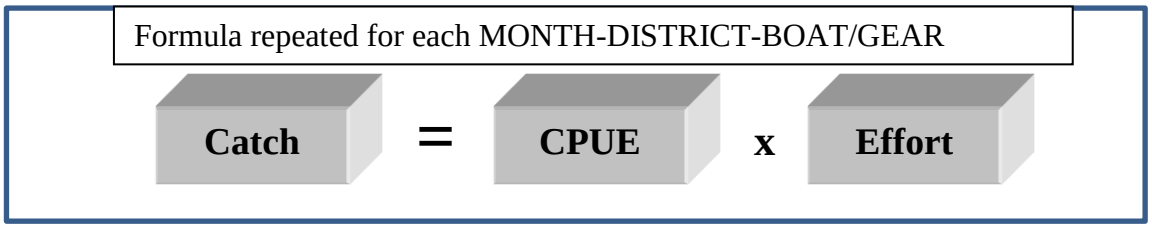


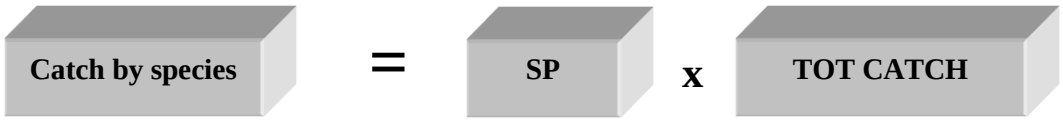
Fig 1. The generic estimation formula for total catch.

The above generic formula applies to each estimation context that consists of a TIME PERIOD (i.e. month), a STRATUM, and a BOAT/GEAR category.

1.2 Secondary estimates

Catch by species

Once the total catch has been estimated, the quantities by species are given by the formula:

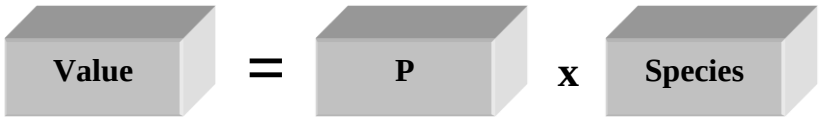


where:

a) *Catch by species* is computed within the same estimation context described earlier.
b) *SP* is a fraction indicating the proportion of a species in the total sampled weight.
c) *TOT CATCH* is the total catch estimated by the generic formula.

Values and prices

Once all species quantities have been estimated it is possible to calculate the related values using the formula given below:



where:

a) *Value by species* is calculated within the same estimation context.

b) *P* is the average first-sale price of a species in the sample landings.
c) *Species* is the quantity by species estimated earlier.

Unit value of grouped catches

When all values by species have been calculated on the basis of sample prices (see previous process), then any group of catch-value records will result in a UNIT VALUE (or a weighted price mean) determined as follows:

Average weight of fish

In addition to catch by species and prices sample-based surveys often provide information relating to the average fish size for certain key species. This is achieved by supplementing the quantities expressed in kg with the number of individuals found in the catch. In this manner it is possible to formulate indices of fish size by simply dividing the sampled catch of a species by the number of individuals found in the sample.

2. THE FOUR SURVEYS OF THE ESTIMATION PROCESS

2.1 General aspects

Each of the components of the generic estimation formula in Fig. 1 corresponds to a census or sampling survey as is illustrated below by Fig. 2. Here the diagram of Fig. 1 is used supplemented by four boxes that represent the data needed for estimating the variables of the equation. To be noted that CPUE needs only one survey while estimation of effort requires three different sets of data.

