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# THE MARINE LIVING RESOURCES OF BURMA: A SHORT REVIEW

by

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Abstract

The major features of the distribution in space and time of the demersal and pelagic marine stocks of Burma are presented and discussed. These stocks are presently abundant and subjected to little fishing pressure.

Intensification of fishing is thus permissible; in the case of the pelagic stocks, new gears will have to be introduced for the resource to become fully utilized.

## 1. INTRODUCTION

The present account of the marine living resources of Burma is based predominantly on results obtained in the course of the recently concluded UNDP/FAO/PPFC "Marine Fisheries Resources and Exploratory Fishing Project" (BUR/77/003), notably on Strømme et al. (1981), Rijavec and Htun Htein (1984), Pauly and Sann Aung (1984) and Pauly (1984).

Research on the marine resources of Burma began in the last century, but was limited mainly to taxonomic studies, and to occasional observations on the life histories of various important species of turtles, fishes and invertebrates (see comprehensive bibliography in Pauly, 1984).

The results of the first stock assessments conducted in Burmese waters were published by Ba Kyaw (1956) and Hida and Pereyra (1969), later complemented by the work of A.D. Druzhinin and his Burmese counterparts (FAO/UNDP, 1970; Druzhinin, 1970; Druzhinin and Phone Hlaing, 1972; Druzhinin and Tin Tin Myint, 1970). Other useful information on the Burmese shelf and its resources were included in the report of the second cruise of the R.V. AKADEMIK KNIPOVICH in the Indian Ocean (Bogdanov, 1973). These include data on the physical oceanography (Maslennikov, 1973), the benthos (Neiman, 1973), the plankton (Movchan, 1973), the commercial invertebrates (Chekunova, 1973) and the fish resources (Shubnikov and Tokareva, 1973) of the Burma shelf, as well as a number of references to further papers, published in Russian, on these topics.

It was only in 1979, however, that a systematic coverage of Burmese marine resources was initiated in the frame of the project mentioned above. This project, which lasted to the end of 1983 and included pelagic and demersal surveys, has led to a vastly increased knowledge of the resources off Burma. It is the purpose of this paper to briefly review the major results obtained during these surveys, and to put these results in a wider Southeast Asian context.

## 2. DISTRIBUTION, ABUNDANCE AND COMPOSITION OF THE DEMERSAL STOCKS

Several factors affect the distribution of demersal fish (and invertebrates) along the Burmese coast. Among these, some (depth, river inflow, bottom type) are the same as those reported to affect fish distribution in other Southeast Asian countries.

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Another factor - oxygen - seems, however, to have a large impact on Burmese stocks; since this is a feature not reported from anywhere else in Southeast Asia, it will be dealt with in some detail in the discussion which follows.

## 2.1 The effects of depth

The bulk of the demersal fish resources of Burma occurs at depths of less than 50 m, as is also reported from other Southeast Asian countries (Fig.1); as elsewhere in Southeast Asia, certain species and families occur predominantly in distinct depth ranges. Important fish species characteristic of shallower waters (10-50 m) are Pomadasys hasta, Lutjanus johni (Rhakine Coast), Dasyatis spp., Arius caelatus, Osteogeniosus militaris, Polynemus indicus (Delta Area), Carangoides malabaricus and Leiognathus spp. (Tenasserim Coast).

The species abundant in waters of medium depth (50-100 m) are Nemipterus japonicus (Rhakine Coast), Lutjanus malabaricus (Delta Area), L. argentimaculatus, Pennahia macrocephalus (Tenasserim Coast) and especially Lutjanus sanguineus, which is abundant all along the Burma Coast.

At depths exceeding 100 m, the most important species are Priacanthus macracanthus and Saurida undosquamis, which are common throughout Southeast Asia, as well as crocodile fishes (Peristedion weberi, P. adeni), i.e., species which, as opposed to all previously named species, occur rarely in other Southeast Asian countries.

The major invertebrate resources of Burma, penaeid shrimps and deep sea lobster (Puerulus sewelli), occur very close inshore (< 10 m) and at relatively great depth (150-350 m, off Tenasserim Coast), respectively. The shrimps are presently subjected to an intensive, if ill-documented fishery. The deep sea lobster on the other hand is only a potential resource. Its biomass is rather limited, as is its density; it seems unlikely, therefore, that commercial exploitation of this resource will be attempted in the near future (Rijavec and Htun Htein, 1984).

## 2.2 The effects of river inflow and bottom type

The coast of Burma can be readily divided into three sub-areas with distinct characteristics (Fig.2):

- Rhakine Coast: narrow shelf, generally trawlable, with isolated coral heads and rocks.

