The dynamic of the Javanese coastal seiners fleet according to the 1995 censuses

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Abstract: In 1995, three censuses were carried out to assess the importance of the coastal seiners fleet of the North coast of the Java Island. According to these three censuses (March, June and November), the number of coastal seiners varies from 1,580 to 1,660. The spatial distribution of the fishing units is characterised by an increasing gradient from the West to the East of the Java Island.

During each census, some technical characteristics were recorded. Inside this fleet, two main opposites are described: the first depends on the level of the technical characterisation (type of the fishing aggregating device, differentiated holds); the second is linked to the ability to migrate along the North coast of the Java Island (shape of boat, motorization). So, a first image of the dynamic of this fleet is outlined thanks to the different results.

Keywords: census, purse seine, fleet dynamic, Java Sea, Indonesia.

The living aquatic resources of the Java Sea whether they are demersal or pelagic fishes, are exploited by many inshore or deep sea fishing fleets. The Pelfish Project[3] (Durand and Widodo, 1997) dealt with the study of the pelagic stocks of the Java Sea. These last ones are exploited by various fishing fleets from numerous ports located mainly on the Java Island (fig. 1).

More particularly, this stock of pelagic fishes is widely exploited by fishing fleets using the encircling purse seine[4]. An assessment of the exploitation of pelagic species of the Java Sea was made by Potier and Nurhakim (1995), Pelfish (1996), Roch *et al.* (1998), Potier (1998), and Sadhotomo (1998). The different synthesis lay out the results of the study carried out between 1990 and 1995.

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[4] Although, according to Potier and Sadhotomo (1995), it would be better to use the term ring net, the expression purse seine is used here to agree with the Indonesian terminology.

Part of the fleets is formed by small coastal seiners. This fleet is described by Potier and Boely (1990) as composed of 10 to 15-meter-long boats that are mainly equipped with out-board motors and which use a 300-meter-long (maximum) seine.

Along the year, mini seiners present intense fishing activity. In 1995, fishing operations last between 330 and 340 days (Ecoutin and Dharmadi, 1999). According to the ports of registration, dynamics of the activity can be different. Such differences can be explained either by the physical configuration specific to each port or by the social behaviour of the units related to the owners (Ecoutin and Dharmadi, 1999).

This global approach gives a lot of information on the dynamic of the fleet that is being studied. However it does not allow the estimation of the necessary parameters for the evaluation of the whole contribution of this fleet to the fishing production of the Java Sea. An estimation of the fishing effort that may be expressed in a number of tides per time unit is necessary to get an indication of the global contribution.

To estimate the fishing effort, the first step is to assess the importance of the fleet, which is concerned. Therefore different censuses of fishing units were regularly carried out during the two-year study. The first one, carried out in October 1994 (Ecoutin *et al.,* 1997) allowed a better characterisation of the fleet. The next three were carried out in 1995 on the whole North coast of the Java Island from the city of Labuhan (West Java province) in the Sunda Strait, to Madura Island (East Java province) on the one hand, and the city of Situbondo (East Java) in the Strait of Bali on the other hand (fig. 1). They provided the basic indications to estimate the importance of the fleet.

The global analysis of this publication is to link the evolution of the fleet (through its technical description) with, on the one hand the observation location of the fishing units and on the other hand the location of origin of the same fishing units. This will give the ability to establish some spatial heterogeneousness within the fleet, that Wijopriono *et al.* (1996) have already noted down.

Most of the results are taken out the chapter 4 of the Master of Science work (D.E.S.S.) presented by Jung (1998).

Material and methods

To characterise the mini seiner fleet of the North coast of the Java Island, the questionnaire, used exhaustively in all the villages involved, takes up the one that was used for the first census conducted in November 1994 (Ecoutin *et al.,* 1997).

This questionnaire describes all the units of mini seiners that were observed on the investigation place the day of the investigation. The boats, observed visually at the investigation spot, are numbered and, if possible, each unit is described. Seven informations are recorded: the name of the boat or its registration number, its shape, the province and the port of origin, the type of lights used to attract the fish, the number and type of engines visible onboard, the methods used to preserve the fish onboard. Most of the information is registered visually and directly by the investigator. The information regarding the province and the port of origin of the unit is collected by interview of the people met on the spot.

During the first census, in November 1994, the presence of a capstan was noted as well as its position on the boat (Ecoutin *et al.,* 1997). The analysis of this census shows that a capstan placed on the deck "first third at starboard" is a recognition criterion of a mini seiner

unit. Therefore the description of this parameter was not mentioned any more in the 1995 censuses.
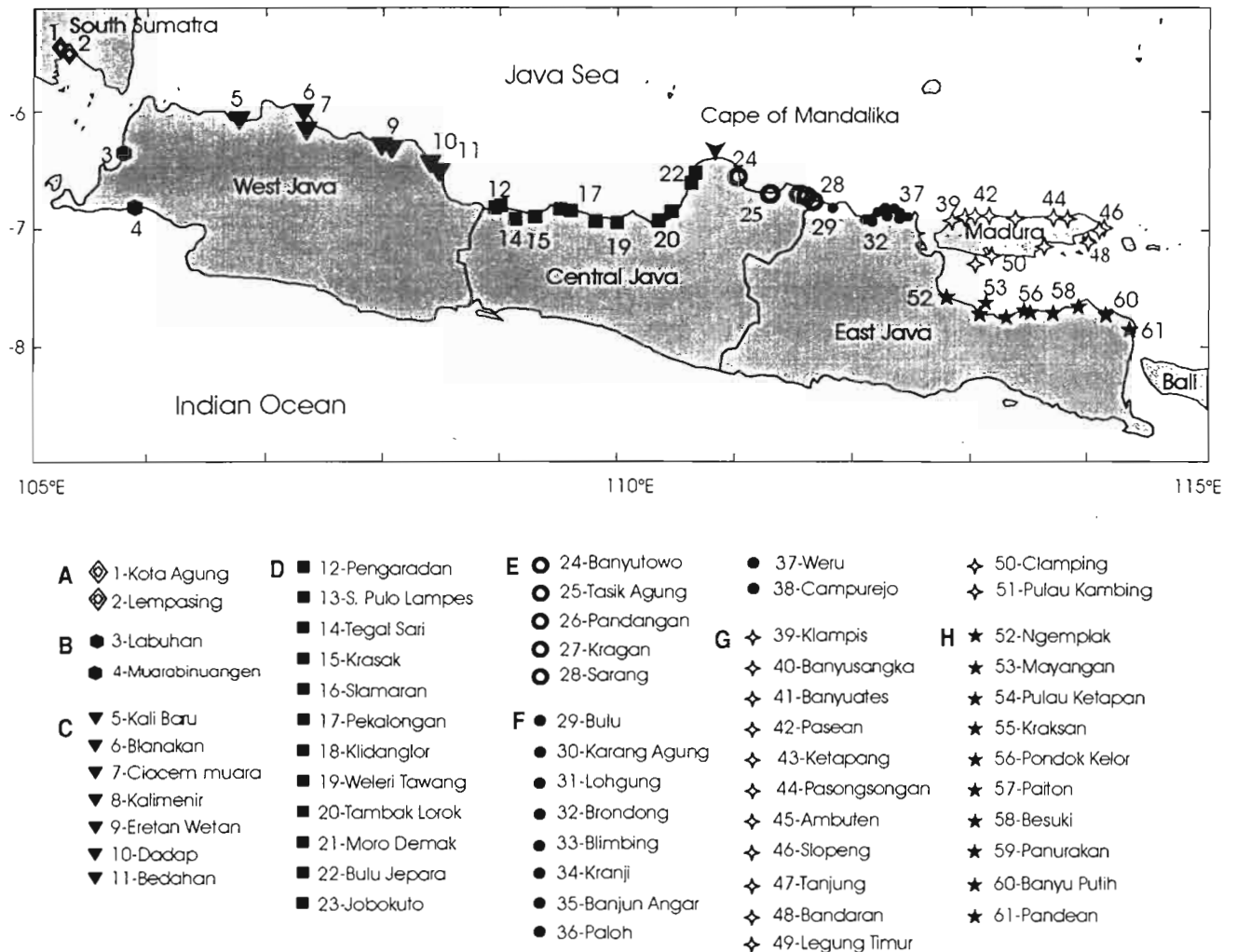

