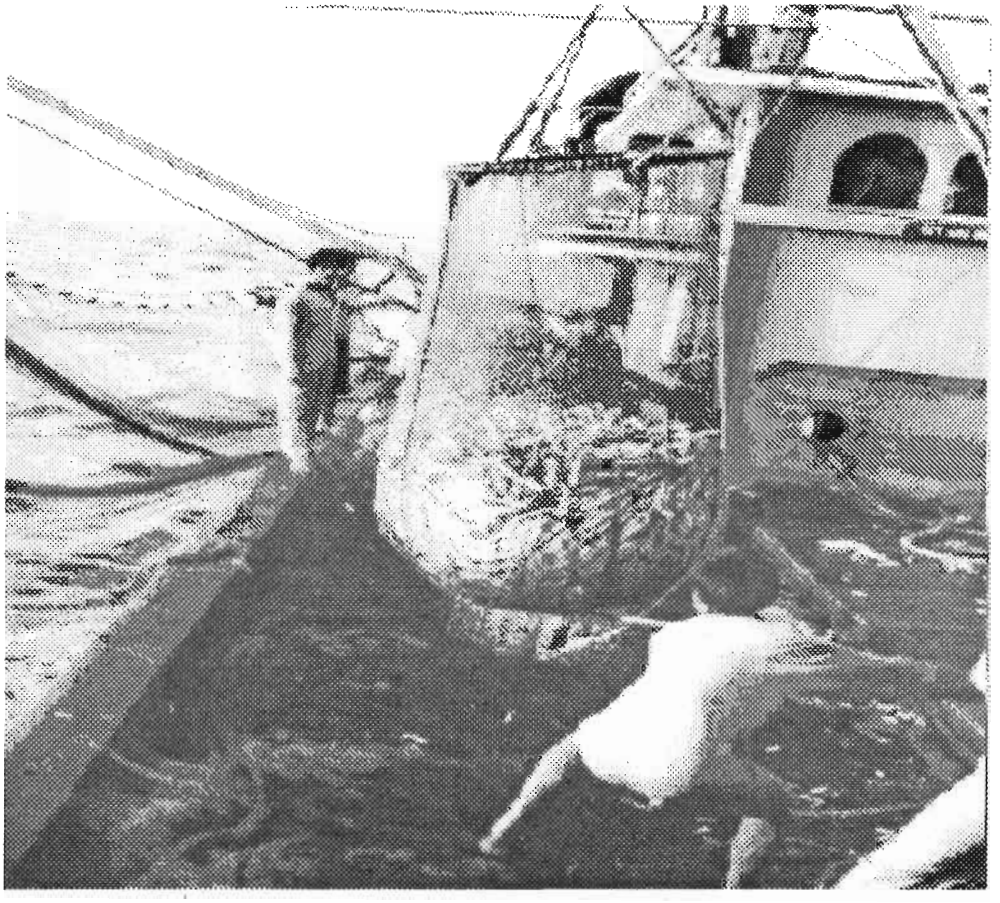
FISHING STRATEGIES AND TACTICS IN THE JAVANESE SEINERS FISHERIES

M. POTIER, D. PETIT

BRAILING THE FISH ON BOARD

MENANGKAI IKAN KE ATAS KAPAL



ABSTRACT

Fishing strategies and tactics are related to the knowledge fishermen have about environment , to the behavior of the fish and to the socio-economical factors which affect the fishery.

The fishermen knowledge is applied to the strategy (time scale from the trips - less than one month up to one year), and to the tactics which is the way fish are caught (time scale, fishing operations). The strategy of the Javanese fishermen is highly correlated with the monsoons regime. The alternation of these seasons induces changes in the abundance of fish in the Java Sea. Fishermen choose their fishing areas according to the fluctuation of the abundance.

Before 1992, the trip strategy was to choose one fishing ground and to spend all the fishing days in this zone. Since then, some technical changes have appeared. All fishing vessels are now equipped with radio and the strategy is to prospect two or three fishing zones during one trip. The strategy which was an individual one is becoming a fleet one. But even now the aim is to be at sea during the new moon when the catch is believed to be higher.

Because of the fish behavior and of the vessels they use, the fishing tactic of the Javanese fishermen consists of concentrating the fish by means of Fish Aggregating Devices (FAD) and lamps. During the first development stage of this fishery the FAD had the main role in aggregating the fish. Since 1988 lamps have replaced the FAD in this function. The number of set by night will vary from one in full moon to two in new moon. Seiners are not randomly distributed in the fishing grounds.

Strategi dan taktik penangkapan adalah berhubungan dengan pengetahuan alami dari nelayan, tingkah laku ikan yang akan ditangkap dan faktor sosial ekonomi yang mempengaruhi perikanan.

Pengetahuan tersebut diterapkan dalam pengaturan strategi dan taktik penangkapan untuk penangkapan ikan. Strategi penangkapan nelayan Jawa sangat berhubungan dengan musim muson. Pergantian musim mempengaruhi perubahan kelimpahan ikan di Laut Jawa. Nelayan akan memilih daerah penangkapan menurut naik turunnya ikan yang tersedia pada daerah tersebut. Sebelum 1992, dalam satu trip dipilih hanya satu daerah penangkapan. Selanjutnya setelah kapal-kapal dilengkapi dengan radio, maka dalam satu trip dapat beroperasi pada beberapa daerah penangkapan. Pada bulan baru penangkapan meningkat dengan harapan hasil tangkapan lebih baik.

Sesuai dengan tingkah laku ikan dan kondisi kapal, maka dipakai rumpon dan lampu untuk mengumpulkan ikan. Pada awalnya rumpon mempunyai peranan yang penting dan setelah tahun 1988 peranan tersebut digantikan oleh lampu. Jumlah tawur per malam berbeda, tergantung apakah saat itu bulan penuh atau bulan baru. Penyebaran kapal pada suatu daerah penangkapan adalah tidak acak.