- Delta area: shallow, wide shelf covered by sand and especially mud, generally easily trawlable except in areas of very soft mud and mud hills.

- Tenasserim Coast: very heterogeneous, with coral reefs and rocky bottom becoming predominant as one moves south towards the Mergui Archipelago. Continental slope (> 250 m) trawlable (but untrawlable off Rhakine and Delta Coast).

Detailed analyses of the relationship between bottom type and bottom fish communities have not yet been performed off Burma; casual examination of the catch data obtained during the above-named project suggests a rather strong association between the fish communities and the habitats (see also Rijavec and Htun Htein, 1984). This is particularly apparent in the Delta area, which may be conceived as a very large estuary, and where in fact a typical estuarine fauna occurs, dominated by rays, threadfins, catfish and conger eels, and in which fish biomasses are very high (see Strømme et al., 1981; Rijavec and Htun Htein, 1984), despite the fact that it is an area which is subjected to more trawling pressure than the outlying areas because of its proximity to Rangoon (Fig.3).

## 2.3 The effects of oxygen

Oceanographic data collected by R.V. FRIDTJOF NANSEN in 1979-80 off Burma showed the presence of zones with low oxygen (<0.8 ml/1), especially off the Rhakine Coast, where oxygen concentrations may drop below 0.2 ml/l. This phenomenon, which is not reported from elsewhere in Southeast Asia is rather common off the western Indian coast where it causes massive fish kills, and/or forces fish which usually occur offshore, or in deep waters to crowd themselves just under the coast. That such "crowding" also occurs off Burma is suggested by Fig.4 which compares the size-depth relationship of Nemipterus japonicus off Northern Borneo (where larger fish occur in deeper water) with the size-depth relationship of N. japonicus off Burma, where no such trend is apparent. Such crowding would explain the rather low densities of fish in deep water, particularly off the Rhakin Coast. However, further studies will have to be conducted to assess whether the low oxygen levels recorded by R.V. FRIDTJOF NANSEN occur regularly (i.e., seasonally) or whether they are a freak occurrence.

## 2.4 Diurnal cycles of apparent abundance

Night hauls made during the period November 1981 to June 1983 (n = 261) were systematically lower than day hauls made during the same period (n = 337); overall, the night hauls represent 65% of the day hauls (Rijavec and Htun Htein, 1984). This suggests that at least some of the fishes sampled by the bottom trawl disperse at night in the water column. The catch data collected in the various surveys recently conducted off Burma should allow for the identification of this component of the catch, to which pelagic fishes may be expected to contribute greatly.

## 2.5 Seasonal changes in abundance and species composition

As elsewhere in Southeast Asia, the abundance and species composition of demersal fishes off Burma change seasonally (Rijavec and Htun Htein, 1984; Simpson, 1982). Major seasons are the "pre- and post-monsoon seasons" (both of which refer to the southwest monsoon). Although the overall biomass estimates for these two seasons (see below) are rather close to each other, relatively larger changes in abundance become apparent when species-specific biomasses are compared. Detailed information on this and related phenomena are included in the cruise reports produced by above-mentioned project in the period 1981-1983, while Pauly and Sann Aung (1984) discuss seasonal patterns of recruitment in demersal fishes of Burma (see also Fig.5).

## 2.6 Long-term changes in species composition (1953-1983)

Demersal trawling along the Burma coast has never been particularly intensive. This allows for testing the suggestion made by various authors (e.g., in Pauly and Murphy, 1982) that tropical demersal stocks may undergo massive spontaneous (i.e., non-fishery induced) changes in species composition and dominance patterns.

Table 1 gives four lists of the seven most important groups (in terms of weight) during four demersal trawl surveys conducted from 1953 to 1983, ranked for each survey from the most to the least abundant. As might be seen, three families (Sciaenidae, Ariidae and Pomadasydae) appear in all four lists, one family (Lutjanidae) appears in three and three families (Leiognathidae, Synodontidae, and Muraenesocidae) appear in two lists. These data suggest a remarkable persistence of the dominance patterns, especially in light of the fact that the four surveys were all conducted by different teams, in slightly different parts of the Burmese coasts and using different gears and sampling designs.

Fish stocks similar to those off Burma, e.g., those along the Andaman Coast of Thailand, have, on the other hand, been subjected to intensive fishing in the same period, resulting in massive change in species composition and biomass decline (Pauly, 1979). This comparison suggests that the composition of Southeast Asian multispecies demersal stocks does not undergo massive changes when not subjected to strong exploitation; conversely the changes in catch composition displayed, e.g., by the Thai stocks, are attributable to fishing and not to natural causes.