Figure 1: Mini seiners census: location of the inquiries along the Northern and south-western coast of the Java Island (from Jung, 1998)

All locations where some mini seiners could potentially be observed have been visited. They may correspond to a port, a village, a landing place or a beach (fig. 1). Because of their easy access places where wharfs, mooring quays and auctions are observed, are chosen preferentially by the mini seiners. Drawing alongside is definitely an important point, consequently places located along river banks near the mouth, offer sheltered sites which are of great interest for mini seiners (Pandangan, Batang, Eretan Wetan, Karang Agung, fig. 1).

The inquiry area was divided into eight zones, noted from A to H. It allows a better repartition of the working field (fig. 1). Zone A corresponds to Lampung province in the South of Sumatra Island. West Java province was divided into two sectors: B covers the Sunda Strait, C starts from Jakarta to the west and reaches the border of the Central Java province. The Western part of this province is called D and extends to Cape of Mandalika (fig. 1). Zone E stretches from Mandalika to the border of the East Java province. This last one was divided into three zones: F and H cover the northern part of the province, respectively from Bulu to Campurejo and from Ngemplak to Pandean. Madura Island is a specific unit, G.

The censuses dates were chosen to find the highest number of fishing units ashore or at least with a minimum of units working. The first census was conducted between March 9 and March 11, 1995. These dates correspond to the period of *Idul Fitri*. This religious festival, the most important in Indonesia, is a Public Holiday and the fishing activity is stopped for the few days before and after the festival (Ecoutin and Dharmadi, 1999). The second census took place between June 14 and June 18, 1995. This period corresponds to the full moon and most of the fishing units present no activity. Finally, the third census period from November 5 to November 12 corresponds to a full moon period and to the yearly weather changes with the beginning of the northwest monsoon and of the rainy season. At this time, the fishing activity of the mini seiners fleet tends to decrease due to difficult weather conditions.

Results

During an investigation conducted in 1995, the description of some fishing units could not be achieved with precision, the units being too far at sea. The number of units recorded in a site is the sum of the vessels described, of the vessels observed but not described because too far from the shore and of the vessels which just leave the spot to go at sea (by interviews). The sums registered in every site give an estimation of the mini seiners fleet operating along the northern coast of Java (tab. 1).

The result of the three censuses varies from 1,580 to 1,660 mini seiners landing along the northern coast of the Java Island (tab. 1). In November, the number of vessels recorded is slightly less due to difficulties in the sampling. The investigators did not always have the possibility to reach the spots (especially in the East of Java, the rainy season making it impossible to reach some beaches). This is a good agreement with the estimates presented by Potier and Sadhotomo (1995) with a fleet ranging from 1,500 to 1,600 boats or Hariati *et al.* (1995) with a number of 1,555 units in 1991. The lesser estimate given by Ecoutin *et al.* (1997), slightly over 1,000 units in November 1994, may be explained by the fact that the spatial investigation was not exhaustive.

Table 1: Estimate of the mini seiners fleet according to three 1995 censuses

	March	June	November
Described fishing units	1,199	1,300	1,369
Observed fishing units	195	108	26
Just left fishing units	236	193	188
Estimated total	1,660	1,601	1,583

It is nevertheless possible to count a unit twice when it is spotted at sea off a village and registered in another village as having been observed in the latter.

About 90% fishing units observed are described. The dataset is based on the described units of which the number is very close to the estimated fleet. Then the results can be extended to the entire fleet.

1. Investigation place

For the three investigations in 1995, 110 locations were visited by the investigators and mini seiners were observed in 61 places (tab. 2). More than 2/3 of these spots were visited

during every census and these locations represent more than 90% of the fleet has been observed there.

Table 2: Number of ports investigated in 1995

	March	June	November	Total
Ports investigated	56	69	86	110
Ports with seiners	45	52	52	61

Along the northern coast of Java, the spatial distribution of the fishing units is characterised by an increasing gradient from the West to the East (fig. 2).

Whatever the month the census was conducted, less than 5% of the fleet is observed in the sectors A and B (tab. 3). Lempasing, zone A and Labuhan, zone B gather 90% of the units observed in each sector.

By contrast, 18 to 24% of the entire fleet observed in sector H and the towns of Besuki and Banyu Putih gather together only half of the fleet in this sector.

Table 3: Geographical distribution (in numbers and %) of the mini seiner units

Census zone	March		June		November	
	Nb	%	Nb	%	Nb	%
A	42	3	47	4	45	3
B	46	4	55	4	38	3
C	38	3	72	6	78	6
D	102	9	122	9	154	11
E	183	15	197	15	195	14
F	266	22	147	11	171	13
G	308	26	403	31	356	26
H	214	18	257	20	332	24

Three areas can be recognised in the region studied. The first one includes the provinces of Lempasing and West Java as well as zone D in Central Java. They are characterised by a low percentage of the fleet observed and by a concentration of the mini seiners in few places. East of Cape Mandalika, more mini seiners are observed and two areas are recognised. In zones E and F many small villages with a large number of mini seiners are noted. 10 to 20% of the fleet are found in each zone (tab. 3). Certain small spots, which have been checked regularly, count more than 40 units. Zones G and H show the biggest concentrations of mini seiners with 20% (or more) of the fleet observed in each census. In three to five villages a number of units close to 80 can be observed.

