RECOMMENDATIONS FOR THE IMPROVED MANAGEMENT OF SMALL SCALE MARINE FISHERIES OF NORTHERN JAVA, INDONESIA

Prepared by

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The information reported in this document was collected in 1983 and 1984. Some of the findings and data have been reported in the following publications. However, there may be information in this document that is not in the published papers.

Dudley, R.G., Tampubolon, G.H., 1985. The trammel net shrimp fishery of Java Indonesia. Oceanologi di Indonesia 19, 41-56.

Dudley, R.G., Tampubolon, G., 1986. The artisanal seine- and lift-net fisheries of the north coast of Java. Aquaculture and Fisheries Management 17(3), 167-184.

Dudley, R.G., Harris, K.C., 1987. The fisheries statistics system of Java, Indonesia: Operational realities in a developing country. Aquaculture & Fisheries Management 18(4), 365-374.

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Chapter 1

INTRODUCTION

1.1 The Purpose of this Project

This project was initiated to provide assistance in developing fishery management programs for Indonesia's small scale fisheries, and for the fisheries of northern Java in particular. While other fisheries were originally included in the project, operational realities restricted most of the project activities to the north coast, although several trips to other areas contributed additional useful information.

The project was funded by the United States Agency for International Development (USAID) via contractual arrangements with the United States National Marine Fisheries Service (NMFS) and Oregon State University.

1.2 Fisheries of Java's North Coast

The fisheries of the northern coast of Java are among the most important in Indonesia. The fishery is one of the largest in the country and is also at the population center of Indonesia. While much of the fish landed on Java's north coast is caught near to the coast, it is not true of all the fish landed there. A relatively large proportion of the purse seine catch is caught farther out in the Java sea and near the coast of Kalimantan. Likewise a portion of the gillnet catch is taken offshore. However, most of the some 300,000 tons of fish landed on the north coast of Java is caught within 20 Km of the coast.

Not only does the north coast of Java have one of the largest fisheries in Indonesia, it also has a very valuable component: the north coast shrimp fishery. This fishery has attracted a lot of attention recently because conflicts between trawlers and the small scale fishery resulted in a ban on trawling in much of Indonesia. This ban was first implemented in Java and adjacent areas in October of 1980 and was later extended to include much of the country.

The primary fishing gear types and corresponding catches are summarized in Table 1.1,and catches for the north coast of Central Java province are summarized in Table 1.2. More detailed data from Central Java is recorded in Table 1.3.

Some of the fish groups caught are listed in Table 1.4. These are the primary species groups caught in the gear types which will be discussed in chapters 2 through 5 and also include most of the commercially important species of the north coast fishery.

Several factors make the rational management of these fisheries difficult. Even under ideal conditions the multi-species multi-gear nature of the fishery creates problems for the decision makers. A management action (for example a mesh size regulation) may be suitable for one species of fish but not for others. The population of some fishes might be quite high and might support increased development of the fishery, but that increased fishing might overfish another species.

In addition the social and economic situation on Java's north coast further complicates the management of the fisheries. Much of the population is poor and dependent on the sea to make a living. Any regulations or development programs must consider this factor. Management actions which would limit fishing could also result in increased unemployment and less favorable economic conditions. Such actions must be avoided.

1.3 A Fishery Management System: INFORMATION, ANALYSIS, ACTION

The primary purpose of this project was to provide assistance to develop a fishery management system. The purpose was not just to formulate a regulation or a development program for a particular species or fishery, but to improve the overall system for making rational management decisions about these fisheries.

Such a management system includes three basic steps: the collection of INFORMATION, the ANALYSIS of that information, and a management ACTION. The action ,in turn, will consist of the formulation of management policy, and the execution of that policy.

The conceptual diagram of a fishery management system (Figure 1.1) illustrates the many types of information needed to develop and carry out fishery management activities.

1.4 Contents of this Report

This report has three components. Chapter 2 is a description of the purpose and procedure for developing fishery management plans for each Fishery Management Unit (FMU). Chapters 3, 4, and 5 are brief examples of fishery management plans for the Beach Seine, Shrimp, and Small Pelagics FMUs respectively. Chapter 6 is a review of the system for collecting fishery statistics.

Table 1.1. Northern Coast of Java Fishery Statistics Summary.
A comparison of some fishery statistics for 1980, 1981 and 1982. Data is taken from the annual reports of the Indonesian Government. Data shown here is for the units of gear found on the northern coast of Java and for fish landed there.

	Number of Units			Production (tons)			Production (%)			Catch per Unit (tons)		
TYPE OF FISHING GEAR	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Otter Trawl	579	0	0	50881	0	0	15.6	0	0	87.9	-	-
Payang	6419	4093	5376	46985	47321	49905	14.4	15.4	14.6	7.3	11.6	9.3
Dogol	1259	2342	1767	9781	14213	10910	3.0	4.6	3.2	7.8	6.1	6.2
Beach Seine	334	338	333	2214	5526	6285	0.7	1.8	1.8	6.6	16.3	18.9
Purse Seine	1542	1251	1613	84475	77940	91277	25.8	25.3	26.7	54.8	62.3	56.6
Drift Gill Net	19782	19119	24345	50928	64907	68547	15.6	21.1	20.1	2.6	3.4	2.8
Surrounding Gill Net	479	1317	1245	3667	7650	4168	1.1	2.5	1.2	7.7	5.8	3.3
Set Gill Net	4609	4135	4134	6628	8450	9040	2.0	2.7	2.6	1.4	2.0	2.2
Shrimp Gill/Trammel Net	13494	13900	14836	17806	22278	40945	5.4	7.2	12.0	1.3	1.6	2.8
Fixed Liftnet (Bagan)	4801	4591	3643	18953	20544	21567	5.8	6.7	6.3	3.9	4.5	5.9
Troll Lines	1676	462	2478	1514	2167	1250	0.5	0.7	0.4	0.9	4.7	0.5
Other Lines	11354	9969	12020	13168	12905	18757	4.0	4.2	5.5	1.2	1.3	1.6
Sum of above	66328	61517	71790	307000	283901	322651	93.8	92.1	94.5			
TOTAL ALL GEAR	77061	73900	84934	327170	308262	341454	100.0	100.0	100.0			
other gear	10733	12383	13144	20170	24361	18803	6.2	7.9	5.5			

Notes: 1. Data for 1980 and 1981 from published national statistics.
2. Data for 1982 from preliminary national statistics.
3. Trawling was banned in most of Indonesia in October 1980.
4. Much of the purse seine catch and some of the trawl and drift gillnet catches are not from the inshore areas of north Java, but are actually caught further out on the Java sea or near the coast of Kalimantan.

Table 1.2. Central Java North Coast Fishery Statistics Summary.
A comparison of some fishery statistics for 1980, 1981 and 1982. Data is taken from the annual reports of the Indonesian Government. Data shown here is for the units of gear based on the northern coast of Central Java and for fish landed there.

	Number of Units			Production (tons)			Production (%)			Catch per Unit (tons)		
TYPE OF FISHING GEAR	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Otter Trawl	258	0	0	17021	0	0	15.9	0	0	66.0	-	-
Payang	1396	487	499	6811	8109	2771	6.4	8.6	2.6	4.9	16.7	5.6
Dogol	143	345	368	1647	2143	2257	1.5	2.3	2.1	11.5	6.2	6.1
Beach Seine	151	202	152	617	1800	3367	0.6	1.9	3.2	4.1	8.9	22.2
Purse Seine	543	653	682	51928	48994	57844	48.7	51.7	54.2	95.6	75.0	84.8
Drift Gill Net	6594	5416	6212	11821	14320	13452	11.1	15.1	12.6	1.8	2.6	2.2
Surrounding Gill Net	383	1129	363	1426	1022	532	1.3	1.1	0.5	3.7	0.9	1.5
Set Gill Net	1794	1547	1536	1002	934	951	0.9	1.0	0.9	0.6	0.6	0.6
Shrimp Gill/Trammel Net	4644	3813	6277	6695	10513	20897	6.3	11.1	19.6	1.4	2.8	3.3
Fixed Liftnet (Bagan)	1981	1968	414	3809	3097	1082	3.6	3.3	1.0	1.9	1.6	2.6
Sum of above	17887	15560	16503	102777	90932	103153	96.3	95.9	96.6			
TOTAL ALL GEAR	23889	20981	19469	106716	94836	106779	100.0	100.0	100.0			
other gear	6002	5421	2966	3939	3904	3626	3.7	4.1	3.4			

Notes: 1. Data for 1980 and 1981 from published national statistics.
2. Data for 1982 from preliminary national statistics.
3. Trawling was banned in most of Indonesia in October 1980.
4. Much of the purse seine catch and some of the trawl and drift gillnet catches are not from the inshore areas of north Java, but are actually caught further out on the Java sea or near the coast of Kalimantan.

Table 1.3. Data taken from the Central Java annual report for 1982, including data about number of trips. For several reasons data from the official statistics is of limited use at present. Nevertheless they are of some use in gaining general information about the fishery.

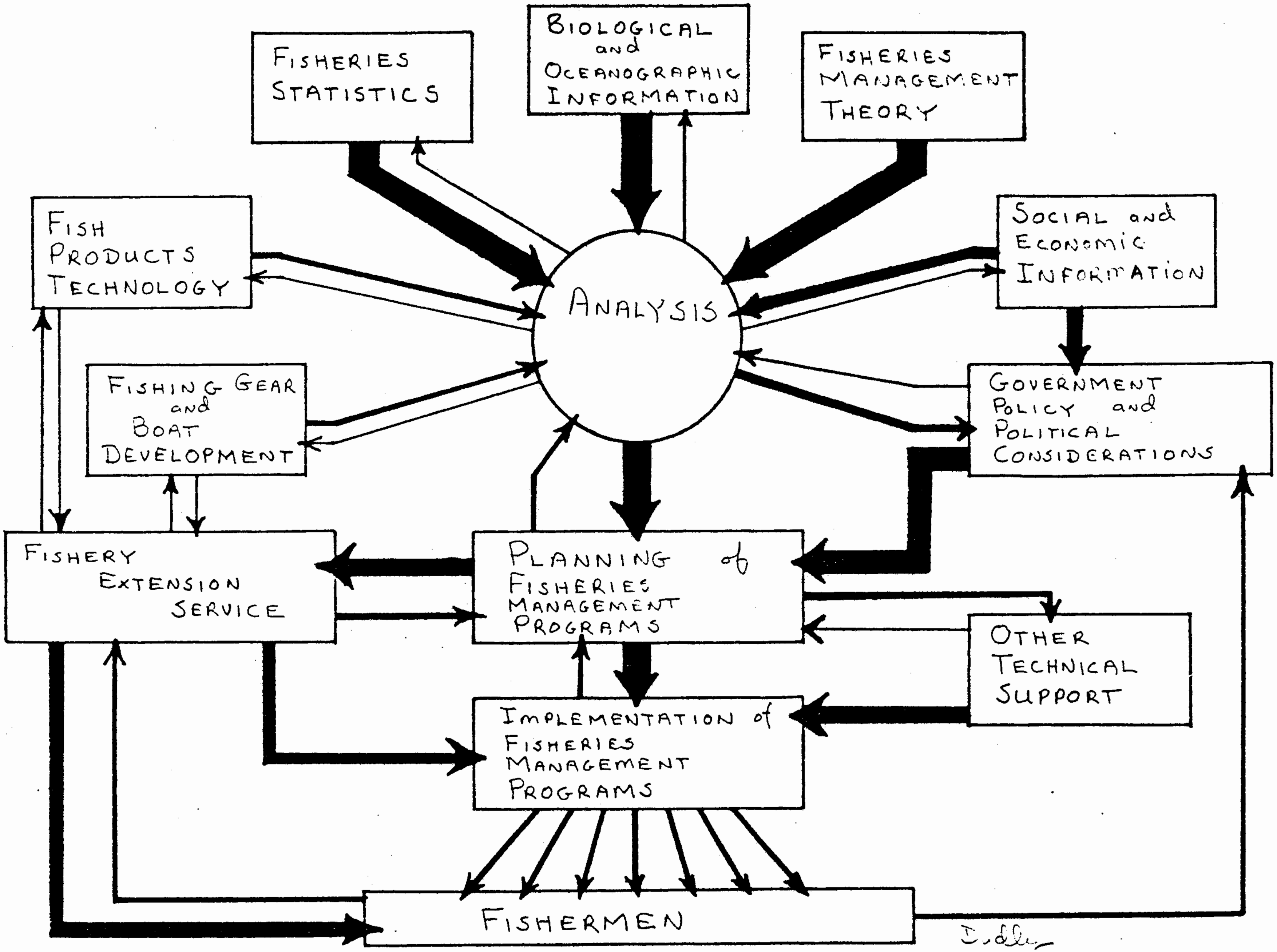
TYPE OF FISHING GEAR	A Number of Units	B Total Catch (tons)	C Percent of Catch	D Catch per Unit B/A	E Number of Trips	F Trips per Unit E/A	G Kilograms per Trip B/E
Payang	498	2799	2.7	5.6	73830	148	38
Dogol	368	2285	2.2	6.2	17669	48	129
Beach Seine	152	3098	3.0	20.4	21763	143	142
Purse Seine	1113 *	57330	54.7	51.5	93151	84	615
Drift Gill Net	6724	12501	11.9	1.9	344419	51	36
Surrounding Gill Net	363	584	0.6	1.6	6007	17	97
Set Gill Net	1530	940	0.9	0.6	321956	210	3
Shrimp Gill/Trammel Net	6504	20301	19.4	3.1	1049403	161	19
Fixed Liftnet (Bagan)	414	1413 **	1.3	3.4	97361	235	15
Sum of above	17666	101251	96.6		2025559	115	50
TOTAL ALL GEAR	19952	104859	100.0				
Other gear	2286	3608	3.4				

