

## THE STATE OF EXPLOITATION OF SMALL PELAGIC FISHES BY LARGE AND MEDIUM PURSE SEINERS IN THE JAVA SEA

S. NURHAKIM, J.R. DURAND, M. POTIER and B. SADHOTOMO

### ABSTRACT

The small pelagic fisheries in the Java Sea play an important role in fishery development in Indonesia. It is one of the answers to the protein need for the Java numerous population. It represents also a major source of employment and revenue in the coastal communities along the North coast of Java. Through three main flotillas, seining is the main fishing method used and the development of fishing tactics and strategy is still in progress. Consequently the fishing grounds extended to new areas and the landing increased. This paper will describe the evolution of the main parameters of exploitation such as number and power of boats, spatial distribution of effort, total and specific catches as well as the problems of exploitation level and fish quality.

KEYWORDS : catches, effort, fishing strategy, seiners, Java Sea.

### ABSTRAK

*Perikanan pelagis kecil memainkan peranan yang penting dalam perkembangan perikanan di Indonesia. Selain merupakan satu alternatif untuk memenuhi kebutuhan protein bagi penduduk pulau Jawa yang padat, sektor ini juga menjanjikan lapangan pekerjaan dan sumber penghasilan bagi masyarakat sepanjang Pantai Utara Jawa. Dari tiga armada penangkap ikan utama, pukat adalah metode penangkap ikan yang paling sering digunakan. Sementara itu, taktik dan strategi menangkap ikan terus berkembang, akibatnya area penangkapan ikan semakin meluas. Makalah ini mendeskripsikan perkembangan dari parameter utama pengeksploitasian seperti jumlah dan power yang digunakan, distribusi spasial upaya penangkapan, total tangkapan dan tangkapan khusus, serta masalah tingkat pemanfaatan dan kualitas ikan.*

KATA KUNCI : tangkapan, upaya, strategi penangkapan, pukat cincin, Laut Jawa.

The small pelagic fisheries in the Java Sea play an important role in fishery development in Indonesia. Because it could answer the need of animal proteins for the population of Java. Additionally, this activity is a major source of employment and revenue in the coastal communities along the North coast of Java as well as of the South coast of Kalimantan. Consequently a rational management of the natural resources, namely fishery pelagic resources is essential to support national economy, social and nutritional goals.

Since the trawl ban in 1980, pelagic species are the main resources exploited in the Java Sea. Their exploitation by artisanal fisheries is very old and has an important socio-economic impact on the islands bordering that sea. Initially limited to inshore resources of the North coast of the Java island, the exploitation extended offshore since the implementation of the purse seine.

The purse seine was introduced in the Java Sea in order to have a longer fishing period and a higher catch than with the traditional nets. It spreads out quickly and the seiners were able to extend their exploitation area outside the Java Sea in order to free themselves from the high seasonal fluctuation of the catch occurring there. The exploitation of the resources by large purse seiners is now twenty years old and during this period many changes occurred.

The fishery is a dynamic system which quickly react to internal and external changes. In 1987 smaller seiners coming from the Pekalongan harbour entered the fishery. The geographic distribution of the pelagic species is such that the mini, medium and large seiners are now exploiting same or overlapping populations. This is why in the statistics analysis on large and medium seiners the data collected on other fisheries has also to be taken in to account.

#### MATERIALS AND METHOD

Since 1985 with the beginning of the research co-operation between ORSTOM (France) and RIMF (Indonesia) a sampling scheme for the collect of the data coming from large seiners fishery has been set in the different landing places. The catch and effort are now known by fishing ground and by commercial category.

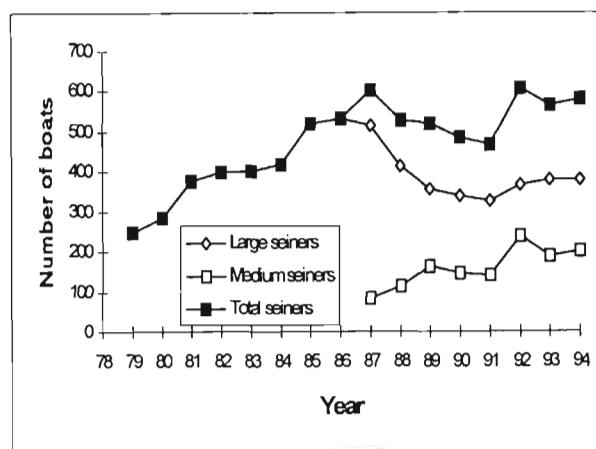
Since the beginning of the Java Sea Pelagic Fishery Assessment Project the sampling scheme has been improved. Catch is known by species and by fishing ground. Effort data is collected from the fishing port administration of Pekalongan where entries and exits of the seiners are registered. At other landing places the effort estimation is derived from enquiries on board of the Seiners during every landing.

