



SEAFDEC Training Department

Southeast Asian Fisheries Development Center

TD/RES/12

February 1987

DYNAMICS OF DEMERSAL FISH COMMUNITIES IN THE GULF OF THAILAND, 1963-1981

Prichar Sommani



Published by the Training Department, Southeast Asian Fisheries Development Center
P.O. Box 4, Phrapradaeng, Samutprakarn, Thailand.

Research Paper Series No.12

February 1987

DYNAMICS OF DEMERSAL FISH COMMUNITIES IN THE GULF OF
THAILAND, 1963-1981

Prichar Sommani



Training Department
Southeast Asian Fisheries Development Center

7/9(2)

CONTENTS

| | Page |
|--|------|
| Introduction | 1 |
| Materials and Methods | 3 |
| Results and Discussion | 4 |
| 1. Relative coefficients of catchability | 4 |
| 2. Fisheries and stock dynamics | 5 |
| 3. Community status in 1963 | 7 |
| 4. Community dynamics | 9 |
| 5. Relationship between the small prey and the intermediate predators | 16 |
| Conclusion | 18 |
| Acknowledgements | 20 |
| References | 21 |

LIST OF FIGURES

| | Page |
|--|------|
| Figure 1. The Gulf of Thailand showing the study areas | 23 |
| Figure 2. Changes in the stock size | 24 |
| Figure 3. Dynamics of the demersal fish community composition in the 3 areas during 1963 to 1981 | 25 |
| Figure 4. Relationship between the small prey and the intermediate predators | 27 |

LIST OF TABLES

| | |
|--|----|
| Table 1. List of group numbers and species groups with their relative coefficients of catchability | 28 |
|--|----|

DYNAMICS OF DEMERSAL FISH COMMUNITIES IN THE GULF OF THAILAND, 1963-1981

Prichar Sommani

INTRODUCTION

The demersal fish stocks in the Gulf of Thailand have been intensively studied since the exploitation of these fisheries started in the early 1960's. Investigations by otter board trawl have been conducted annually by the research vessels of the Thai Department of Fisheries since that time. The statistics of catch per unit of effort of total catch and of major species groups, in terms of kilograms per trawling hour of the research vessels, have been compiled since 1963.

The demersal fishes in the Gulf of Thailand, as well as those in other tropical areas, consist of many species. It is said that there are more than 300 demersal fishes species attributed to these fisheries. Although some species are grouped for the sake of simple analysis, there are still 18 major species groups (SOMMANI 1983).

Studies of the fish stocks have been conducted intensively both in terms of the biology and the dynamics of the stocks and their fisheries. Species composition is also an interesting topic that has been reported on by many authors such as TIEWS *et al.* (1967), EIAMSAARD *et al.* (1979), EIAMSAARD and DHAMNIYOM (1980 and 1981) and CHARNPRASERTPORN (1982). These authors, however, considered only the species composition of the catch, not the fish community.

In this paper, attempts have been made to monitor the changes in the demersal fish community by considering the species group composition, calculated using the estimated stock size indices. The fishes are separated here into four main groups, plus one other called "The Others". They are as follows:

- a) The Large predator group includes two species i.e. Sharks and Serranidae.
- b) The Large zoobenthos feeders are composed of Rhinobathidae and Rays.
- c) The Intermediate predators include *Psettodes erumei*, Lutjanidae, *Priacanthus*, Synodontidae, *Sphyræna*, Carangidae, Plectorhynchidae and *Pomadasys*.
- d) The Small prey group includes four species groups, namely; *Scoropæsis*, Mullidae, Leiognathidae and Gerridae, and *Nemipterus*.
- e) "The Others" include the other good fishes and the trash fishes.

Except for the last group, it should be noted that this is a similar grouping to that of PAULY (1979).

The nine sampling areas in the Gulf of Thailand, as defined by the Marine Fisheries Division of the Thai Department of Fisheries, are combined and redefined into three areas as shown in Figure. 1.

1. The Northern part of the Gulf includes the East, the Inner and a part of the upper area of the Western Gulf i.e. Areas 1, 2, 3 and 4 in the aforementioned papers.

2. The Central part covers Areas 5, 6 and 7.
3. The Southern part covers Areas 8 and 9 and is the same as in SOMMANI's (1983) report.

MATERIALS AND METHODS

The statistics of catch per unit of effort (CPUE) used in this study are taken from the Marine Fisheries Division of the Thai Department of Fisheries. The CPUE statistics of the major species groups, resulting from otter board trawling surveys by the research vessels are available from 1963, (RITRAGSA 1974, EIAMSAARD *et al.* 1979, EIAMSAARD and DHAMNIYOM 1980 and 1981, CHARNPRASERTPORN 1982, and VADHANAKUL *et al.* 1985. The 1973-1976 data have not been published but were made available to me through Mrs. MATANA BOONYUBOL.

The demersal fish stocks are divided into 18 species groups as in a previous paper (SOMMANI 1983, Table 2), and are shown here in a slightly adapted form, in Table 1.

The coefficients of catchability of these species groups, based on the exponential surplus production model developed by FOX (1970), were estimated by SOMMANI (1983). These figures are the estimates of the groups inhabiting the Southern part of the Gulf of Thailand, but can be used to calculate the relative coefficients of catchability of the species groups which can be applied in the other two areas. The relative coefficient of catchability (r_i) of species group i is defined here as the ratio of the catchability coefficient of that species group (q_i) to that of the *Sphyraena* ($q_{10} = 0.1989 \times 10^{-3}$) that is:

$$r_i = \frac{q_i}{q_{10}} \quad (1)$$

The estimates of the relative coefficients of catchability of the species groups are given in Table 1.

The catch per unit of effort in the Northern and Central areas is adjusted to make it comparable to the commercial fisheries as explained by SOMMANI (1983). The adjusted CPUE and the relative coefficients of catchability are used to estimate the stock size index from the following equation:

$$B_i = \frac{U_i}{r_i} \quad (2)$$

Where B_i = stock size index of species group i

U_i = adjusted CPUE of species group i

and r_i = relative coefficient of catchability of species group i

The stock size index is in turn used to calculate the percentage of species group i (P_i) in the community from the equation:

$$P_i = \frac{B_i}{\sum B_i} \times 100 \quad (3)$$

Note that this is the percentage of the species group i in the community.

