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PROPOSALS FOR ROUTINE CATCH DATA PROCESSING
AND ASSESSMENT OF THE SPANISH MACKEREL AND
TUNA BAITFISH STOCKS IN FIJI WATERS

by

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INTRODUCTION

Routine processing of data and assessing stock potential are two logistically independent facets of the broader problem of resource management and will, for that reason, be discussed separately in this paper. The word 'proposals' in the title indicates that both tasks are still at a stage at which critical comment might result in beneficial changes in plan, methods or perhaps priorities. Such comments would be welcomed by the author.

DATA PROCESSING

Over the past few years a large volume of catch, effort and environmental data has been generated by Departmental exploratory fishing projects and the activities of tuna vessels owned or chartered by the Government's fishing corporation. Field-data recording sheets had provision for a comprehensive variety of data, but by and large very few records had been satisfactorily completed. This, and the

lack of any system of rapid access to the data, probably
explains why no analyses apart from simple data reduction
have yet been performed. In the author's opinion, the follow-
ing six requirements are essential for the successful operation
of a large fisheries data-base system:

    i. Accurate, comprehensive and complete field records.

    ii. Documentation of data to be collected; formats;
        units of measurement and specific instructions to
        staff responsible for recording data. There
        should be no room for ambiguity.

    iii. Rapid-access bulk data storage facility.

    iv. Duplication of data into archive and rapid access
        files.

    v. Availability and thorough documentation of routine
        processing algorithms.

    vi. Access to special-purpose analytical algorithms.

A potential fulfilment of many of these requirements was
seen in transferring the whole data-base to computer file.
Fiji is fortunate to have a Government-run electronic data
processing centre willing to support this venture by provid-
ing facilities and expertise.

    The first step in the conversion process was to ensure
that we had some conception of the ultimate aims of the exer-
cise. It is an obvious waste of time and effort to collect
information that will never be used, and conversely, unless
the objectives are reasonably clear there is a strong
possibility that some important information may be overlooked.

The twofold purpose of data collection by the Fiji Fisheries Division may be classified broadly into 'monitoring' and 'research' components. The monitoring component is designed to keep a check on the state of currently-exploited stocks (e.g. tuna and baitfish), while the research component is seen to involve an analysis of the relationship between CPUE and an array of environmental variables. The rationale behind the latter approach is the ever present (but perhaps somewhat forlorn) hope of introducing some predictive capability into management.

As soon as it was established what types of data were required, the recording sheets were re-drafted in a form enabling the information to be transferred directly to punch-cards or magnetic tape. Four data sheet types have been drawn up, to cater for exploratory surface trolling and handlining projects as well as the skipjack and tuna-baitfisheries. An attempt was made to standardise the format as far as possible, the basic layout consisting of three 'header' lines (identification, environmental, and effort data) followed by a number of 'detail' lines (detailed fishing information). A manual will also be produced with general and specific instructions to data recorders. Samples of these sheets and manuals may be obtained from the author.

A suite of routine 'monitoring' analytical programs will be compiled in collaboration with EDP Centre staff to give a breakdown of catch and various CPUE statistics by the usual vessel, statistical block, moonphase etc. In addition, flow diagrams and draft programs for data sorting and more detailed statistical analyses of the catch data (e.g. analyses of variance in catch between vessels and areas) will also be prepared.

STOCK ASSESSMENT

The future of large commercial fisheries in Fiji appears to rest predominately with a relatively few pelagic species- notably skipjack and yellowfin tuna, and perhaps Spanish mackerel. Even now there are strong indications that demersal reef-fish stocks have been over-exploited. Commercial vessels are having to range much farther afield to obtain paying quantities of fish than they did a few years ago. The relatively slow growth rates and territorial behaviour of many reef species makes them particularly susceptible to overfishing, and the general feeling at present is that it would be unwise to develop the reef fishery any further by increasing the number or size of boats or by introducing more sophisticated gear and technology.

The pole-and-line livebait fishery for skipjack has reached the stage of being a viable commercial proposition although at present the small fleet is entirely controlled by a Government corporation. Apart from the expected fluctuations due to lunar effects, supplies of livebait (captured by lift-netting at night) are adequate. The initial investigatory phase of this industry concluded that the local stocks of bait-fish would support a moderate sized tuna fleet of eight to ten 75' vessels, but as little is known of the population parameters of these species, it is impossible to predict with any accuracy what effect continuing and increasing exploitation will have on the stocks.

Exploratory surface troll-fishing operations during 1976 have indicated that considerable potential exists for a seasonal Spanish mackerel (<u>Scomberomorus</u> <u>commerson</u>) fishery in nearshore pelagic waters. In 1975 and 1976 an estimated 20 and 26 tonnes respectively were marketed at various outlets in Fiji, but it seems that the stock could be safely exploited to a much greater extent. Prior to 1976 the bulk of the mackerel was caught by handlining, but the Department's 'quasi-commercial' endeavours have shown that surface trolling could be a viable and perhaps less labour-intensive method.

