INDICATORS FOR SUSTAINABLE DEVELOPMENT AND MANAGEMENT OF THE DEMERSAL AND SHRIMP FISHERIES IN NORTH COAST OF CENTRAL JAVA WITH SPECIAL REFERENCE TO PEKALONGAN AND ITS ADJACENT WATERS

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Introduction

The marine fisheries sector has played a significant role in the development of Indonesia. The national geographical condition of the Java Sea with an area of approximately 440.000 sq. km (Figure 1) shows that the bio-ecological conditions, physically influenced by two monsoonal regimes, is related to the environmental changes as part of an internal body process. The long-term climate changes and the internal oscillation which are related to the precipitation rates as an impact of *El-Nino* events also plays a significant role in the area (Sadhotomo and Durand 1997; Potier, 1998). There are several estuaries of rivers along the coast indicating the potential area of shrimping grounds.

Generally, the bottom substrate in the Java Sea is muddy and sandy. This typical bottom substrate indicates good fishing grounds for trawl operations that exploit the demersal fish and shrimp resources. Slip mouths (*Leiognathus* spp.) are the dominant species in the catch of the north coast of central Java where the area had been exploited intensively since 1970's by trawlers (Losse and Dwiponggo, 1977). The main fishing grounds for shrimps are located along the coast of central Java at the water depth of 10-40m The estimated inshore area with water depth less than 20m was 4700 nm^2 while the off shore area was 13.500 nm^2 approximately (Dwipongo, 1982). However, the Presidential Decree No. 39/80 had banned the trawl fishery since 1980.

Fishing gear, particularly those categorized as traditional ones, had been modified to increase their productivity. Modifications were made to the design, construction and fishing operation mainly to the gear *arad* and *cantrang* (Danish seine) and trammel nets to exploit shrimps and some other demersal fishes with high economic value.

The demersal fish and shrimp stocks tended to be exploited heavily since 1975 (Dwiponggo, 1978). The "*bagan siapi-api*" trawler played a significant role in the fishery. Martosubroto (1982) concluded that the exploitation was still under the MSY estimated at 85.000 90.500 tonnes. An analysis done in 1997 showed that the exploitation rate was beyond the maximum sustainable yield (Badrudin *et al.*, 1997). This information needs to be re-evaluated through observations that are more intensive and by using multidisciplinary indicators. A pilot study on the use of indicators started in May 2003. Hopefully, the output from this study will contribute to the better understanding of the status of the demersal fisheries. The study will be conducted with the cooperation of the stakeholders and the local government and the results will be discussed and presented to them. This study will provide the baseline for fisheries management purposes in the local area. The selected area for the pilot study is Jambean and Wonokerto to the west of Pekalongan in central Java.

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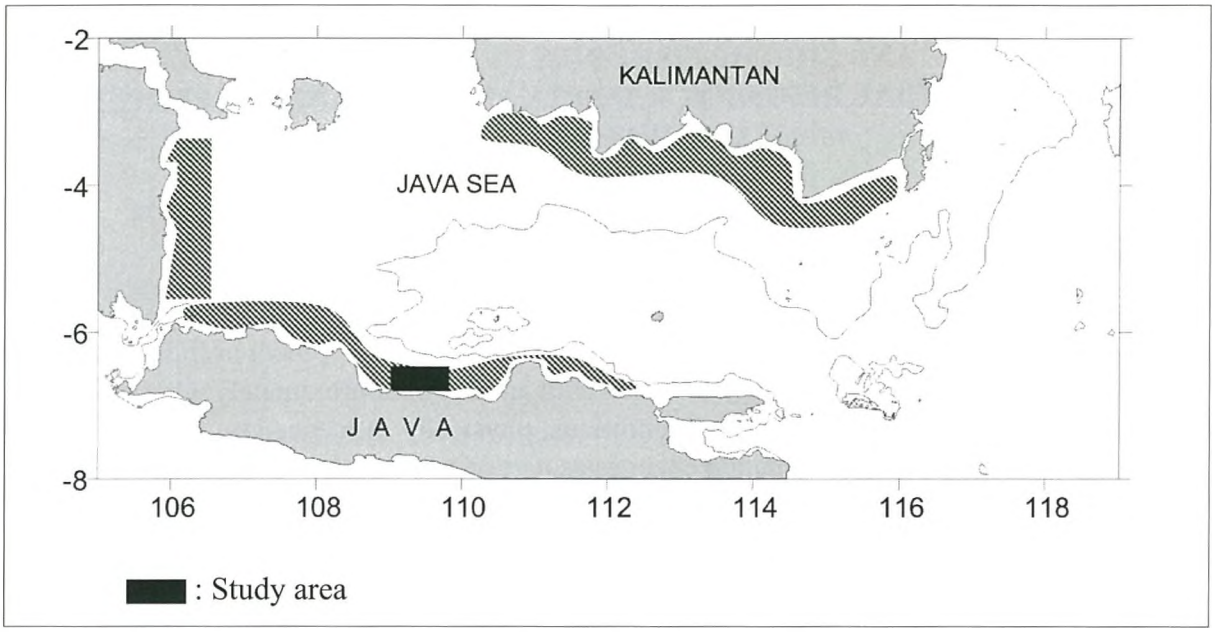