RESULTS AND DISCUSSION

1. Relative coefficients of catchability

The estimates of the relative coefficients of catchability of the major species groups are given in Table 1. It should be noted that these figures are expressed in relation to that of *Sphyræna*. They vary from 0.3248 for *Psettodes erumei* to 3.8120 for *Rhinobathidae*. The majority fall in the range of 0.7562 to 1.8949.

There are nine species groups whose coefficients of catchability are greater than unity while for the other eight species groups, the values are less than unity. It might be interpreted that nine species groups are more easily fished, by the otter board trawl, than the *Sphyræna* group. The probabilities of being caught by trawl of the other eight species groups are less than that of *Sphyræna*.

Since these are the relative figures, they could be applied in the Northern and Central areas as well as in the Southern part of the Gulf, although the original values are obtained from the latter. The stock biomass estimated will be expressed in relation to that of *Sphyræna*. Thus, they can be used to study the species composition of the fishes in the three areas.

2. Fisheries and stock dynamics

The standing stock size is defined as the sum of all stock size indices in the given area. In general, the demersal fish stocks in the three areas show a similar trend of decline during the period 1963 through 1975, although there are some minor differences (Figure 2). Sharp declines in stock sizes occur during 1963 to 1972 and then decrease slowly during 1973 to 1975. Some minor differences are shown during 1967 to 1971. The Northern stock decreases to the minimum in 1968, then increases for two years. The Central stock shows a rising trend with a small variation while the size of the Southern stock increases in 1967 and then declines rapidly. In 1976, the Northern stock increases slightly while the Central and Southern stocks increase sharply. But in the following year, all stocks decline. The Southern stock continues to decrease until 1981. During the same period, the Central and Northern stocks show a similar rising trend except that the Central stock drops suddenly in 1981.

As mentioned in the previous paragraph, the general trends of decrease in the standing stocks in the three areas are similar for the period 1963 to 1975. To test this hypothesis, an analysis of covariance was conducted using the 1963-1975 data, where y is the natural logarithm of stock size and x is time (Figure 2). The result of the analysis shows that all three regression lines are parallel ($F = 2.72$, with degree of freedom 2, 27). The equations for the regression lines are as follows:

$$\text{Northern stock} \quad y = 5.6948 - 0.1367 x$$

$$\text{Central stock} \quad y = 6.1672 - 0.1367 x$$

$$\text{Southern stock} \quad y = 6.2210 - 0.1367 x$$

The result indicates that we can accept the hypothesis that the rate of decrease in stocks of fish in all areas are the same and is 0.1367 per year. In other words, the rate of decrease is 0.1367 per year in natural logarithmic unit. This suggests that effects of the fisheries in all three areas were on average the same, at least during the period 1963 to 1975.

The demersal fishing activities in the Gulf of Thailand started at the beginning of the 1960's. The effect of fishing during the first half of the decade was very slight. The number of trawlers was only 99 boats in 1960 and 2,026 boats in 1963. In the same years, the annual demersal catches were reported to be about 6,000 and 20,000 metric tons respectively. This amount is very small when compared with the maximum sustainable yield of 674,315 metric tons estimated by PRAMOKCHUTIMA and EIAMSAARD (1979). Thus, the demersal fish stock during these years should have been more or less in a virgin state. Therefore, it can be safely assumed here that the stocks inhabiting the three areas in 1963 were approximately in a virgin state.

The development of the demersal fisheries in the Southern part of the Gulf of Thailand has been described by SOMMANI (1983). According to his report, the demersal fisheries operated

in this area expanded rather slowly during the second half of the 1960's and rapidly during 1970 to 1973. After that there was no marked trend in fishing effort made in the fisheries, but rather some variations in annual fishing effort might be observed.

As discussed earlier, the effects of the fisheries on the demersal stocks in the three areas were, on the average, the same during 1963 through 1975. Thus, the trend in expansion of the fisheries in the Southern part of the Gulf may be applied to explain the development of the fisheries in the other two areas. The annual fishing effort made in this area increased from 1966 to 1974/1975 by about 7.6-9.8 times. This amount of increased fishing effort would be about the same as that in the Northern and Central parts of the Gulf.

Some differences might be observed, however, for the period 1963 to 1968. For example, the rise of the fisheries operated in the Northern part of the Gulf was more prominent than in the Central part and the Southern part. The result is not unexpected because the Northern part of the Gulf is located near the Bangkok Fish Market which, at that time, was the only fish market in the Gulf. In addition most fishing boats were small ones, as compared with those found today, thus they tended to fish firstly in the Northern part rather than the Central and Southern parts of the Gulf. Then, they moved southward as the fish stocks in the Northern part declined.

The fishing pressure seemed to be reduced after 1975. Judging from the changes in the standing stocks the reduction was probably high in the Northern and Central areas while it was low in the Southern part of the Gulf.

3. Community status in 1963

As pointed out earlier, the stocks of demersal fishes were in 1963 nearly in a virgin state. It is therefore worthwhile to study the composition of the demersal fish community based on the data collected in that year. The results should reveal the status of the community in the so-called virgin state.

The sizes of the standing community in the virgin state was high, 477.63 kilograms, in the Northern area. The Central community was intermediate in abundance and was estimated to be 340.37 kilograms. The size of the Southern community was smallest and equalled 321.25 kilograms. These figures suggest that in the virgin condition the Northern part of the Gulf of Thailand is most productive, while the Southern area has the lowest demersal productivity.

The demersal fish community in the Northern part of the Gulf was composed of: 0.94% large predators, 1.84% large zoobenthos feeders, 24.57% other good and trash fish, 31.52% small prey and 41.13% intermediate predators. The Central community, on the other hand, consisted of the five main groups which could be ranked as follows: 0.45% large predators, 5.41% large zoobenthos feeders, 17.07% intermediate predators, 35.19% small prey and 41.85% "the others". While in the Southern area, the order of magnitude of the first three main groups in the community was similar to those in the Central area. The percentages were calculated to be: 0.69% large predators, 8.84% large zoobenthos feeders and 15.73% intermediate predators. The small prey contributed the highest proportion to the community, 41.01%, while the other good fish and trash fish combined only amounted to 33.74%.

