

SAMPLING

R. C. Hennemuth

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Sampling activities and problems pervade the field of fishery research. Hardly any statistics come from complete enumeration or counting. Samples of data form the basis of most population dynamic studies. The statistical literature is replete with the theoretical basis and methods of application. Hardly any statistical subject is better known. It is safe to say, sampling studies are the rarest in fisheries literature. For example, one sampling study, related to estimation of length composition, was done in years of IATTC research on tunas; only in the last year have some sampling studies been reported to ICNAF.

The general neglect of this vital work may be related to a more general problem - the lack of dedication to routine work for the common good, as opposed to special work of particular interest. This may be related to the national interest - for example, the development of new fisheries, or to the individual interest - for example, the stock-recruitment of haddock. Never mind that the data comes from samples. The focus is to complete the study of interest as quickly and painlessly as possible. Sampling studies and programs fall more in the line of routine monitoring, with very little immediate and direct pay-off - either in the personal or national sense. They continue year after year and are not exciting.

This malaise is particularly detrimental to accomplishing the required research in international commissions, particularly those not including a scientific staff. The accomplishment of research is dependent on the coordination of scientific activities of many nations with a diversity of scientific organization, development and national goals.

If this is not, at least, a major part of the reason for lack of sampling studies, what are some others? The actual implementation of comprehensive sampling programs is the most important need.

The broader needs of assessment and management within an international commission or similar institutional framework requires a common data base. This must be formed from standard, continuous sampling and reporting. Certain considerations are of paramount importance.

1. Emphasis should be placed on design and analysis. Ideally, the analytical procedures should be defined before the samples are taken. The methods of sampling must be related to the analysis. For example, is it the characteristics of the population, catch or landings that are to be estimated? Different weighing coefficients are used in each case. For the population, the samples are best taken from p.s.u.'s (primary sampling units) which represent time and area strata - an individual tow or catch. These samples may well be summed without weighing coefficients, or may use c.p.u.e. For the landings, the p.s.u. may be a larger aggregate of catch (a hold or vessel), and samples weighted by the magnitude thereof. What segments of the universe being sampled need to be stratified and what require random sampling? For example, it is probably more efficient, in terms of minimizing variance per unit cost, to stratify the age composition samples by length.

There are other, more technical, factors to be considered as well. Is there, for example, a population parameter being measured (binomial theory), or is there a population of parameters. Fish often school by size, and this size varies. Studies of variability are required to elucidate these aspects.

2. It is necessary, also, to obtain information on the physical characteristics of each type of gear, so that the p.s.u. is uniform with respect to the basic parameter to be estimated. Thus, a comprehensive survey of the methods of sampling and opportunities for sampling, both ashore and at sea, must be undertaken by each country. Guidelines for a standard methodology must be developed. The methodology must assure that the samples are representative and that the scheme is practicable.

3. A minimum-acceptable level of sampling should be implemented as soon as possible. It may take some time to define and achieve the optimum required sampling density; it may not, in fact, be possible to ever achieve this. It is necessary, however, to set up a minimum standard so that countries can implement measures to achieve the target. The best reason may be that national administrators need a commission requirement in order to obtain the resources necessary to carry out the work.

The specification of the minimum standard provides the opportunity to assure more uniform set of samples. Thus, such factors as time and area strata may be included which assure sampling of all segments of the fishery. It is probable that under-sampling of all segments is better than adequate sampling of just a few segments. The minimum is designed to be achievable, not optimal.

For example, ICNAF recently agreed to a minimum standard "at one length sample per 1,000 tons of fish caught for each division, quarter of the year, and gear. Each sample should consist of 200 fish from the entire length range and one fish per centimeter length group for age". It is reasonably certain that achieving an objective of, say, a 20 percent coefficient of variation of estimated numbers caught per age group would require more samples than this, but a sample from each 1,000 tons of fish will assure some samples from each aggregate of catch which at least assures that estimates will not be entirely prohibited because of missing data.

4. Individual samples should be submitted to a Secretariate for standard processing and analysis. The objective is to furnish an acceptable, common data base for study. It is likely that a single unit can achieve a more standard, known form of processing than, say, individual national laboratories. The individual samples also permit general studies of sampling efficacy. An alternative would be for each country to process their own samples according to proscribed methods. However, processing is considered here to mean an end product representing the best estimate of characteristics (e.g. length composition) of a convenient aggregate (e.g. catch by month and area), and this requires combination over country and gear categories for which all samples from all countries are required.

5. A data processing capability is most likely required to do the necessary processing. This is usually cost effective when numerous samples are involved and estimates for several different strata configurations might be required. It permits each country to equitably share the cost of this activity (assuming, of course, the commission scheme for allocating costs of operations is equitable in the first place). Most commissions have statistical reporting and tabulating requirements anyway which may already have initiated an ADP system.

In summary: Design and analysis assures that we measure what we purport to measure. Definition of field sampling practices and definition of the primary sampling units assures uniformity of collection: A minimum standard provides for accountability and assures a better performance. Central processing means we scientists can sit down together at a table and do assessments much more expeditiously with more acceptable results.