## 2.7 Biomass estimates

Present best estimates of demersal biomass off Burma and their 95% confidence intervals are

755 000 $\pm$ 184 000 tonnes for the "post-monsoon"
and 815 000 $\pm$ 250 000 tonnes for the "pre-monsoon" periods

as computed on the basis of a stratified random survey by Rijavec and Htun Htein (1984). An earlier estimate of demersal biomass off Burma is 750 000 - 800 000 tonnes, obtained from an acoustic survey by Strømme et al. (1981), and which tallies rather well with the values from the trawl survey.

The seasonal differences in total biomass are relatively smaller than those noticeable at the species or family level, suggesting that most species - specific seasonal changes compensate for each other, and result in a seasonally stable biomass of demersal fish.

Table 1

The seven most important groups of fishes in demersal trawl surveys conducted in shallow waters (down to 50-70 m) off Burma, 1953 to 1983 (families ranked in order of relative abundance).

| A<br>1953-55 | B<br>1963 | C<br>1966-68 | D<br>1980-83 |
|---|---|---|---|
| Sciaenidae | Dasyatidae | Scianidae | Lutjanidae |
| Pomadasydae | Sciaenidae | Pomadasydae | Pomadasydae |
| Leiognathidae | Ariidae | Trichiuridae | Ariidae |
| Lutjanidae | Polynemidae | Carangidae | Carangidae |
| Synodontidae | Muraenesocidae | Leiognathidae | Sciaenidae |
| Ariidae | Nemipteridae | Lutjanidae | Synodontidae |
| Muraenesocidae | Pomadasydae | Ariidae | Nemipteridae |

A - based on Table II in Ba Kyaw (1956), with catches averaged over all five areas covered by surveys

B - based on Table IV (shallow waters only) in Hida and Pereyra (1969)

C - based on Table V, VII, IX, X, XI and XII in Druzhinin and Phone Hlaing (1972), with catches averaged over the whole survey period

D - based on Table XXX in Rijavec and Htun Htein (1984)

## 3. DISTRIBUTION, ABUNDANCE AND COMPOSITION OF THE PELAGIC STOCKS

### 3.1 Major groups of small pelagics

The following small pelagic fishes are relatively abundant off Burma: clupeids (Sardinella spp., Dussumeria spp., Ilisha spp.), engraulids (mainly Stolephorus spp.), carangids (various genera), scombrids (Scomberamorus spp., Rastrelliger spp.), as well as a number of other groups such as, e.g., Sphyraenidae, Stromateidae and Rachycentridae.

### 3.2 Major distributional features of Burmese pelagic stocks

The acoustic surveys conducted by R.V. FRIDTJOF NANSEN from September 1979 to April 1980 suggest that the bulk of the stocks of small pelagic fishes off Burma occur within about 20 nautical miles of the coast, with the densest concentrations immediately under the coast. Areas with dense concentrations form small, and probably highly mobile "islands" in a background of lesser concentrations (Fig.2).

### 3.3 Seasonal changes in biomass and species composition

Since the surveys conducted by R.V. FRIDTJOF NANSEN covered two seasons (i.e., pre- and post-monsoons) it is possible to provide a tentative estimate of the amplitude of seasonal changes in biomass of pelagic resources off Burma.

Strømme et al. (1981) report that the biomass of small pelagics is about twice as high during the pre-monsoon as during the post-monsoon season ($1.33 \cdot 10^6$ tonnes against $0.62 \cdot 10^6$ tonnes (see Table 2)) and suggest that these differences are "caused by a seasonal fluctuation in biological production of these generally short-lived fishes", also reporting that similar seasonal changes have been noted in comparable stocks and areas in India and Pakistan.

This inference is supported by the results of the detailed analysis of length-frequency data on Rastrelliger brachysoma from Southern Burma performed by Pauly and Sann Aung (1984) which showed that this short-lived fish has two well-defined spawning/recruitment seasons per year, with one recruitment pulse dominating the other to an extent such that large seasonal oscillations of biomass will be generated (Fig.6)

Table 2

Biomass in thousands of tonnes of small pelagics (mainly sardines, anchovies, mackerels and jacks) off Burma, as estimated during acoustic survey of R/V Fridtjof Nansen, 1979-1980 (from Strømme et al. 1981).

| Area | Season | |
|---|---|---|
| | Pre-monsoon | Post-monsoon |
| Rhakine Coast | 170 | 180 |
| Delta Area | 640 | 370 |
| Tenasserim Coast | 520 | 70 |
| TOTAL | 1330 | 620 |

3.4 Potential catches of demersal and pelagic fish off Burma

In Southeast Asia, potential catches (Py) from multispecies stocks have traditionally been estimated using the formula of Gulland (1971)

$$Py = 0.5\, M \cdot B_o \qquad \text{.........1)}$$

where M is the average natural mortality in the multispecies stock, and $B_o$ is the virgin stock size.