Figure 1: The fishing ground of the "Danish Seine" fisheries in the Java Sea

The justifications for the selected site and fishery for the pilot study were:

- Several specific areas with specific fisheries in the country were proposed to the central fisheries administrator. These included the Arafura Sea and Malacca Strait with trawl fishery, Bali Strait with the ring net sardine fishery, Java Sea with the scad ring net fishery and Tomini Bay with the scad ring net and skipjack pole and line fishery. However the high cost for implementing the indicator pilot project was a major constraint although historical fisheries and research data were available.
- So, the north coast of central Java was selected as an appropriate and cost-effective site location. The aim is to study the exploitation of the demersal and shrimp fishery by the small-scale fishing boats (under 30 GT).
- Based on the distribution of the number of fishing boats by gear from the whole province around the Java Sea, the north coast of central Java is the appropriate pilot study area (Figure 2).
- Observations through interviewing several fishers at the landing sites showed that some historical data were available.
- The fishing effort is high but this is not well documented. The licensing system is fully under the control of the local authority.
- There is a general tendency that these types of fisheries are already hopeless and in an uncontrollable situation. These fisheries are multi-gear and there is seasonal movement of the fishing vessels to and from the main fishing grounds.
- The government would like to increase the standard of living of those involved, but proper fisheries management plans should be in place with appropriate milestones indicated.

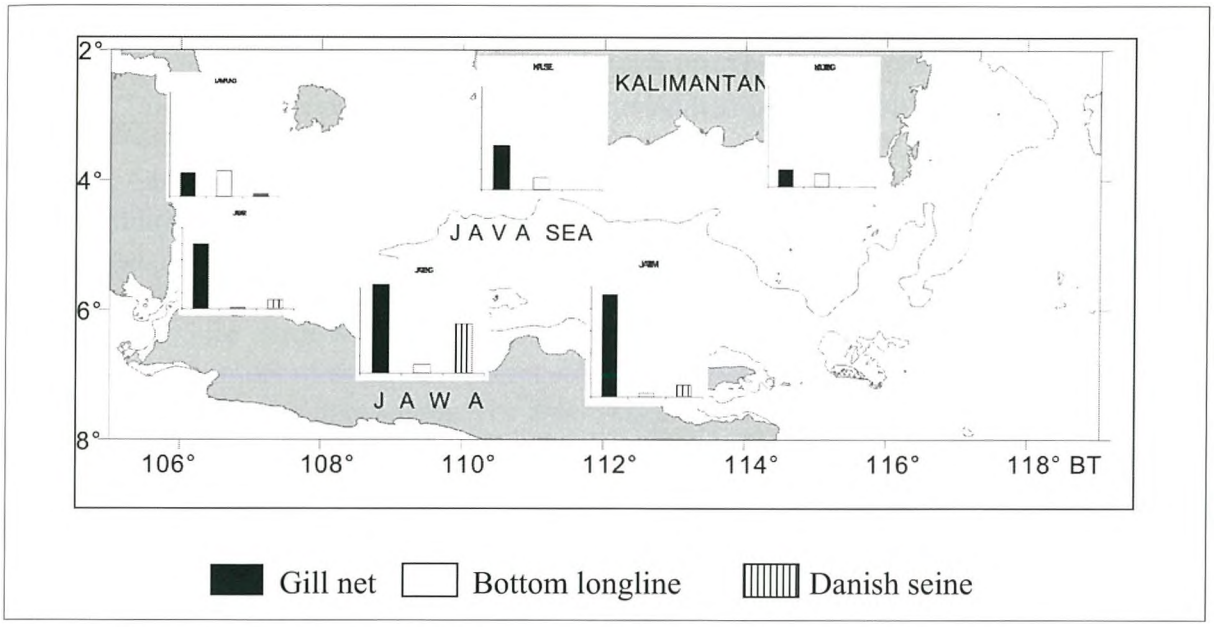

Figure 2: Distribution of fishing boats by main demersal fishing gear

The project started in May 2003 with national funding. The following activities were planned for implementation on a monthly basis.