#### RESULTS

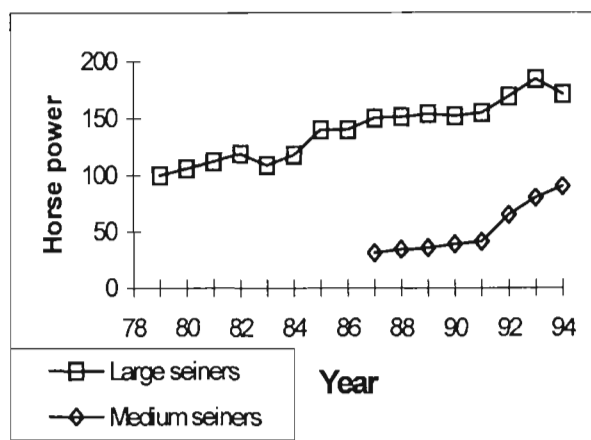
##### **Fleets**

The large seiners fleet is the oldest to use the seine net in the Java Sea. The number of fishing vessels increased from 1979 until 1985 when the fleet reached 520 units. In 1987 and 1988 the number of large seiners drastically decreased. Despite the construction of many new vessels in the last years the number of seiners, with 372 units in activity in 1994 (Fig. 1) is still far from 1985. This fleet represent 61% of the whole seiners in activity in the province of Central Java.

Medium seiners appeared in 1987 and their number slightly increased until 1991. With new investors, the fleet quickly expanded and reached 238 units in 1992 and decreased to 201 units in 1994 (Fig. 1).



**Figure 1 :** Evolution of number of seiners belonging to the two main flotillas between 1978 and 1994  
*Perkembangan jumlah armada penangkap ikan utama sejak 1978 sampai 1994*



**Figure 2 :** Evolution of horse powers of purse seiners  
*Perkembangan kekuatan mesin tenaga kuda dari pukot cincin*

These two fleets with differing vessels and distinct fishing strategies tend to overlap. Since 1979, size, horse power (Fig. 2) and fish hold capacity have increased. This evolution, linked with a better fishing efficiency, allowed the exploitation located in the traditional Javanese fishing ground to extend to the eastern part of the Java Sea, to the Makassar Strait and to the South China Sea. In 1992, we can describe three segments exploiting different fishing grounds in the fishery :

- the first one which exploits the traditional fishing ground of the Javanese fishermen consist of the old medium seiners (16-18 meters);
- the second one whose fishing grounds extend from the Karimunjawa Islands to Matasirih is made of old large seiners built before 1985 and a new generation of medium seiners;
- the last one which mainly exploits the eastern part of the Java Sea, the Makassar Strait and the South China Sea consist of the newest large seiners built since 1985.

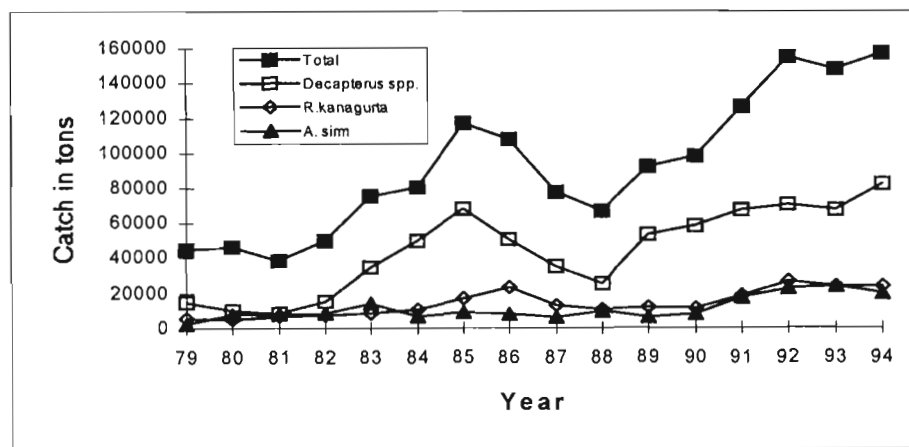
## Catches

The small pelagic species in the Java Sea are mostly caught by large and medium purse seines. Their landings show great variations. But since 1979 the catch increased four times reaching 157 000 tons in 1994 (Fig. 3).