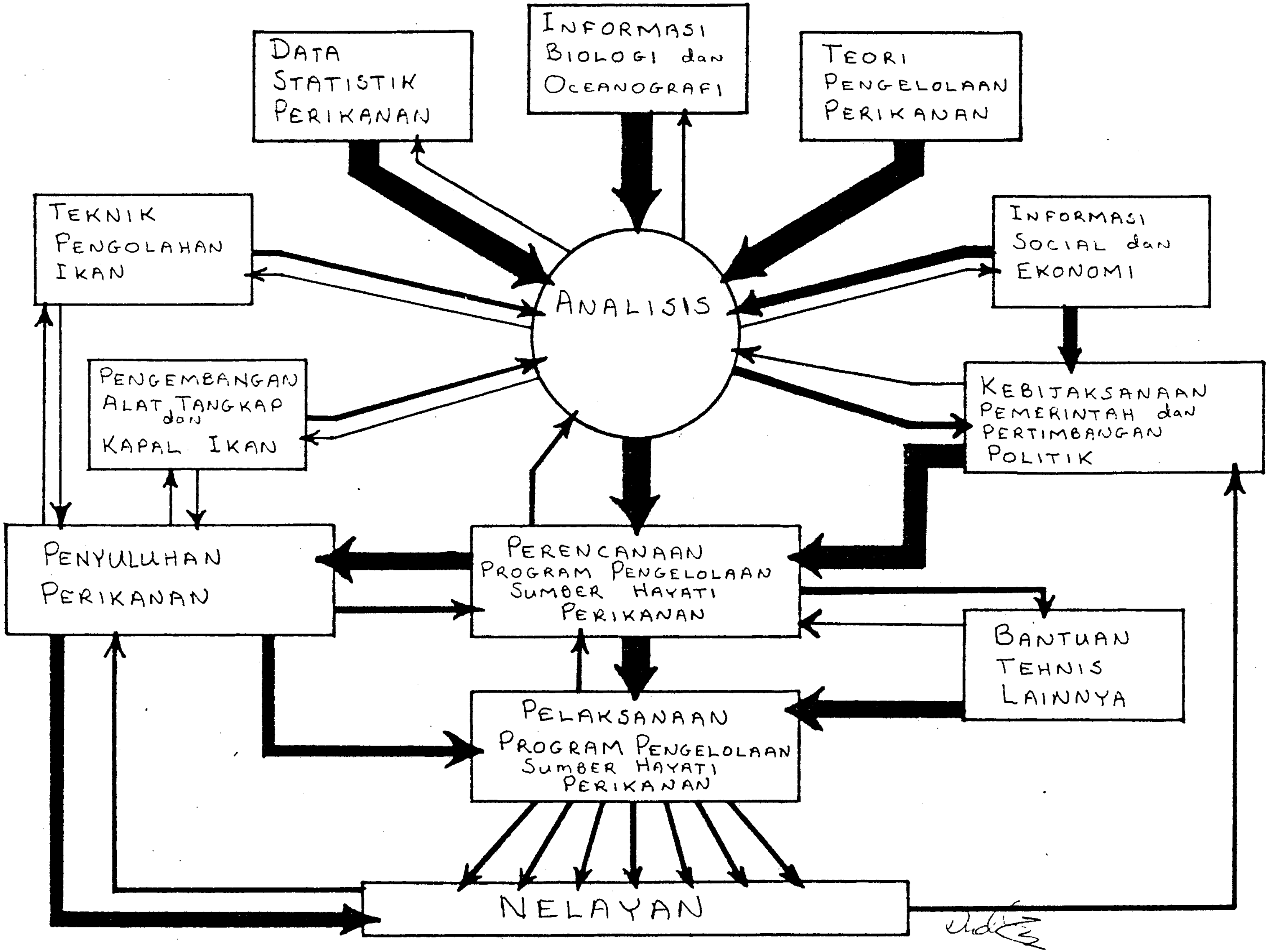
Notes: * The preliminary national statistics list 682 purse seine. The mini purse seine is included with the purse seine.

** This is the value for floating Bagan, no catch is listed for fixed bagan.

Table 1.4. Abbreviations of fish names used in various tables in this report. In general the code consists of the first four letters of the family name (exceptions noted by an *). If the sample in question is also identified to genus then the first two letters of the genus name are appended to the family code (exceptions noted by an #). In most cases identification was limited to that which could be reliably made by the field staff.

Group Name:	Abbreviation	
Ariidae	ARII	
Carangidae	CARA	
Decapterus	CARADE	
Megalaspis	CARAME	
Scomberoides	CARASC	(=Chorinemus)
Selar	CARASE	
Selaroides	CARASL #	
Clupeidae	CLUP	
Anodontostoma	CLUPAN	(="Dorosoma" chacunda)
Dussumeria	CLUPDU	
Ilisha	CLUPIL	
Sardinella	CLUPSA	
Cynoglossidae	CYNO	
Engraulidae	ENGR	
Stolephorus	ENGRST	
Thryssa	ENGRTH	
Formionidae	FORM	
Lactariidae	LACT	
Leiognathidae	LEIO	
LOLIGO (all squids)	LOLI *	
Mugilidae	MUGI	
Mullidae	MULL	
Muraenesocidae	MURA	
Nemipteridae	NEMI	
Penaeidae (Penaeus)	PENA	
P. indicus	PENAIN	
P. merguiensis	PENAME	
P. monodon	PENAMO	
Platycephalidae	PLAT	
Plotosidae	PLOT	
Polynemidae	POLY	
Priacanthidae	PRIA	
Psettodidae	PSET	
RAYS (several families)	RAY *	
Mysidae (mysid shrimps)	MYSI	
Sciaenidae	SCIA	
Otolithes	SCIAOT	
Scombridae	SCOM	
Auxis	SCOMAU	
Euthynnus	SCOMEU	
Rastrelliger	SCOMRA	
Scomberomorus	SCOMSC	
SHARK	SHARK *	
Sillaginidae	SILL	
Stromatiidae	STRO	
Pampas	STROPA	
Synodontidae	SYNO	
Theroponidae	THER	
Tetradontidae	TETR	
Triacanthidae	TRIA	
Trichiuridae	TRIC	
OTHER	OTHER *	


Fisheries Statistics
Biological and Oceanographic Information
Fisheries Management Theory
Fish Products Technology
Social and Economic Information
Analysis
Fishing Gear and Boat Development
Government Policy and Political Considerations
Fishery Extension Service
Planning of Fisheries Management Programs
Other Technical Support
Implementation of Fisheries Management Programs
Fishermen


DATA STATISTIK PERIKANAN
INFORMASI BIOLOGI dan OCEANOGRAFI
TEORI PENGELOLAAN PERIKANAN
TEKNIK PENGOLAHAN IKAN
INFORMASI SOCIAL dan EKONOMI
ANALISIS
PENGEMBANGAN ALAT TANGKAP dan KAPAL IKAN
KEBIJAKSANAAN PEMERINTAH dan PERTIMBANGAN POLITIK
PENYULUHAN PERIKANAN
PERENCANAAN PROGRAM PENGELOLAAN SUMBER HAYATI PERIKANAN
BANTUAN TEHNIS LAINNYA
PELAKSANAAN PROGRAM PENGELOLAAN SUMBER HAYATI PERIKANAN
NELAYAN

Chapter 2

DEVELOPMENT OF FISHERY MANAGEMENT PLANS

2.1 Purpose of Management Plans

A fishery management plan is a plan of action for a fishery. It is a summary of all available data about the fishery with suggestions for development and control. Such a plan should provide specific recommended actions for the fishery in question.

One of the major reasons for developing fishery management plans is to provide better planning and coordination for making decisions about fishery management. A management plan provides a framework for discussion of the various problems, development programs, and possibilities for managing a fishery.

2.1.1 Provides a Framework for Management

The purpose of the management plan is not to discuss fishery research findings, but to provide a framework for using such research findings and other information to determine the best management actions for the fishery in question. In fact the organization and summarization of research data is a primary component of a good fishery management plan, and a portion of the plan should be directed toward the research agencies with suggestions for future research which is of use to the fishery manager. In Indonesia in particular, where there is a need for additional information, a strong link between the fishery research and fishery management agencies is needed. Fishery management plans will help maintain that link, and will help clarify the purpose of the research.

In general a fishery management plan will summarize all existing information about a fishery, not just research data. Information about on the numbers of boats, units of gear of various types, the catch per unit of effort, the export and local value of the product should be summarized if possible. The effect of the catch on local processors and the local economy is an important consideration too, as is the effect on employment in the village. All such factors should be considered when making management policy.

2.1.2 Helps Develop Specific Fisheries Policy

One purpose of a fishery management plan is to develop appropriate policies for the fishery in question. Indonesia currently has an excellent statement of national fisheries policy. From this national policy, with the help of the fishery management planning process, specific goals for individual fisheries can be developed. For example, if providing employment is a national goal, then how can each fishery be managed to support that goal? What types of gear are more labor intensive and how can they be encouraged? If the fishery in question is not suitable for supporting that goal, then a different national goal, say increasing exports, might be emphasized instead.

2.1.3 Recommends Specific Management Actions

Once the goals and policy for a specific fishery are established then management recommendations can be made. From the summaries of all available information a list of possible management activities can be written. The list should include such things as loans for specific types of development, introduction of boat designs, restrictions on mesh sizes, establishment of fishing seasons, limits on the number of licenses, improvement of marketing. The list should also include suggestions for the research agency concerning the future data needs for management. The important point is that this list of possible actions should be based on the biological, social, and economic information about the fishery.

Once the list of possible management activities is made, the positive and negative aspects of each possible action need to be summarized. The final part of the plan is a selection of the most appropriate activities with specific plans for implementation.

2.2 Contents of Management Plans

2.2.1 Define Specific Fisheries

Each fishery for which a plan is developed should be defined very precisely. "Fisheries of the North Coast of Java" is not specific enough. In some cases the fishery can be based on on a certain stock of fish (such as the Bali Straits sardine fishery). In other cases the fishery should be defined by a group of fishing gears operating in a specific geographic area (for example: pelagic seine nets used for small species near the north central coast of Java).