For cases where stocks are lightly exploited - as is apparently the case with the pelagic and demersal stocks off Burma, Gulland (1979) proposed

$$Py = 0.5\ (MB + Y) \qquad \text{.........2)}$$

where B is the present biomass and Y is the present catch, M being defined as in equation 1).

Using a range of M values of 0.4 - 1.0, and a figure of 300 000 tonnes for the present annual catch, Rijavec and Htun Htein (1984) estimated a potential yield of 310 000 - 550 000 tonnes of demersal fish from equation 2).

The catch figure of 300 000 tonnes used by Rijavec and Htun Htein (1984) which is adapted from (Burma,1983) may be largely overestimating present catches, which moreover are taken also from the pelagic component of the overall Burmese marine stock (see below); using equation (1) alternatively with M = 0.4 - 1.0 and $B_o$ = 800 000 tonnes gives $P_Y$ = 160 000 to 400 000 tonnes.

Combining the pelagic and demersal biomasses and using equation (2), the catch figure of 300 000 tonnes and a conservative overall mean value of M (= 0.6) gives, finally, an estimated total marine potential yield of about 700 000 tonnes/year (see also Strømme et al., 1981, p.52).

Two problems must be considered to appreciate the meaning of these potential yield estimates, however:

(i) equation (1) used here to estimate potential yields has been shown by a number of authors to overestimate potential yields considerably, particularly in short-lived animals (Francis, 1976; Caddy and Csirke, 1983; Beddington and Cooke, 1983); also the range of value M usually used in Southeast Asia to assess demersal stocks (0.4-1.0) may be on the high side (Sainsbury, 1979);

(ii) fishing gears suitable for catching large quantities of small pelagic fishes (lighted lift nets, fish aggregation devices, modern purse seiners, etc.) are presently not in use in Burma. Their deployment and effective use require considerable skills and major emphasis will have to be given to technology transfers involving these skills.

Burma is one of the few countries in Southeast Asia (if not actually the only one) in which potential yields do exist, i.e., in which fleet expansions appear possible. It will be important, in the course of this expansion, to carefully monitor the stocks and to prevent over-capitalization, e.g., by building elements of fisheries management into the present and future fishing development programmes.