Disregarding the group called "the others", the intermediate predators and the small prey were the larger components of the community, ranging from 15.73% to 41.13%. And as one would expect, the large predators and the large zoobenthos feeders were the smallest portion of the community, about 0.45% to 8.84%. It is surprising to note that although the group called "the others" consists of many species groups, it contributed only 24.57% to 41.85% of the community.

The areal distribution of these fishes should also be considered here since this would provide a better understanding of the community dynamics occurring in later periods. The areal

distributions can be monitored from Figure 3. As for the large predators, this group contributed a larger portion in the Northern and Southern communities than in the Central area. The proportions in the communities of the large zoobenthos feeders and the small prey showed an increasing trend from the North to the South. While the intermediate predators in these communities decreased from the North to the South. The relative abundance of the other good fish and trash fish in the Central area was higher than in the other two areas.

It should be noted that three species groups were not observed in the samples collected in 1963 Rhinobathidae in all three areas, *Psettodes erumei* in the Central and the Southern areas and *Pomadasys* in the Central part of the Gulf. The reasons for this are not known, however, it would have resulted in the low proportions of the large zoobenthos feeders and the intermediate predators in the communities.

4. Community dynamics

The changes in the percentages of the large predators, the large zoobenthos feeders, the intermediate predators, the small prey, and the so-called "other group" are shown in Figure three. For simplicity of the analysis, the study period is divided into three short periods; 1963 to 1970, 1971 to 1975, and 1976 to 1981. This is not an unreasonable division. The first period is concerned with the slow growing fisheries, in the second period, the fisheries expanded rapidly and during the third interval, the stocks were fished heavily but at a relatively constant level.

4.1 The 1963 to 1970 period.

The Northern community.

The percentage of the large predators rises from 1963 to 1966 and then declines continuously until 1968, after which there is an increase for two years. The proportion of the

large zoobenthos feeders shows a similar trend except that it drops until 1968 and then increases. It can be observed that the relative stock size of the intermediate predators continues to increase throughout the period. On the contrary, the percentage of the small prey tends to decrease continuously during this period. The contribution of the "other group" to the community is relatively constant throughout the period.

The Central community.

The portion of the large predators increases from 1963 to 1966 and decreases continuously through 1970. The change in the percentage of the large zoobenthos feeders in this area differs slightly from the Northern area in that it declines continuously from 1963 to 1968 and then rises for two years. For the intermediate predators, an increasing trend similar to the Northern area is observed. From 1963, the proportion of the small prey drops in 1966 and increases in the following year, then declines continuously. For the other good fish and trash fish, the percentage decreases from 1963 to 1967 and then increases for two years. It drops again in 1970.

The Southern community.

From 1963, the percentage of the large predators increases to 1967 and then tends to decrease there after. The proportions of the large zoobenthos feeders in 1963 are approximately equal. After these years it tends to decline. The rising trend of percentages of the intermediate predators is also clearly show in this area. For the small prey, their contributions to the community in 1963 and 1966 are approximately the same. During 1966 to 1970, a continuous decline shows throughout the period. For the other good and trash fish group, the proportion drops sharply from 1963 to 1966 and after that it tends to increase slightly throughout the remaining period.

4.2 The 1971 to 1975 period.

The Northern community.

From the last two years of the previous period, the percentage of the large predators increases quite sharply until 1971 though it drops rapidly in the following years and increases again in 1975. While the proportion of the large zoobenthos feeders, continues to rise from the previous year until 1971 and then drops slightly in the following year. It increases sharply in 1973 and during the last three years of the period it shows a decreasing trend. For the intermediate predators, their contribution to the community during this period remains relatively constant after dropping sharply from the previous interval's level. The relative abundance of the small prey continues to increase for three years and then declines quite sharply in 1974. It rises slightly the following year. For the "other group", the percentage shows an increasing trend in this period although it declines slightly in 1973 and 1975.

The Central community.

The change in relative abundance of the large predators is not as markedly observed as in the Northern area since it remains relatively constant at the level occurring in 1970. For the large zoobenthos feeders, their proportion declines rapidly from the previous period to relative abundance in the first year of the period and then increases very slightly throughout the period. The intermediate predators, however, show a very large variation in their percentage in the community. From the previous year, their percentage drops sharply until 1972 and then rises markedly for two years. It drops quickly again in 1975. For the small prey, the proportion in 1971 is about the same as previously. It increases a little in 1972 and then after falling continuously for two years, it rises again in 1975. A rising trend is markedly observed for the "other group".

The Southern community.

The proportion of the large predators drops in 1971. It rises for two years and drops sharply again in 1974. It increases markedly in 1975. The percentage of the large zoobenthos feeders increases continuously from the previous year through 1973. It declines sharply in 1974 and rises slightly in 1975. The portion of the intermediate predators increases a little in 1971 and falls rapidly through 1973. A marked rise and fall of their relative abundance occurring in 1974 and 1975 respectively. For the small prey, a decreasing trend is observed during the first four years and then it increases suddenly in 1975. A rising trend is also observed for the "other group" during the first three years. It drops sharply in 1974 and then rises again in 1975.

4.3 The 1976 to 1981 period.

The Northern area.

From the 1975 condition, the relative abundance of the large predators drops slightly in 1976. After that it tends to rise until 1979 and then decreases sharply in the following year. It increases again in 1981. Large variations occur for the large zoobenthos feeders. The percentage declines from 1975 to 1977. Then after increasing in 1978, it decreases in the following two years and rises again in 1981. The intermediate predators show an increasing trend throughout the period, although their proportion drops in 1979. On the contrary, a tendency for the small prey to decrease in abundance is observed during 1976 to 1980. It increases slightly in 1981. For the group called "the others", a marked rise is observed in 1976. Then after declining for two years, it increases in 1979 and then decreases again in the following two years.

The Central area.