In general we need two items to adequately define the fishery: 1. A specific description of the geographic area included, and 2. a list of the primary species groups and fishing gear included.

A specific time schedule for the plan should be included as well. At present, plans should be developed for two to three year periods.

2.2.2 Summary of Available Data

The management plan should summarize in detail all available information about the fishery. This should include data and analysis about the fish species, about current catch rates, about the fishing gear used, and about the socio-economic situation of the people in the fishing villages.

If research has been done on the fishery then the results of the research should be summarized. If two conflicting research reports are available, information from both should be included. All sources of data should be indicated, and if possible, some assessment of the accuracy of the data should be given.

It is particularly important to include stock assessment information if it is available. Any decisions concerning the development or restriction of the fishery should be based on information about the amount of fish present.

Of course summaries of data from national, provincial, district and auction place sources should also be used. However, it is important to present this data in a helpful way. Some sort of analysis should be made. For example graphs showing the seasonal trends in fish landings and catch per unit effort will be helpful in planning management.

If available, specific data about the economics of the fishery and its impact on the village, regional or national economy should be included. For example the effect of any management actions must consider the problems of employment on fishing boats or in local fish processing.

Also, a summary of constraints on the management of the fishery should be given.

2.2.3 Determine Management Actions

The final and most important component of a fishery management plan is the recommendation of specific management actions. It is very important to remember that "management actions" can include fishery development as well as fishery limitation. Thus, loans for new fishing boats and introduction of a new fishing gear are management actions. So are limitations of the fishing season and restrictions on the mesh size of nets. Some examples of management actions are:

- Actions for Development and Expansion:
  - Provide Loans
    - More Fishing Gear
    - Better Fishing Boats
    - Improved landing places, harbors, etc.
  - Introduce new fishing gear
  - Training programs
- Actions for Redirection or Stabilization of the fishery
  - Loans for specific types of fishing gear for:
    - underutilized species
    - fishing farther offshore
  - Trade old fishing gear for new type
- Actions for Regulation and Limitation:
  - Limitation of loans
  - Stop Development Projects
  - Fishing Gear Design Restrictions
    - type of gear permitted
    - mesh size regulation
    - regulations about length of net
  - Limitations on Number of Fishing Gear
  - Limitations on the Number of Boats
  - Establishment of Fishing Seasons
  - Establishment of Closed Fishing Areas
  - Move fishermen to a new area

The first step toward selecting the best management actions is to list all possible management actions. This list should include benefits, costs, and difficulties of implementation. The realities of the implementation must be considered. Even if a management action is a good one, it would be senseless to recommend it if it cannot be implemented. For example if the fishermen refuse to follow a regulation it will be very difficult to enforce, thus any regulations must have some support from the people who fish.

In trying to determine the most realistic management actions it would be helpful to consult with the fishermen themselves. This could be done through the fishermen's organizations and fishing cooperative, but only if such organizations actually represent the small scale fishermen.

After developing a list of possible actions, the best should be selected for implementation. It is necessary to determine what agency will have responsibility for implementation. If it is a regulation, who will enforce it. How will it be done?

2.3 Suggested Management Units for the North Coast of Java

At present I would suggest that management plans be prepared for six fisheries of the northern coast of Java. These Fishery Management Units are based on groups of fishing gears and the species groups which they catch.

1. SMALL PELAGIC FISHES caught in pelagic seine nets and related gear. This FMU (Fishery Management Unit) is composed primarily of the following fishing gear: purse seine, mini purse seine, payang, and bagan. Fish genera of primary importance are: Sardinella, Decapterus, Selar, Rastrelliger, Stolephorus (and perhaps consideration of the larger genera Trichiurus and Scomberomorus which are common in the Payang catches). Separate consideration needs to be given to the offshore fishery (mostly purse seine) and the nearshore fishery.

2. LARGE PELAGIC FISHES caught primarily by drift gillnet, troll lines and hand lines. Along the north coast of Java these catch primarily Scomberomorus, Auxis, Euthynnus. Thunnus tonggol and Choryphaena are sometimes important as well. The migratory nature of these species needs to be taken into account since they may be subject to high fishing rates for restricted time periods.

3. SHRIMP TRAMMEL NETS and related gear. This is now

one of the most important fisheries of northern Java and has replaced the trawl fishery as the primary source of shrimp. Management considerations must include an assessment of the relative effect of trawls versus trammelnets on the shrimp and fish resource as well as on the fishing villages. This unit should include, but not emphasize, information about other species caught. Of these the Sciaenidae and Leiognathidae are the primary groups.

4. CORAL REEF FISHES. Although this group is of minor importance along the northern coast of Java, it should be managed as a separate fishery. This FMU should include the fishery for ornamental fishes as well as the handline fishery in deeper shelf areas.

5. OTHER DEMERSAL gears for the northern coast should be considered as another FMU for the present. These include set gillnets and perhaps some of the drift gillnet catches. In theory these are the replacement for the trawl, but the mesh sizes are much larger. Typical catches include a variety of demersal fishes including Ariidae, Sciaenidae, Mugillidae, Nemipteridae, Polynemidae and the Psettodidae.

6. BEACH SEINE and other shoreline fisheries. This FMU should include all onshore fishing gear but should emphasize beach seine and perhaps fish barriers in some areas. Special attention should be given to the possibility that these gears catch large numbers of juvenile fishes. Although there are large numbers of species in these fishing gears, the dominant groups at present are: Leiognathidae, Sciaenidae, inshore Clupeidae, and Thryssa mystax and T. hamiltoni (Engraulidae).

At present these Fishery Management Units appear to give the best possibility for organized planning of fisheries management activities in northern Java. However, it is not essential that these particular units be selected, but rather that a logical stepwise approach to fishery management be adopted and that management of each fishery be based on all available information coupled with careful analysis.

Fishery Management Units 1, 3, and 6 will be discussed in more detail in the following three chapters.

Chapter 3

THE BEACH SEINE FISHERY

Early in this project the beach seine fishery was identified as a fishery which may be harmful since it was thought that beach seine were catching many juvenile fishes. As a consequence the beach seine fishery was selected for study.

3.1 Methods of data collection

While much of the data about beach seine can be collected at the fish auction places it is not possible to get accurate species composition data from the auction place records. This is because most of the fish from beach seine are sold under the sales group "other". Therefore a sampling system was designed to determine species composition of beach seine catches. Two methods of obtaining species composition data were used:

> In the first method data was recorded in the field using a special form. A field worker from BPPI (the Fishing Development Center) collected data from a single boat on each form. The worker examined each basket of fish and recorded the total weight and the approximate percent composition of each basket. The average length of each species was also recorded. Although this method is not the most accurate method possible, it allowed us to gather data relatively rapidly without disturbing the sale of the fish. Using this method we collected data from 80 beach seine.
>
> Because fish caught in beach seine are often very small and hard to identify we also used a second method to determine species composition. Samples, collected from several villages, were placed in formalin and the fishes later identified in Semarang.

Because fish at the landing places are sorted into different piles at the auction it was necessary to take sub-samples from each pile of fish or group of similar piles. The weight of each pile was recorded. After the species composition of the samples was determined, the species composition of the total catch was determined by combining the calculated weight of each species in each group of piles.

For example: If there were two piles of 40 kg each and one pile of 60 kg. A sample from the first pile is 10% Thryssa mystax, from the second 20% and from the third 85%. The total catch of T. mystax is 63 kg or 45%. This procedure was carried out for each species.

Although this second procedure worked well, it was very time consuming allowing us to sample only a few nets per day. However, it did produce more detailed species composition data.

Additional data about total catch landed and catch per trip was collected from auction place records at selected locations. Note that at many auction places weights are only estimated.

3.2 Comments About the Fishery

3.2.1 Confusion About Names of Beach Seine

There is considerable confusion over the names used for beach seines of different types. While this is partly a problem of translation into english, it is quite apparent that it is a problem in local languages as well.

In general there are three types of beach seine:

1. Those with the whole net made from a woven plastic or polypropylene cloth called "waring" which has a mesh size of 2-3mm bar measure. (Names: Bundes, Bundes Waring, Krikit)

2. Nets with most of the net made from 3/4 inch to 2 inch mesh, but with a bag made from "waring". (Names: Bundes Jotang, Jotang, Payang Jotang, Krakad, Krakat)

3. Nets made entirely of 3/4 to 2 inch mesh.

Other names used for beach seine are "Payang Tarik" and "Pukat Pantai." Confusion about the names sometimes results in beach seine data being recorded in other gear categories. For example at some fish auction places the name "Payang Jotang" is used and the catch data is later recorded as being from payang which is a type of pelagic seine net.

For the purposes of management it is realistic to recognize two types of beach seine: those made entirely of small mesh (2 to 3 mm) "waring" and those made from larger meshes.

When the BPPI staff sampled beach seine catches they also asked the fishermen the length of the nets. This was usually given in "depa" (length of the outstretched arms) which we assumed was about 1.5 m. The length distribution of nets we sampled is given in Figure 3.1.

3.2.2 Number of Beach Seine

Statistical data indicates that the number of beach seine has been quite constant over the years and has remained at about 330 to 340 units for the whole north coast (which includes the Madura Straits). Data for Central Java for 1982 lists 152. However, none are listed for Kendal and Demak, although we regularly sampled beach seine at villages in these districts. One fisherman we spoke with was quite sure there were only about 45 beach seine on the whole north central coast. Although that is surely an underestimate, it is possible that the official statistics give only the approximate numbers. For the purposes of management we will assume that the official numbers are correct: between 150 and 200 beach seine units for the northern coast of Central Java, and about 340 units for the whole north coast.

3.3 Catches from Beach Seine

Catches from beach seine for the whole north coast of Java are listed as 2,200 tons in 1980, 5,500 tons in 1981, and 6285 tons in 1982 (see Tables 1.1 through 1.3). It is possible perhaps, but very unlikely that the catch from beach seine is increasing so much each year year, especially when the number of units has remained the same. In general the official catch statistics for beach seine are insufficiently accurate for any type of trend analysis.

Catch per trip, from our data, for beach seine in our samples averaged 212 kg per daily trip (207 kg for fine mesh beach seine and 244 kg for larger mesh seines). Mean catch per trip averaged over a year ranged between 57 for small mesh seines at Asemdoyong in 1982 to 318 for all size beach seines at WonoKarto in 1982. Our data indicates that a daily catch of 50 to 700 kg can be expected with considerable variation. On the average about 200 kg per trip is reasonable (Figure 3.2). Catch data collected by the BPPI staff at various auction places agrees with this figure for the most part.

It is difficult to get accurate data concerning the number of trips made per year since many of the beach seine move with the season. A fisherman at Asemdoyong told us that in general the beach seines tended to be farther west during the east monsoon (dry season). If beach seine move from one village to another, data from a single auction place will not be an accurate measure of number of trips. Central Java statistics for 1982 yield a figure of 143 trips per unit.

The seasonal trend in trips made and catch landed is illustrated with data from the Asemdoyong auction place (Figure 3.3). About 90% of the catch is landed between March and November. The catch per trip follows the same trend (Figure 3.4).

If we assume that 15 to 20 trips are made per month during this period then we could conclude that 135 to 180 trips are made per year. Catches recorded in our sampling, and data from most auction places indicate a catch per day of about 200 kg. This would suggest that the total catch per unit each year would be about 27 to 36 tons. Even if we took a conservative estimate of 100 kg per trip and only 15 trips per month the yearly catch per unit would be 13.5 tons per year per unit. I would suggest that this is a minimum for beach seine. Perhaps the national statistics underestimate beach seine landings.

For Central Java we would thus expect a catch from beach seine of between 2,025 and 7,200 tons. The lower end of this range is probably more likely.

For small mesh beach seine catch per trip increased slightly with the length of the net (Figure 3.5). Most of the large mesh beach seine were the same size, so no real trend in catch versus length of net is apparent (Figure 3.6).