INTRODUCTION

Fishermen want to catch the fish in the most efficient way in order to maximize the time they spend at sea and raise their profit. To achieve this goal, they are willing to quickly adopt new technologies. The introduction of the seine in the Java Sea was a technological improvement

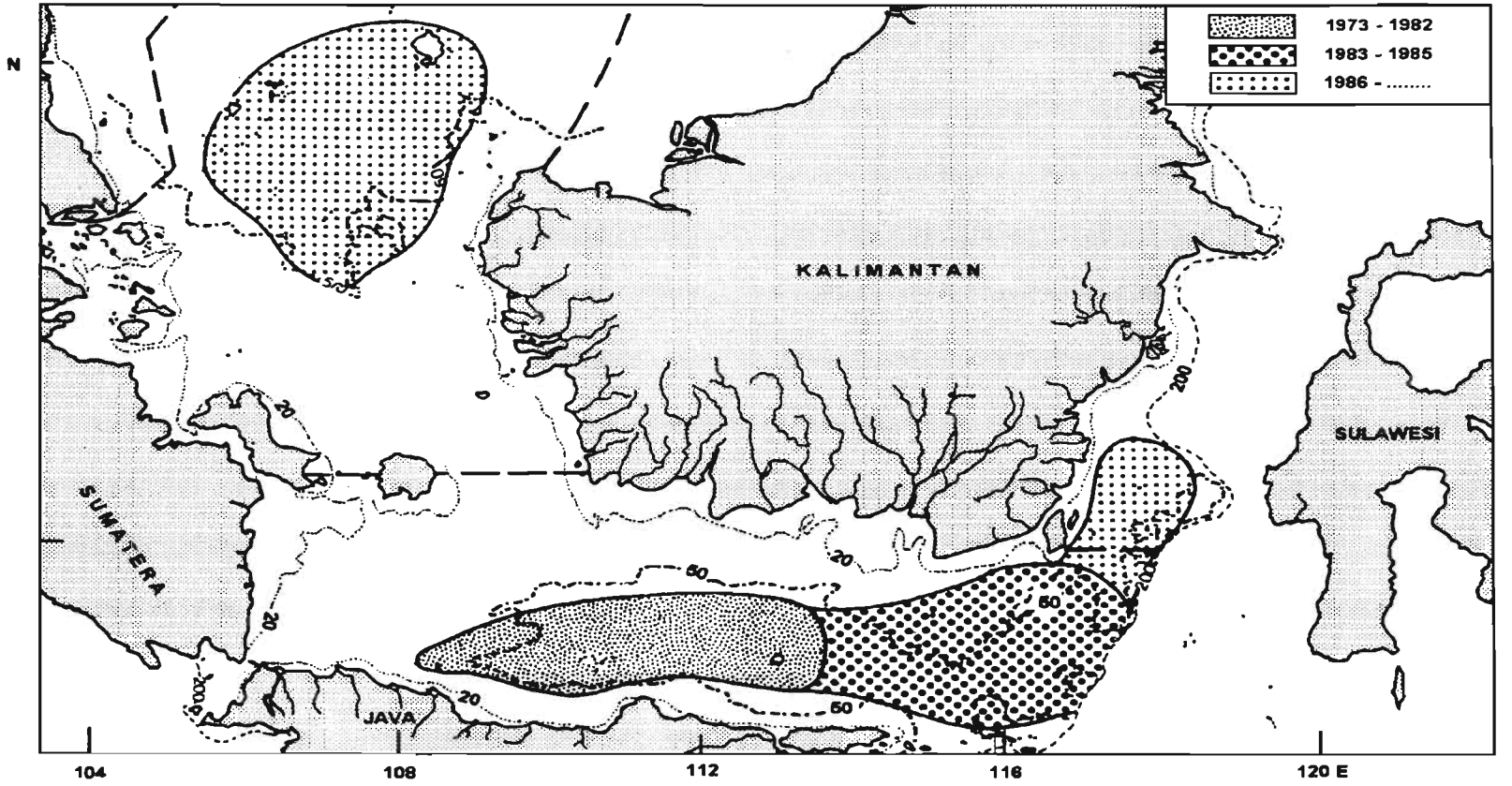


Figure 1

FISHING GROUNDS EXTENSION FOR THE LARGE SEINERS FISHERY.

PERLUASAN DAERAH PENANGKAPAN PURSE SEINE BESAR

which allowed the Javanese fishermen to fish all along the year and to have a higher catch compared with the catch of traditional nets such as **"payang"**.

Fishermen rely on their knowledge of the environment and of the fish behavior then they apply it to the fishing strategies and tactics. The fishing strategies are related to mid and long time scales (Ferraris, 1993) such as the trips or the yearly occupation of the fishing space by the fisheries. They are a set of coordinate actions to track and find the fish. The fishing tactics are related to short time scale, mainly the fishing operation to catch fish.

In this paper, we analyze the strategies and fishing tactics of the Javanese seiners fisheries. We used the data collected by the Project since 1985, as we know the number of trips by fishing ground only since that year. We also performed monthly enquiries among the fishing masters of large, medium and mini seiners.

1. FISHING STRATEGIES

Three times scales can be used to understand the fishing strategies followed by the seiners fisheries of the Java Sea; a long-term one (historical evolution), a mid-term one (yearly occupation of the space) and a short-term one (trip).

1.1 Long-term strategy : Occupation of the available space.

Since its implementation in 1971, the seiners fisheries continuously extend the prospected space. The large seiners fishery had two extension phases;

- In the first one, from 1973 to 1985, the fishery occupied the whole Java Sea above 50m deep. Concentrated on the traditional fishing grounds until 1982, it extended its fishing zones eastward to Masalembo, Matasiri and Kangean (fig. 1).

- In the second one, from 1986 to 1988, the seiners left the fishing grounds of the Java Sea to extend eastward to the Makassar Strait, and northward to the South China Sea. First, located in the fishing grounds of the Central Java Sea, the medium seiners which appeared in 1987 at Pekalongan extended eastward to Masalembo and Matasiri since 1990.

1.2 Mid-term strategy : Use of the space.

It is based on the yearly occupation of the space and differs from one fishery to another.

- LARGE SEINERS.

The strategy of large seiners is to change fishing grounds according to the environmental conditions and to the fish accessibility. A multivariable analysis in principal components of the number of trips according to the fishing grounds since 1985 shows that the scheme is almost the same year after year (fig. 2). From January to April the vessels are concentrated on the Makassar Strait grounds. In April-May they move to the grounds of the South China Sea. In August they come back on the Central Java Sea fishing grounds close to the landing places and move eastward as the North-West monsoon approaches. In December they reach the eastern limit of the Java Sea (fig. 3). At the time being, half of the fishing year is spent outside the Java Sea.

