

CMFRI

Winter School on
Towards Ecosystem Based Management of Marine
Fisheries – Building Mass Balance Trophic and
Simulation Models

INFORMATION ONLY

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Technical Notes



SAMPLING DESIGN FOR ESTIMATION OF MARINE FISH LANDINGS

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India has a coast line of about 8129 km. Fishing is largely in the hands of a number fishermen and fishing is done by small mechanized and indigenous craft. Landings take place almost all along in the coast line throughout the day and sometimes during night. There are about 2000 fishing villages scattered along the coast line from where fishermen go for fishing and return to a landing centre which may be distinct from the fishing village. There are about 1300 landing centres scattered along the coastline of the main land. Under these conditions collection of statistics by complete enumeration would involve a very large number of enumerators and a huge sum of money apart from the time involved in collection of data. In this context a feasible solution for obtaining marine fish landings is the adoption of a suitable sampling technique for the collection of fish landing data.

To evolve a suitable sampling design, pilot surveys were organised by different organizations in India from time to time. The design of the present survey has been evolved on the basis of results obtained in these pilot surveys undertaken from time to time.

The sampling design adopted by the Central Marine Fisheries Research Institute (CMFRI) is based on stratified multi-stage random sampling technique, the stratification being over space and time. The stratification is made by dividing each maritime state into several zones on the basis of fishing practices and geographical considerations. The number of centres included vary from zone to zone depending on the topography. These zones have been further stratified into substrata, on the basis of intensity of fishing in a centre. There are zones which have only one centre, usually known as Single Centre Zone.

One zone and a calendar month are taken as the basis of space-time stratum. If in a zone, there are 20 landing centres, there will be $20 \times 30 = 600$ landing centre days in that zone for that month (of 30 days). For observation purpose, a month is divided into 3 groups, each of 10 days. From each group, a cluster of 6 consecutive days are selected systematically with a random start with a sampling interval of ten days: Thus from the first five days of a month, a day is selected randomly, which together with the next 5 consecutive days (6 days in all) form the first cluster. The next 6 days each from the other groups follow systematically. For example, if for a zone, the observation starts from the 4th of a month and continue upto 9th, the next cluster will start from the 14th and the last cluster from 24th. As the days are selected as per the above procedure, three centres are randomly selected for observations over 6 days and each selected centre is observed for two consecutive days. The observation is made from 1200 hrs to 1800 hrs on the first day and from 0600 hrs to 1200 hrs on the second day, in a centre. The intervening period of these two days ie, data collected by enquiry from 1800 hrs of the

first day of observation to 0600 hrs of the 2nd day of observation of a landing centre-day is termed as 'night landing'.

The 'night landing' obtained by enquiry on the second day covering the period of 1800 hrs of the first day to 0600 hrs of the next day are added to the day landings so as to arrive at the landings for one day (24 hours). Thus in a 10 day period, data from 3 centre-days are sampled and consequently, in a month 9 landing centre-days are sampled.

Selection of units and recording of landings

It may not be practicable to record the catches of all boats landed during an observation period, if the number of boats/craft is large. A sampling of the boats/craft become essential. When the total number of boats landed is 15 or less, the total landings from all the boats are enumerated for catch composition and other particulars. When the total number of boats exceeds 15, the following procedure is followed to sample the number of boats:

Number of units landed	Fraction to be examined
Less than or equal to 15	100 %
Between 16 and 19	First 10 and the balance 50 %
Between 20 and 29	1 in 2
Between 30 and 39	1 in 3
Between 40 and 49	1 in 4
Between 50 and 59	1 in 5
and so on	

From the boats, the catches are normally removed in baskets of standard size. The weight of fish contained in these baskets being known, the weight of fish in each boat under observation is obtained.