3.3.1 Species Composition of Beach Seine Catches

Auction place data and data from the statistics system provides virtually no data about species composition of beach seine catches because 99% of the catch is sold as "other".

The BPPI staff and I collected species composition data by the two methods mentioned above. Species composition varied considerably from net to net. Even the most commonly found species (Thryssa mystax and T. hamiltoni) were found in only 60% of the nets. However, the dominant species groups were: Thryssa, Ambassis, Sciaenidae, Mysidae, Leiognathidae, and several Clupeidae (mostly Anadontostoma, Clupeoides, and Sprattus) Species composition data from the auction place catch inspections is presented in Table 3.1 and Figure 3.7. More detailed data from a limited number of nets is given in Table 3.2.

There were significant differences in the species composition of the large mesh and the small mesh beach seines. The small mesh seines were much more likely to catch mysid shrimp and Ambassis, while the larger mesh beach seines were more likely to catch Sciaenidae (Figure 3.7 and Tables 3.3 and 3.4).

A fairly large proportion of the beach seine catch is composed of small species rather than juvenile fish as was previously thought. There are substantial numbers of juvenile fish present in the catch, but they do not make up a large part of the catch. Most of the catch is composed of small pelagic or in-shore species. However, some of the Sciaenidae are being caught at small sizes which could be harmful to the overall fishery. Length data is given in the rightmost columns of Tables 3.1, 3.3 and 3.4.

3.4 Significant Points of Importance to Management

From the above information the following points emerge as being the most important consideration for setting up a management plan for beach seine on the northern coast of Java.

1. SIZE OF FISH IN CATCHES. Although many small fish are caught most of them are not juvenile fish. There is a good market for the small fish. Also, certain species groups, such as the Mysid and similar small shrimps, could not be caught if larger meshes were required.

2. SOME JUVENILE FISHES. Although most of the catch is composed of small species, there are some species which are caught at excessively small sizes. These are the Sciaenidae and perhaps the Leiognathidae. juveniles of many other species are also present, but not in consistently large numbers. Nevertheless, these species are important.

3. DIFFERENT NET TYPES. There are two different types of gear in the beach seine fishery: large mesh seines with meshes of 1.9 to 6.4 cm, and small mesh seines with meshes of 2 to 3 mm. The small mesh and large mesh seines catch different species groups, are of different lengths and perhaps will need different management measures.

4. EMPLOYMENT IMPORTANT. Each beach seine boat employs a crew of 25 to 30.

5. SPECIAL FISHERY FOR "REBON". A special industry exists for the catching, processing and marketing of "rebon" (mysid shrimps). This local industry is to a large extent dependent on the use of fine mesh beach seine.

6. NATURAL LIMITATIONS. The beach seine fishery is naturally limited by waves during the rainy season and to a lesser extent during the dry season. The peak fishing periods are during the inter-monsoon periods. Also, seines are limited to suitable sites.

3.5 Recommendations for Management of Beach Seine

1. STABLIZE NUMBERS. At present numbers beach seine do not appear to be excessive. I would not, however, recommend any action which would increase the number of beach seine. The management objective should be to stableize the numbers.

2. NO ADDITIONAL DEVELOPMENT. I recommend that no loans or other development programs be directed at beach seine gear, or boats which use beach seine gear.

3. MESH SIZES. I do not recommend any effort to establish or enforce mesh size regulations at present. Although some juvenile fishes are caught, much of the catch consists of small species. Some of these species (the small shrimps Mysidae or "Rebon" for example) support specialty markets and local processing. Also, at present it is unlikely that any mesh size regulations could be enforced. However, I recommend the following actions to prepare for future regulations:

> 3.1. A program of continued monitoring of beach seine catches to determine more accurately the effect of this type of gear on the Sciaenidae.
>
> 3.2. Experiments with larger mesh (up to 7 to 10 cm) beach seines should be carried out to determine their economic feasibility.

3.3. In the future, if more regulation is needed, I would recommend: a)for the fine mesh beach seines a limit be set on the length of the net, and b)for larger mesh beach seines a minimum legal mesh size limit be determined. This is because it is the larger mesh nets which catch most of the small Sciaenidae.

3.4. A regulation requiring larger mesh wings but allowing a fine mesh bag might also be considered.

4. In the future, if more limitation is needed, a fishing season could be set. I would recommend that the closed season correspond to periods when fishing is limited by the west monsoon. Although this may seem contrary to what we might want to do, it will be much more acceptable to the fishermen, and would thus permit the introduction of the idea of a closed season. Then such a closed season could be extended into the better seasons if necessary. Any such proposal for a closed season should examine the loss of income at a time of year when many of the fisheries are limited by weather. I do not recommend this action at present.