A first criterion of the heterogeneity of the fleet may be observed from the spatial distribution of its units.

2. Characteristics of the fishing units

Describing the fishing units observed on investigation spots, five main characteristics were noted down: the name of the boat or its registration number, its shape, the type of light device used to attract the fish, the type of engines visible on the boat, and the method used to preserve the fish onboard. The analysis of this information conducted on the whole fleet and taking account the description of each unit allows the description of the heterogeneity of this fishing fleet and the definition of groups within it.

2.1 Shape of the boats

The term mini seiner includes boats with different shapes. Each shape presents characteristics, which identify it easily. Then some models of mini seiners can be recognised (Ecoutin *et al.,* 1997):

- boat with decks : this category consists of three models *kranji, bulu* and *dadap,*

- boat with double stems: two models are found, *payang* and *sopeck.*

But inside the fleet, some vessels are difficult to classify as their shape presents characteristics belonging to different models (mainly *kranji* and *bulu*).

Thus, depending on what the observer sees (and his accuracy) a unit will be classified in either category. That is why only four categories have been chosen in this analysis to define the shape of the boats. The category "annexed shapes"[5] was connected to *payang* model, and the *kranji* to the category *bulu.* The other two categories are composed of the *sopeck* and the *dadap.*

The fleet described in 1995 is mainly composed of shapes *kranji-bulu* (tab. 4). They represent 55 to 65% of the units observed. Shape *payang* ranks second (25 to 38% of the models). Then come the *sopeck* (3 to 6%), finally the *dadap.* This last one never represents more than 4% of the fishing units. These results are slightly different from the ones observed in November 1994 (Ecoutin *et al.,* 1997): *bulu-kranji* 42%; *payang* 44%; *dadap* 6%; *sopeck* 8%; but the differences may be related to the fact that the investigation conducted in 1994 was not exhaustive.

In zones A and B the mini seiners are mainly of type *kranji-bulu* (fig. 3). It is almost the same situation which prevails in zones E and F, even though a few *payang* units are registered in zone F. Zones C and D are more diversified, three out of the four categories are found: *dadap, sopeck* and *kranji-bulu.* Each one varies in proportion depending on the census. In zones G and F, the fourth category "*payang* and annexes" represents the majority of the boats described. In November 1995, the informations collected in zone H lack of accuracy due to the difficulties encountered at the beginning of the rainy season. According to the informations collected in March and June 1995, put together with the various reports of missions conducted in this sector, we may conclude that most of the boats found in zone H are of *payang* type. On Madura Island (zone G), the *payang* shape represents up to 76% of all the mini seiners described.

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[5] It includes the *ketiping, ketapang* and *mandagin* shapes. They differ in their closed rear deck and/or an axial or lateral, in-board, double or triple motorisation.
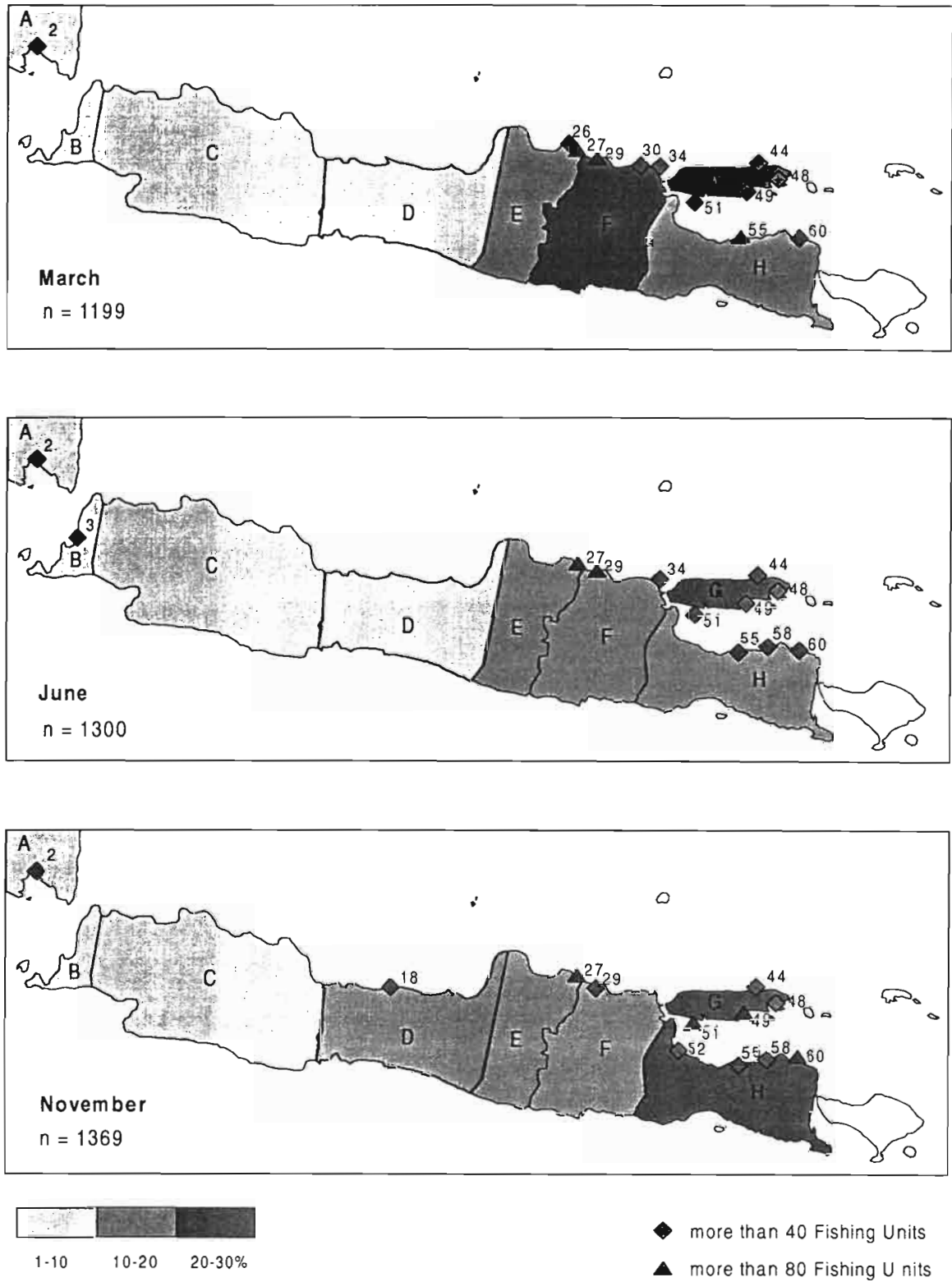
Figure 2: Geographical distribution of the mini seiners described in the three 1995 censuses