Two rising modes are observed for the abundance of the large predators. The first peak occurs in 1977 and the second in 1980. The percentage of the large zoobenthos feeders drops markedly in 1977 and increases slightly in the following year. After that it declines in 1979 and remains relatively constant for three years. For the intermediate predators, a clearly increasing trend is observed throughout the period, although it drops slightly in 1978. The percentage of the small prey, on the other hand, tends to decrease during the first four years and then increases in 1981. The proportion of "the others" falls in 1976 and 1977. Then after increasing in the following year, it continues to decline during the remaining period.

The Southern area.

A great variation is observed for the large predators. Their percentage drops quickly in 1976 followed by a prominent rise and fall in abundance in 1977 and 1978. Then after increasing during the next two years, it declines again in 1981. The proportion of the large zoobenthos feeders shows a small drop in 1976. It continues to increase sharply until 1978. A sharp decline is observed in 1979 and then it decreases slowly in the following two years. As in the other two areas, the relative abundance of the intermediate predators has a tendency to increase throughout the period. The small prey, on the other hand, show the opposite change. Their contribution to the community continues to decrease sharply from 1975 to 1979 and then increases very little during the remaining period. The "other group" in this area shows a different trend of changes from those occurring in the other two areas. It tends to rise from 1975 to 1980 and then decreases in 1981.

The overall trends might be viewed as follows:

The "other group" shows an increasing trend throughout the period of 1963 to 1981 although there are some large variations and they seem to decline during the latter years of the period. Among the four remaining groups, recombined from the 17 other major species groups, three groups demonstrate either decreasing trends or large variations or both. The changes in abundance of the intermediate predators have some characteristics that should be considered in detail. For this group, it is of interest to note the observable trends of increase in abundance occurring, at least, during the first and third periods of this study. These rising trends have been clearly observed in all three study areas. The major species groups that play important roles in these increases include *Psettodes erumei*, *Priacanthus*, Synodontidae and *Sphyræna*. The roles of these species groups in the increases in abundance are different in both timing and areal aspects.

During the period 1971 to 1975, the following phenomena have been observed. In the Northern area, *Psettodes erumei*, *Priacanthus* and Synodontidae are the most important groups that increase markedly. In the Central area, the prominent species groups that result in the rising trend include *Priacanthus*, Synodontidae and *Sphyræna*. The two species groups that contribute a great deal to the increase of abundance in the Southern community are *Priacanthus* and Synodontidae. During 1976 to 1981, *Priacanthus* mainly causes the rise of the group in the Northern area. In the Central area, *Priacanthus* and *Sphyræna* are the dominant causes of the increase in abundance of this group. While the Synodontidae and *Sphyræna* are the prominent components of the rise in the Southern community.

Besides the increases of these species groups, some species groups are seen to have disappeared from the communities. They include *Pomadasys* and the Plectorhynchidae. In the North, *Pomadasys* is not present firstly in 1973 and

secondly in 1979 through 1981. The disappearance of Plectorhynchidae occurs in 1981. *Pomadasys* and Plectorhynchidae disappear from the Central community in 1981, and inspite of this the intermediate predators still increase markedly during this year. In the Southern community, *Pomadasys* is not present in 1975, 1977 to 1978 and 1980 to 1981, while the Plectorhynchidae disappears in 1981. It is not known whether the disappearances of these fish is temporary or permanent. In fact, during the history of the demersal fisheries in the Gulf of Thailand, besides these two species groups, the loss of Rays and Rhinobathidae have also been observed. The Rays disappeared from the Northern and Central communities in 1977. The disappearance of the Rhinobathidae in the Northern area occurred during 1975 to 1976 and 1980 to 1981. But in the Central part of the Gulf, they vanished from the community during 1973 to 1974 and 1976 to 1981. Except for the last case, the disappearances all seem to be temporary. This might be the case of the *Pomadasys* and the Plectorhynchidae in the Central part of the Gulf and the Plectorhynchidae in the Southern community, but as for the *Pomadasys* in the Northern and Southern areas these might not be included. In other words, it might be said that *Pomadasys* in these two areas is endangered as well as Rhinobathidae in the Central part of the Gulf.

After 18 years of changes, the composition of the demersal fish communities in all three areas is as follows: In 1981, the Northern community is composed of 2.03% large predators, 0.81% large zoobenthos feeders, 44.73% intermediate predators, 13.13% small prey and 39.30% "the others". While the Central community consists of 0.61% large predators, 0.12% large zoobenthos feeders, 55.74% intermediate predators, 10.56% small prey and 32.96% the "other group". The community inhabiting the South is composed of 1.42% large predators, 0.09% large zoobenthos feeders, 47.82% intermediate predators, 13.73% small prey and 36.92% "the others".

5. Relationship between the small prey and the intermediate predators

After taking a close look at the rises and falls of the four main groups as described in Section 4, it is observed that the rises of the intermediate predators largely correspond to the falls of the small prey, and vice versa. These relationships clearly show up during the periods 1963 to 1970/1971 and 1975/1976 to 1980/1981. The relationship during the first period seems to occur at a higher level of abundance of both groups than occurs in the later period. To illustrate this difference, it is replotted in Figure 4 with the small prey on the abscissa and the intermediate predators on the ordinate.

According to Figure 4, it can be clearly seen that there appears to be a different form of relationship occurring in these two periods. Therefore, the correlation analysis was separately conducted for each period. The criteria for selecting the data points were as follows. Firstly, it was intended to use the data of the middle period as little as possible. Secondly, these must be data belonging to the following years. Thirdly, the points to be deleted from the analysis must be the points at either end of the periods.

The results of the analysis show that the relationships during the first period in the Northern, Central and the Southern areas are significant at a 95% level with the correlation coefficients of -0.9739 (degree of freedom 4), -0.8042 (degree of freedom 5) and -0.9294 (degree of freedom 5) respectively. During the later period, however, the relationship in the Central community is the only one that is significant at the 95% level ($r = -0.8455$ with degree of freedom 4). The correlation coefficients for the North and the South are -0.7185 (degree of freedom 5) and -0.7944 (degree of freedom 4) which are close to the critical values of -0.754 and -0.811 respectively. Thus, these relationships are almost significant. All six regression lines are drawn in Figure 4 to illustrate the general trends of the relationships.