FIGURE 3.1

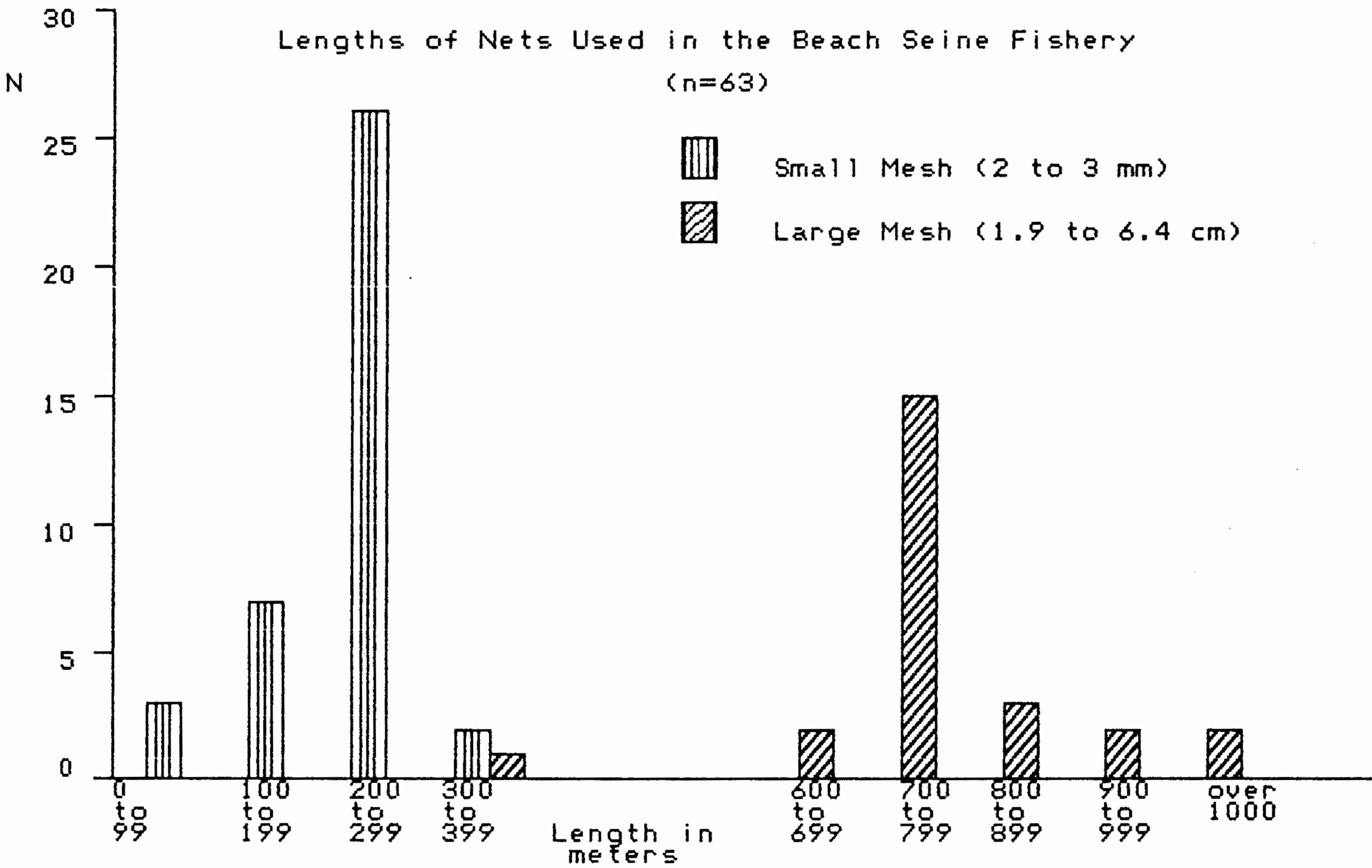
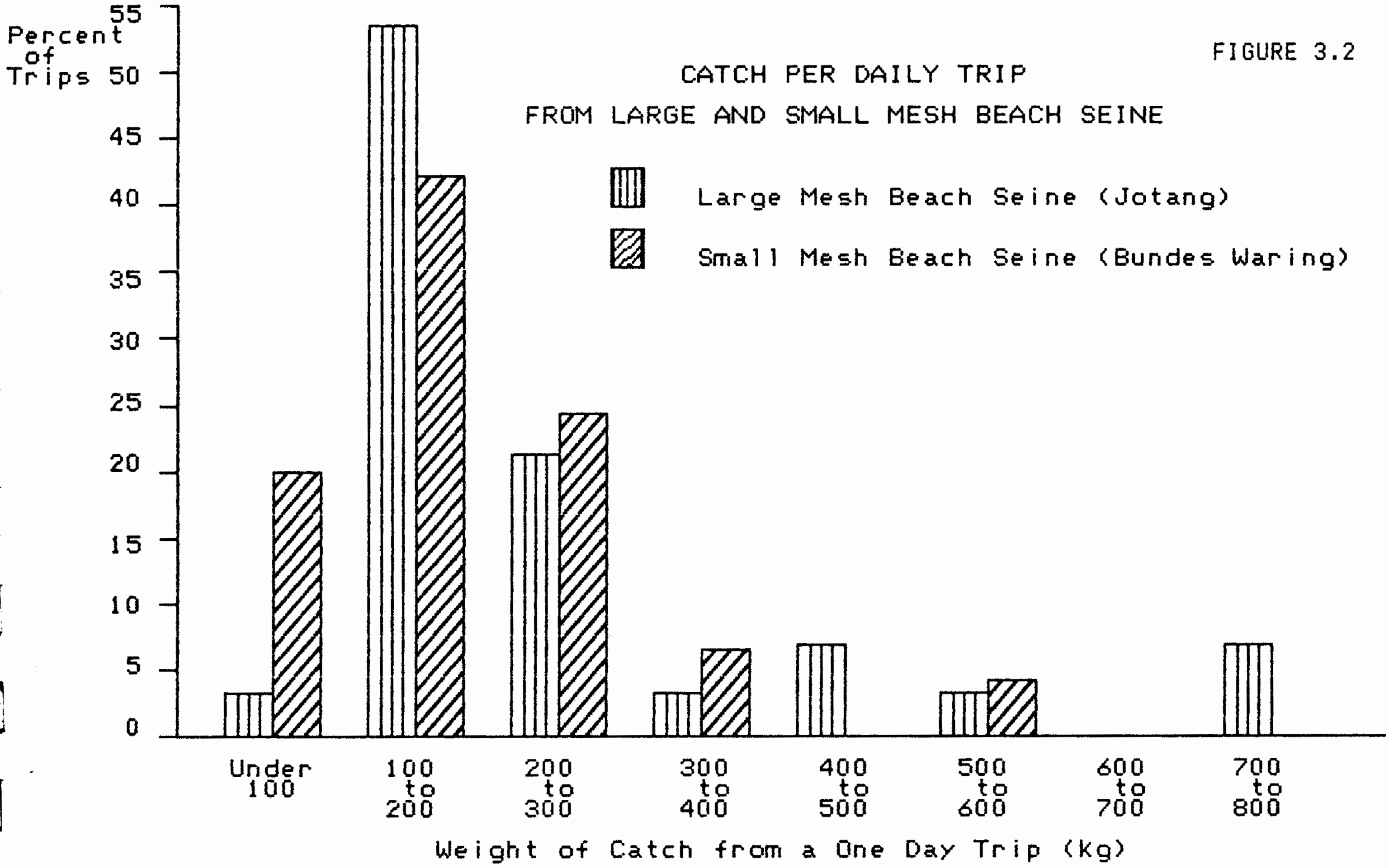
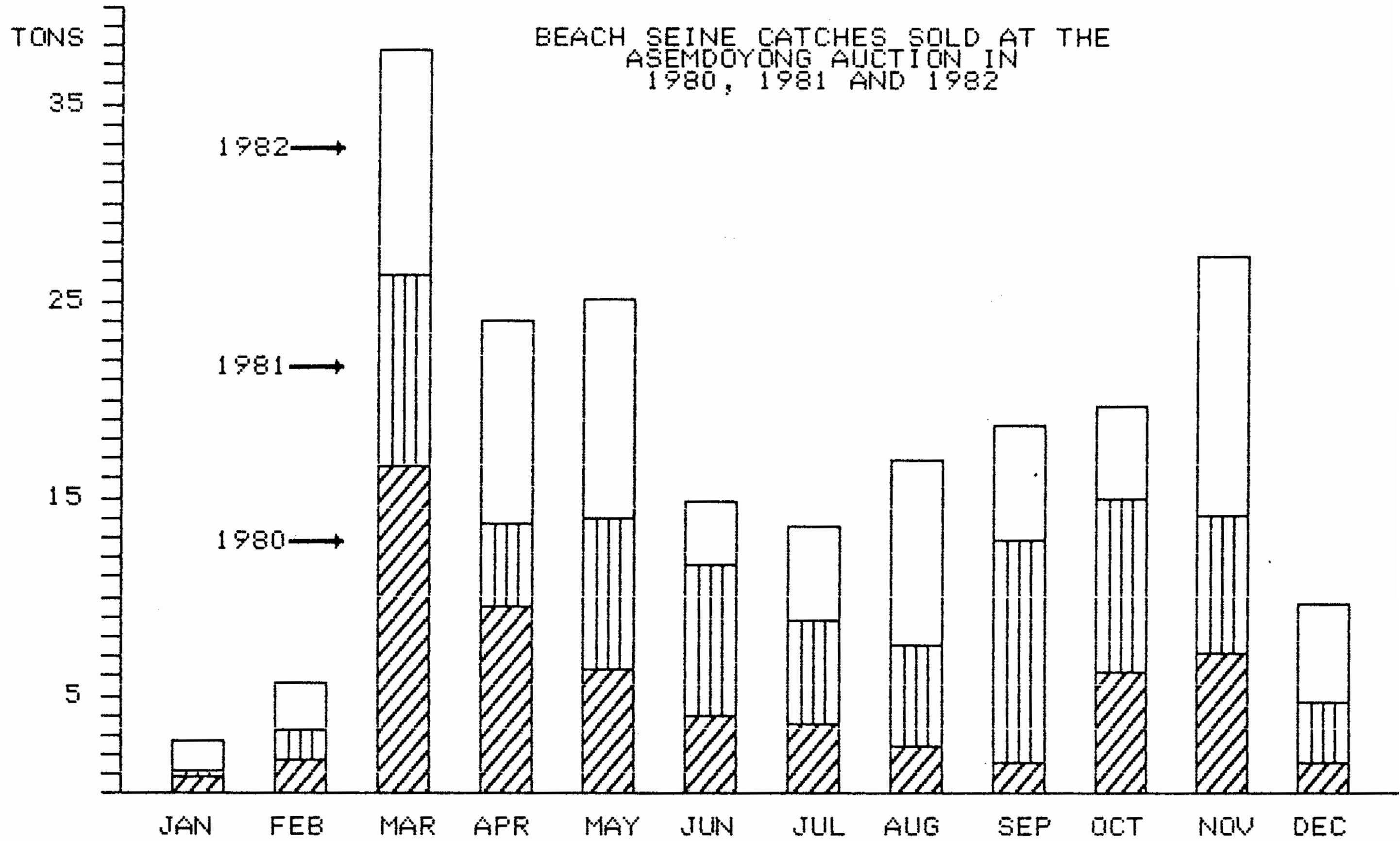
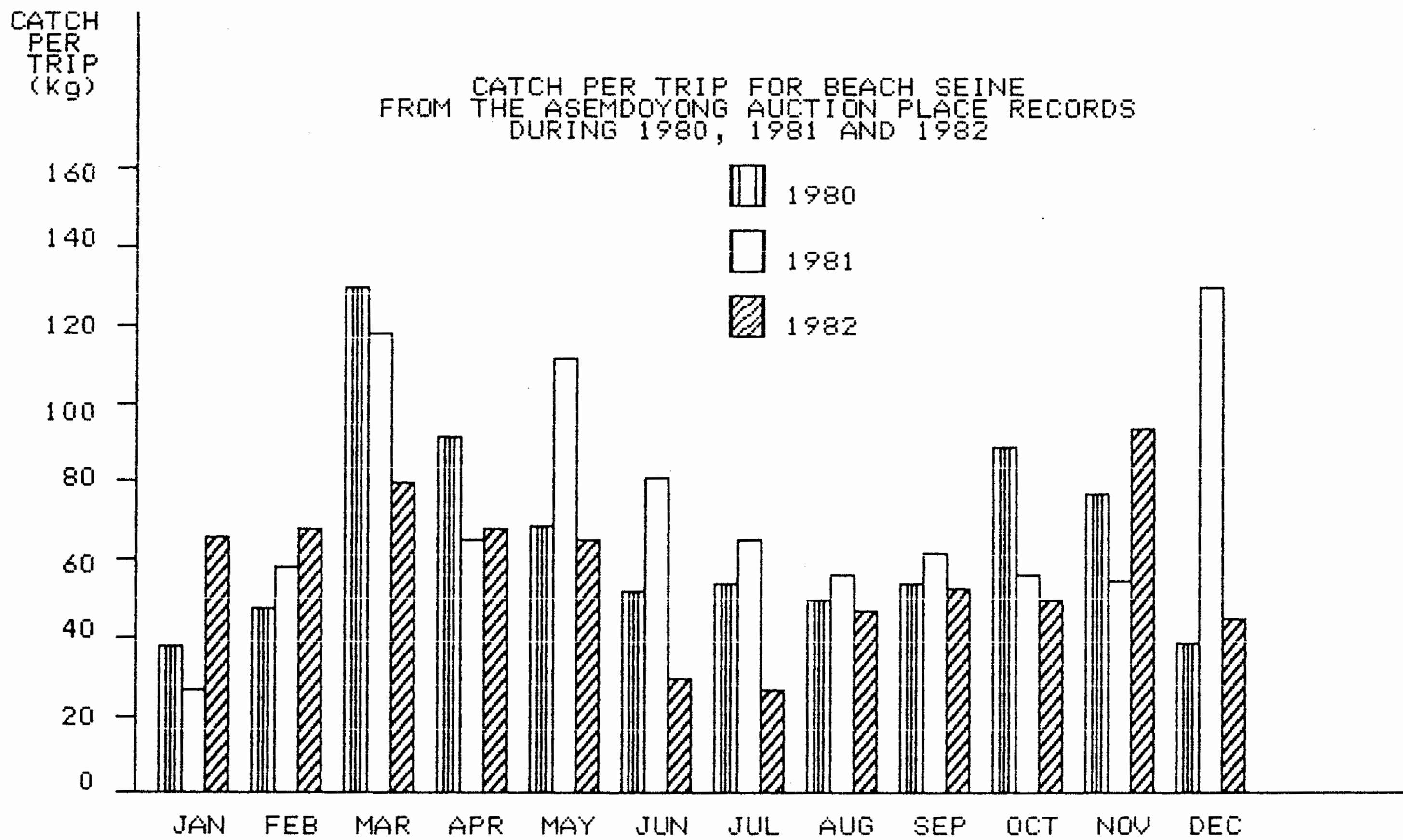
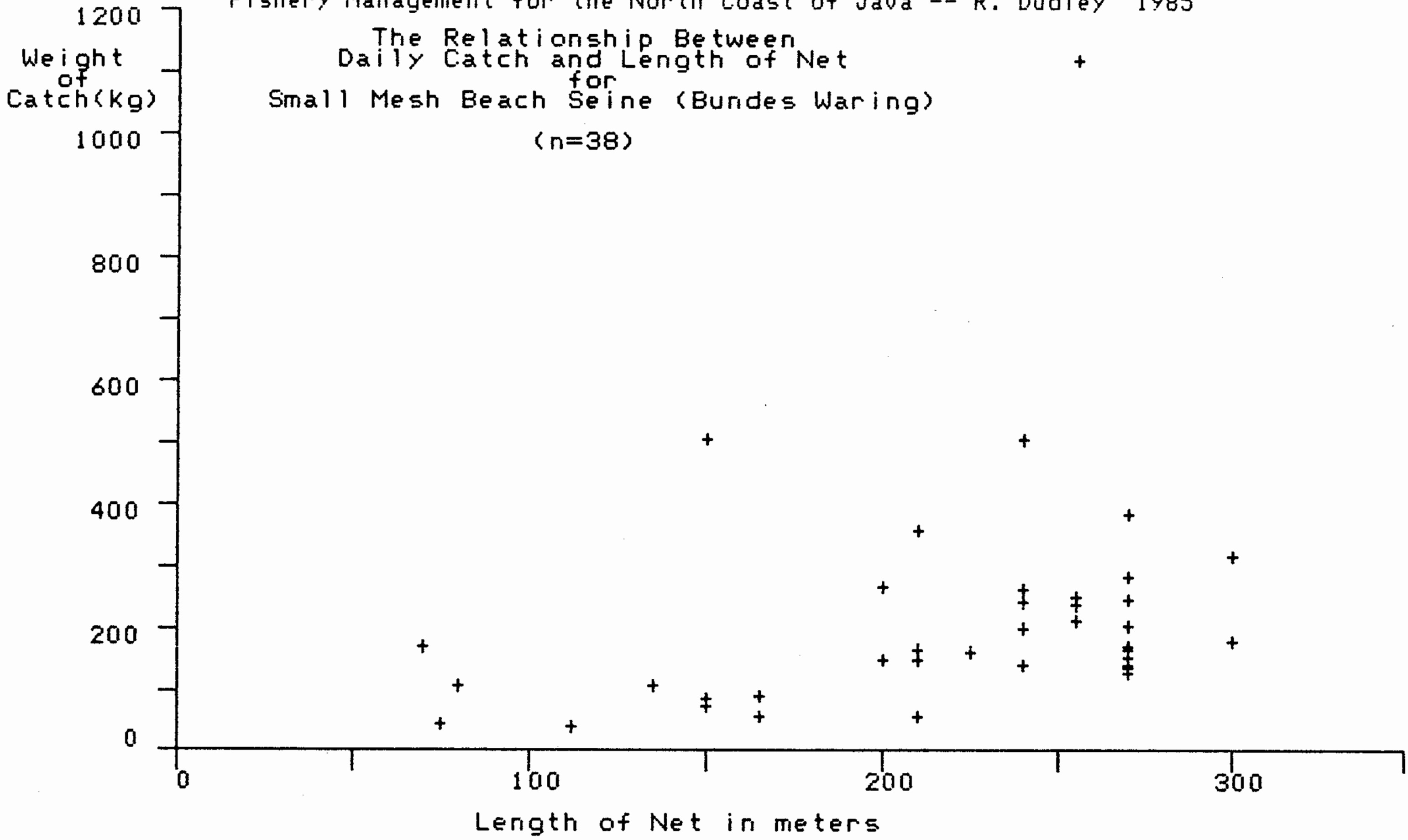

Lengths of Nets Used in the Beach Seine Fishery
(n=63)
Small Mesh (2 to 3 mm)
Large Mesh (1.9 to 6.4 cm)
N
30
25
20
15
10
5
0
0 to 99
100 to 199
200 to 299
300 to 399
Length in meters
600 to 699
700 to 799
800 to 899
900 to 999
over 1000