The Javanese seiners catch around thirty pelagic and semi-pelagic species. Eleven of these species account to 90% of the landing. According to official statistics, these eleven species are gathered in five statistical categories. In the different landing places the names of these categories are replaced by local names related to species and size.

Two species of *layang* scads (*Decapterus russelli* and *Decapterus macrosoma*) are caught by the seiners. The catch shows high fluctuations with two production peak in 1985 and 1991-1994 (Fig. 3). Since 1993, every year, they account at least for 50% of the total catch and form the bulk of the catch in each fishing ground. The total landings of the seiners fishery is highly related to the fluctuation of the scad landings (Fig. 3).

As the fishing grounds move eastward, the catch of the species shows different trends. The landing of *D. russelli* decrease while those of *D. macrosoma* increase. In 1992, *D. macrosoma* was dominant in landings. Due to different fishing areas, the exploitation of the two fleets do not focus on the same species. Medium seiners mainly catch *D. russelli*.



**Figure 3 : Evolution of the total and main species catches for the last sixteen years (excluding China Sea)**

*Perkembangan jumlah hasil tangkapan dan menurut spesies utama untuk masa 16 tahun terakhir (tidak termasuk Laut Cina)*

Most *banyar* mackerels represented in the large and medium seiners catch are *Rastrelliger kanagurta*, while *Rastrelliger brachysoma* being accidentally present in the landings. The evolution of *R. kanagurta* catch shows the same trend as for the scads with high fluctuations and a production peak in 1986 (Fig. 3) when 23,000 tons were landed. Most part of the catch comes from the eastern part of the Java Sea and the Makassar Strait.

The landing of *siro* *Amblygaster sirm* was relatively more important between 1979 and 1993 : it could represent up to 20% of the seiners catch. From 1983 and until 1988 the landing decreased a lot before increasing again from 1991 (Fig. 3). The bulk of the catch is made in the Makassar Strait. It is mainly caught by the large seiners and accounts for a small part in the medium seiners landing.

Landing of *tanjan* (*Sardinella gibbosa*, *Sardinella fimbriata* and *Sardinella lemuru*) shows regular fluctuation. These fishes are not the target species of the seiners fleet. They are caught by the large seiners as well as the medium seiners. In 1992 the landing sharply increased. The major part of the catch comes from the Java Sea in May-June.

The *bentong* big-eye scad (*Selar crumenophthalmus*) is caught in small quantity by the large and medium seiners. Since 1979, the landing tends to decrease slightly. The bulk of the catch is made in the Java Sea. Certain years, some important catch occurs in the South China Sea.

The other species account for 6 to 8% of the catch. They are accidentally caught and among others consist of *japuh* (*Dusumeria acuta*), *bawal hitam* (*Formio niger*) and small coastal tunas as *Auxis spp.*

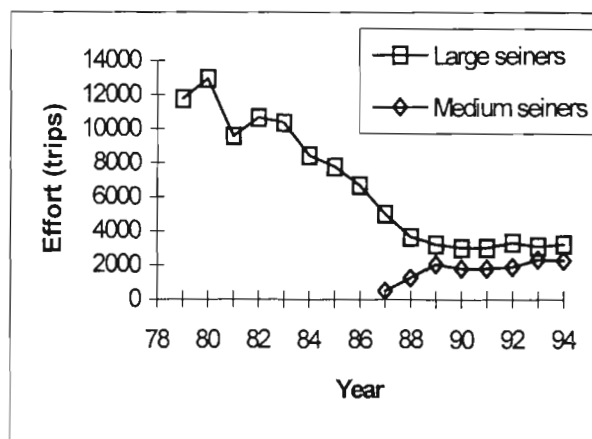
Landings show a high seasonal trend which is more or less related to the monsoons (Potier and Boely, 1990), it shows two peaks, a minor one in March-April, a maximum in September-November (Potier and Sadhotomo, 1995). The decrease of landings in December-January is highly related to the North-West winds which prevent the fishing vessels to go to sea. During the peak fishing season (September-December) most of the catch is made in the Java Sea, while from January to March-April it is made in the Makassar Strait. As the waters of low salinity extend eastward and reach their maximum of extension in May-June, the bulk of the catch is made in the South China Sea.