- Collecting and evaluating representative fisheries data.
- Collecting and reviewing all information and existing research data available.
- Collecting biological data (*in situ* catch composition, bio-reproduction)
- Collecting catch-effort data (*in situ*) including the actual fishing effort
- Collecting existing data on the share system.
- Studying the licensing system in detail
- Studying the dynamics of fishing boats - in and out movement
- Doing experimental fishing with Juvenile and Trash Fish Excluder Devices (JTED)

List of Persons Involved

Subhat Nurhakim Dr.	(Director RCCF-AMFR)
Parlin Tambunan	(Director of Fish Resource, DGCF)
Duto Nugroho	(Principal Investigator, Researcher, RCCF)
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Dian Oktaviani	(Jr. Biologist, RCCF)
Ria Fauziah	(Jr. Biologist. RCCF)
Natsir	(Jr. Fisheries Biologist, RIMF)
Sarjono	(Fisheries Economics, AAAT)
Planning division	(Officer, Central Java Fisheries Service)
Turhadi	(Officer, Pekalongan National Fishing Port)
Planning division	(Officer, Pekalongan Fisheries Service)
Head of Resort	(Officer, Wonokerto Fisheries Resort Service)
Sodikin	(Fisher, Wonokerto)
Darsono	(Fisher, Wonokerto)
Marzuki	(Fisher, Jambean)
Supono	(Fisher, Jambean)
Zaenal Arifin	(Field Technician, CDFT, DGCF)

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Endon	(Field Technician, CDFT, DGCF)

This preliminary report deals with the progress based on general information of the activities collected during the period from May to December 2003. This study will continue until the end of 2005. The expected output is to obtain an example that can be used for a local fishery by the local management authority. The results should be treated as only preliminary because further analysis is still needed.

Fishery Status

The Fish Resources

The demersal fish resources in the coastal areas are important to the communities and coastal fishers in the north coast of Java. This can be seen through the presence of a large number of small size fishing boats and small scale fishing gear and the high fishing effort. The active fishing gear dominating the area is the *cantrang* or *arad* which is trawl- like but are classified as the Danish seine.

Previous studies showed that the species composition before the trawl ban in 1979 were dominated by the pony fishes (*Leiognathus* spp.) with of catch rates of about 30% in the standard trawl (Dwiponggo and Badrudin, 1980). However, in the next seven years i.e. until 1986, the composition increased to 60% (Badrudin, 1987). The estimated stock density determined by the swept area method in 1986 was around 6.2 tonnes/sq km. (Badrudin, 1988). The structure and community analysis of the demersal fishes before and after trawl ban (up to 1986), indicated a recovery of the quality of fish and an increase in the biomass of the large food fish such as *Lutjanus* sp., *Lactarius lactarius*, *Eleutheronema tetradactylum*, *Muraena* sp. but with uncertainties for the shrimp stocks (Sadhotomo, 1991). Atmadja *et al.*, (2003) stated that in the depth of 20 to 50m, the composition in weight shifted slightly compared with the existing data that had been collected on 1976. At present Leiognathidae is a dominant group of species followed by Nemiptridae, Priacanthidae and Synodontidae (Figure 3).