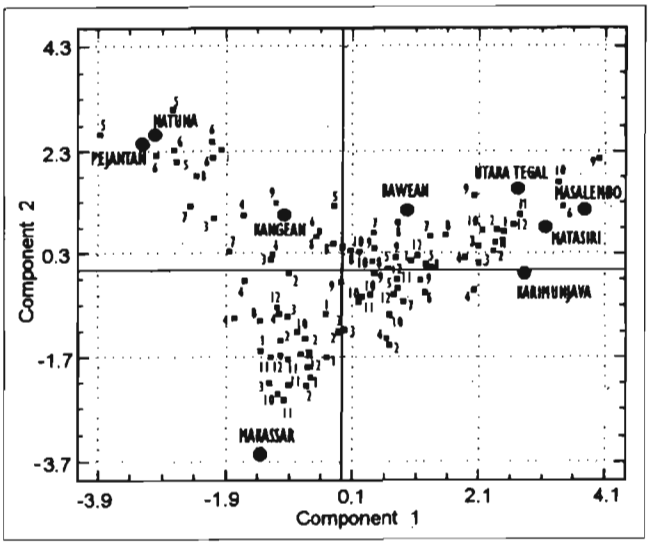


Figure 2

MULTIVARIATE ANALYSIS OF THE LARGE SEINERS TRIPS DISTRIBUTION ACCORDING TO THE FISHING GROUNDS BETWEEN 1985 AND 1992

ANALISIS MULTIVARIAT PENYEBARAN TRIP PURSE SEINE BESAR BERDASARKAN DAERAH PENANGKAPAN DARI TAHUN 1985 SAMPAI DENGAN 1992.