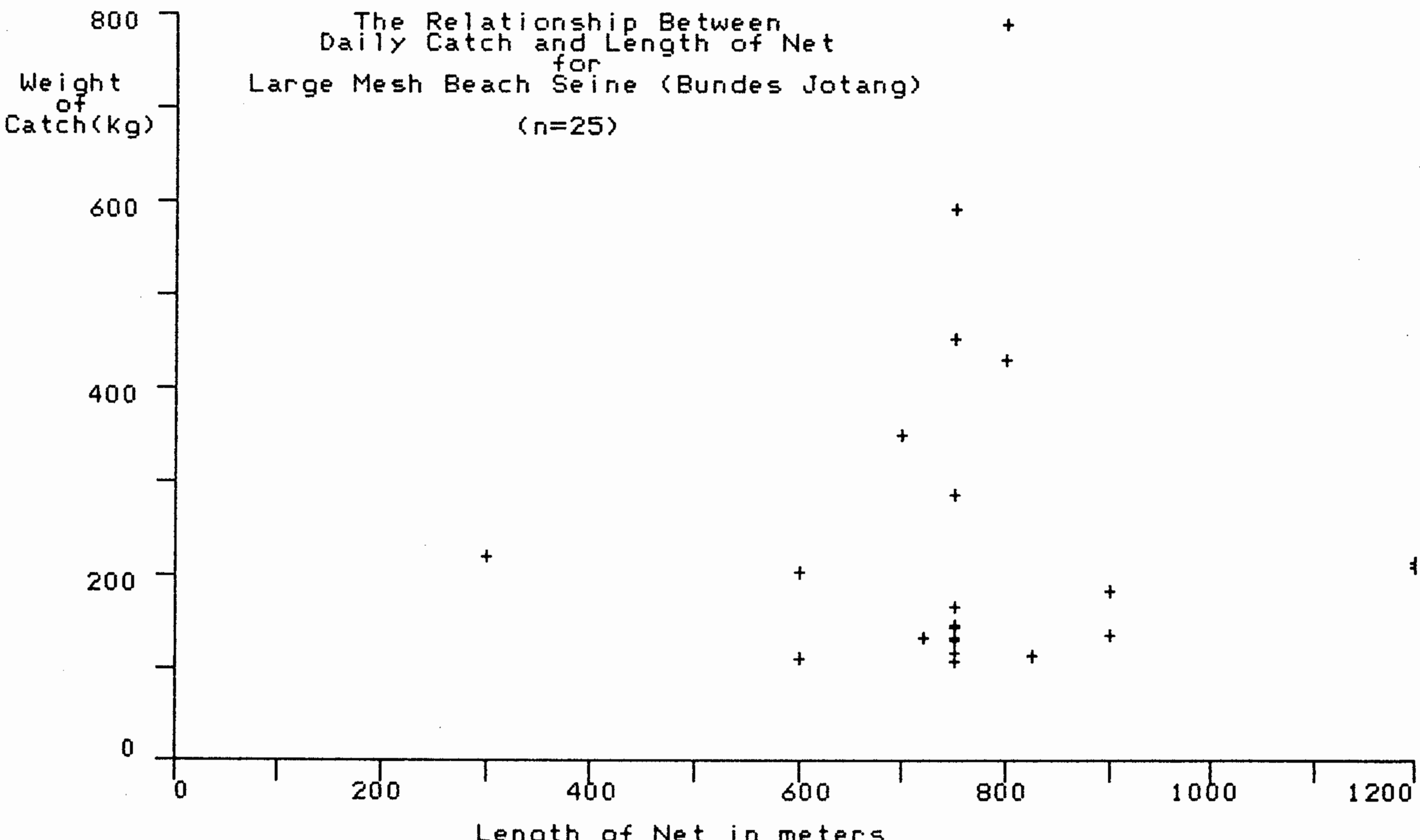
FIGURE 3.2


CATCH PER DAILY TRIP
FROM LARGE AND SMALL MESH BEACH SEINE
Large Mesh Beach Seine (Jotang)
Small Mesh Beach Seine (Bundes Waring)
Percent of Trips
55
50
45
40
35
30
25
20
15
10
5
0
Under 100
100 to 200
200 to 300
300 to 400
400 to 500
500 to 600
600 to 700
700 to 800
Weight of Catch from a One Day Trip (kg)


TONS
35
25
15
5
BEACH SEINE CATCHES SOLD AT THE ASEMDOYONG AUCTION IN 1980, 1981 AND 1982
1982
1981
1980
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

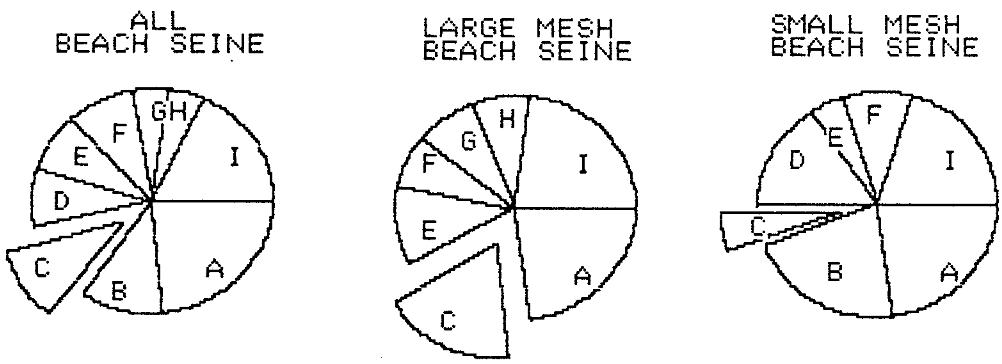

CATCH PER TRIP (Kg)
160
140
120
100
80
60
40
20
0
CATCH PER TRIP FOR BEACH SEINE FROM THE ASEMDOYONG AUCTION PLACE RECORDS DURING 1980, 1981 AND 1982
1980
1981
1982
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC





Figures 3.5 and 3.6

SPECIES COMPOSITION IN BEACH SEINE CATCHES



	ALL	LARGE MESH	SMALL MESH
A. Thryssa (ENGRTH)	23.5%	23.3%	23.2%
B. Ambassis (CENTAM)	11.6	-	21.0
C. Sciaenidae (SCIA)	11.0	18.3	5.6
D. Mysidae (MYSI)	9.1	-	16.0
E. Leiognathidae (LEIO)	8.0	12.0	4.8
F. Clupeidae (CLUP)	9.1	7.6	9.3
G. Triacanthidae (TRIA)	5.3	8.0	-
H. Trichiuridae (TRIC)	4.8	8.0	-
I. Other	17.6	22.8	20.1

Figure 3.7

Table 3.1. Species composition data collected from 80 beach seines (both large and small mesh) along the north coast of Java between May and October 1984. The catch from an average net was 212.3 kg.

Name of Fish Group	Percent of Total Catch	Average Catch kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
ENGRTH	23.56	40.168	18.92	11.8	4.0	18.0	49
CENTAM	11.68	25.022	11.78	6.3	3.0	17.0	34
SCIA	10.68	22.037	10.38	15.7	8.0	22.0	46
MYSI	9.10	22.462	10.58	1.9	1.0	2.0	22
LEIO	8.07	14.702	6.92	7.7	4.0	12.0	42
CLUP	6.52	10.217	4.81	8.2	6.0	20.0	26
TRIA	5.33	17.790	8.38	9.7	9.0	10.0	10
TRIC	4.80	8.374	3.94	39.9	19.0	60.0	25
ENGRST	3.71	12.770	6.01	6.2	4.0	9.0	14
CLUPSA	2.10	4.690	2.21	13.4	9.0	19.0	12
ARII	1.82	3.298	1.55	16.0	8.0	25.0	11
MUGI	1.68	4.843	2.28	12.9	8.0	18.0	16
CARASL	1.67	4.689	2.21	13.3	8.0	16.0	9
PENA	1.10	2.015	0.95	9.5	5.0	14.0	14
CARAME	0.62	1.890	0.89	16.3	12.0	22.0	7
SCIAOT	0.41	0.671	0.32	-	-	-	3
HAEM	0.37	1.270	0.60	19.5	16.0	22.0	4
CLUPIL	0.34	0.718	0.34	9.5	8.0	12.0	6
TETR	0.34	0.255	0.12	-	-	-	2
ENGR	0.33	0.327	0.15	13.0	11.0	15.0	4
LACT	0.31	0.642	0.30	10.8	4.0	15.0	6
CARA	0.31	1.050	0.49	11.7	9.0	16.0	6
STROPA	0.31	0.694	0.33	15.0	15.0	15.0	2
CLUPAN	0.30	1.281	0.60	15.3	9.0	19.0	3
RAY	0.26	1.141	0.54	56.5	13.0	100.0	4
MULL	0.19	0.743	0.35	11.3	8.0	14.0	6
SCOMRA	0.15	0.249	0.12	16.5	15.0	18.0	2
PLOT	0.14	0.201	0.09	-	-	-	1
FORM	0.12	0.253	0.12	14.0	14.0	14.0	3
NEMI	0.12	0.309	0.15	-	-	-	1
CARASC	0.10	0.137	0.06	-	-	-	1
POLY	0.10	0.315	0.15	13.5	13.0	14.0	3
SILL	0.07	0.234	0.11	15.0	12.0	19.0	4
HEMI	0.07	0.216	0.10	24.7	14.0	35.0	3
SCOMSC	0.04	0.185	0.09	40.0	40.0	40.0	2
LOLI	0.03	0.097	0.05	15.0	15.0	15.0	1
THER	0.01	0.031	0.01	12.5	9.0	16.0	2
MURA	0.01	0.102	0.05	45.0	45.0	45.0	1
CLUPDU	0.01	0.088	0.04	14.0	14.0	14.0	1
SCAT	0.01	0.102	0.05	-	-	-	1
OTHER	3.11	6.048	2.85	-	-	-	25