Table 4: Repartition (%) of the fleet by shape described in the various censuses of 1995

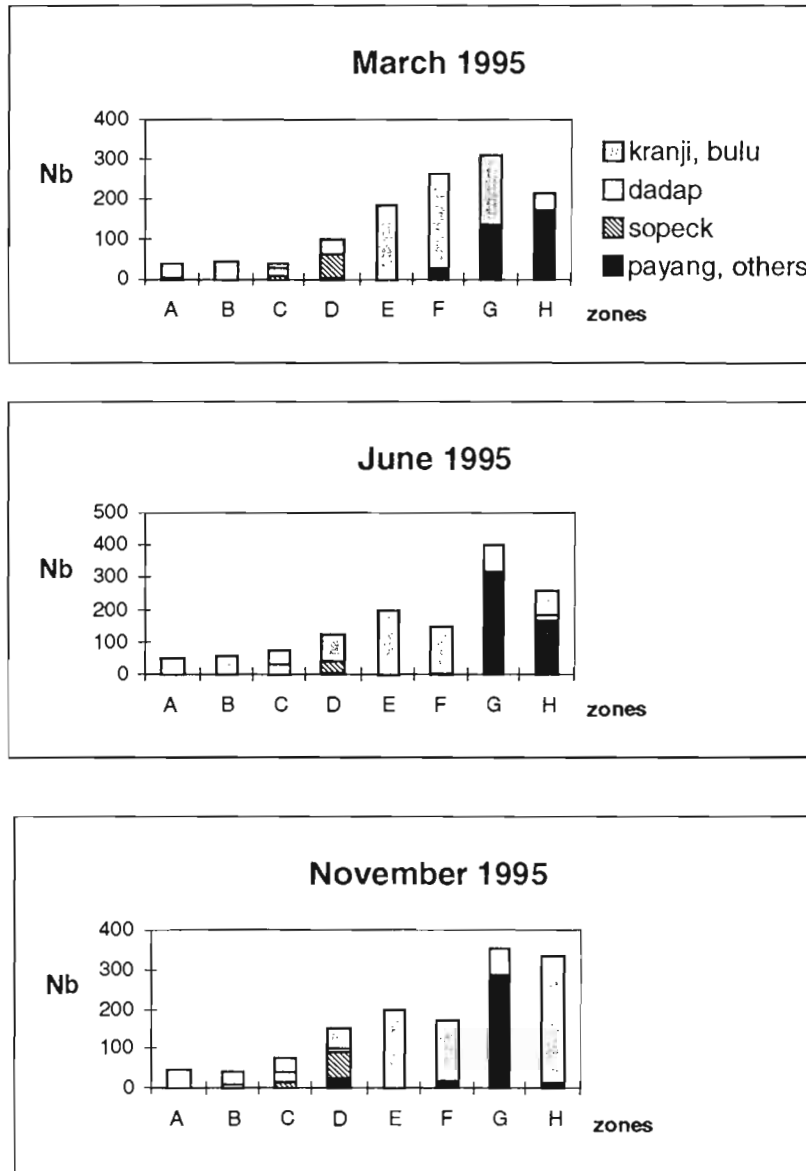| Shape of boat	March	June	November
kranji-bulu	63	55	65
dadap	3	4	4
sopeck	5	3	6
payang and annexes	29	38	25

Figure 3: Geographical repartition of the boat shapes found in the 1995 census

The various shapes observed during the censuses are not randomly distributed. The *kranji-bulu,* the most numerous type, are found everywhere, they are noted in all zones of the study whatever the month of observation. Models *dadap* and *sopeck* are much more localised: they are observed almost solely in the province of Central Java where they may represent up to 2/3 of the local population. *Payang* are observed in the three Eastern zones, mostly in Madura Island where 62% of the whole *payang* fleet may be found.

Shapes increase the heterogeneity observed with the distribution of the mini seiners along the northern coast of Java. Two stages can be identified. The first one covers the numeric distribution of the shapes, the second the geographic distribution, some shapes being found everywhere, other being very localised.

2.2 Name of the fishing unit

Each boat has a registration number allowing its identification. The name is used to identify the boat when fish is sold under auction. It is painted on the hull of the boat and is subjected to a tax[6] when the boat is registered at the auction office. In order to get the information by personal means the census was conducted regardless of the administrative lists[7].

During the censuses, for the units that were too far off shore, the name was eventually collected via crewmembers or fishermen present on the investigation spot. The goal was to get as many individual identification of fishing units as possible.

This report has not been systematic due to difficulties encountered on the field (boats too far off shore, casting off....), or proper to the teams. This was the case for Madura Island, that was not properly investigated (no names collected in March and November). However the rest of the coast was thoroughly investigated and trustworthy.

The raw lists of names collected in 1995 have two drawbacks: redundancy and lack of precision. The name noted down by the investigators is sometimes a random choice between several words visible on the fishing unit. Double, even triple names for a boat are common and may cause a boat to be registered under different names according to whether the investigator takes one name or the other into consideration. The name given to the TPI employee during registration for a sale is the name painted on the stern of the boat. Writing is sometimes visible on the upper part of the poop deck it may be similar to the name written on the bow, or recall the last renovation. The bow and the rear wings of the *kranji-bulu* may be adorned as well, it is freewriting expressed by the sailors[8].

Some fishing units have names with very close spelling. Boats with different characteristics may even have the same name. These differences may as well be due to the language used Indonesian, Javanese or Madurese.

In order to get accuracy, these cases were thoroughly examined until the results were trustworthy. The information collected with the fishermen confirmed the existence of several units described under the same name, often individualised thanks to a number. They allowed the correction of mistakes, increasing our list of boats described and named with accuracy.

We may note a wide heterogeneity in the collection of this information (tab. 5). The zones in the Western and Central provinces were fairly well investigated and the percentage of units named reaches more than 85% of the population described. In the Eastern provinces

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[6] This tax must be paid together with the fishing licence, it is valid in the administrative province where it was applied for and for a period of three years.

[7] These lists remain non exhaustive and difficult to obtain.

[8] Film titles, cigarette brands or girls' first names may have been chosen.

(Zones E, F and H), getting the data depends on the census campaign. The mini seiners of the Madura Island were not well identified, which is partly the reason why we will concentrate our analysis on the Java Island, which was better investigated, at least for this parameter.

Table 5: Percentage of fishing units identified by a name per zone investigated in 1995

Census zone	March	June	November
A	100	87	95
B	100	100	100
C	97	90	93
D	89	88	81
E	95	72	96
F	81	56	61
G	0	97	0
H	14	16	98

This part of the investigation consisted in the identification of the highest number of fishing units in order to cross the data with catch data in order to be able to estimate the activity rate of the mini seiners. The results will not be treated in this report but will be published later on.