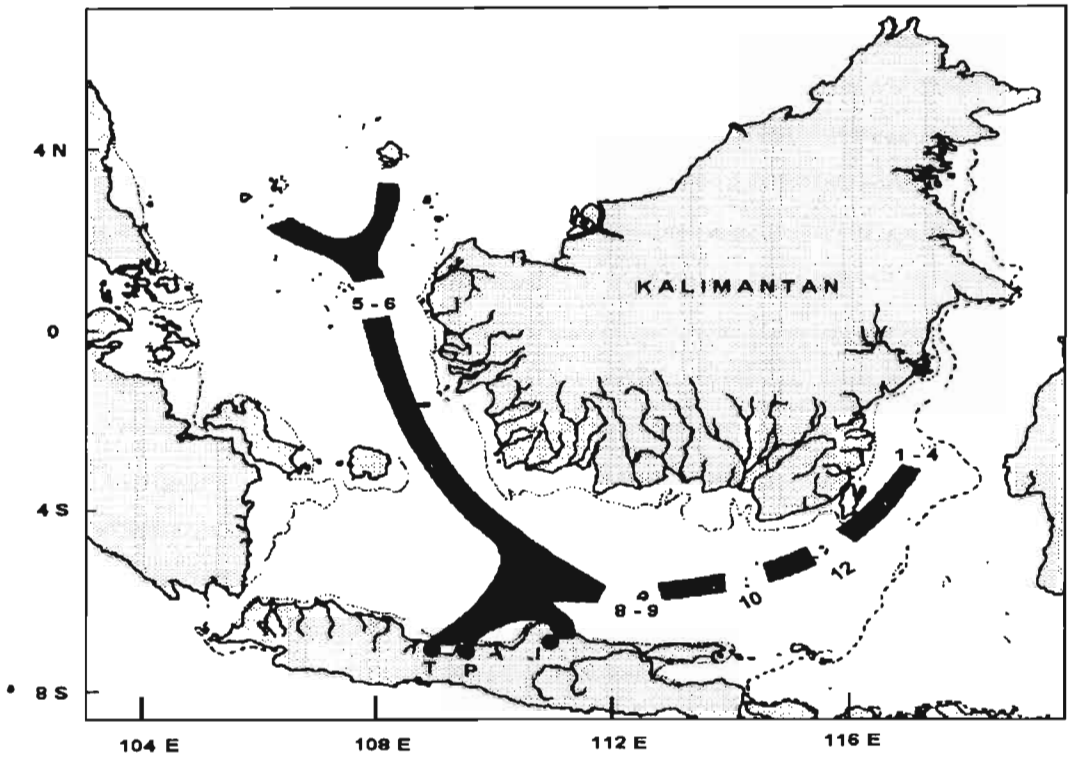


Figure 3

YEARLY FISHING CYCLE OF THE LARGE SEINERS FISHERY

CYCLUS TAHUNAN PENANGKAPAN PERIKANAN PURSE SEINE BESAR

1-12 : Months

T : Tegal, P : Pekalongan, J : Juwana

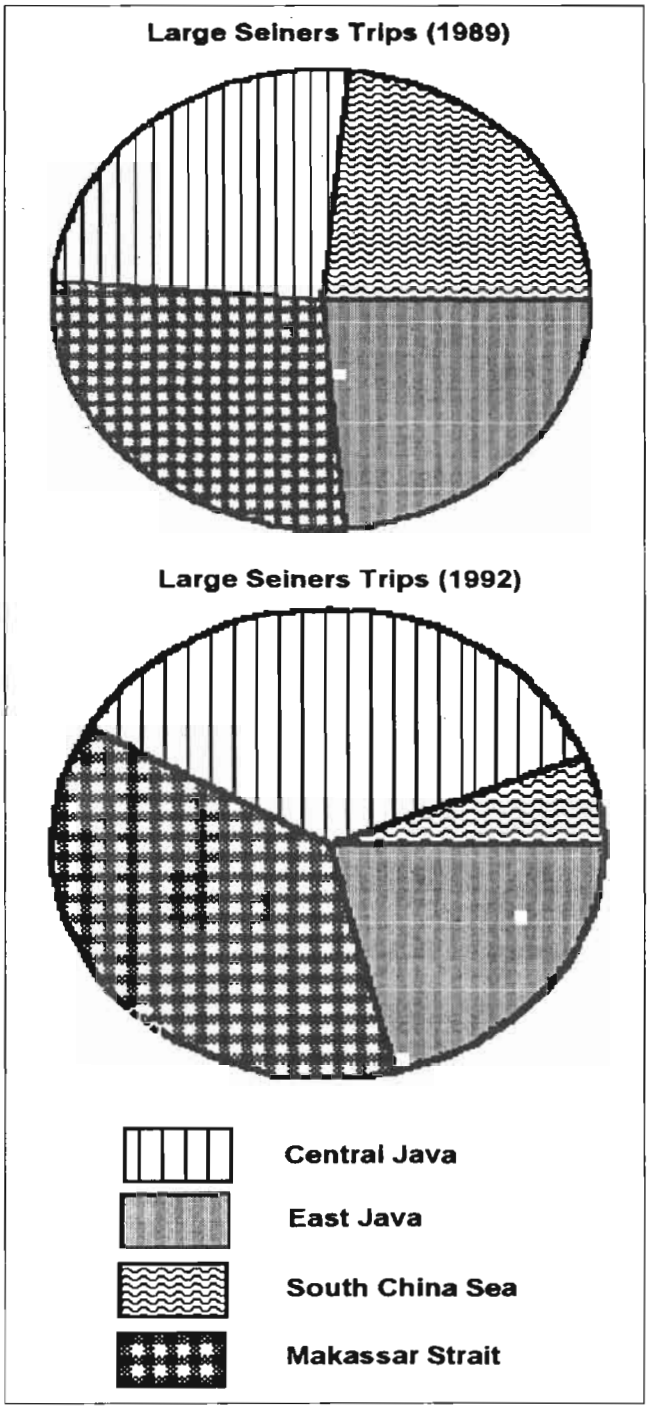


Figure 4

FISHING STRATEGY FOR TWO TYPICAL YEARS

STRATEGI PENANGKAPAN UNTUK DUA TAHUN YANG BERBEDA.

However, this strategy can be easily adapted. Sometimes, when the environmental conditions prevailing in the Java Sea are not good (1989) the fishing vessels spend more time outside the Java Sea (fig. 4a). Similarly, due to low rainfalls during the first months of the year or to a delay in the beginning of the North-West monsoon, the oceanic waters enter far in the Java Sea and the fish is found in the fishing grounds close to the landing places (1992). In this case the fishing vessels stay longer on these fishing grounds (fig. 4b).

■ MEDIUM SIZE SEINERS

These seiners stay along the year in the Java Sea and follow a strategy used by the large seiners before 1985. In May-June, when the fish accessibility is low, they lay up or dock. They start fishing in July-August on grounds close to the landing places. Until December they move eastward as the large seiners do. From January to April they stay close to the coast because of the bad weather (strong winds) (fig. 5).

■ MINI SEINERS

The mini seiners based along the northern coast of the Java Island move along the coast toward the Sunda Strait and the Bali Strait (fig. 6). During the July-December period they remain in the vicinity of their registration places. From

January to April, the mini seiners of the province of East Java move to the Madura Strait and the western part of the Java Island in order to avoid the rough conditions of the Java Sea. In May-June they leave the Java Sea and reach the Bali or Sunda Strait as during the **"Musim Sepi"** (quiet monsoon) the Java Sea seems to be empty of fish.

To avoid the prevailing winds of the monsoons, the mini seiners of South Kalimantan migrate from around the Laut Island during the North-West monsoon and to the **"Matasiri"** archipelago during the South-East monsoon.

Some of them can change fishing gear according to the target species. The Laut Island fishermen use seines for the mackerel season which occurs from November to April (*Rastrelliger kanagurta* and *Rastrelliger brachysoma*) and gill nets to fish small tunas. In Bulu, the fishermen change the bunt of the seine according to the target species.

1.3 Short-term strategy: The trip

■ LARGE SEINERS.

Since radio (S.S.B.) has been set on the vessels board, the fishery has changed from an individual to a fleet strategy. Before 90-91, the vessels did not prospect more than one fishing ground per trip.

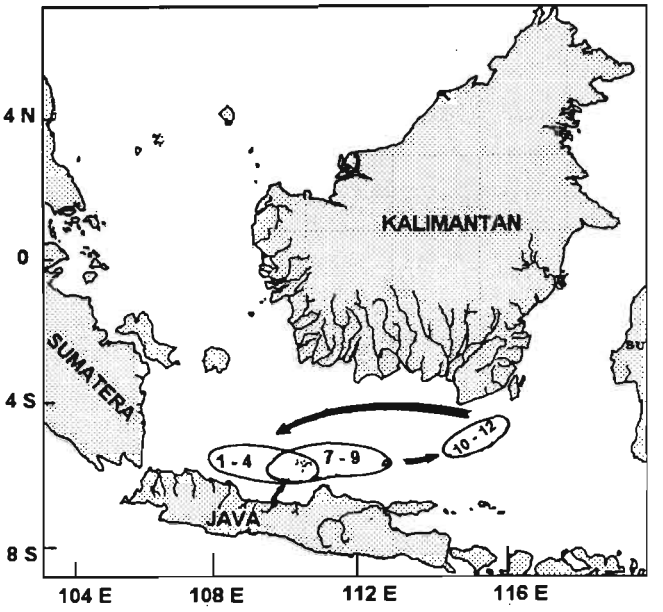


Figure 5

MEDIUM SEINERS FISHING GROUNDS ALONG THE YEAR.

DAERAH PENANGKAPAN PURSE SEINE SEDANG MENURUT PERIODE TAHUN.

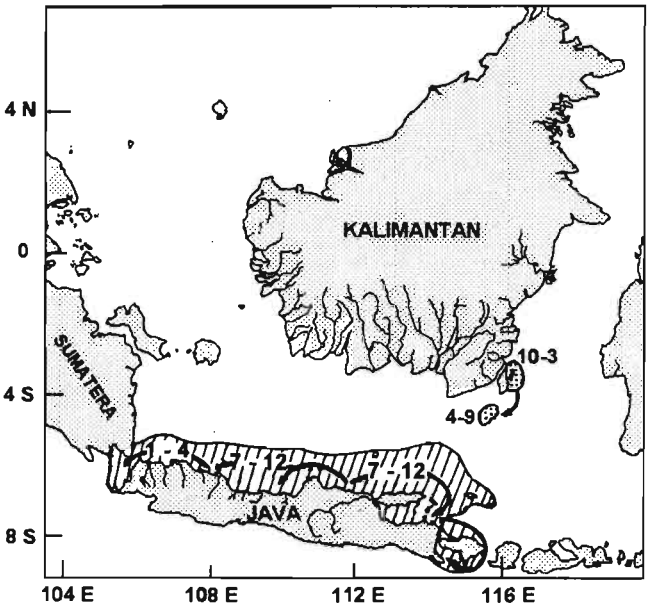


Figure 6

MINI SEINERS FISHING GROUNDS ALONG THE YEAR

PERIKANAN MINI PURSE SEINE, DAERAH PENANGKAPAN MENURUT PERIODE TAHUN.