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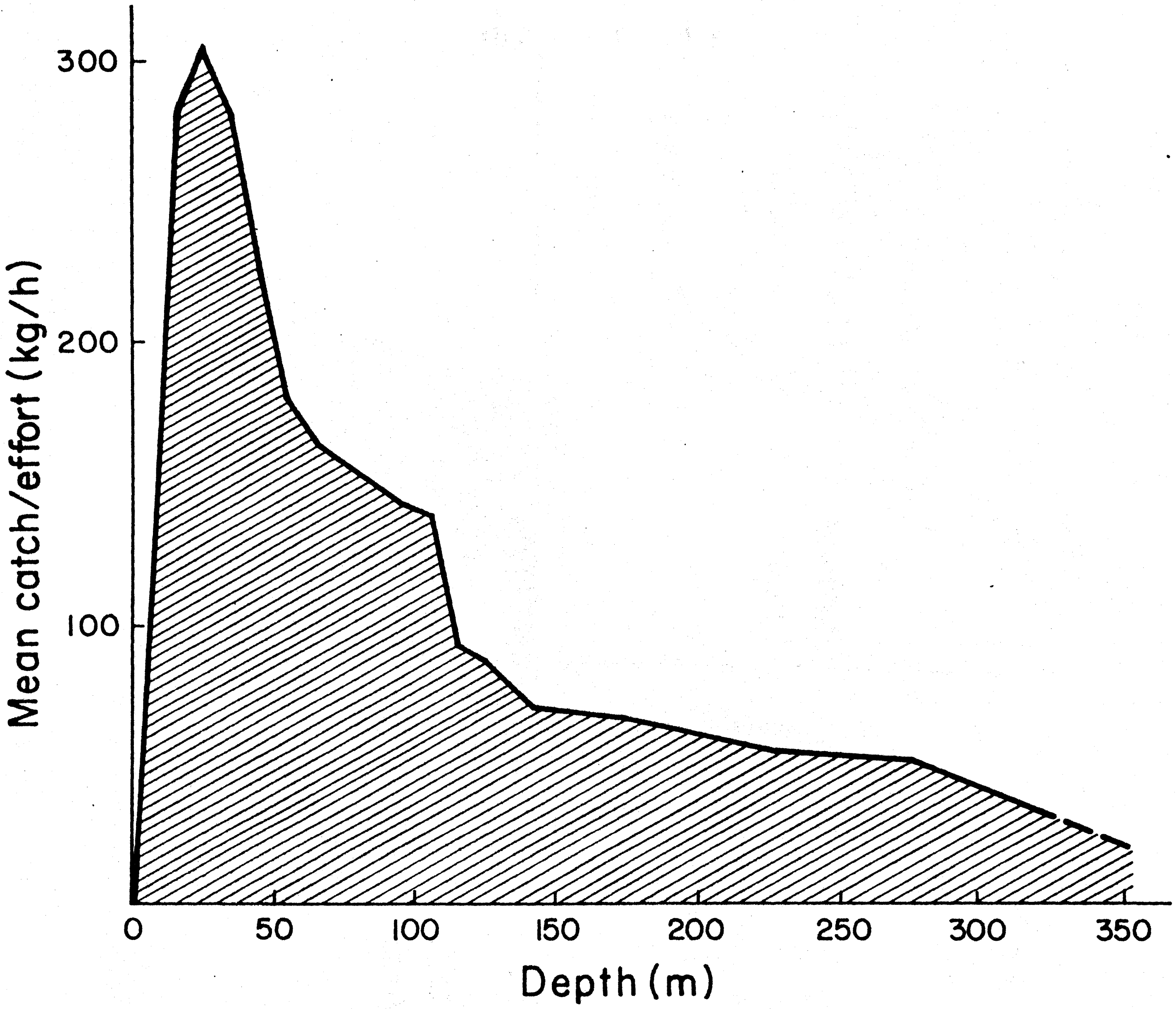


Fig. 1. Relationship between apparent density of demersal fish off Burma and sampling depth (1981-1983) (based on Table II in Rijavec and Htun Htein 1984, with smoothing over three 10 m depth classes to extract prevailing pattern).