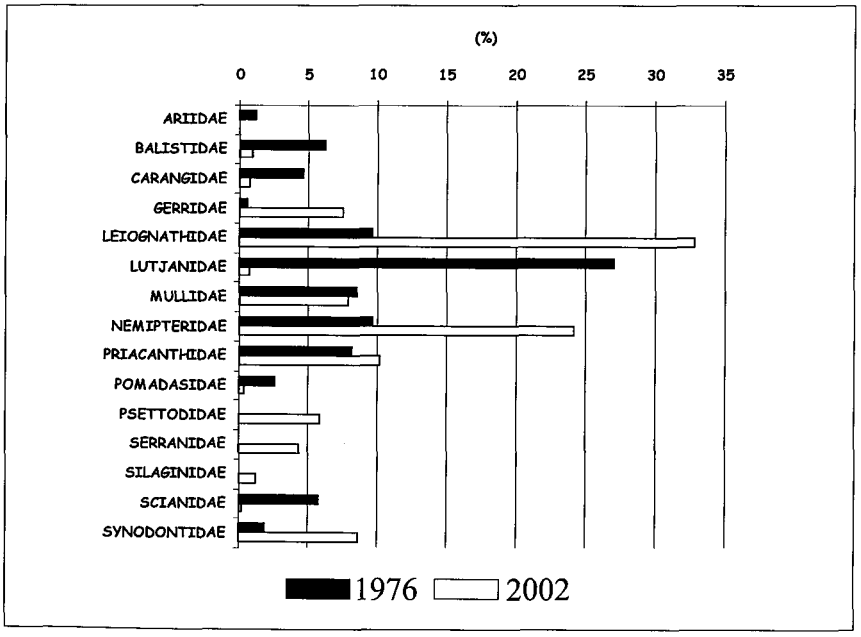

Figure 3: The catch composition of demersal fish between 1976 and 2002

Based on the local statistical data, there are some difficulties to understand the level of fishing effort really in the area. A quick analysis showed that the fishing gear is dominated by the "*payang*" or surface seine for catching small pelagic fish, followed by the beach seine and trammel net. There are missing or unclear information on the number of *arad* and *cantrang* as the main fishing gear exploiting the coastal demersal fish resources.

After explaining and discussing the importance of such baseline information for evaluating fisheries to the local officer, the level of the actual effort is better understood. The data were not missing but since there was no column in the official data form for the landing records of *cantrang*, the number of this gear, was recorded under *payang*. These data had to be extracted manually from the raw data sheets. The a*rad* was not recorded because this gear requires low investment and gives low profit levels.

A quick analysis of the monthly production by fishing gear showed that *payang* (which is representing *cantrang*) played a dominant role in the total landing. The production by month in 2003 is shown in Figure 4. The trends of monthly landings by groups of fish including their average price for 1997 to 2002 in Wonokerto were also determined and shown in the Appendices 1 and 2.

To solve this problem, an approximation was applied to determine the range of the number of existing *arad* and *cantrang* in the area, and completed by conducting regular census in the study site.

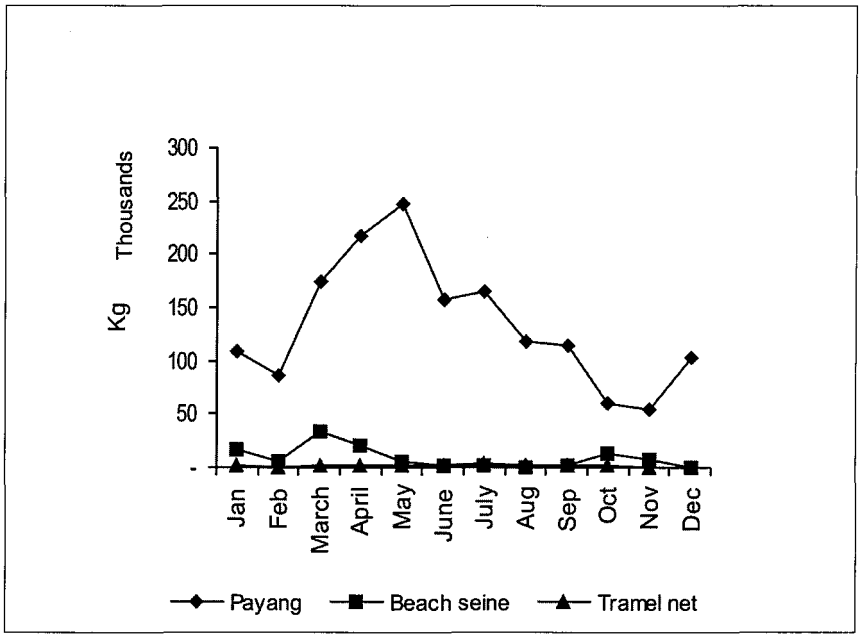

Figure 4: Monthly catch by fishing gear in Wonokerto, 2003

The catch composition derived from 24 samples of *arad* landings at the Jambean auction place showed that shrimps contributed 2-3% of the total catch. Lizardfish (*Saurida* spp.) and squid temporally played a dominant role as shown in Figures 5 and 6.