If the surface trolling and tuna pole-fisheries in Fiji expand to any extent, and it seems very likely that they will, their continued viability will depend on rational management of the local baitfish and Spanish mackerel resources. Management success depends in turn on the accuracy and extent of information provided by the statistician and biologist. The relationship between catch and effort must be monitored, and biological data relating to growth-rates, reproductive potential and environmental requirements of the species concerned should be made available to refine management decisions. In many instances (particularly with pelagic species) it is impracticable to measure total biomass or standing crop, but it is very important to have some knowledge at least of its distribution and relative abundance.

The following plan was conceived in an attempt to provide the sort of information required for effective management. For the purposes of this document the plan is divided into three sections:- 'catch analysis', 'abundance estimation', and 'biological background'.

A. Catch analysis

The main purpose of this exercise will be to ensure a routine check on the catch-effort relationship to detect any variations which could be attributed to over-exploitation. The data should eventually be sufficient to allow estimation of total, fishing, and natural mortalities.coefficients. Particular attention should be given to periods in which fishing effort is significantly increased by the introduction of more vessels or innovations in gear technology. An attempt should also be made to estimate the relative fishing power of the vessels in each fishery, and the units of effort should be examined periodically to ensure that they are still relevant.

B. Estimation of abundance and availability

The distribution of Spanish mackerel will be investigated by sampling an area bounded by the Great Sea Reef (to the north), the Yasawa and Mamanuca Islands (to the south-west), northern Viti Levu (to the south), and Longitude $179°E$ to the east. This area, of about 7200 mi^2 is divided into statistical blocks 400 mi^2 in area, which are in turn divided into four equal sub-blocks. The allocation of Departmental resources (primarily boat-time) favours a two-level mixed sampling strategy in which the major blocks are chosen randomly, but sub-blocks are sampled according to a predefined pattern. In a particular cruise, each sub-block will be subjected to 4 - 5 hr continuous fishing, with appropriate environmental data collected at a central point. In this way each statistical block in the area should be subsampled once every 4 - 6 weeks, providing information off stock distribution and local movement patterns as well as environmental data from areas both frequented and avoided by the fish.

A question of considerable importance to management is whether the fish spend their life cycle (particularly the reproductive phase) in local waters, or whether they migrate. One current hypothesis is that the mackerel in Fiji constitute a resident stock whose seasonal availability is the result of behavioural patterns related to reproductive activity. However there are few data available either to support or dispute this at present. Tagging immediately springs to mind as the appropriate method of investigating this sort of problem, but it is

unlikely that a tagging programme will be mounted in the near future, mainly for logistic reasons. A possible alternative method to be examined is the comparison of various Indo-Pacific stocks by immunological and/or electrophoretic studies.

Most information relating to the baitfish species will be obtained from the tuna fleet's night-baiting operations. However it may be possible to equip a small vessel with lights and a 'try-net' so that spot sampling can be carried out in areas not usually fished by the fleet.

C. Biological Background:

The resilience of a stock to fishing mortality is largely a function of its rate of production, the main components of which are growth (biomass accumulation) and fecundity (potential recruitment to the population). As growth rates and recruitment are both susceptible to changes in environmental conditions, including 'predation' by fishermen, it seems desirable to estimate the natural capacity for increasing biomass and production of eggs while the populations are still more or less in a state of equilibrium.

Otoliths will be used initially in conjunction with length -
frequency analyses, to estimate the age of Spanish mackerel and
several of the more important tuna bait species. If annual
growth checks are absent, as is the case with many tropical species,
it may be necessary to resort to the relatively new technique
of counting daily growth increments. The parameters of the Von
Bertalanffy growth model will be estimated from the resulting
length-at-age data for comparison between species and localities.

Reproductive cycles will be investigated using techniques
involving gonad weights, gonadal indices (if applicable) and
macroscopically-determined developmental stages. Fecundities
will also be determined by standard methods and the ecological
characteristics of preferred spawning areas, if located, will be
thoroughly documented.

Probably one of the most important natural factors
influencing the distribution of a fish species is the availability
of suitable food. A 12-month study of the diets of mackerel
and baitfish, taking seasonal and geographic factors into account,
should provide a good indication of their trophic adaptability.
This in turn might indicate the extent to which food availability
is likely to be a source of potential limitation to the growth
of these species.

The project description above has placed more emphasis on
objectives and rationale than on specific details of methodology
or chronology. Once the objectives have been adequately defined,
suitable methods fall into place fairly easily. Indications of

the time-scale involved in the study have been purposely omitted:
the commencement of many of the tasks will depend on how soon
the necessary equipment can be acquired and how long it takes to
assess the usefulness of, and refine, some of the techniques.
Finally, the duration of the tasks will depend on the outcome of
periodic assessments of the value of information being obtained.