With the radio, they use a pack strategy. Seiners from a same fishing company prospect different fishing grounds. When one of them find the fish it calls the others which then concentrate on this area. When the catch decreases they spread again on several fishing grounds in order to find the fish. With this expansion-contraction strategy they can survey two or three fishing grounds during the trip. For a few years the strategy was to stay at sea until the vessels were full. Nowadays, most of the owners can call their vessels and ask them to come back to the landing places when the price of the fish is high. But, the strategy is still to be at sea around the new moon when the catch is believed to be higher.

■ MEDIUM SEINERS.

These vessels still spend most of the trips on the same fishing ground and land in the registration place. They stay 8 to 10 days at sea, their strategy being to land fresh fish.

■ MINI SEINERS.

The strategy is adapted to the target species. If they catch small tunas or mackerels, they only stay one day at sea, looking for fish during daytime.

For the ones which catch small pelagic as scads, sardines and mackerels, the strategy is to maximize the benefit of the trip. They can stay at sea up to eight days even if they only have 4 days food and water stocks. Staying along their FAD they sell their catch at sea to some buyers coming on small boats who provide them some food and fuel.

2. FISHING TACTICS

Traditionally the Indonesian fishermen used the FADs or **"rumpon"** to catch fish. Around 1950, the use of light (paraffin pressure lamps) spreads. All the seiners fisheries in Indonesia use these tools widespread in Asia. In the seiners fisheries of the Java Sea lamps and rafts are combined. More often, the fishing operation takes place at night (Potier *et al.*, 1992) after aggregation of the fish.

2.1 Traditional Fishing tactics

The tactic is similar for all the fisheries and only differs in small details. It can be divided in two parts; the mooring of the rafts and the fishing operation itself.

■ MOORING OF THE RAFTS.

The choice of the rafts on a fishing ground depends on the color and the transparency of the water. A good fishing ground should be with transparent and deep-blue colored waters. The catch of fish with lines around old rafts or the observation of shoals at the surface just before dusk are good indicators.

Until 1988 the large seiners used to moor around 12 rafts on the same fishing ground. Now, the number decreases to four or five rafts, moored several nautical miles apart. They are laid according to compass bearings the first one used as a starting point, and marked with distinguishing flags to identify the parent vessel. The rafts remain there for several fishing trips (two to three months) until they deteriorate.

Mini seiners often moor only one raft which can stay five to six months in activity. This raft is moored 20 to 30 nautical miles of the coast. It is not used before 3 to 4 days, average time to get colonized. However, sometimes the sets occur the first night after the raft is moored.

■ Fishing operation.

Choice of the "rumpon": it starts in the afternoon when the vessel inspects the rafts. Every time lines are laid on, the raft in which the catch is the best or around which shoals have been seen is chosen. Before anchoring close to the raft, the vessel moves to find the best position according to the current and to the wind. The raft is secured with a rope remaining 10 to 20 m behind the stern of the vessel. As soon as mooring is done, before dusk (17h15-17h45), lamps are turned on and their supporting framework lowered to the horizontal so that they shine down into the sea. Mini seiners leave their landing place at 14h00-15h00 to be near their raft at dusk. After mooring they light on some paraffin pressure lamps placed on the raft.

Hauling the "rumpon": the setting starts by hauling the raft (fig. 7A) which is put on board with the ballast. The upper part of the line, around 18m, is laid on and placed along the hull. Paraffin pressure lamps are placed on floats in the water. Every 2 minutes the vessels lights are gradually turned off.

Setting: the vessel weighs anchor and moves away from the raft. It moves around the raft following the informations given by the "**Juru**

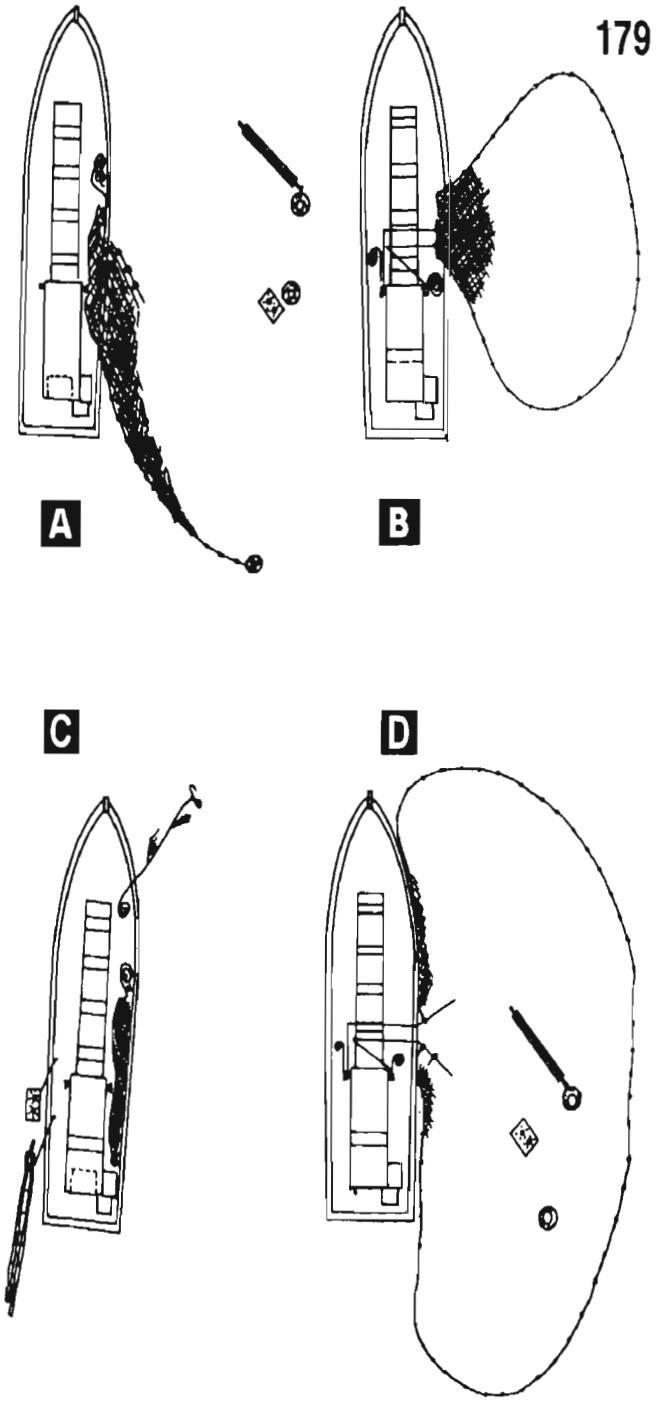


Figure 7

Different phases of a purse seine set

Urutan operasional penangkapan dengan purse seine

arus" (current master) about the current direction and the fish position .