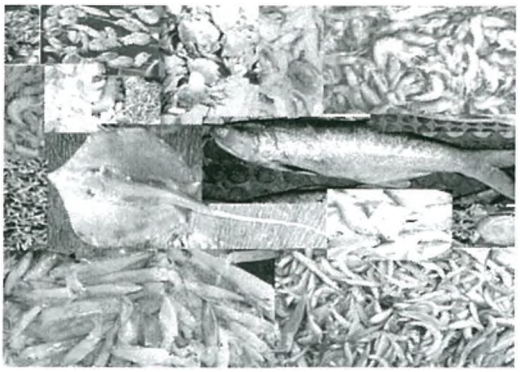

Figure 5: Catch composition of *arad*

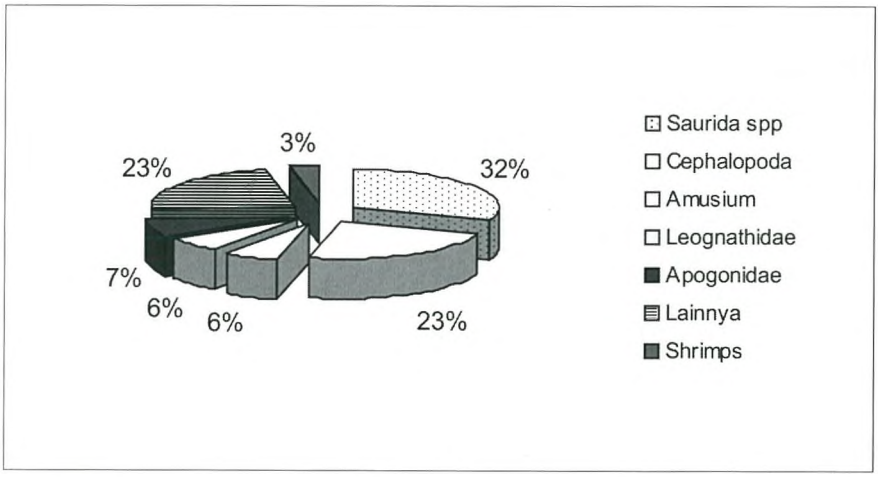

Figure 6: Catch composition of a*rad* with meshes of 0.75 inches

Observations on the catch composition of *cantrang* based on several landings *in situ* in September/October 2003 showed that *Nemipterus japonicus* and *Saurida* sp. were the dominant species (Table 1). The overall catch composition is still being analyzed.

Table 1: Catch composition by *cantrang* in Wonokerto

Family/Species	Wonokerto %
Fish	
Dasyatidae	2.00
Ariidae	3.20
Leiognathus splendens	9.81
Lutjanidae	1.39
Muraenesox sp	0.11
Nemipterus japonicus	13.94
Psettodes erumei	2.94
Priacanthus macracanthus	3.73
Pentaprion longimanus	1.51
Serranidae	2.44
Saurida longimanus	4.89
Saurida micropectoralis	11.01
Saurida undusquamis	2.85
Sciaenidae	1.30
Soleidae	5.05
Trichyuridae	1.09
Upeneus sulphureus	4.83
Others	22.18
Non-Fish	
Squid and cuttle	3.50
Shrimps	0.85

Fishing Effort

The dimensions of small scale fishing boats locally called *payang* and *sopek*, are LOA 8.6310.87m, breadth 2.823.11m and depth 0.55-0.90m. Interviews with fishers clearly showed that the boats were multi-gear and related to the fishing seasons. The general dimensions of the fishing boats are presented in Table 2.

Table 2: Geometrical dimensions of *arad and cantrang* by location

Location	LOA (m)		B (m)		Draft (m)		HP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pekalongan	10.87	0.73	3.11	0.10	0.90	0.23	49.37	29.83
Jambean	8.63	0.15	2.82	0.25	0.55	0.17	22.50	5.20
Kendal	9.44	2.32	3.23	0.65	1.26	0.27		

The long-term effect of the trawl ban had given a higher probability of success to coastal and traditional fishing fleets to catch shrimps and some large important and economical demersal species. Several types of fishing boats were modified after the fishers found a relatively cheap "*gardan*" in 1987 that is very powerful for towing and hauling the net of *cantrang*, together with the otterboards and sinkers. Using boats with an engine power of 33 HP and at a towing speed of

around 1-3 knots, an average of less than four hauls during the day were made and this showed the low productivity of this gear.

Modifications were made by the fishers because they were easily done at a relatively low cost of investment and maintenance facilities were available in the neighboring area. The target species are shrimps and some demersal fish of high economic value such as catfish (*Arius* spp.), red snapper (*Lutjanus sanguineus*) and pomfrets (*Pampus* spp.).