Table 3.2. Detailed summary of fishes caught in 15 beach seines. Only those species or groups which comprised at least five percent of a catch at least once are shown here. For the Sciaenidae, only catches over five percent are shown. For the other groups which exceeded five percent at least once, all catches are indicated. This data is based on catch samples which were examined in the laboratory.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
						Weight of Catch (kg)										Mean
FISH GROUP	318.00	28.00	752.00	182.00	74.00	170.00	108.00	140.00	215.00	160.00	220.00	41.85	164.00	50.00	249.00	%
				PERCENT IN EACH BEACH SEINE												
CARANGIDAE	9.82	0.94	1.91		12.77	0.15		2.10	3.26		8.69	0.95	0.34	13.36	4.53	3.9
Alepes djeddaba		0.69			6.49				1.10		8.09			2.17		1.2
Carangoides		0.25			0.70			2.10	0.25					6.02		
CENTROPOMIDAE (Ambassis)	0.20	0.35	0.02	20.40		1.42	4.24		3.20	0.05	0.11	14.43	67.66	0.43	1.99	7.6
CLUPEIDAE	13.55	1.65	2.63		22.30	18.62	2.13	23.54	7.55	0.72	32.78	10.30	0.75	4.66	6.53	9.8
Anodontostoma chacunda	0.34		1.50		0.13	14.24				0.18		3.85				1.3
Dussumeria acuta	0.11	0.24			0.43	0.07		12.57	0.53		0.40					
Clupeoides borneensis	4.56	0.87			18.41	0.14			0.21		31.04	1.24			2.63	3.9
Sardinella		0.21	0.21				1.47	10.82		0.54	0.10	1.07	0.75	0.78		
Sprattus bassensis	8.20		0.09			4.15		0.15	5.50			4.14			3.36	1.7
ENGRAULIDAE	24.92	42.04		16.65	10.67	7.86	19.18		24.55	7.64	26.03	40.49	1.15	36.44	42.07	19.9
Stolephorus	0.34	2.31			2.65	1.36	0.28		0.57	0.27	0.15	7.06		0.76		1.0
Thryssa mystax	24.57	32.68		15.91	7.53	4.11	18.91		21.76	7.17	21.75	8.72	1.15	20.65	42.07	15.1
Thryssa hamiltoni		7.05			0.48	2.22			2.22	0.20	4.13	9.93		15.03		2.7
Thryssa (other)				0.74		0.16						14.79				1.0
HAEMULIDAE						0.06		5.48	0.16				0.32			0.4
LIOGNATHIDAE	0.41	16.60	82.32	38.40	3.54	15.85	0.98	23.79	7.68	0.29	1.29	0.80	1.14	16.05	0.71	13.9
Leognathus	0.41	9.47	78.38	28.08		14.73	0.81	23.79	1.31		0.58	0.52	1.14	9.53		11.2
Secutor		7.13	2.65	6.70	3.45	1.21	0.17		6.24		0.71	0.17		6.52	0.63	2.3
MUGILIDAE	1.31		0.38	5.06	0.85	7.44	5.28					6.19	20.77			3.1
PLOTOSIDAE	7.57				1.35											0.5
SCIAENIDAE	16.58	12.80	1.29	5.47	2.36	31.99	33.33	0.16	35.35	75.00	8.27	8.02	0.55	9.04	17.06	17.1
Argyosomus										11.62						
Dendrophysa russelli				5.47		5.29										
Johniopsis										40.31						
Johnius belangerii		10.77							12.33	7.30						
Johnius sp.							5.93							5.77		
Nibea soldado						23.90			6.54							
Otolithes ruber	10.09								9.95	11.25					11.55	
Other large (19-30cm)							19.35									
other							8.05					7.26				
SCOMBRIDAE	2.74		0.86		0.98			0.75	0.41		2.17	0.07		5.66		0.91
Scomberomorus	1.41		0.13								1.82	0.07		5.16		0.57
STROMATEIDAE	2.28	0.69			17.38						0.78	0.10		0.14	0.94	1.49
Pampus argenteus	2.28	0.69			17.38						0.71	0.10		0.14	0.94	1.48
TETRADONTIDAE	1.02		7.19	2.46					0.44		0.18	0.04				0.76
THERAPONIDAE	0.41					0.38		0.40	0.53		1.79		0.47		5.45	0.63
TRIACANTHIDAE								40.42	0.29			0.24				2.73
TRICHIURIDAE	3.60	13.40		0.31	23.09	0.32	0.09	0.70	8.26	5.26	8.92	3.63		8.56		5.08
Invertebrates																
MYSIDAE ("rebon")						6.35	9.35									1.05
PENAEIDAE	1.02	1.27			0.68	2.71	22.03		2.05	0.51	1.98	0.45	4.77	0.70	4.48	2.84
Sum of %	85.43	89.74	96.60	88.74	95.97	93.15	96.61	97.34	93.73	89.48	92.99	85.71	97.92	95.04	83.76	92.15

Net A: Wonokarto, June 83
B: Asemdoyong, August 83 b
C: Eretan, July 83 j
D: Eretan, July 83 b
E: Sendang Sekucing, September 83 j
F: Eretan, September 83 b
G: Eretan, September 83 b
H: Sendang Sekucing, May 84 j
I: Asemdoyong, May 84 j
J: Asemdoyong, May 84 j
K: Sendang Sekucing, September 83 j
L: WonoKarto, June 83
M: Asemdoyong, August 83 b
N: Asemdoyong, August 83
O: WonoKarto, June 83

note: b=bundes: fine mesh beach seine.
j=jotang: large mesh beach seine.

Table 3.3. Species composition data collected from 28 large mesh beach seine ("bundes jotang") along the north coast of Java between May and October 1984. The catch from an average net was 244.9 kg. These beach seine have 2 to 4 cm mesh in the wings but have mesh from 1 cm to as small as 2 mm in the bag. The percent of Triacanthidae (TRIA) is higher than would normally be expected since ten of these nets were sampled during a period of unusual abundance of this family.

Name of Fish Group	Percent of Total Catch	Average Catch kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
ENGRTH	23.39	52.068	21.25	13.3	8.0	18.0	16
SCIA	18.20	40.374	16.48	16.3	10.0	22.0	21
TRIA	13.21	58.643	23.94	9.7	9.0	10.0	10
LEIO	12.58	18.780	7.67	8.4	4.0	12.0	13
TRIC	8.84	17.339	7.08	48.8	35.0	60.0	10
CLUP	4.55	12.735	5.20	7.7	6.0	10.0	10
CLUPSA	3.11	7.266	2.97	13.1	9.0	19.0	8
CARASL	2.68	9.444	3.86	14.3	12.0	16.0	5
ARII	2.28	3.210	1.31	19.8	15.0	25.0	6
PENA	1.46	1.772	0.72	14.0	14.0	14.0	3
HAEM	0.83	3.936	1.61	19.3	16.0	22.0	3
ENGR	0.82	1.078	0.44	13.0	11.0	15.0	4
TETR	0.79	0.629	0.26	-	-	-	1
STROPA	0.77	2.289	0.93	15.0	15.0	15.0	2
CARA	0.59	2.118	0.86	10.0	10.0	10.0	3
LACT	0.51	1.312	0.54	13.0	10.0	15.0	3
CLUPAN	0.44	1.193	0.49	19.0	19.0	19.0	1
SCOMRA	0.36	0.822	0.34	16.5	15.0	18.0	2
FORM	0.29	0.836	0.34	14.0	14.0	14.0	3
CARAME	0.29	1.190	0.49	15.0	15.0	15.0	1
HEMI	0.15	0.398	0.16	25.0	25.0	25.0	1
SCIAOT	0.12	0.322	0.13	-	-	-	1
RAY	0.12	0.118	0.05	13.0	13.0	13.0	1
MUGI	0.11	0.439	0.18	9.0	9.0	9.0	1
POLY	0.07	0.319	0.13	14.0	14.0	14.0	1
SILL	0.07	0.319	0.13	19.0	19.0	19.0	1
LOLI	0.07	0.319	0.13	15.0	15.0	15.0	1
SCOMSC	0.06	0.172	0.07	40.0	40.0	40.0	1
OTHER	3.25	5.532	2.26	-	-	-	8

Table 3.4. Species composition data collected from 45 small mesh beach seines ("bundes waring") along the north coast of Java between May and October 1984. The catch from an average net was 207.9 kg. These nets are made of "waring" a fine mesh synthetic material with mesh openings of about 2 mm by 2 mm. See Table 1.4 for names of fish groups.

Name of Fish Group	Percent of Total Catch	Average Catch kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
ENGRTH	23.22	34.336	16.52	11.0	4.0	18.0	28
CENTAM	21.05	41.784	20.10	6.0	3.0	8.0	31
MYSI	16.52	39.101	18.81	1.9	1.0	2.0	22
CLUP	7.81	9.511	4.57	8.6	7.0	20.0	12
ENGRST	6.55	20.713	9.96	6.4	5.0	9.0	12
SCIA	5.62	13.755	6.62	15.1	8.0	20.0	20
LEIO	4.80	9.728	4.68	7.4	4.0	10.0	25
MUGI	2.95	7.911	3.80	13.3	8.0	18.0	14
TRIC	1.90	4.013	1.93	32.9	19.0	50.0	11
ARII	1.63	4.046	1.95	11.3	8.0	14.0	5
CLUPSA	1.51	3.971	1.91	14.5	14.0	15.0	3
CARASL	1.07	3.175	1.53	12.3	8.0	16.0	4
CARAME	0.91	2.661	1.28	16.5	12.0	22.0	6
PENA	0.81	2.366	1.14	8.0	5.0	10.0	10
CLUPIL	0.62	1.249	0.60	9.5	8.0	12.0	6
RAY	0.40	1.924	0.93	100.0	100.0	100.0	3
MULL	0.30	0.752	0.36	10.3	8.0	13.0	4
CLUPAN	0.22	1.600	0.77	13.5	9.0	18.0	2
NEMI	0.21	0.537	0.26	-	-	-	1
SILL	0.08	0.238	0.11	13.0	12.0	14.0	3
CARA	0.06	0.173	0.08	12.5	9.0	16.0	2
HAEM	0.05	0.133	0.06	20.0	20.0	20.0	1
TETR	0.05	0.112	0.05	-	-	-	1
LACT	0.03	0.041	0.02	4.0	4.0	4.0	1
THER	0.02	0.054	0.03	12.5	9.0	16.0	2
HEMI	0.02	0.167	0.08	24.5	14.0	35.0	2
POLY	0.02	0.205	0.10	13.0	13.0	13.0	1
CLUPDU	0.02	0.154	0.07	14.0	14.0	14.0	1
OTHER	1.53	3.490	1.68	-	-	-	12

Chapter 4

PELAGIC SEINE AND LIFTNET FISHERY

Catches of small pelagic fishes account for a large proportion of the total fish catch of northern Java. The small scale inshore fishery includes several pelagic fishing gears but the contribution of these gears to the overall catch is somewhat unclear. Catches of the small or "mini" purse seine are combined, in the offical statistics, with the catches of the larger purse seine. Some of the purse seine catch is from as far away as the eastern coast of Kalimantan. Species caught by the small scale fishery are, in some cases, the same as those caught by the larger scale offshore fishery. As a consequence the data base for fishery management is somewhat confused, but it is clear that management actions must consider the purse seine fishery as well as the small scale fishery.

The ocean liftnet (bagan) fishery catches primarily small pelagic fishes as well and any management of pelagic fisheries must consider these.

This fishery management unit thus includes all inshore pelagic fishing gears, but must also consider the role of the offshore purse seine fishery.

4.1 Methods of Data Collection

The data used in this section is a mixture of data collected by myself and the BPPI staff, data obtained from various statistical sources and auction place books, and reports of others. Original data was collected at the auction places using the same techniques as were previously described for the beach seine fishery. Most data for the liftnet fishery was obtained from the reports of others (e. g. Willoughby et al 1984), and that for the purse seine fishery from Mr. Gomal Tampubolon of BPPI. Reports concerning the fishery for small pelagic fishes include Tampubolon (1982) and for earlier information Subroto (1975).

For statistical data I relied most heavily on the data for the north coast of Central Java. I did this for two reasons: 1)the data for Central Java is more reliable, and 2)the northern coast of Central Java is the most representative statistical unit for the central part of northern Java.

Also data for the whole northern coast of Java includes landings from the Madura Straits and the Bali Straits. Both these areas must be considered as separate management areas with their own fishery management units.

4.2 Comments About the Fishery

4.2.1 Types of Fishing Gear

Three major types of fishing gear are included in this fishery management unit: Mini-purse seine, Payang, and Bagan. In addition management of this fishery must also take into account the purse seine fishery and some payang which are fished offshore.

Mini purse seine are almost exclusively made of 1.9 cm (.75 inch) mesh nylon. This is in spite of a regulation requiring 2.54 cm (one inch) mesh. Our data indicates that most mini purse seine are less than 200 m long, and that the average length is 191 m. Mini purse seine are normally fished at night while using powerful lamps to attract fish. The boats leave at 16:00 and return early in the morning. Sometimes mini purse seine are used during the day with fish attraction devices, but this method does not seem to be as common as it is with the larger purse seine. The crew for a mini purse seine boat ranges from 10 to 30 with an average of about 18 people.

The payang is a pelagic seine of a significantly different design. Payang we examined ranged from 110 to 600 meters in length. However, most of them were slightly less than 200 meters long and the average length was 201 m. The payang typically has very large meshes in the wings, usually 20 to 30 cm or larger. Toward the bag the meshes get progressively smaller to perhaps 2 to 3 cm near the bag. The bag is usually made from a fine mesh woven plastic or polypropylene material called "waring", which has mesh openings 2 to 3 mm across. An unusual characteristic of the payang is that it usually has no head or foot rope except in the middle third of the net. The payang is usually fished during the day. Because the large meshes make it easier to pull, the payang is usually set a large number of times (as much as 15 to 20 times) each day. The larger versions of the payang require a crew of about 6 to 20 people with 15 as an average.