Starting leeward, the net is shot over the stern (fig. 7B) while one fisherman in the water, with an inflated inner tube, holds on to a bamboo pole attached to the floating line and acts as a marker buoy. In order to be seen in the dark he carries an electric torch. The net is shot in a circle at full speed, the bamboo pole and the floating line are picked up at the bow. The boat is kept leeward from the net so that it does not drift into it. The setting operation is very fast, 3 minutes for the shooting, 15 minutes for the purse line hauling (fig. 7C) and 35 minutes to form the bag (fig. 7D). According to the moon one or two sets will take place during the night (Boely *et al.*, 1988). Setting times are usually between 11 p.m. and 1 a.m. and between 3 a.m. and 5 a.m. (fig. 8).

The mini seiners catch the small pelagic species as scads and sardines in the same way. To catch small tunas and mackerels they fish during the day "at sight" when the shoals are near the surface. At night they can catch some mackerels (*Rastrelliger brachysoma*). The fishermen look for the luminescence coming from the shoals of this species.

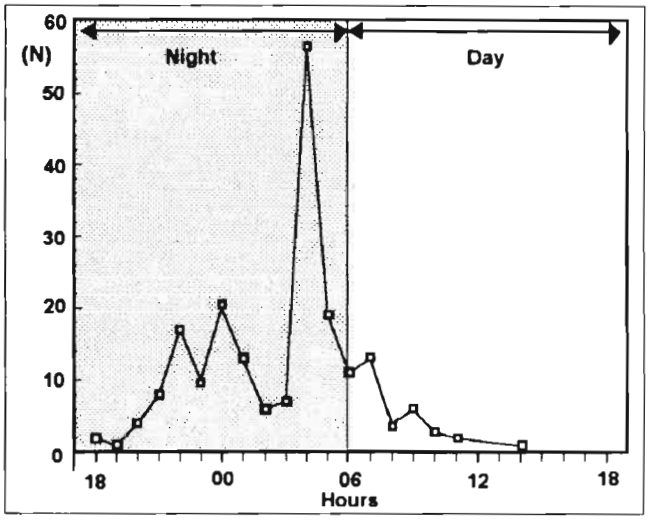


Figure 8

DISTRIBUTION OF THE SEINE SETS(N) ACCORDING TO THE NIGHT HOURS
PENYEBARAN JUMLAH SETING (N) BERDASARKAN WAKTU.

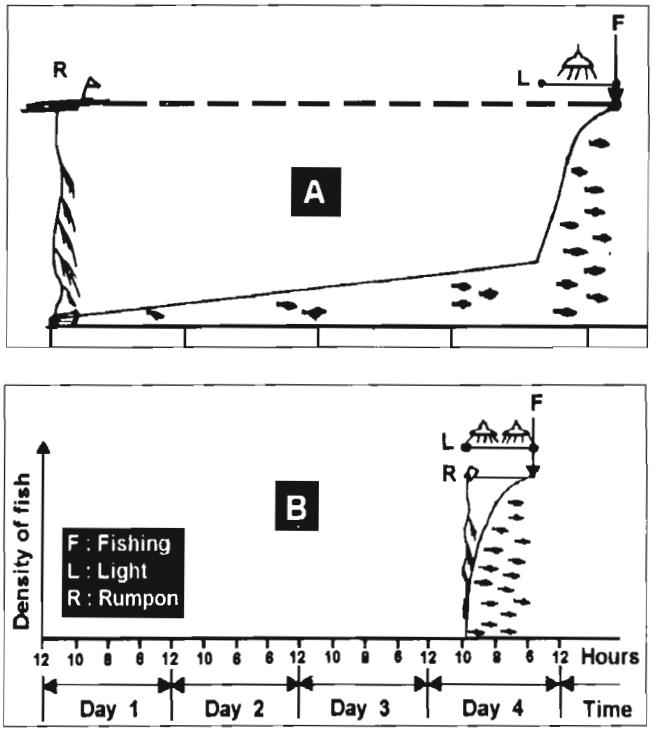


Figure 9

PHASES OF FISH ATTRACTION. OLD (A) AND NEW (B) FISHING TACTICS
TINGKAT KETERTARIKAN IKAN. TAKTIK PENANGKAPAN LAMA (A) DAN BARU (B)