However, on the operational scale, the authority found some difficulties with this type of fishery due to its operation. The gears are categorized as trawl-like and these are not allowed under presidential decree No. 39/80. As the number of *arad/cantrang* increased with time, the issue of decreasing shrimp resources emerged as a source of conflict with the legal gear, the trammel net. This situation called for a need to study the relationship between the *arad/cantrang* fishery and the demersal fish resource availability. The towing technique used differentiates the *arad* and *cantrang*. The a*rad* is operated by anchoring the boat, then towing the net. The *cantrang* is operated just like a trawler, but has a smaller net and the boat used has a lower engine power.

The specifications of the *cantrang* net is roughly as follows. The length is approximately 26.7m; the wing is 11.75m with a mesh size of 2.5 - 3.5 inches. The bunt is 11.6m with 1.25 - 2 inches mesh, and a codend of 2.5m long and mesh size of 0.75 - 1 inch. Some used otterboards of 70 x 36 inches complete with a chain of 8kg.

Evaluation of Existing Effort
A fishing fleet census (made through 10 sampling trips) in the selected area with a total number of 140 fishing boats showed that during a period of two months, from July-August 2003, only 30 to 45 % of the boats were actively fishing (Figure 7). The rest stayed inshore due to several reasons. The main reason was that the catch would not able to cover the operating cost. This "myopic decision" showed that fishing that started during a period of high shrimp prices and a low price of fuel in 1998 led to profit orientation. These boats became idle when the price of shrimps was 40% lower and the fuel price rose almost 300% higher. The change in fishing effort was a boom and bust that is commonly occurring in the capture fisheries of the north coast of Java.

Data were collected from the fishers. As an example, a fisher Sodikin, who has records was selected. It was shown that during the period September/October 2003, the number of trips per month was 12, with average of 36 hours fishing and 4-5 hauls per trip. The average catch per trip showed that the economic species was dominated by squid/cuttlefish of around 10% of the catch but with a 70% contribution to the total price. A quick analysis of the sharing system indicated that at an average operation cost of Rp. 250.000, (following a share system of 50% for boat and gear owner, and 50% for the fishers), the net income was around Rp. 150.000 per boat (with two crew members) per trip. The share for the crew was 50% of the net income or Rp. 37.500 per trip. The helmsman earned 20% extra from the owner's share.

In some cases, the owner of the *arad / cantrang* would leave their own gear and work as a crew member on a short term contract in the ring net fishery (boats more than 100 GRT) which operates further off their fishing area (Makassar Strait or Natuna Sea). Some also work as contract crew in the fishnet fishery (trawlers of more than 150 GRT) that operate for a certain time in the Natuna Sea or Arafura Sea. These were the reasons to explain the idle boats.

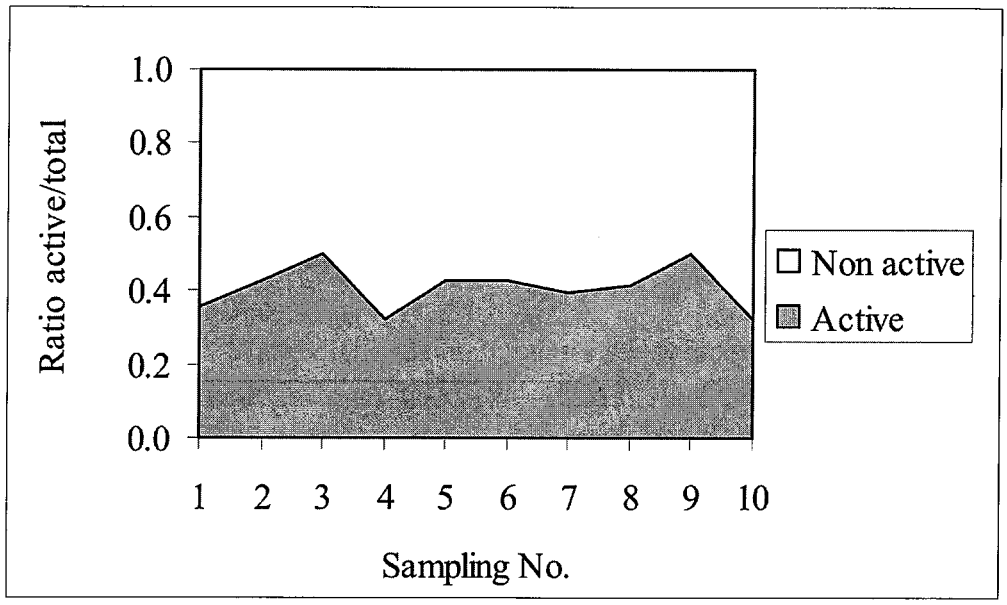

Figure 7: Ratio of active to total number of *arad* by sampling

Miscellaneous Data and Information

During regular observations in the year 2003, some data and information were collected and they are still under analysis. These were:

- Length frequency as a tool to evaluate the decreasing on average length within a decade
- Sexual Maturity as an indicator because most of the catch were in immature stage
- Experimental JTED as a tool to enhance fishers understanding of the optimum mesh size to reduce the catch of small and non-economic fish due the importance on survival and ecological balance
- Yield by fishers (catch and economic value Figures 8 and 9)
- Demography of fishers (age, education structure)
- Introduction to concept that quality is better than quantity of fish being landed

Conclusions

- The data being collected still need to be evaluated to see how far the output can be designed as an outcome to be accepted by local stakeholders as indicators to develop their resource sustainability
- Continuous observation of the modifications to fishing boats will be done in the year 2004 to propose a strategy to obtain reliable data cost-effectively
- Statistical data are most powerful and can be used by stakeholders to do self-assessments on the state of the fish resources by their own community. These data can also be shown to the communities to enable them to understand the state of the resources

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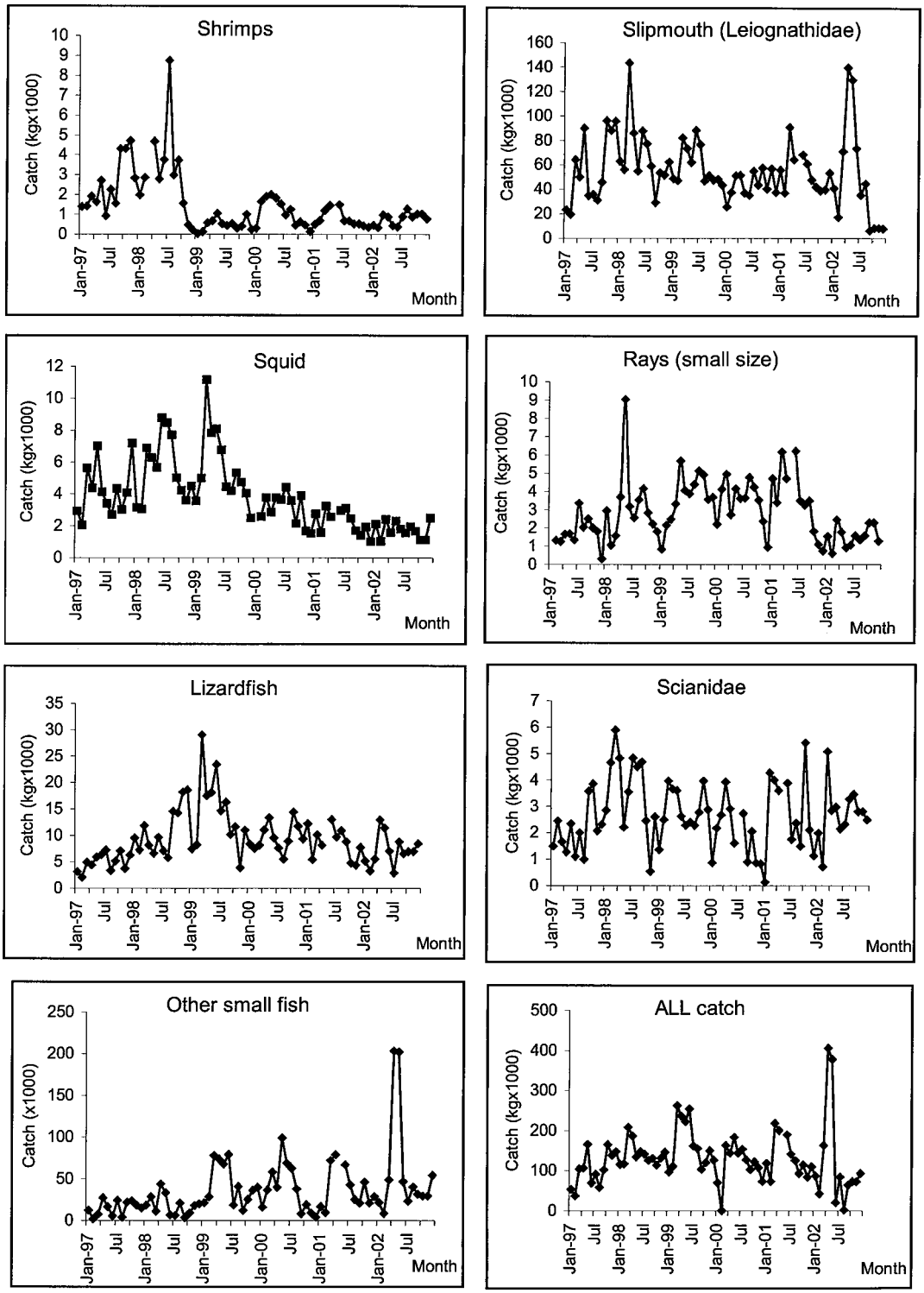