The results reveal that there are reverse relationships between the small prey and the intermediate predators. These relationships are not unreasonable. Firstly, the two groups are much closer together than the other groups, e.g. the first must be consumed directly by the latter. Secondly, both groups contribute high and significant proportions to the communities. Therefore, they should have greater effect on the communities than the others. It is observed, however, that the effects of one on another differ between areas. During the first period, the slopes of the regression lines range from -1.0934 for the Northern area to -1.7860 for the South, with that for the Central area in the middle at -1.5274. The slopes of the regression lines during the later period seem to be considerably different. They range from -0.3377 for the Southern community to -2.5395 for the North, and the intermediate value is -1.1776 for the Central area. It should be noted that the highest and lowest figures are those of the North and the South. The reasons for this are not clearly known. They might well be the effects of the fisheries as well as the differences in abundance of the other groups and/or of that of the two groups themselves.

It must be pointed out here that in the correlation analysis, the variables used here, i.e. the percentages, must be used with utmost caution due to the nature of these variables. It is known that, for percentages, when one is low, the other must be high and vice versa. But this does not seem to be the case for this study. Firstly, the "other group" has, in general, an increasing trend. Secondly, the large predators and large zoobenthos feeders show overall decreasing trends. Thus, in this analysis, although our variables are the percentages, they seem to be independent and can be safely applied for our purpose.

CONCLUSION

It is found that the relative coefficients of catchability, expressed in terms of that of *Sphyræna*, range from 0.3248 for *Psettodes erumei* to 3.8120 for Rhinobathidae. The majority lie between 0.7562 and 1.8949. In the otter board trawl fisheries, nine species groups are caught more easily than *Sphyræna* while the rest are more difficult to fish.

The stock sizes of all species groups combined in the Northern, Central and Southern parts of the Gulf decline, on average, at the same rate during 1963 to 1975. The decreasing rate is 0.1367 per year in natural logarithmic unit. This suggests that the development of the trawl fisheries in all areas has, in general, a similar trend although during the first few years the Northern stock might have been fished more heavily than the Central and the Southern stocks but this is compensated for by the reduction of the fishing pressure in the later years. The annual fishing effort made in the fisheries in the Central and Southern areas increases from 1966 to 1974/1975 by about 7.6-9.8 times.

After 1975, the Northern and the Central stocks tend to increase slightly while the Southern stock continues to decline. This suggests that the fishing pressure in the first two areas reduced at a higher rate than in the South.

In a virgin condition, the productivity of the demersal fish is higher in the North than in the Central area, which in turn is higher than in the South. The percentages of the large predators in the Northern and Southern communities are higher than in the Central area. The status of the "other group" is contrary to this. The proportion of the large zoobenthos feeders and the small prey increases from the North to the South, while the proportion of the intermediate predators decreases from the North to the South.

After increasing from a virgin condition, the percentages of the large predators are, on the average, decreasing for many years until 1974. They then tend to steadily increase during the first few years of the late 1970's. After these years, large variations occur. The proportion of the large zoobenthos feeders tends to decrease throughout the study period. But for the "other group", their proportion has a general rising trend until 1975/1976. After this, the Northern and Central stocks tend to decline. While in the South they increase from 1975 to 1978 and remain relatively constant for years and then drop in 1981. The relative stock sizes of the intermediate predators increase continuously during 1963 to 1970/1971. There is no definite trend during the first half of the 1970's, but after 1974/1975, they tend to rise continuously again. The increases during both periods are a consequence of the addition of *Psettodes erumei*, *Priacanthus*, Synodontidae and *Sphyraena* to the communities. During the first period, these species groups are *Psettodes erumei*, *Priacanthus* and Synodontidae in the North; *Priacanthus* Synodontidae and *Sphyraena* in the Central area; and *Priacanthus* and Synodontidae in the South. During the later period, the increasing species groups include *Priacanthus* in the North; *Priacanthus* and *Sphyraena* in the Central area; and Synodontidae and *Sphyraena* in the South.

The Rays, Rhinobathidae, *Pomadasys* and Plectorhynchidae disappear from the communities, either for a short or a long interval. The species groups that disappear temporarily include the Rays in the North and Central areas, Plectorhynchidae in all areas, *Pomadasys* in the North and Central areas and possibly Rhinobathidae in the North. The species groups that disappear for a long interval and probably become endangered are *Pomadasys* in the Southern community and Rhinobathidae in the Central area. The losses of *Pomadasys* and the Plectorhynchidae are compensated for by the increase of *Psettodes erumei*, *Priacanthus*, *Sphyraena* and Synodontidae.



The relative abundance of small prey and intermediate predators are inversely correlated during the periods of, 1963 to 1970/1971 and 1975/1976 to 1980/1981. The negative relationships are the consequence of the effect of the feeding habits of the intermediate predators on the small prey. The regression lines illustrating the relationships during the later period are located lower and to the left of the first period. These phenomena are caused by the high percentage of the "other group" during the later period which results in the low proportions of both the small prey and the intermediate predators. The effects of one on another differ between areas. During the first period, the slopes of the regression lines decrease from the North to the South. During the second period, however, they increase from the North to the South.

ACKNOWLEDGEMENTS

I wish to thank Mrs. Matana BOONYUBOL who provided the unpublished survey data used in this study; without her assistance this study would not have been possible. Thanks are also due to Dr. Veravat HONGSKUL, and the SEAFDEC staff who reviewed the manuscript and gave many valuable comments and recommendations.