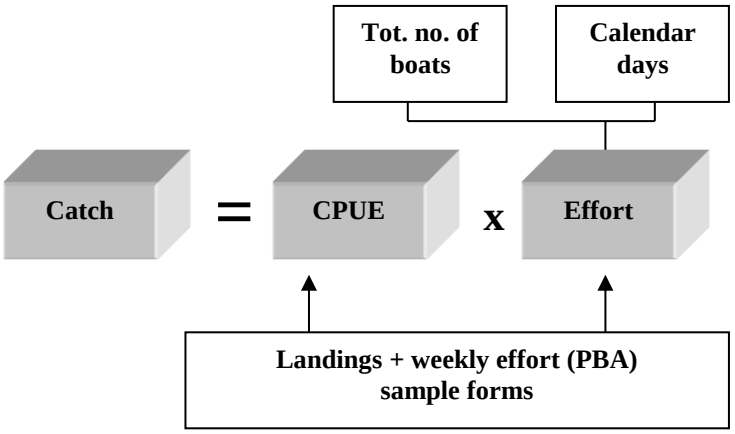


Fig 2. The four surveys of the generic estimation formula.

The surveys used for estimating fishing effort require:

HOMEPORTS to be used as sites for data collection

a) A frame survey to be conducted at all homeports in order to provide SPATIAL extrapolating factors F expressing the NUMBER OF POTENTIALLY OPERATING BOATS organized by site and boat/gear category. Alternatively the boat counts can be obtained automatically from an existing vessel database.
b) A survey (or similar exercise) permitting the determination of a temporal extrapolation factor A that expresses the total number of fishing days of the estimation context.
c) A sampling survey that determines the Probability of a Boat being Active (PBA) on any given day.

The CPUE surveys require :

LANDING SITES to be used as sites for data collection

d) A sampling survey to collect data from landings with the purpose of determining the overall CPUE, species composition, sample prices and sample average weight.

2.2 Discussion on the four surveys

Landings surveys

These surveys are conducted at the LANDING SITES. Their objective is to collect data in order to formulate the overall CPUE, species composition, sample prices and sample average weight. The six variables involved are:

a) Total catch;
b) Associated fishing effort;
c) Overall (or compound) CPUE;
d) Catch by species;
e) First-sale price;
f) Number of individuals in the catch by species.

PBA or Boat Activity Surveys (PBA = Probability Boat Active)

The objective of a PBA survey is to formulate the sample PBA for each boat/gear category in a given stratum. Its characteristics are:

a) it is always conducted at HOMEPORTS ;
b) formulation of the sample PBA can be done "vertically" that is by examining on a given day and at a homeport the number of active boats over a total number of examined boats;
c) formulation of the sample PBA can also be done by the "horizontal" approach, i.e. by examining the number of active days of sampled boats over a period, such as a month, a week or the number of days during two successive fishing trips;
d) PBA is formulated separately for each boat/gear category and by stratum;

To be noted that the PBA surveys are parallel to and independent of those dealing with landings, and they should always be conducted at HOMEPORTS.

Frame surveys

A frame survey has the objective of producing total numbers of fishing units that are operational (or potentially operational) within a statistical stratum. These numbers are categorized by boat/gear category and, if seasonality is evident, by month.

Here are the principal characteristics of a frame survey:

a) it is always conducted at HOMEPORTS;
b) it is census-based;
c) in theory it should be conducted on a monthly basis in order to be synchronized with the sample-based survey for PBA ;
d) in practice it is conducted on an annual basis or over longer year intervals;
e) it is usually part of a more general data collection programme such as a census of fishing vessels ;
f) it can potentially furnish useful information in support to the planning stage of a fisheries data collection programme, such as numbers of landings, sequential or concurrent use of different fishing gears, seasonality of operations from homeports, etc.

Fishing (or active) days

This survey is more of a monthly exercise that is conducted at the end of a reference month with the purpose of furnishing a TEMPORAL extrapolating factor for fishing effort. It thus assumes that all sampling operations have been completed and the system is at the point of calculating catch/effort estimates. Here are the principal characteristics of the survey:

a) it has a significant impact on the estimation of fishing effort;
b) it simply concerns the reduction of the days of the month to only those during which fishing was not negligible;
c) it should not be confused with the INDIVIDUAL VARIABILITY of fishermen' activities (this role is given to PBA);
d) for instance negligible or "zero" days are those relating to bad weather, weekends, national or religious holidays, market days, etc.;
e) active days can be relevant to one stratum but not to others. Also they can be affecting a specific boat/gear type but not the others. Thus it should be setup separately by stratum and by boat/gear category ;
f) the numerical process is simple enough. For each combination STRATUM-BOAT/GEAR we start with an initial value which is the number of days in the month. If there is no reason to assume that any period was negligible due to bad weather, weekends, etc. this number becomes the temporal extrapolating factor. If, on the other hand, there is evidence that certain days were of zero or negligible activity, then these days are subtracted from the initial figure ;
g) when the sampling scheme is such that boat activities are recorded irrespective of their zero value, then the days of zero or negligible activity are integrated into the sampling survey for PBA and in such a case the temporal extrapolating factor is the same as the number of days in the month.