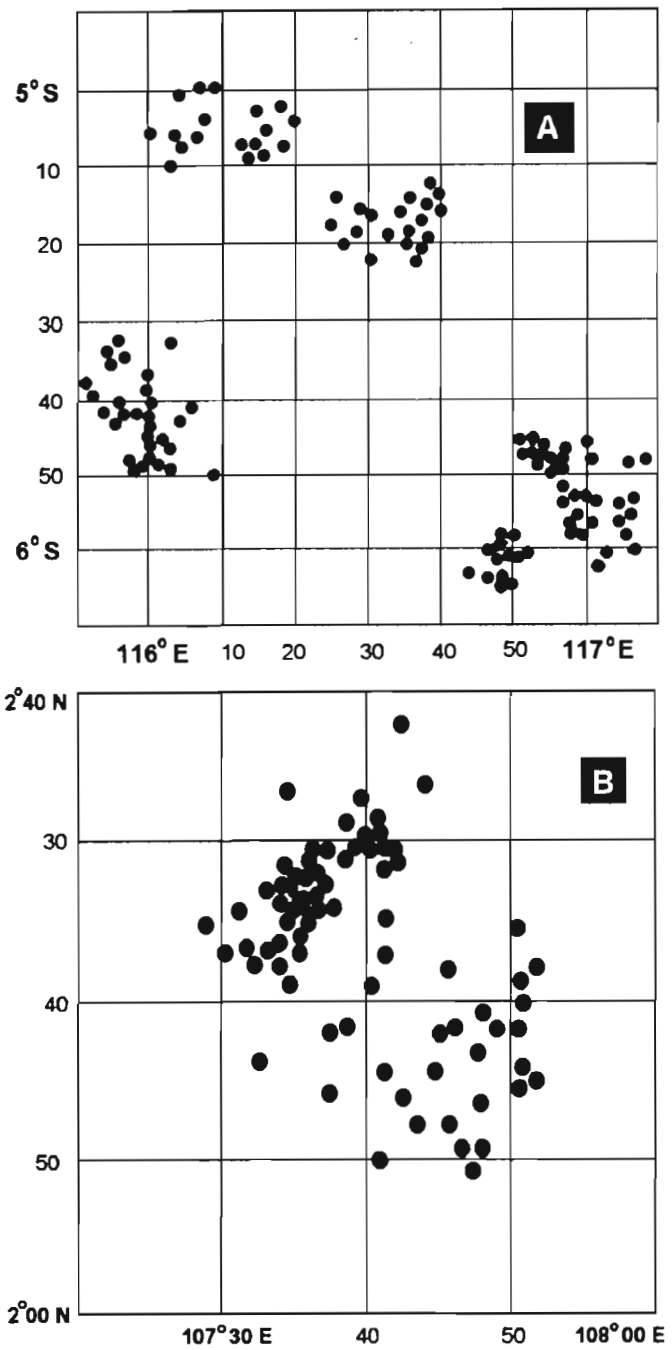


Figure 10

DISTRIBUTION OF THE PURSE SEINERS DURING THE FISHING OPERATIONS IN MATASARI (A), 4 NIGHTS IN OCTOBER 1992 AND SOUTH CHINA SEA (B), APRIL 20 AND 21, 1993.

PENYEBARAN PURSE SEINE SELAMA OPERASI PENANGKAPAN PADA DUA DAERAH PENANGKAPAN.

2.2 Evolution of the traditional tactic

It only occurs in the medium and large seiners fisheries.

■ LIGHT FISHING

Since 1987, the use of auxiliary generators has widely replaced the paraffin pressure lamps formerly used in the large seiners fishery, most of the vessels carrying 12-36 lamps of 200-1000 watts. First using mercury lamps, some are now using enclosed halogen floodlights.

Today the light initializes the concentration and the raft only helps to the aggregation and the setting. The traditional roles of these tools have been inverted (fig. 9). Fish search is still done late afternoon. When the fishing master estimates an area good, he stops the boat. The lights are turned on before dusk. Two rafts called **"tendak"** are moored at the stern and the bow of the boat respectively. Before setting, they are hauled on board. The upper part of the one placed at the stern is moored again and the setting occurs in the same way as before.

■ PACK FISHING.

Whenever fishermen go at sea they try to find the fishing area where fish is most abundant. To achieve this aim radio communication is very helpful. The fishing vessels adopt a "pack" strategy. They can track

the fish in several fishing grounds during a trip. The distribution of the fishing vessels in the fishing areas is highly related to this strategic change.

To illustrate these changes, some visual and radar observations made during acoustic cruises in the fishing grounds add to the informations collected during enquiries on the field. The survey of these distributions consisted of the following method. The trips made on **Bawal Putih I** followed a transect line Semarang-Matasiri. This line goes through the fishing area of medium and large seiners in the Java Sea. At night, when the fishing vessels are grouped, their spotting is easy. According to the size of the clusters they can be detected 30-35 nautical miles away. When the distance between **Bawal Putih I** and these clusters is less than 15 nautical miles, the position of each fishing vessels is noted with the help of the radar.

In October and November 1992, large clusters of purse-seiners were observed South of the Matasiri Island and in April 1993 South the Midai Island (South China Sea). In October 1992 and April 1993 their movements were observed during several days. Such clusters consisted of 36 vessels in October and 79 vessels in April. They make up patches of 20 to 30 nautical miles in surface (fig. 10A and 10B). The number of light spots echoed by the radar control allow us to confirm that most of the observed vessels were in fishing operation. In such clusters, the average distance between the seiners is 1.4 nautical miles and the maximal 4 nautical miles. Sometimes seiners are less than half a nautical mile apart (fig. 11A and 11B).

From such observations, we can assess that the fishing vessels are not randomly distributed in a fishing area. Using this strategy, even if their fishing zone is not located over areas where the fish abundance is the highest they can exploit a fishing ground to its maximum level.

The average surface of attraction of the fishing vessels is not yet known and we don't know if such a strategy leads to a competition among the fishing vessels for the aggregation of the fish.

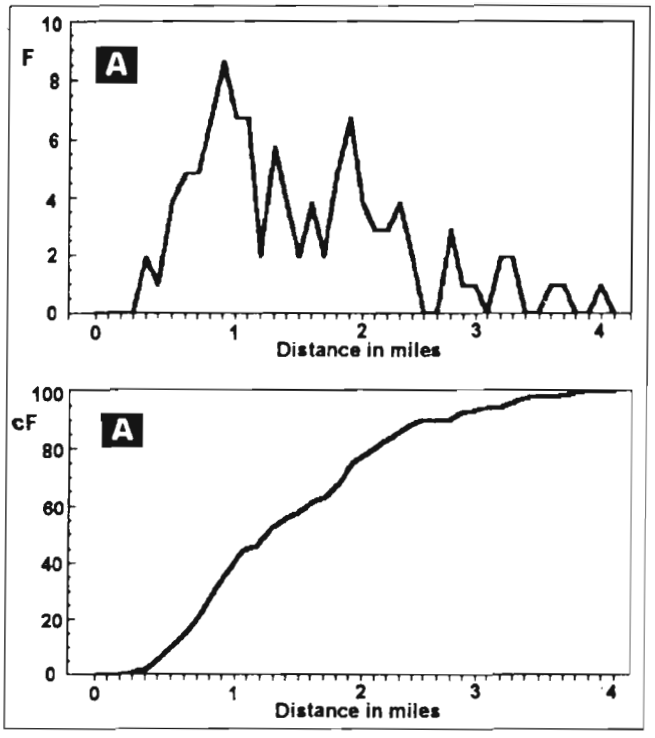
CONCLUSION

The use of rafts in a fishery sets the question of their presence and their utility. In the case of the Javanese seiners fisheries several interpretations can be given :