2.3 Motorisation

All the fishing units that use a purse seine are powered by engines. Ten models of different engines were identified during the investigations. Most of them are out-board engines with long shafts and power ranging from 14 to 27CV. The different models are grouped into two categories depending where the shaft is positioned: rear or side.

The engines of the mini seiners are found mainly in a rear position, engines fixed on the sides represent between 30 to 40% of the boats observed (fig. 4).
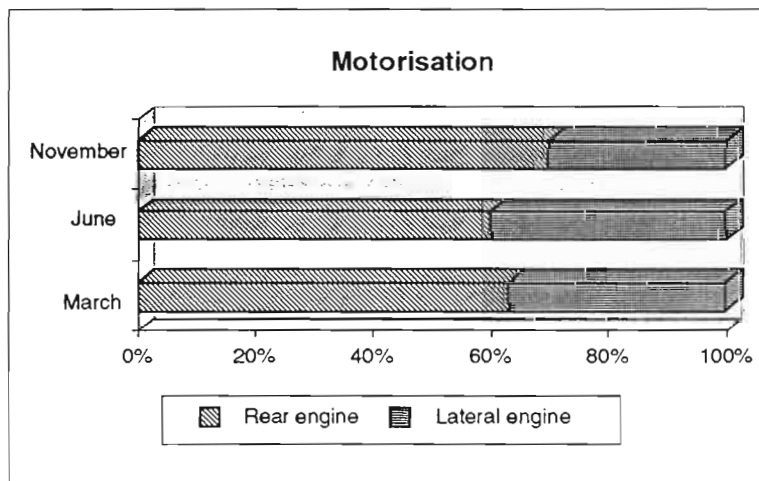

Figure 4: Type of engines described during the 1995 censuses

Table 6: Distribution (%) of categories of engines according to the shape of the boats

Month	Motorisation	Shape of the boat			
		kranji-bulu	dadap	sopeck	payang
March	Lateral	1	23	96	99
	Rear	99	77	4	1
June	Lateral	4	51	99	77
	Rear	96	49	1	23
November	Lateral	1	1	88	82
	Rear	99	100	12	18

The rear engines are mainly associated with mini seiners of the *kranji-bulu* and *dadap* shapes (tab. 6). These models are well adapted to the installation of an engine at the stern. Navigation is easier. Double-stemmed models, *payang* and *sopeck,* are powered with lateral out-board engines (over 77%).

The choice of the motorisation (lateral or rear) is directly linked to the shape of the boat. The exceptions to this simple and sensible rule are due to errors of observation (units that were too far off and probably not well observed).

The high number of rear engines may be explained by the fact that the shapes *kranji-bulu* are the most common model of mini seiners.

2.4 Light equipment

In Indonesia, fishing with purse seine is traditionally done with FAD (Fish Aggregating Device) which consist of bamboo and palm leaves (*rumpon*) or equipped with light.

Oil pressure lamps locally called *Petromax* installed on wooden or polystyrene floating rafts (*bangrak)* are commonly used in Indonesia by fishing fleets, particularly by mini seiners. Some mini seiners use now electric lamps to attract the fish. This method requires the use of generators. Two models of lamps, fixed directly on the boat structure, are used: incandescent bulbs (*Galaxy*) or halogen lamps (*Mercury*).

The fishing units observed without light equipment were recorded in the category called *Petromax* (oil pressure lamps), as these lamps are unshipped when there is no activity.

Petromax is used by almost the entire fleet described in 1995. The data are homogenous for the three surveys. 4% boats are equipped with an electrical system (combined or not with rafts with *Petromax* lamps). This equipment is quite new and is usually used by medium or large seiners fleets (Potier and Petit, 1995). It is uncommon on mini seiners fleets in 1995.

Only a very small part of the mini seiners fleet has an electric equipment. The use of this equipment seems related to the shape of the boat (tab. 7). Most of *payang* and *kranji-bulu* types are equipped with *Petromax*, only 7 of them were described with electric equipment in November 1995. On the contrary, 20 to 30% of *sopeck* and *dadap* types have an electric equipment (tab. 7). Although these two types of boats are fewer in number, there is definitely a difference in light equipment within the fleet. These results confirm the first conclusions drawn from the 1994 census (Ecoutin *et al.,* 1997).

Table 7: Light equipment (%) depending on the shape of the fishing units

Month	Type of lamp	Shape of the boat			
		kranji-bulu	dadap	sopeck	payang
March	Oil	99	63	79	99
	Electric	1	37	20	1
June	Oil	99	64	100	100
	Electric	1	36	0	0
November	Oil	99	96	66	95
	Electric	1	4	34	5

2.5 Structures used to preserve the fish

Several methods are used to preserve the fish onboard the mini seiners. The boats are traditionally equipped with baskets made of weaned bamboo stems: the fish is stocked in the baskets until the boat reaches the landing place. Then baskets are taken to the place where fish is to be sold. Plastic or wooden crates are used as well for the same purpose. Moreover some boats are equipped with fixed storage structures, under-deck holds with central opening.

Data on storage method has not always been reported by the investigators. Nevertheless, the information remains useable by defining the hold in its simplest form: the hold is then defined as an under-deck structure that allows the storage of the fish or other items[9]. The units that were described without any equipment (6% of the units) were counted with the units equipped with baskets only.

Therefore, the analysis takes into account the presence or absence of a storage structure either iceboxes or holds.

Both storage methods may be observed in the mini seiners fleet. Some differences appear in the observations made during the three investigations, which is mainly due to the definition of the word "hold". Considering the precision of the information collected, about half of the units recorded are equipped with holds.

All the units are equipped with baskets (the few cases noted without are due to the fact that the baskets had been removed while the boat was not being used) and 50% have an under-deck structure for the storage of the fish. The use of iceboxes was put in another category but represents only a small proportion of the seiners (1 to 7 units recorded depending on the month).

The storage methods (iceboxes or holds) are more particularly associated to the *sopeck, dadap* and *payang* (over 67%, except for March, tab. 8). The *kranji-bulu* are seldom equipped with those (less than 30%, except for March, not homogenous).

The differentiated storage structure, linked to the way the holds are built, represents a technological progress for the fishing unit. A clue to this technical evolution would be to know whether the holds were installed as the boat was being built or added later on.

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[9] The compartments may contain cans, fuel, oil, salt, fishing rods, pots and pans as well as food and drinkable water.