2.3 Stratification aspects

Stratification is the process by means of which a target population is partitioned into sub-populations according to statistical and/or administrative criteria. When the criteria are strictly statistical, the stratification process has as objective the application of sampling methods into populations that are more "homogeneous" and meaningful. There is some sort of debate as to why we stratify. Several authors advocate that the objective of stratification is to reduce variability. Several others use it for reducing the risk of bias in the estimations and consider the consequent reduction in variability as a bonus. This paper is inclined toward that second view for the following reason:

Assuming that we could theoretically stratify as much as we want for reducing variability, then it is evident that by stratifying the original population down to its elements, the resulting total variance will be zero. This implies that the variability objective does not provide a criterion to terminate the process.

On the other hand, if we use the criterion of reducing the risk of bias, it is also evident that the stratification process can stop when all of the resulting strata (i.e. sub-populations) have uniform (or random or orthogonal) distributions.

In any event stratification is a costly process and is usually limited by operational constraints. Its impact on sampling requirements is significant. Consider for instance a very large population of 100 000 landings of two gears: gillnet and handline. If no stratification is applied, then a total of 32 samples should be sufficient to estimate catch with an accuracy of at least 90%.

If 60 000 are gillnet landings and 40 000 are handline landings and we want to separate the two estimates at 90% accuracy, then we would still need 32 samples for gillnets and another 32 for handlines, i.e. the stratification process has doubled the sample needs.

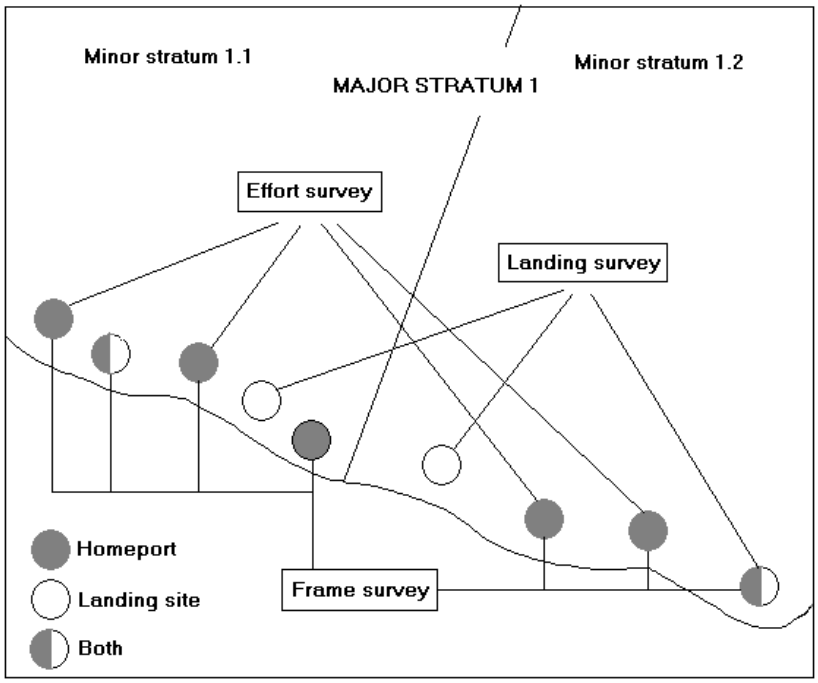


Fig 3. A synthesis of stratification and sampling operations for landings and PBA. Homeports are the shaded sites. Notice that a site can be both a homeport and a landing site.

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