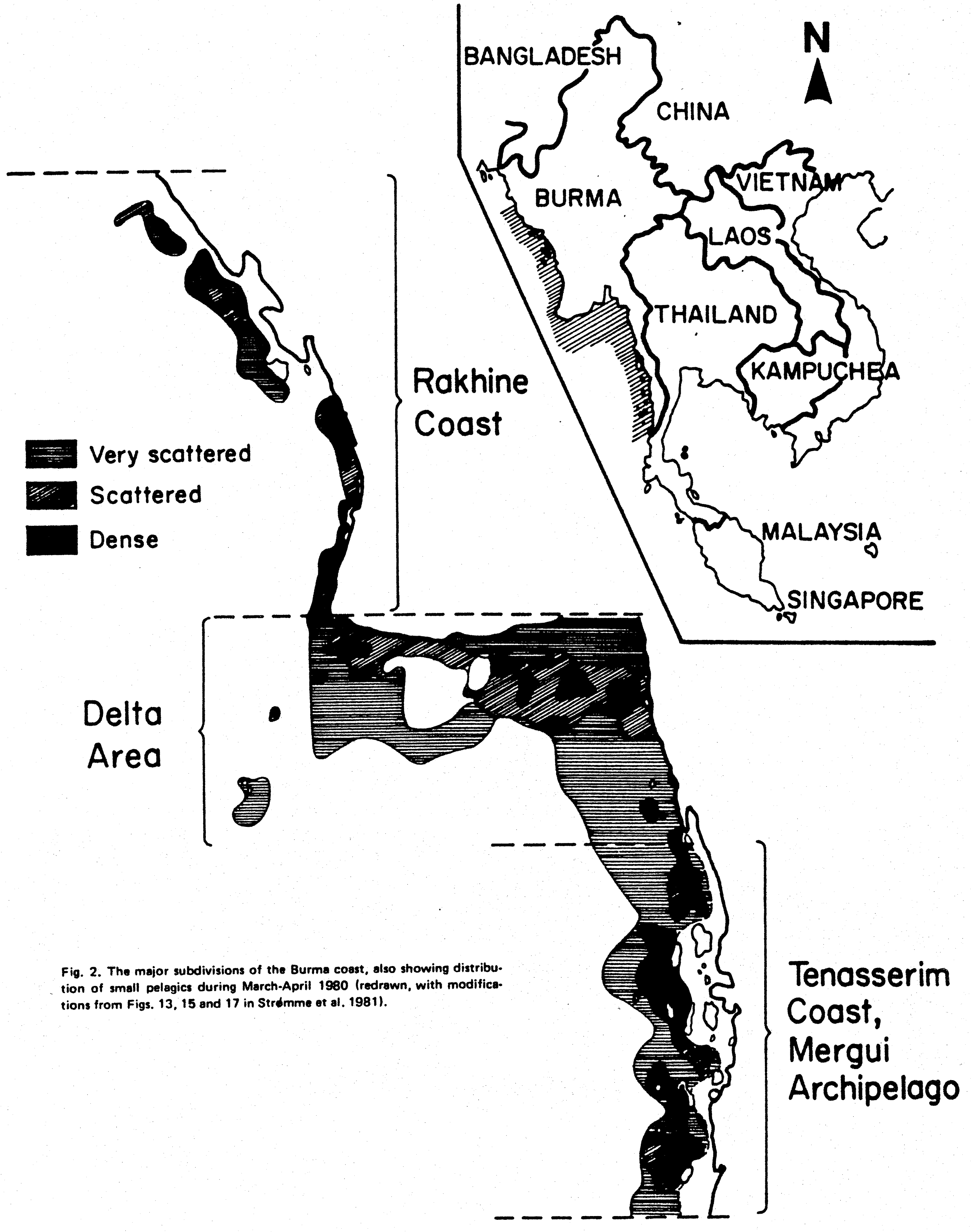


Fig. 2. The major subdivisions of the Burma coast, also showing distribution of small pelagics during March-April 1980 (redrawn, with modifications from Figs. 13, 15 and 17 in Strømme et al. 1981).