Figure 8: Monthly changes of the total catch by group of species in Wonokerto for 1997-2002

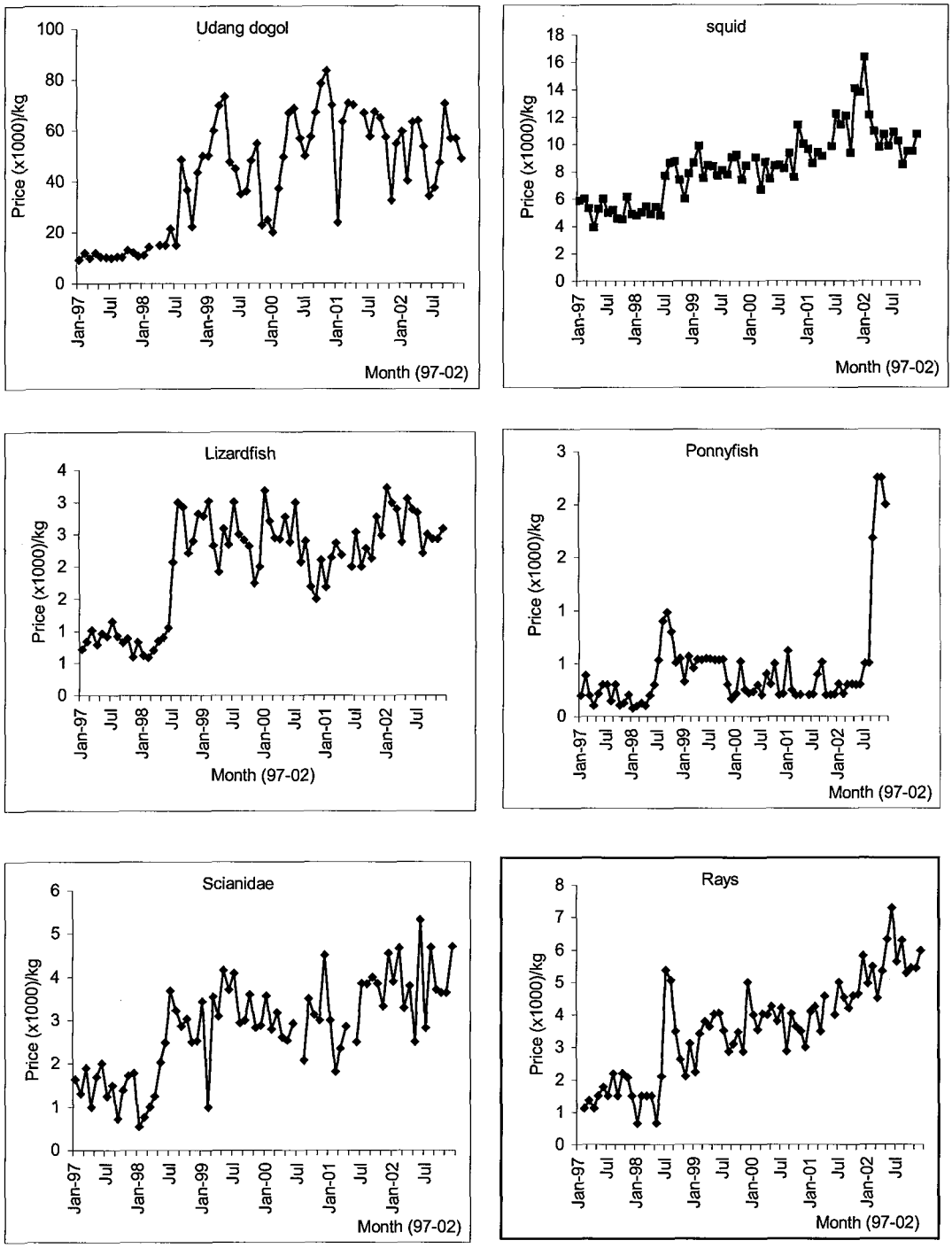

Figure 9: Monthly changes of the average price by group of species in Wonokerto for 1997-2002