Estimation procedure:

From the landings of the observed fishing units, the landings for all the units landed during the observation period are estimated. By adding the quantities landed during the two 6- hours periods and during the night (12-hours) the quantity landed for a day (24-hours) at a centre that is the landings for each centre day included in the sample is estimated. From these, the monthly zonal landings are obtained.

$$\bar{Y}_{ijk} = \frac{N_{ijk}}{n} \sum_{l=1}^n Y_{ijkl}$$

where \bar{Y}_{ijk} is the estimated landings for the k th month in the j th zone of the i th state, N_{ijk} is the number of landings centre-days in the k th month for the respective zone, n is the corresponding number of centre days actually sampled and Y_{ijkl} is the estimated yield for the l th landing centre-day in the sample for the respective space-time stratum.

However, important centres such as Veraval, Sassoon Dock, Sakthikulangara etc. larger sampling coverage is ensured as they are treated as Single Centre Zones.

From the zonal estimates, districtwise, statewise and all India landings are arrived. The corresponding sampling errors are also estimated.

Determination of overall sample size and variance in different strata/states:

The sampling fractions at the level of the first stage units vary from 1.5 to 3% in different states. With the present sample size, the error in the estimated total annual landings in India is about 5%. The sample size allocated to each stratum (zone) is the same. As the variance is found to increase with the size of the landings, the good landing centres are given more chances of being included in the sample. This is done by sub-stratifying the landing centres of a zone on the basis of the intensity of landings. A statewise allocation of the sample size on the basis of the mean annual landings is found to be practical and close to the optimum allocation.

Observational errors their magnitude and control:

The estimated zonal landings are always compared with the previous year's survey figures, and if any discrepancy which cannot be explained is observed, the technique of interpenetrating sub-samples is adopted to detect observational errors. Observational errors are rarely confirmed and when confirmed, the field staff is either called back to the headquarters for giving intensive training or he is replaced.

Errors due to non-response, their magnitude and control:

Non-response occurs only when the regular field staff is not available to observe the centre-day included in the sample. Usually, arrangements are made to substitute the regular one by another on such occasions.

Sampling errors, methods for its estimation, statewise magnitude and control:

The sampling errors involved in sub-sampling the centre-day and the boats (units) are assumed to be negligible (Sukhathme et al., 1958). Therefore an estimate of the variance of the estimated landings (Y_{ijk}) of the k th month in the j th zone of the i th state ignoring the finite population correction factor is given by

$$V_{Y_{ijk}} = \frac{N_{ijk}^2}{n} V_{ijk} \quad \text{where}$$

$$V_{ijk} = \frac{\sum_{l=1}^n y_{ijkl}^2 - \frac{(\sum_{l=1}^n y_{ijkl})^2}{n}}{n-1}$$

The percentage errors at the states level vary from 5 to 20%. To control the error, the stratification (based on the intensity of landings) is made from time to time.

Plan of operation:

The survey staff immediately after recruitment undergoes a training course which lasts 10-12 weeks and is posted to the survey centres. Each survey centre is housed in 1-2 room rented apartment and each centre is provided with the necessary literature connected with the identification of fish, a reference collection of local fishes, crustaceans and molluscs, field note- books and registers. At the end of every month, the survey staff receives by post, the programme of work for the following month which includes the names of landing centres to be visited and details such as date and time of observations at each landing centre. The programme is carefully designed at the headquarters by the statistical staff. The field staff send the data collected during a month to the Institute's Headquarter before the end of the first week of the subsequent month where, they are scrutinised and processed by the statistical staff.

Supervision of scrutiny:

Surprise inspections are carried out at frequent intervals by the supervisory staff of the Institute and the enumerators are inspected while at work in the field and their field note-books and diaries are scrutinised and initialed. A survey staff is usually inspected twice in a month. The data received at the Headquarter are scrutinised carefully at every stage for finding it in order. The processed data are counter- checked for errors if any in the method of estimation. Usually only cross checks are made; but when discrepancies are detected the estimation procedures for any zone are scrutinized in detail.

Tabulation and processing

Different schedules are used to collect fishery survey data. Necessary coding of species were also done to process the data with the help of computer facilities at Headquarters.