REFERENCES

- CHARNPRASSERTPORN, T. (1982). An analysis of demersal fish catches taken from otter board trawling survey in the Gulf of Thailand, 1980. Dept. of Fish., Demersal Fish. Rept. No. 1/1982, 82 p.
- EIAMSAARD, M., D. DHAMNIYOM and S. PRAMOKCHUTIMA (1979). An analysis of demersal fish catches taken from otter board trawling survey in the Gulf of Thailand, 1977. Dept. of Fish., Demersal Fish. Rept. No. 1/1979, 21 p.
- EIAMSAARD, M. and D. DHAMNIYOM (1980). An analysis of demersal fish catches taken from otter board trawling survey in the Gulf of Thailand, 1978. Dept. of Fish., Demersal Fish. Rept. No. 2/1980, 40 p.
- (1981). An analysis of demersal fish catches taken from otter board trawling survey in the Gulf of Thailand, 1979. Dept. of Fish., Demersal Fish. Rept. No. 1/1981, 106 p.
- FOX, W. W. (1970). An exponential surplus production model for optimizing exploited fish population. Trans. Amer. Fish. Soc., 99(1): 80-88.
- PAULY, D. (1979). Theory and management of tropical multispecies stock: A review with emphasis on the Southeast Asian demersal fisheries. ICLARM Studies and Review. No. 1, 35 p.
- PRAMOKCHUTIMA, S. and M. EIAMSAARD (1979). Status of trawl fisheries resources in the Gulf of Thailand. Dept. of Fish., Demersal Fish. Rept. No. 7/1979, 31 p.
- RITRAGSA, S. (1974). Results of the study on the status of fish resources in the Gulf of Thailand from trawling surveys, 1963 to 1973. Mar. Fish. Res. Lab., Bangkok.

- SOMMANI, P. (1983). An assessment of the multispecies demersal fisheries and fish stocks in the Southern part of the Gulf of Thailand. SEAFDEC Joint Research Paper (Thailand), No. 4, 30 p.
- TIEWS, K., P. SUCONDHAMARN and A. ISARANKURA (1967). On the changes in abundance of demersal fish stocks in the Gulf of Thailand from 1963/1964 to 1966 as a consequence of the trawl fisheries development. Dept. Fish., Demersal Fish. Rept. No. 8, 39 p.
- VADHANAKUL, S., Y. MEMESKUL and S. PRAMOKCHUTIMA (1985). An assessment of demersal fish catches taken from otter board trawling survey in the Gulf of Thailand, 1981. Dept. of Fish., Demersal fish. Rept. No. 5/1983, 71 p.
- FOX, W. W. (1970). An exponential surplus production model for optimizing exploited fish populations. Trans. Am. Fish. Soc., 99: 52-58.
- FAIRY, D. (1979). Theory and management of tropical multispecies stocks: A review with emphasis on the Southeast Asian demersal fisheries. Asian Fisheries and Review, Vol. 1, No. 2.
- PRAMOKCHUTIMA, S. and K. KIRKHAM (1979). Status of small fisheries resources in the Gulf of Thailand. Rept. of Fish., Demersal Fish. Rept. No. 1/1979, 21 p.
- KIRKHAM, S. (1979). Results of the study on the status of fish resources in the Gulf of Thailand from trawling surveys, 1967 to 1973. Rep. Fish. Res. Lab., Bangkok.