Table 8: Method used for the fish storage (%) depending on the shape of the mini seiners

Month	Storage	Shape of the boat			
		kranji-bulu	dadap	sopeck	payang
March	baskets only	50	44	2	53
	ice-boxes	1	6	0	1
	holds	49	50	98	45
June	baskets only	67	2	33	6
	ice-boxes	5	0	0	0
	holds	28	98	67	94
November	baskets only	78	33	1	9
	ice-boxes	1	0	0	0
	holds	21	67	99	91

3. Origin of the fishing unit

In Indonesia, a boat starts taking shape in a fishermen's mind by associating a name (registration name) and a place of origin[10]. It is a means of recognition between fishermen for whom belonging to a social group is essential.

The origin of the fishing unit is often closely linked to the place where its owner lives. The fishermen are recruited in the port of this unit. They are mostly from the port or living close by. The boat and its crew form a fishing unit defined by two names: the boat's and its place of origin. The latter is not always known with accuracy depending on the distance between the place of investigation and the place of origin. The information collected may relate to the main city close to the place of origin[11] or even more simply to the province of origin.

This data was always collected through oral information provided by crewmembers or fishermen present on the investigation spot. The origin of the informer as well as the quality of its relationship with the investigator is important elements to the relevance of the information gathered. One should be cautious when dealing with information collected by that way.

One of the main problems, difficult to tell on the field, is when an information given in good faith proves false. A boat may be landing for several consecutive years on a spot far away from her place of origin. The unit may then be considered native and announced to be so during the interview. This error tends to lessen the number of mini seiners that migrate during their fishing period. Repetitive campaigns allow the evaluation of the problem.

Whenever the information could not be collected on the field, the missing data was looked for in the other two censuses. Two units with the same identifying characteristics (name of the boat, equipment) are then considered as the same and one boat.

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[10] Often heard during our conversations, "*kapal itu nama Widodo, ini dari Blimbing*". This boat is called Widodo, it is from Blimbing. The origin is nearly always given to describe the unit in question.

[11] During an investigation at Eretan Wetan, it is easy to hear that Samudra is originating from Blanakan (distant from 30 km) whereas Widodo is said to be originating from Tuban (*kabupaten* which the village of Blimbing is part of, located 800 km from Eretan Wetan).

Just as it was done for the investigation spot variable, the origin of the unit is regrouped according to the zone codes (A to H) corresponding to the villages or province of origin. From the three censuses, a spatial gradient describing the origin of the units expressed by geographical zones comes out clearly between the East and the West (tab. 9). According to the unit origin percentages three groups may be defined: zones A, B, C and D never register more than 10% of the whole fleet, the western zones have zero rates for two of the investigation months; zones E and F take part for 15 to 25% of the total of the units described; then, the third group, zones F and G, corresponds to zones where 25% of the fleet is said to be originated from.

These three campaigns show a variability that does not exceed 6%. It concerns zones F and H between March and November and zone G between June and the other two censuses (tab. 9).

The comparison of the spatial distribution with that of the investigation spots shows some differences. Indeed, for several zones, the number of units described in a zone is different from the number of units announced as coming from this zone. This is mainly the case for zone A, where about forty units are counted during the investigation although only eleven units are said to be native. The same comments can be made for zones B, C and D although at a smaller scale. The opposite fact is noted for zone F where more units are said to be native whereas fewer units are counted in the censuses for this zone. Zones G and H do not present the same variations and the populations described are native.

These differences may be explained by migration: boats from East Java migrate to the landing places of the West provinces of the island. The three 1995 censuses acknowledge this fact and give a first estimate of its importance.

Knowing these migrations is of the highest importance regarding the fishing activity and the fleet dynamic as they reflect the spatial occupation strategy of the fishing units. It shows a dynamic behaviour in a variable environment, the resource.

Table 9: Geographical distribution (in numbers and %) of the origin of the fishing units

Zone of origin	March N	March %	June N	June %	November N	November %
A	0	0	0	0	11	1
B	13	1	0	0	22	2
C	28	2	34	3	40	3
D	92	8	69	5	108	8
E	184	15	198	15	176	13
F	361	30	353	27	324	24
G	309	26	403	31	356	26
H	212	18	243	19	332	24

3.1 Spatial analysis of the migration: a migration outline

A fishing unit is said to be a migrating unit when it is recorded in a zone that is not its zone of origin; the zone where it is observed is called the reception zone.

In 1995 a maximum of 17% of the described fleet migrate (tab. 10). The variations within the months during the inquiry show the temporal aspect of the phenomenon with a maximum of units away from their original zones in June. The number of migrating fishing units observed in each zone gives a fair idea of the spatial distribution of the phenomenon (tab. 10).

The welcoming zones are mainly zones A, B, C and D. A few migrations are also noted close to zone H in June. Most of the migration movement comes from zone F (East Java province) and heads to the West of Java, whatever the month (fig. 5 and tab. 10).

The South sector of Sumatra (zone A) may be considered as being mostly occupied by units from zone F as they represent slightly less than 100% of the whole number registered in March and June. The smallest value is noted for the month of November (66% of the mini seiners originated from zone F, 8% from zone E and 11 units from zone A, tab. 9), but when considering this value, one must keep in mind, as stated previously, the origin of a fishing unit landing regularly in the same port. The number of units noted down is constant during the year (tab. 3); moreover during the first two censuses, no fishing unit is described as originated from zone A. The informers may have been misled by the continuous presence of fishing units in a port for a long period of time; they then acknowledged them as native units. The presence of seiners from zone F in Sumatra Island is noted from March to November. The detailed analysis of the fishing units will permit to confirm this conclusion.

In zone B, the phenomenon observed previously seems to be similar with a higher rate of migration in March and June from sectors F and D, and a smaller rate in November. During this last census, only 39% of the observed units come from a different zone (E and F). This diminution is superior to the variation of the numbers between the three censuses (tab. 3 and tab. 9). Consequently the problem of information mentioned for zone A can not fully explain this variation. It may probably describe a temporal variation of the migration process: the migrating units present in zone B in March and June moved away in November; they have gone fishing in another zone or more probably returned to their zone of origin.

Migrations in zone C evolve differently during the censuses: 27% in March, whereas 54% and 50% of the whole fleet is present in this zone in June and November. Migration towards zone C is at its highest between March and June and it is shorter in time than zones A and B.

The same thing happens in zone D. The peak of migrating units (originating from zone F) is in June with 58% of the whole local fleet. The percentages obtained in March and November (13 and 15%) seem to prove that the boats leave and come back within this period. The migrating period might be even shorter; the units as a whole stay a maximum of 7 months in zone D. Zone D is ambivalent: it is a welcoming place for the units coming from the East, it is a departure place for its own local boats or for units in transit from the East towards zones located further West.