Based on sun ray plot analysis, the yearly catch and the CPUE trends, Potier and Sadhotomo (1995) mentioned that there are three groups of species which correspond to three different types of populations among the seiners catch :

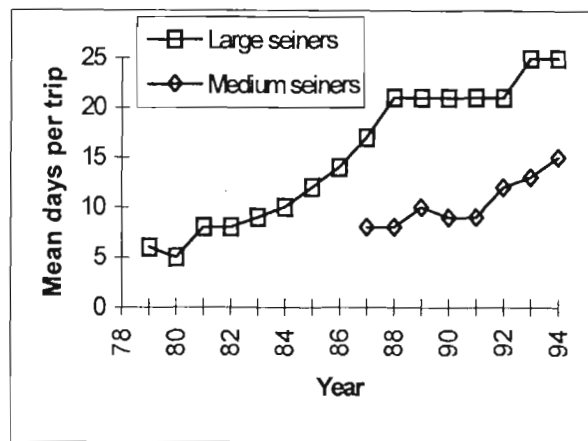
- oceanic population : *D. macrosoma*, *A. sirm*, *R. kanagurta*. They live near the continental shelf edge. They are found in waters where salinity is more than 34‰. They are caught when the oceanic waters enter the Java Sea from August to November;
- neritic populations : *D. russelli*. They live on the continental shelf in waters with salinity between 32-34‰. They are caught along the year by the seiners;
- coastal species : *S. crumenophthalmus*, *S. gibbosa*. They are found near the coast and live in waters with high fluctuations of salinity. They are found along the year in small quantity in the seiners catch.

### Effort

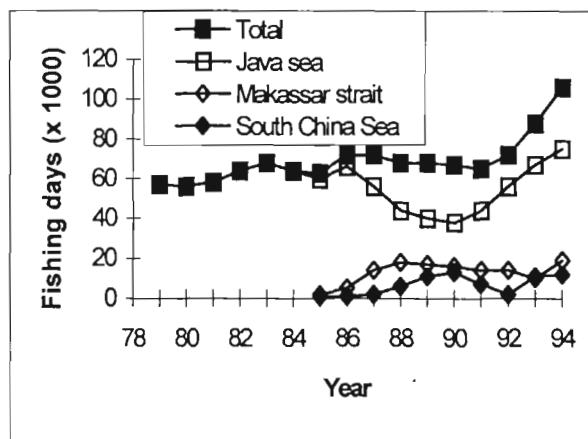
Expressed in number of trips (Fig. 4), the effort has continuously decreased since 1979; consequently the average number of days at sea per trip increased from 6 in 1979 to 25 in 1994 (Fig. 5). It can be related to the extension of the fishery, the growing distance between harbours to the fishing ground and the use of larger vessels which stay longer at sea.



**Figure 4 :** Evolution of the effort of large and medium seiners between 1978 and 1994  
*Perkembangan upaya penangkapan pukat cincin besar dan sedang antara tahun 1978 dan 1994*



**Figure 5 :** Number of mean day by trip between 1978 and 1994  
*Jumlah hari rata-rata per trip antara 1978 dan 1994*



**Figure 6 :** Evolution of fishing days of three main fishing places between 1978 and 1994  
*Evolusi hari melaut dari tiga daerah penangkapan utama antara tahun 1978 dan 1994*

Most of the efforts come from the large seiners vessels and is spent in the Java Sea (50 to 70%), the rest is spent in the Makassar Straits and in South China Sea (Fig. 6). The effort is highly seasonal and related to environmental and human factors. When the winds are stronger than 20 knots the vessels are not able to go to sea. This situation occurs mainly during the first months of the year when the North west monsoon is well established. During these months, floods on the North coast of Java can entirely stop the activity of the seiners because the landing places are flooded. The effort is high inside second part of the year from August to November. Medium seiners deploy their whole effort in the Java Sea, while large seiners share it among the whole fishery space, including Makassar Strait and South China Sea.

### Catch per Unit Effort

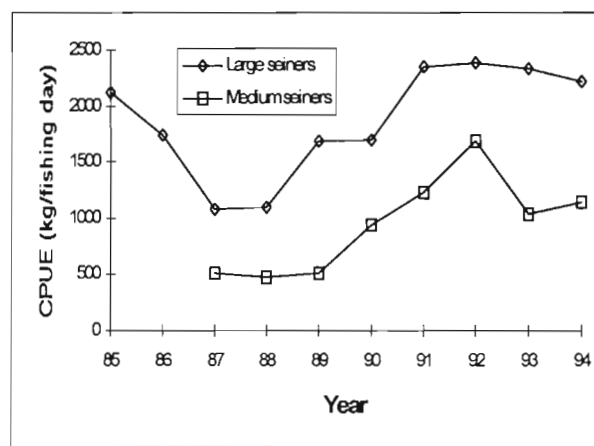
Values of the CPUE show a 50% decrease from 1985 to 1987 (Tab. 1 and Fig. 7) when the catch rate of the large seiners was 1 ton per fishing day. Since 1988, it increased by step and in 1992 is slightly higher than in 1985 reaching 2.4 tons/fishing day. The catch rate of the medium seiners after three years of stagnation increase since 1989.