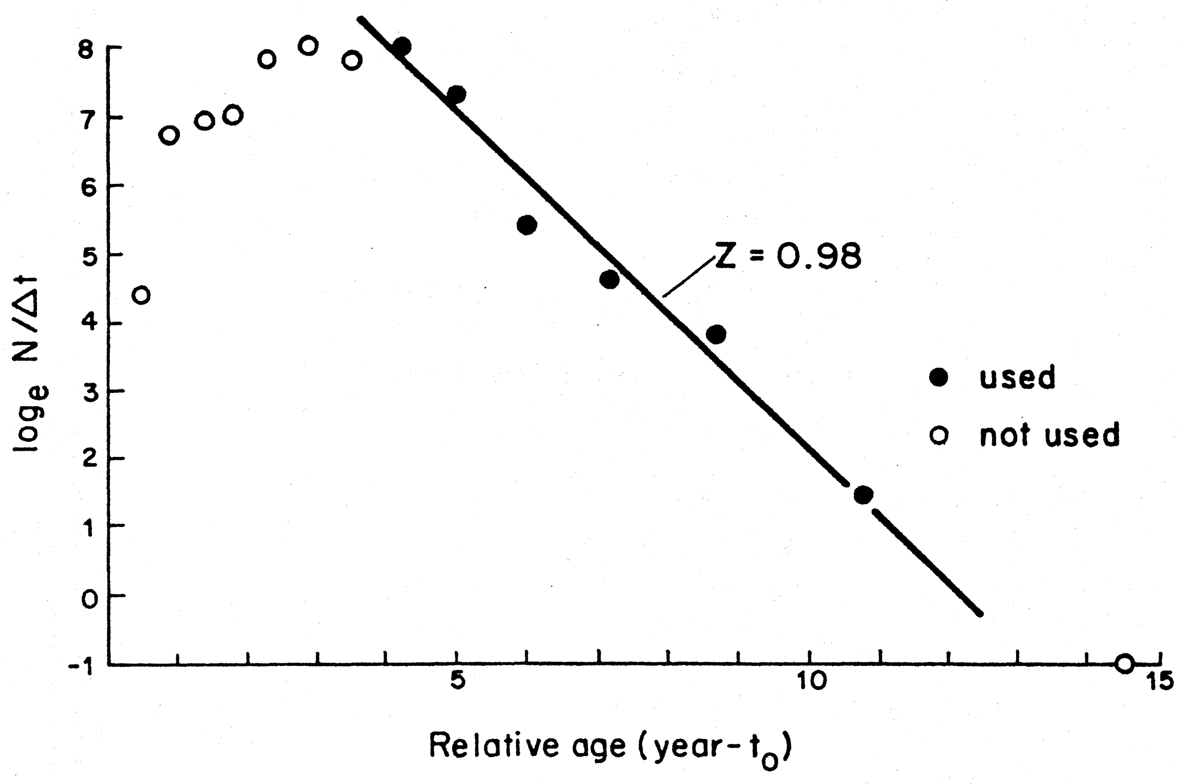


Fig. 3. Length-converted catch curve for Indian threadfin *Polynemus indicus* in the Delta area in 1981-83; the catch curve suggests a relatively high total mortality which, when combined with the estimated natural mortality of M = 0.37 suggests a fishery mortality of F = 0.61 and an exploitation rate of E = 0.62 (from Pauly and Sann Aung 1984).