A small punctual move towards the East may be noted in June between zone F and zone H. It stands out as it heads in the opposite direction and is in such small numbers: 14 fishing units.
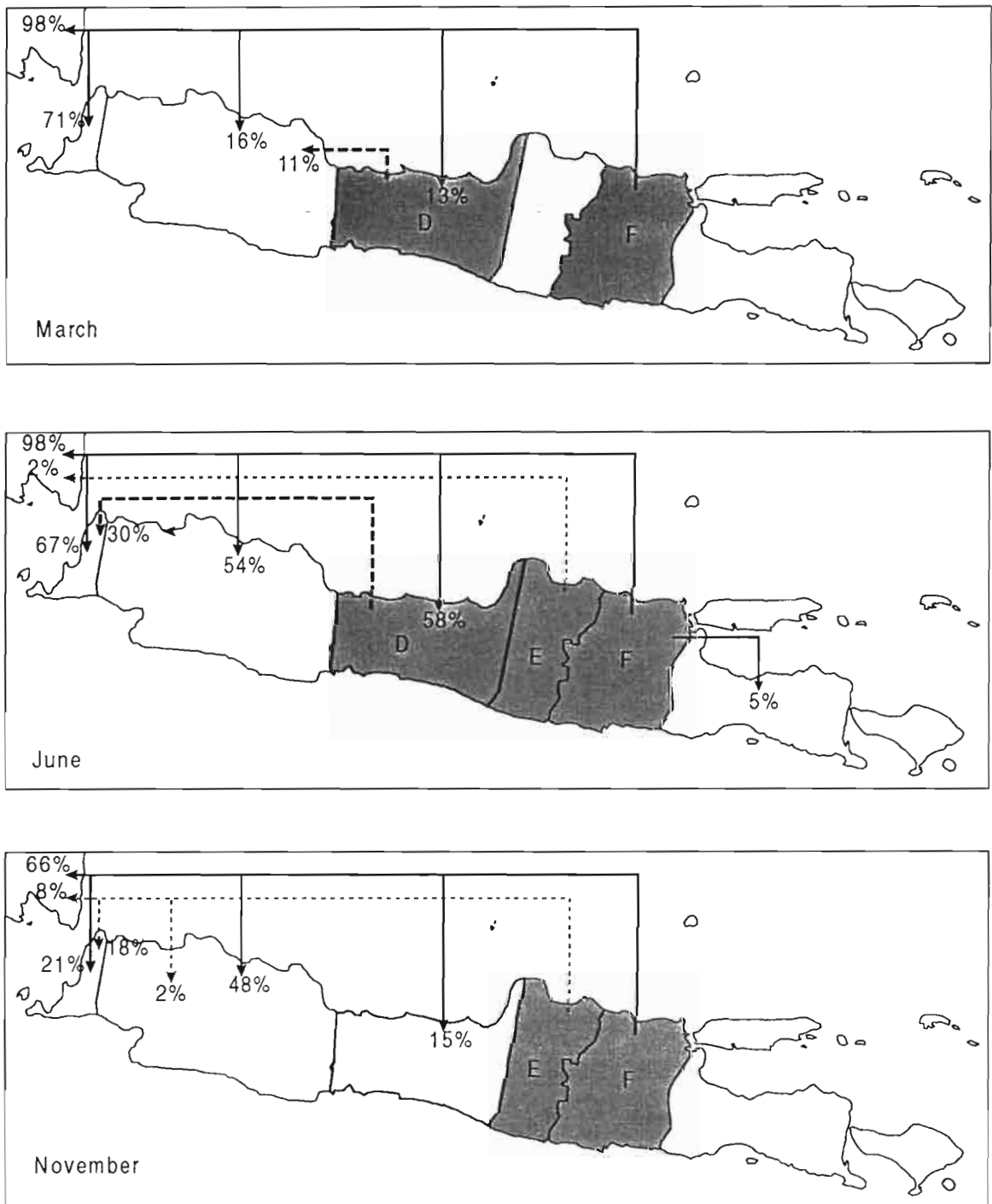
Figure 5: The main migrations observed in the 1995 censuses

The dynamic of the Javanese coastal fleet

Table 10: Zones of origin of the migrating fishing units observed in each reception zone

Zone of origin Census zone	March				June				November			
	D	E	F	G	C	D	E	F	C	D	E	F
A		1	41			1		46			4	30
B			33		1	17		37	1		7	8
C	4		6					39			1	38
D			14					71				47
E										1		31
F											1	
H			1	1			1	13				0
Migrating units	101				226				169			
Non migrating units	1098				1074				1200			
% migrants	8				17				12			

At the level of Java Island, the number of fishing units involved in migration is limited as a maximum of 17% of mini seiners are described out of their zone of origin. Two of the main zones, zones G and H, are not concerned. Out of these two zones the variations observed between the three censuses allow a first global process of migration, the proportion of migrations doubles between March and June, then decreases in November. Migration might start in March, the date of the first census, be at its maximum in June, and then decrease at the beginning of the rainy season, which usually corresponds to a lesser activity of purse seine fishing.

Migration is mainly originated from zone F towards all the zones located further in the West. The number of boats and the time spent are variable. Following through individual courses could confirm this migration process.

3.2 Technical characterisation of migrating fleets

The topological composition of the migrating units is constant during the three months of investigation. The model *kranji-bulu* prevails and represents 4/5th of the migrating boats. A few units of the other shapes are registered as well but are scarce in number.

According to Indonesian fishermen, the shape of the boat has a great influence on sailing, therefore on migration. The building of *kranji-bulu* favour a wide keel and long rear wings[12], they therefore get stability at sea which is an obvious advantage to sail long distances[13]. This explains the large dominance of *kranji-bulu* among the migrating units.

The seiners registered as migrating and equipped with a double rear motorisation are the highest in number in the fleet: 83% of the migrating units have two engines and only 58% for the rest of the fleet. Double motorisation is taken as a security advantage for long distance sailing.

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[12] The fishermen themselves justified the presence of rear wings spread for the stability of the boat.
[13] For example the distance Weru-Lempasing (1,000 km) takes 7 days and 6 nights with a unit type *kranji-bulu* equipped with two engines. The voyage is rarely straight completed, it is coastal navigation and several stops are necessary.

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The migrating seiners, which are mostly kranji-bulu, do not have light equipment. In 1995 this equipment is exclusively composed of *Petromax* lamps set on *bangrak* rafts. Similarly, these migrating units seem to be equipped very simply for the storage of the fish onboard; the percentage of holds is inferior. This observation is not easily explained. Yet, the seiners that choose the migration strategy may favour investments linked to sailing (motorisation) rather than storage facilities.

Discussion: A differentiated migration outline

A first image of the fleet may now be outlined thanks to this different results (tab. 11).