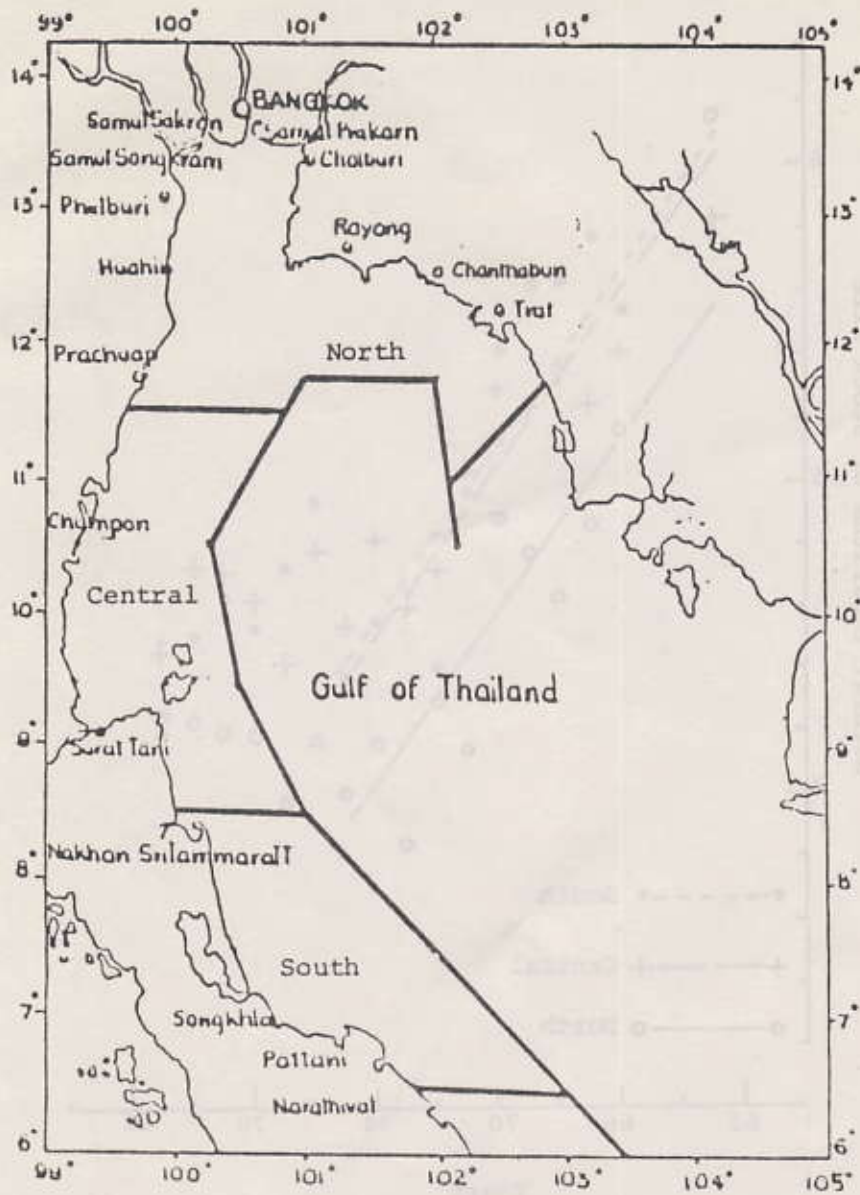


Figure 1. The Gulf of Thailand showing the study areas

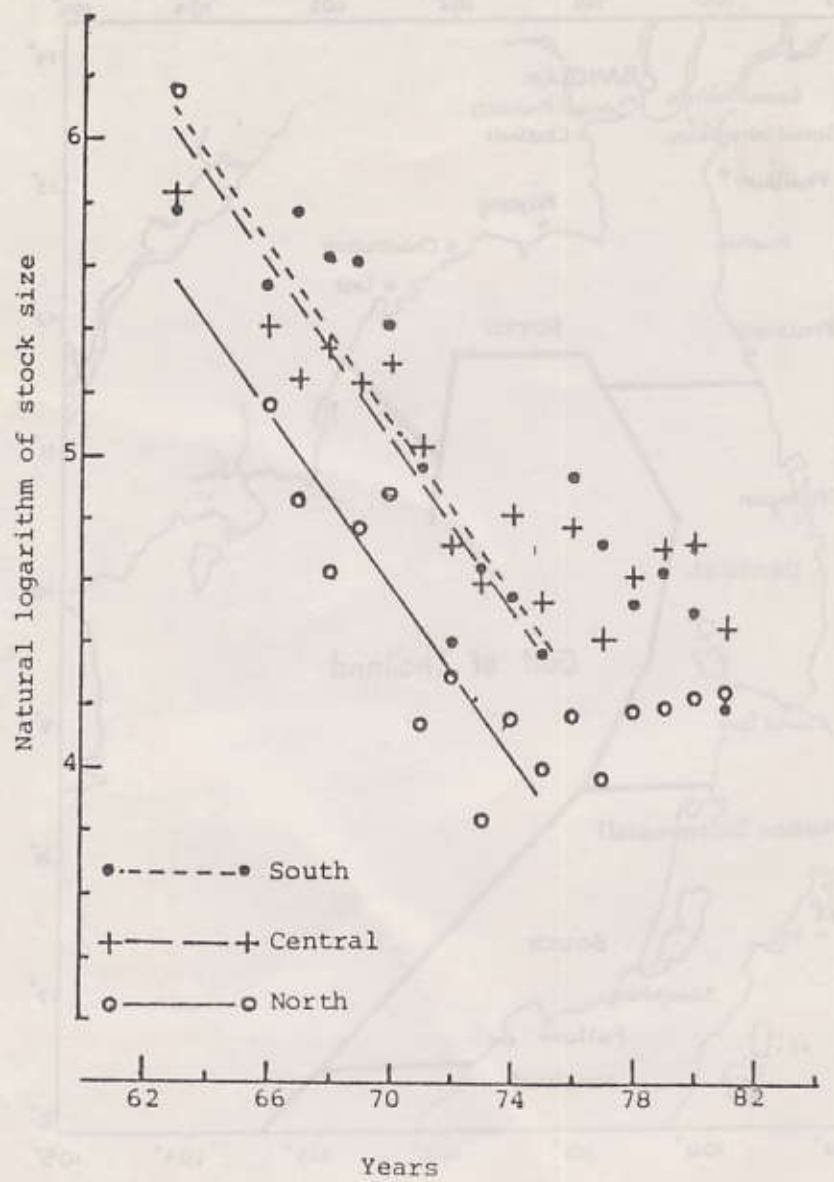


Figure 2. Changes in the stock size

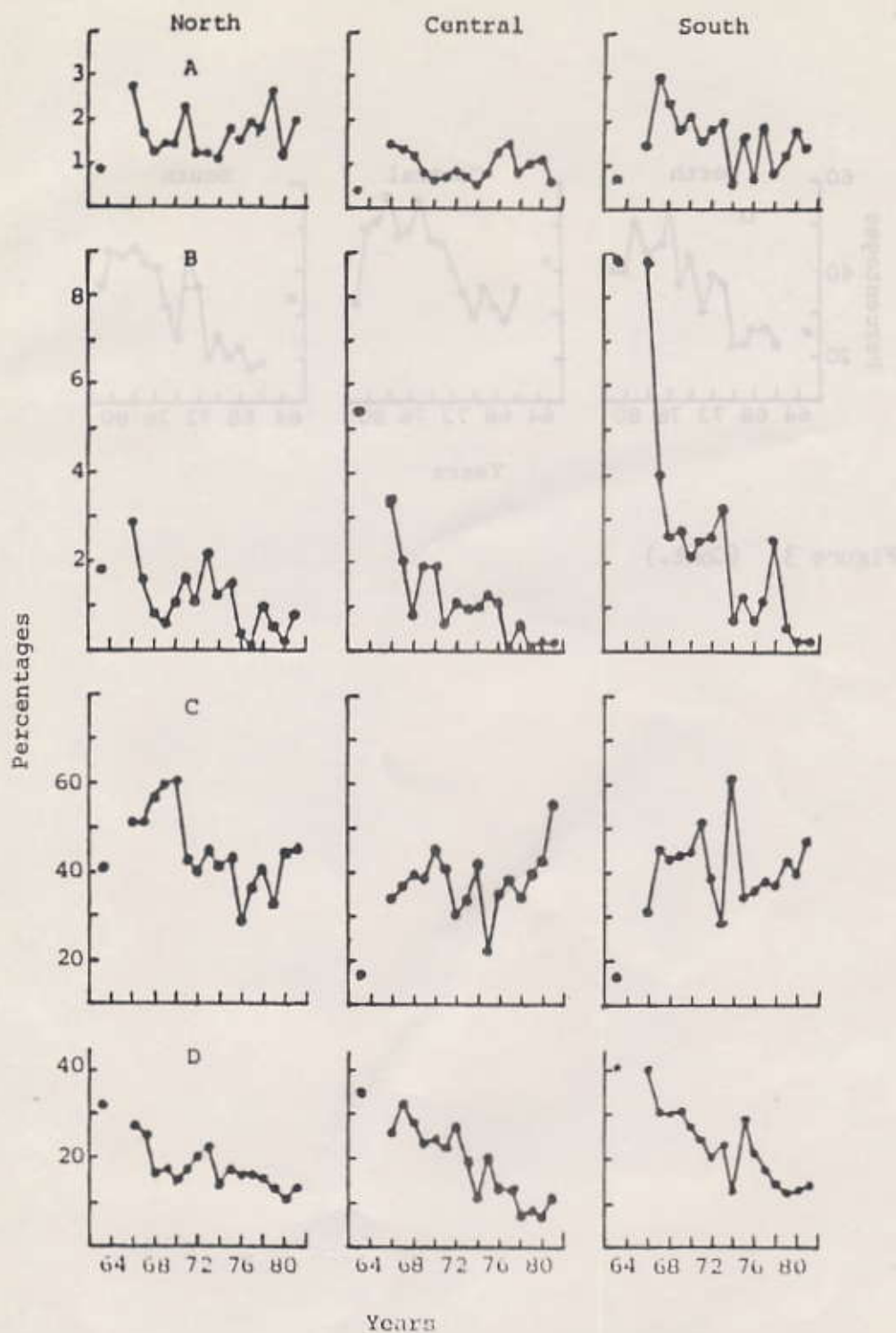


Figure 3. Dynamics of the demersal fish community composition in the 3 areas during 1963 to 1981.
A = Large predator, B = Large zoobenthos feeder,
C = Intermediate predator, D = Small prey, O = Others