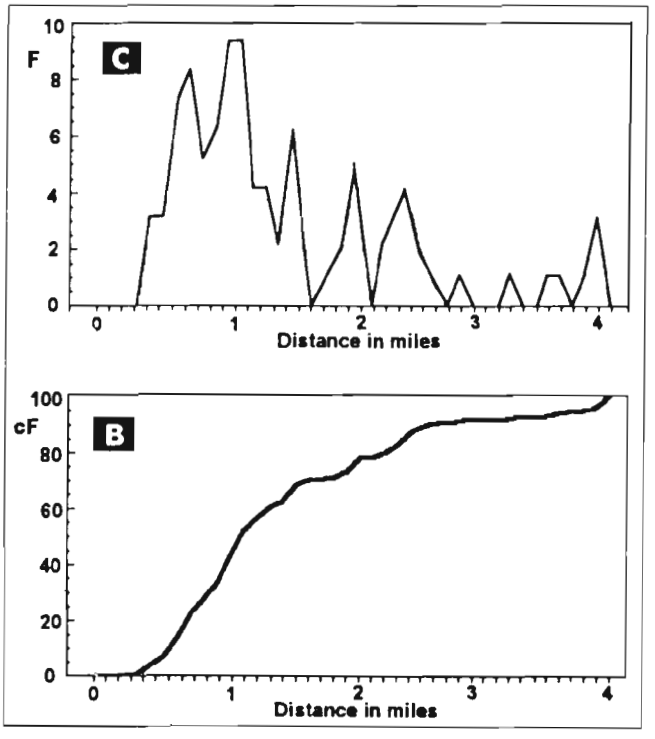
- First, the seiners are not able to fish at "sight" shoals seen at the surface because of their low speed.
- Second, shoals are small and not numerous. Fish is often scattered.

In both cases, it has to be aggregated and fixed before being fished. This is a problem of resource availability. The fluctuation of the number of rafts in an area can also reflects the fish accessibility. More numerous are the rafts less is the fish accessibility and vice versa. The evolution of the tactics since 1987 sets the two aspects of the question. In a first approach the increasing use of electric lamps could be a way to increase the fish vulnerability because there would be a better aggregation around the boat. In a second approach, the replacement of rafts by lights could be linked to a change in the fish accessibility since 1990-1991. Changes in strategy and tactic happen when the fisheries have to face difficulties as stagnation or decrease of the catch (fig. 12).

The mini seiners still use the traditional methods of the Javanese fishermen and don't show any innovative tendencies.



Matasiri (night) :
October 1992, 107 vessels



South China Sea (night) :
April 1993, 96 vessels

Figure 11

FREQUENCY (F) AND CUMULATED FREQUENCIES(cF) OF THE DISTANCE BETWEEN THE FISHING VESSELS DURING THE FISHING OPERATIONS

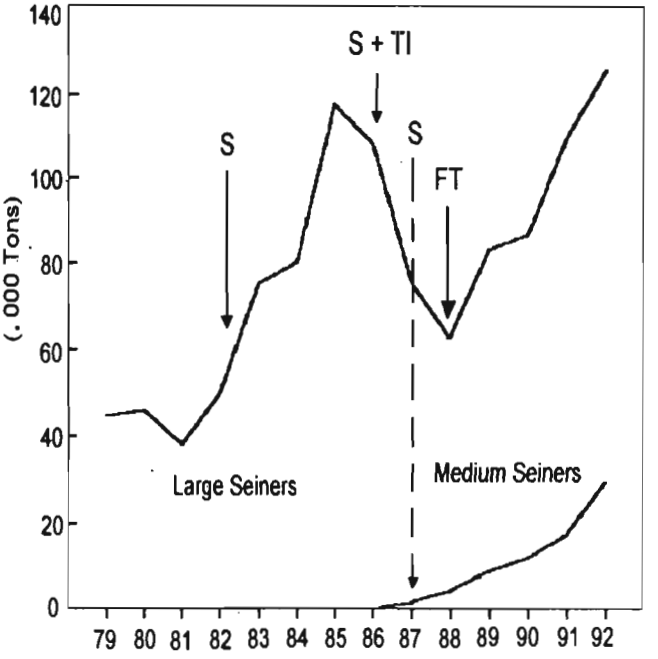
FREKUENSI (F) DAN FREKUENSI KOMULATIF (cF) DARI JARAK ANTAR KAPAL WAKTU OPERASI PENANGKAPAN

Figure 12

STRATEGIC AND TECHNOLOGICAL INNOVATIONS DURING THE SEINERS HISTORY

INOVASI STRATEGI DAN TEKNOLOGI PURSE SEINE DARI TAHUN 1979 SAMPAI DENGAN 1992

***S:** Strategy changes*
***TI:** Technological Innovation*
***FT:** Fishing technics improvement*



These different behaviors seem related to geographical and economical reasons. In Central Java there are rivers where seiners can easily enter and land their catch. Before the trawl ban, these landing centers were used by trawlers owned by ethnic Chinese of the Sumatra Island. When the trawl ban became effective they heavily invested in the seiners fishery. Coming from ethnic groups fishing for many centuries, they are open to technological innovations and can adopt them very quickly. In East Java, the owners are small operators which are unable to highly invest. It is difficult for them to adopt the new technics.

In the actual state of the technology the seiners fisheries in the Java Sea exploit all the space available. As the knowledge of Javanese fishermen about environment and fish behavior is quite good, the fishing strategies and tactics are efficient. The fishing pressure is high on the prospected fishing grounds. A new evolution will be only possible with changes at high cost not only leading changes in fishing strategy but also in economic and commercial ones.

BIBLIOGRAPHY

BOELY T., POTIER M. and NURHAKIM S., 1988. Study on the big purse seiners fishery in the Java Sea. III. The fishing method. *J. Mar. Res. Fish. Inst.*, **47**, 69-86.

FERRARIS J. et SAMBA A., 1992. *Variabilité de la pêche artisanale sénégalaise et statistique exploratoire.* SEMINFOR 5, ORSTOM, Montpellier, 169-190.

FERRARIS J., 1993. *Démarche méthodologique pour l'analyse des comportements tactiques et stratégiques du pêcheur artisan sénégalais.* Table ronde "Questions sur la dynamique de l'exploitation halieutique", ORSTOM, 21p.

POTIER M., BOELY T. et PETIT D., 1992. *La pêche à la senne en Mer de Java. Les dispositifs agrégatifs et l'attraction lumineuse.* Action incitative Comportement agrégatif, ORSTOM Montpellier, 11-21.