From the 1995 censuses we can see two large fishing strategies of the mini seiners in the Java Sea. The units defined as not migrating represent a majority. The migrating mini seiners represent 1/6 of the whole fleet, they come from one of the zones which counts the highest number of mini seiners (zone F); they head to the zones in Sumatra (zone A) and West Java (zone B and C) where they constitute the entire or biggest part of the observed fleet (tab. 3 and 10). This fleet is mostly *kranji-bulu,* it is fitted with relatively basic equipment composed of *Petromax* lamps and bamboo baskets. They are motorised by double rear engines.

The units that never migrate can mainly be found on Madura (zone G) and in East Java (zone E and F). Depending on the shapes of the fishing units, their equipment may or may not be differentiated. Yet, the new types of equipment are found only on the seiners that do not migrate.

Table 11: Main distinctive characters of the mini seiners depending on the strategy chosen

Criterion	Migrating strategy	Non migrating strategy
Shape of boats	*kranji-bulu* near exclusive	All types
Light equipment	Oil pressure lamp	Oil pressure lamp but electric energy as well
Storage of fish	Baskets	Baskets but differentiated structures as well
Motorization	Two rear motors	Adapted to the shape of boat
Zone of origin	Mostly F, E	G, H, F, in lesser proportion D, C
Census zone	Mostly A and B, C and D in lesser proportion	In their zone of origin

Based on a synthetic analysis of the equipment, the fleet is composed of three main groups: the boats that migrate, those that are sedentary with low or high technical characterisation (fig. 6). This classification realised from the units described during the census is relevant to the entire 1,600 mini seiner fleet.

The units that do not migrate are a majority. They may be divided into two groups:

- *kranji-bulu* and *payang* equipped with oil pressure lamps and baskets for the storage of the fish. This combination represents 56% of the number. This group is referred to as sedentary with low technical development;

- the second group is mainly composed of *sopeck* and *dadap* units. They mostly operate in the same zones and have the highest proportion of technical equipment that might be considered as more sophisticated, that is to say differentiated holds and electric lamps. This type of boats represents 5% of the mini seiners described in the Java Sea. This group, which is

sedentary and has a more elaborated technical development, differs by a characteristic considered of the upmost importance in this study, that is to say, its fishing strategy that is, never to migrate.

The migrating units are fairly close to the sedentary *kranji-bulu* as far as equipment is concerned even though some of the equipment of the former are higher in number.

So, whether by tactical choice or not, the migrating boats were observed with equipment that on the whole was less performing than the other groups of mini seiners. There seems to be an opposition between a lesser technological choice and a migrating capacity versus an evolution of the technical equipment copied on fleets, which are said to be more successful.

This partly agrees with the conclusion drawn by Wijopriono *et al.* (1996) from the different data on the Java Sea mini seiners.
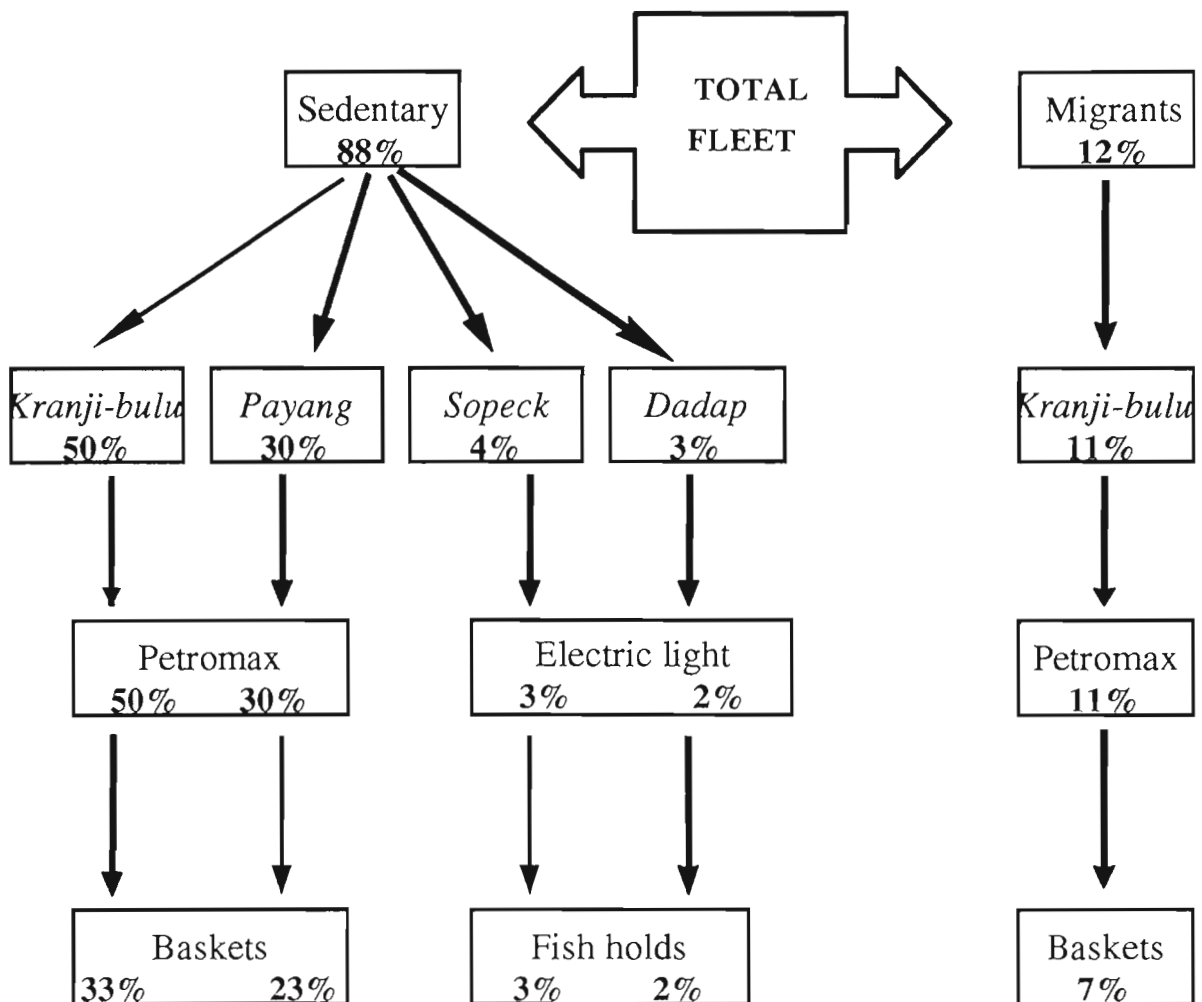
Figure 6: Synthetic outline of the equipment criteria of the mini seiners in the Java Sea

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(ALA/INS/87/17)

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and

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