**Table 1 : Evolution of the effort (fishing days) and the CPUE (kg/fishing day) of large and medium seiners fleet since 1985**

*Perkembangan upaya penangkapan (hari melaut) dan hasil tangkapan per unit (kg/hari melaut) pukat cincin besar dan sedang antara sejak 1985*

Effort	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Large	56,282	62,052	70,345	56,087	50,086	51,256	46,384	52,889	53,150	57,964
Medium			2,873	8,157	16,915	12,569	14,136	17,539	24,412	27,187
Total	56,282	62,052	73,218	64,244	67,001	63 825	60,500	70,428	77,562	85,151
CPUE										
Large	2,120	1,742	1,077	1,097	1,683	1 697	2,350	2,367	2,328	2,216
Medium			512	477	511	939	1,226	1,688	1,034	1,134

The fluctuation of CPUE in the large seiners fishery are seasonal with a maximum peak at the end of the year and a minimum one in May-June. In the medium seiners fishery there is only one annual peak during September-November. The evolution of CPUE differs among the fishing areas. The Makassar Strait and the Java Sea have a similar evolution with higher values in the Makassar Strait. In the South China Sea, CPUE fluctuates a lot.



**Figure 7 : Catch per unit effort : average yearly values for large and medium seiners (kg/fishing day)**

*Hasil tangkapan per unit : nilai rata-rata tahunan untuk pukat besar dan sedang (kg/hari melaut)*

### Fishing strategies and tactics

Before 1992, the trip strategy was to choose one fishing ground and to spend all the fishing days in this zone. Since then, 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 was an individual 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 behaviour and of the vessels they use, the fishing tactic of the Javanese fishermen consist of concentrating the fish by mean 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 ground.

### **Level of exploitation**

The pelagic fishes in the Java Sea consist of several species exploited by various fishing gears, and we still consider that only part of the stocks are captured. The real configuration of the pelagic stocks can not exactly be defined. However, based on recent developments of fishing activities in the whole area, the level of exploitation could be near the maximum.

By assuming that a big part of the stock is being exploited by the large Purse Seine in the Java Sea, the previous studies (Widodo, 1995; Nurhakim, 1995) demonstrated that the level of exploitation of *D. russelli*, *D. macrosoma* and *R. kanagurta* have been close to the optimum level.

### **Management and regulation**

The mesh size regulation and zonation were issued by the government. The minimum allowable mesh size is 1 inch, and the sharing of fishing zones is defined according to the gross tonnage of the fishing boats. The paths of the fishing zones are defined as 0-3 miles, 3-5 miles, 5-7 miles and more than 7 miles from the coast line respectively.

In fact the mesh size used in the fishery never follow the government regulation, while fishing zone of the purse seiners tend to be more further than 7 nautical miles except during the season of certain species (*R. brachysoma*) when the mini seiners tend to catch in near the coast. Eventhough, in some area the mini seiners always operate close to the coastal line such as in Madura and Sunda Straits.

Actually the fishermen tend to avoid the small size of fish during the first recruitment and the use of mesh size 0.5 inch is more intended to prevent the fish entangle on the net.

Since the recruitment occurs in certain period, closed season regulation might be more efficient, with a support of relevant deep biological study.

It seems that the fishermen unconsciously regulate by themselves the effort exerted upon the resources. The large purse seiners tend to reduce their fishing activity in the Java Sea by shifting the fishing ground to the South China Sea and never fish in other areas beyond the Java Sea which are presumed to be the natural migratory grounds of the same exploited stocks.

### **CONCLUSION**

The exploitation of small pelagic in the Java Sea is related to the season and the availability of the fishes is linked to the monsoon regime. The large seiners extend their fishing ground to the South China Sea in order to avoid the lower availability of fish during in the Java Sea. Although the structure of the stocks has not been recognised yet, we believe that the scheme of exploitation of the seiners fleet is related with multispecies stocks repartition the multi stocks. The effort exerted by these fisheries exclusively concentrates on part of the stocks living in the Java Sea.

It seems that the level of exploitation of the small pelagic species in the Java Sea is near to optimum level. However, regarding oceanic stocks, the fishing pressure is lower as their geographic distribution exceeds the fishing boundaries of the seiners fisheries. The changes of fishing tactics and strategies along side with improving equipments and vessels characteristics should be followed in order to monitor the development of fishing effort of small pelagic fishes in the Java Sea and adjacent waters.



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