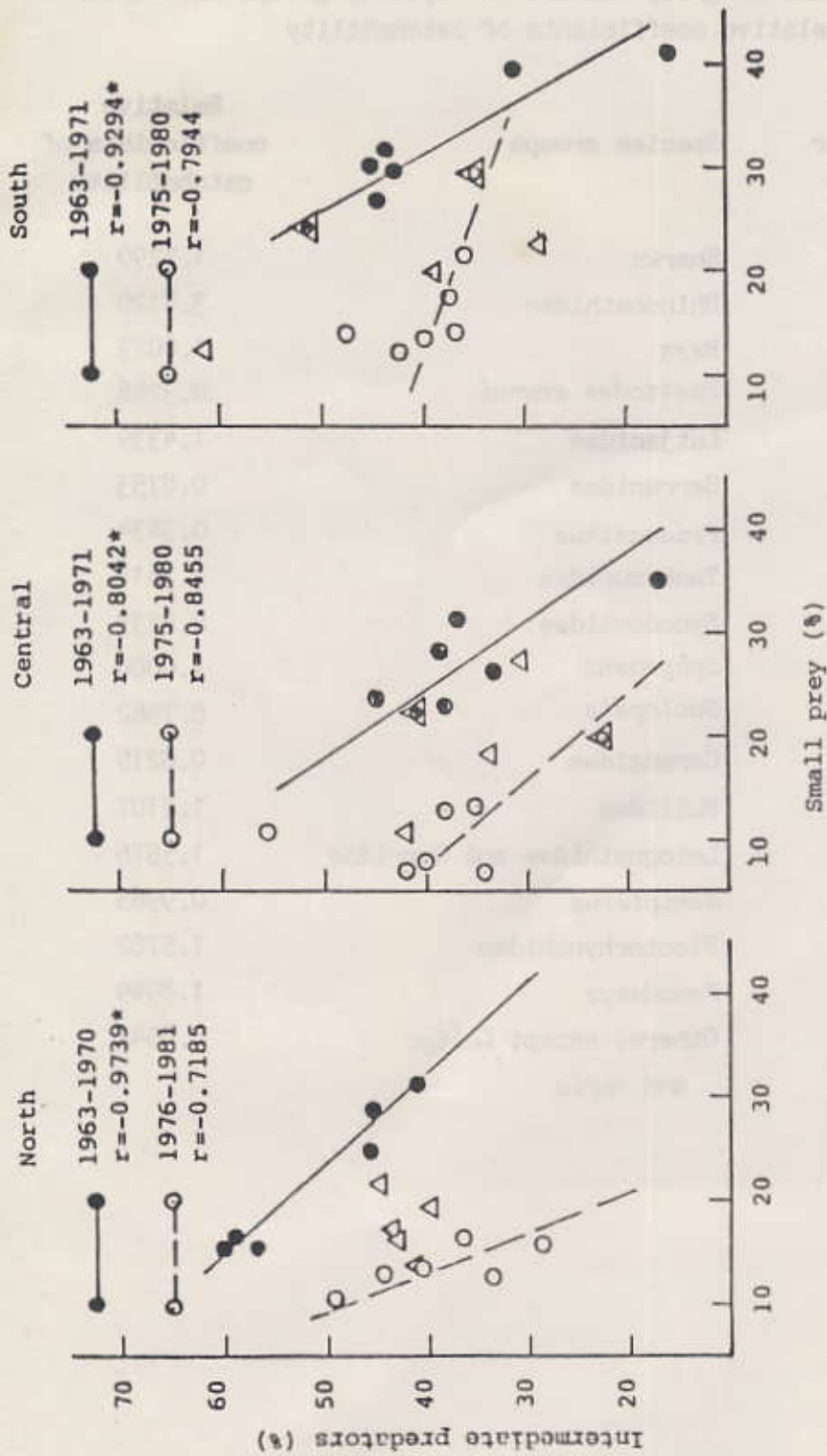


Figure 4. Relationship between the small prey and the intermediate predators.
 (The triangles represent 1971-1975 data the triangles with a circle in the center have been included in the analysis).

Table 1. List of group numbers and species groups with their relative coefficients of catchability

| Group number | Species groups | Relative coefficeints of catchability |
|--------------|--|---|
| 1 | Sharks | 1.7290 |
| 2 | Rhinobathidae | 3.8120 |
| 3 | Rays | 1.6023 |
| 4 | <i>Psettodes erumei</i> | 0.3248 |
| 5 | Lutjanidae | 1.4339 |
| 6 | Serranidae | 0.8753 |
| 7 | <i>Priacanthus</i> | 0.3434 |
| 8 | Tachysuridae | 1.1614 |
| 9 | Synodontidae | 0.4233 |
| 10 | <i>Sphyraena</i> | 1.0000 |
| 11 | <i>Scolopsis</i> | 0.7562 |
| 12 | Carangidae | 0.8215 |
| 13 | Mullidae | 1.2107 |
| 14 | Leiognathidae and Gerridae | 1.5576 |
| 15 | <i>Nemipterus</i> | 0.9965 |
| 16 | Plectorhynchidae | 1.5762 |
| 17 | <i>Pomadasys</i> | 1.8949 |
| 18 | Others, except <i>Loligo</i> and <i>Sepia</i> | 0.8542 |