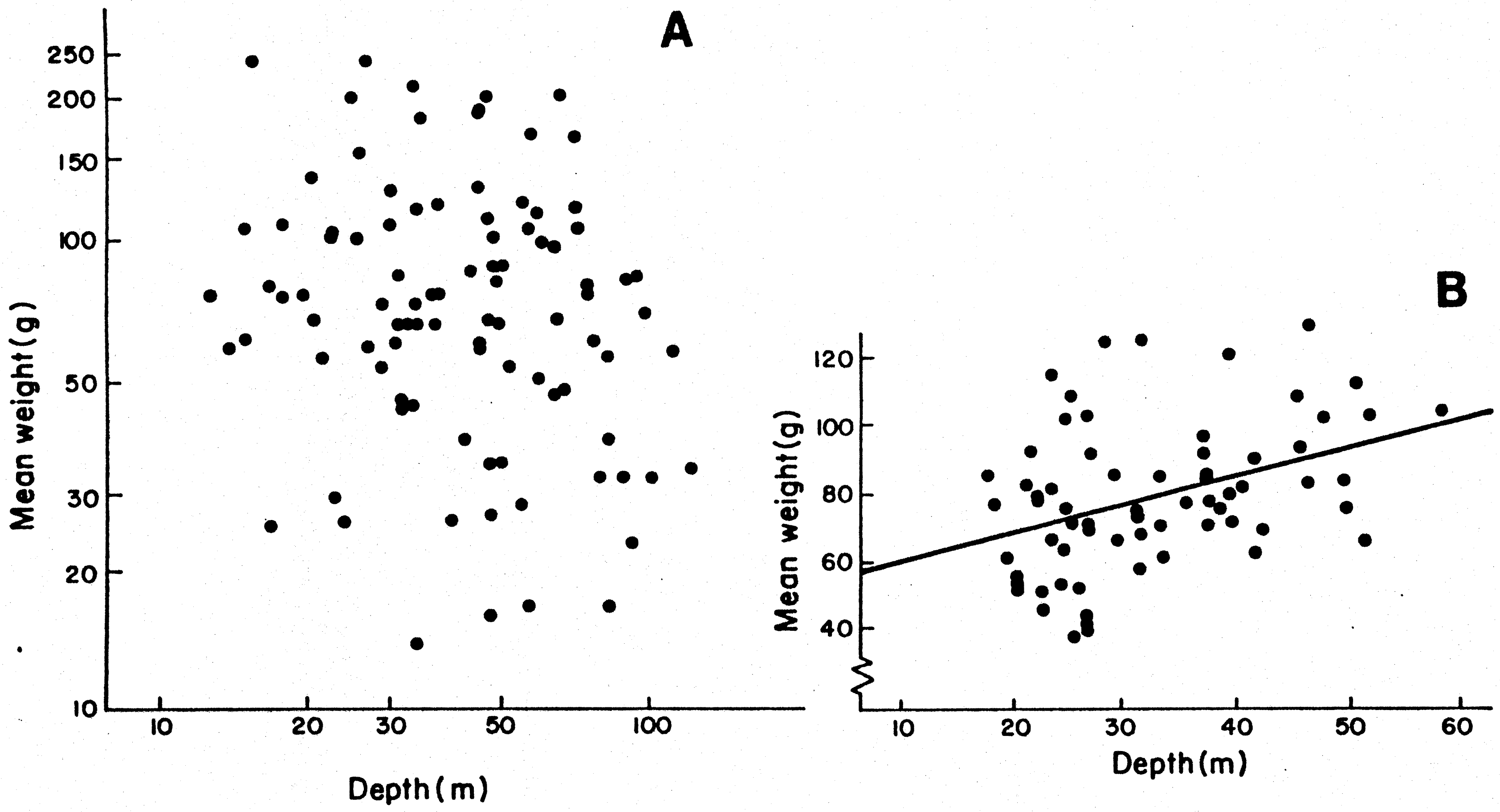


Fig. 4A. Plot of mean weight on water depth for *Nemipterus japonicus* off Burma (from Pauly and Sann Aung 1984, based on raw data of R/V Fridtjof Nansen surveys). Note lack of relationship between mean weight and sampling depth. B. Relationship between mean weight and depth for *Nemipterus japonicus* off Northern Borneo (from Weber and Jothy 1977). Note significant increase of mean weight with sampling depth.

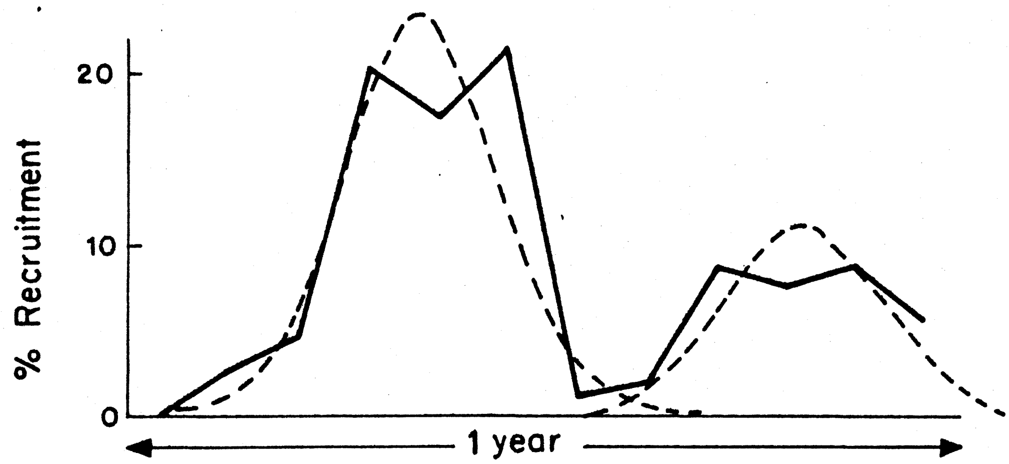


Fig. 5. Recruitment pattern of *Nemipterus japonicus* off Burma, showing distinct seasonal pulses of recruitment (from Pauly and Sann Aung 1984).

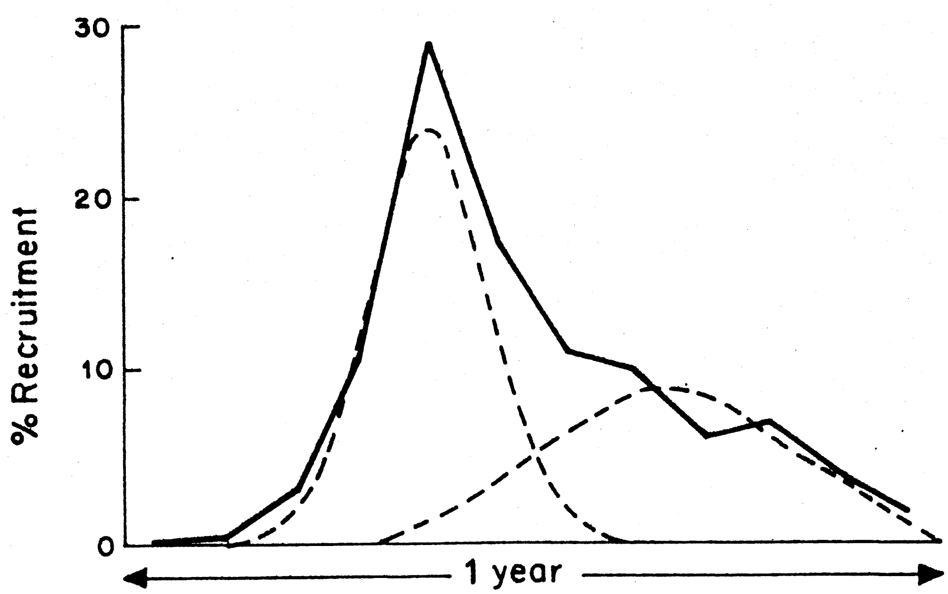


Fig. 6. Recruitment pattern of *Rastrelliger brachysoma* off Burma (Mergui Archipelago) showing seasonal pulses of recruitment (from Pauly and Sann Aung 1984).