Usually the payang is fished near the coast during a one day trip. However, there are some payang which are used on larger vessels with inboard engines (Kapal motor). These boats make offshore trips of up to seven days (Subroto 1975). Many of these boats have now switched to fishing purse seine, so the number of payang vessels fishing offshore is now quite small.

Unfortunately the name "payang" causes considerable confusion which sometimes results in the incorrect recording of statistical data. A part of the confusion results from the fact that there are several sizes and local variations on the payang. The gear described above is typically called payang, payang gemplo, payang jabur, jabur, payang besar as well as other names. The official translation to English is "surface seine".

Some smaller versions of the payang can be fished by one or two people, but the catches from these are often quite different and they should be considered a different gear group. In parts of East Java near Tuban, for example, the payang kecil or payang alit (little payang) is used. This is a very light weight nylon net with a length of 10 to 12 meters. These small payang catch a mixture of pelagic and demersal fishes.

The ocean liftnets commonly known as "bagan" are of two basic types. The fixed bagan (bagan tancap) are liftnets operated from bamboo platforms built in waters as deep as 25 meters. Each platform is 8 to 10 meters on a side and stands 4 to 5 meters above the water. A large square net hung from a bamboo frame is fished under the platform at night. The net is made from "waring" which has a mesh size of 2 to 3 mm. Several kerosine pressure lamps are used to attract fish. Because they are so dependent on light to attract fish, catches from ocean liftnets, like that of the mini purse seine, are very dependent on the moon phase (Figure 4.5).

The other type of bagan, boat bagan (or bagan prahu), uses the same principle but is a floating platform built on one or two boat hulls. These are not very common on the northern coast of Java.

The purse seine fishery is composed of larger boats based at the larger fishing ports which make five to ten day fishing trips in the Java Sea. Descriptions of this fishery are available elsewhere (Tampubolon 1982, Tampubolon, in preparation). The primary differences between the purse seine and the mini purse seine fishery are as follows: The purse seine fishery employs longer nets and bigger boats. The larger boats permit longer trips which now are as long as 10 days. In general the catch per day is somewhat higher than the mini purse seine, and different, more valuable, species are caught. Also the purse seine do much of their fishing during the day and make extensive use of fish attraction devices.

4.2.2 Numbers of Fishing Units

For several reasons the data concerning the numbers of units of these fishing gears is very confusing. Firstly, the data for mini purse seine cannot be separated from that for purse seine very well. Secondly there are several types of fishing gear which are called payang. Thirdly the liftnets, which are somewhat controversial, have a undetermined legal status. A few years ago they were declared illegal, but the declaration has been largely ignored. Thus, the catch of liftnets may not be fully reported.

The official statistics list 682 purse seine (including mini) for the Central Java north coast and 1613 for the entire northern coast of Java. However, data at BPPI indicates that in Central Java there are about 800 purse seine of which about 550 are large purse seine. This leaves 350 mini purse seine (G. Tampubolon, pers. com). The proportion of mini purse seine in the other provinces is probably higher.

There are slightly less than 500 payang listed in the official statistics for Central Java. This seems to be a reasonable figure. The value of 1396 listed for 1980 is probably incorrect. There is no way to quage the accuracy of the total north coast numbers of 4000 to 6000 units. Those figures undoubtedly include many of the smaller payang-like gears. For now we can assume there are about 500 large payang (payang gemplo) along the northern coast of Central Java. We can assume that the majority of these fish close to the shore.

It is very difficult to determine the number of fixed liftnets from the official statistics. It is very unlikely that the 1982 figure of 414 for Central Java is correct, since 1980 and 1981 statistics give numbers of 1,981 and 1,968. Workers at Diponogoro University (Willoughby 1984) counted 391 fixed liftnets just in the Jepara district in July and August of 1982 in an area of 58 km2. The actual numbers for the province are probably more likely to be similar to those reported for 1981, about 1,800 to 2000.

4.3 Catches from Pelagic Seines and Liftnets

4.3.1 Total Catch Data

4.3.1.1 Mini Purse Seine

Mini purse seine catches are virtually impossible to derive from the official statistics since they are recorded along with the large purse seine catches. If official statistics are to be used for this purpose then data must be collected from selected districts which are known to have only mini purse seine. Data which we collected from several locations indicates a catch per trip of between 40 and 900 kg with an average of 294 kg for a one day trip. The frequency distribution of the catches was skewed and over 50 percent of the catches were less than 200 kg (Figure 4.1). Data over an 80 day period from the Tawang auction place gave a catch per trip of 291 kg.

Fishing effort and catch per trip is very much influenced by the moon phase, with relatively little fishing and lower catches occuring during the full moon (Figure 4.2 and 4.3). Perhaps 12 to 15 trips per month is a reasonable value. Fewer trips will be made during the west monsoon when larger waves reportedly cause many fishermen to switch to fishing payang.

For Central Java (350 units, 144 to 180 trips) this would give a value of 50,400 to 63,000 trips per year. The average catch per trip from our data is 290 kg, but because of the skewed distribution (Figure 4.1) perhaps 200 kg per trip is a more realistic value. Using that value the total catch from mini purse seine is about 10,000 to 18,000 tons or 17 to 32 percent of the reported purse seine catch. These figures are very approximate, but nevertheless realistic.

4.3.1.2 Payang

Statistical data for Central Java for payang indicates a total catch of only 2800 tons for 1982 but about 7000 to 8000 tons for 1980 and 1981 (Table 1.2). It is unlikely that the catch changed by that much in one year. Our data indicates a catch per trip of 123 kg, but 65 percent of the trips land less than 100 kg (Figure 4.1). A catch per trip of 100 kg will be used for estimating catches. If we assume there are 500 payang units, and if we assume 15 to 20 trips per month, then the total catch estimate for Central Java is about 9,000 to 12,000 tons per year.

4.3.1.3 Liftnets

From the statistical data, total catch of the ocean liftnets would appear to be between 3,000 and 4,000 tons per year if we ignore the seemingly incorrect 1982 figure (Table 1.2).

Zarochman et al (1982) reported that liftnets in the Jepara district were used during a 7 to 8 month period (Also see Figure 4.4) and estimated that the yearly number of trips was 161 to 181 days. Catch per trip varied considerably, but from their data an average value of 50 kg per night seems realistic. If we assume there are between 1,800 and 2,000 liftnets then the total annual catch from liftnets is between 14,490 and 18,100 tons. This figure is considerably higher than that given by the statistical data and perhaps is too high.

It is unlikely that 23 trips are made per month as Zarochman et al (1982) reported. Because of the dependency on moon phase (Figure 4.5) for good fishing, numbers of trips are probably less. Perhaps 15 trips per month would be a more realistic figure.

Our limited data indicated a catch per trip of 33 kg and Willoughby et al (1984) reported 26 kg per trip. If we assume a minimum catch per trip estimate of 25 kg, the total catch estimate would be 4,725 tons (105 trips x 25 kg x 1800 units). This is approximately the same as that given in the statistical data. This is realistic but perhaps somewhat low. A total catch from liftnets for Central Java could be between 5,000 and 10,000 tons per year.

If the above information is correct then the total catch of small pelagic fishes from the near shore areas of north Central Java is 10,000 to 13,000 tons for mini purse seine, 9,000 to 12,000 tons for inshore payang, and 5,000 to 10,000 tons for liftnets. The total is 24000 to 35000 tons per year (Table 4.4).

4.3.2 Species Composition

4.3.2.1 Comparison of Pelagic Seines

The species composition purse seine and mini-purse seine is similar with the catches of both types of gear being dominated by Sardinella. Both gears also catch significant amounts of Rastrelliger. In spite of this similarity the remainder of the catch is quite different in the two fishing gears. The large purse seines catch significantly more Decapterus and Selar (Figure 4.6 and Table 4.1).

BPPI (the Fishing Development Center) personnel have indications of additional differences between the catches catches of mini- and large purse seine. Apparently the dominant Sardinella species in the large purse seines is Sardinella sirm while that in the mini purse seines is Sardinella fimbriata mixed with other Sardinella species (G. Tampubolon pers. com.).

The catch composition of the inshore payang is very different from the catch composition of the mini purse seine. Almost 50 percent of the inshore payang catches are Stolephorus species with a significant catch of Trichiuridae and Scomberomorus. None of these groups are important in the purse seine and mini purse seine catches. However, Subroto (1975) reported that offshore payang have a catch composition very similar to that of the purse seines (Figure 4.6 and Table 4.2).

4.3.2.2 Fishery for Juvenile Anchovy or "Teri Nasi"

In some areas there is a special fishery and marketing system for small anchovy (Stolephorus) caught primarily by payang and liftnets. This "teri nasi" fishery is quite important for the small scale fishermen in some areas. For example in the village of Bulu in the Tuban district of East Java in October 1984, about 70 small sailing canoes were fishing for "teri nasi" with payang. These fish were about 2 cm long and weighed 0.11 grams each. The catches of 15 to 25 kg per trip contained about 9,000 fish per kg. which means that about 12.5 million of these fish are caught at Bulu each day. This type of fishery exists at many villages.

Although the capture of millions of juvenile fish each day would seem to be a violation of senseable resource management practices, there are other considerations. The effect of such a fishery on overall fish population can only be estimated if the total number of fish or the fishing mortality rates are also known. Data gathered via interviews and examination of the catch at the village of Bulu (numbers of payang fishing, settings per day, length of net, catch per setting) allowed us to calculate very approximate estimates of numbers of anchovy per unit area. By comparing this figure to the catches we estimated that, at a maximum, about 1.3 percent of the juvenile anchovy in the area fished were caught per day. The boats were small sailing craft limited to the nearshore (10 km) area. Presumably the fish population extends over a much wider area making the actual fishing mortality rate much smaller. Nevertheless the overall effect of this fishery is difficult to judge.

4.3.2.3 Comparison of Inshore Payang and Liftnets

Catches of payang and liftnets are quite similar (Figure 4.7 and Table 4.3). Both catch a large proportion of Stolephorus, but the remainder of the catch is rather different. The management of these two types of fishing gear needs to be considered together. The species composition data for liftnets is partly from our data and partly from the reports of Willoughby (1984) and unpublished data from BPPL (the Marine Fisheries Research Center).

4.4 Relationships Among Pelagic Fishing Gears

4.4.1 Relative Fishing Power

From the above data we can calculate the relative fishing power of the different types of pelagic fishing gear (Table 4.5). It is important to remember that the purse seine (including offshore payang) fish in an entirely different area than the mini purse seine, payang and liftnets. From inshore to offshore the fishing grounds are as follows: liftnets, inshore payang, mini purse seine, (offshore payang), and purse seine. Also, the liftnets and mini purse seine fish at night while the other gears fish during the day. Because of this partitioning of the fishing locations and times and because of the differing species composition of the catches, the relative fishing power calculations have limited use.

We can also calculate the relative fishing power for selected species groups to identify areas where different types of fishing gear might be competing (Table 4.6). Competition may occur between the mini purse seine and purse seine (and offshore payang which catches the same fish). Competition may also occur between the inshore payang and the liftnets.

4.4.2 Fishing Gear Conflicts

Some conflicts among the pelagic seine gears have been reported. In many situations the liftnets are viewed as destructive. Much of the dislike of liftnets arises from the fact that their existance limits fishing by other fishing gear. Bamboo remaining from the old liftnets entangle drift gillnets and payang and sometimes mini purse seine as well causing a loss of valuable fishing gear. They are also a hazard to navigation. In addition, liftnets are more visible than other fishing gear because they are relatively permanent and can be seen even when not in use. As a consequence, they are often cited as a destructive type of fishing gear. However, much of the dislike of liftnets is due to these factors and not to evidence that they are damaging the fishery resource.

In several provinces there are laws regulating or banning ocean liftnets. In Central Java, for example, licenses are given by the Marine Communications Department, although the fisheries department considers them illegal. There is also a national regulation which prohibited liftnets. The regulations are generally ignored, partly because there is no enforcement, and partly because of the uncertain legal status of the regulations.

4.5 Resource Availability

The actual management of the fishery needs to be based on the relationship between the catches and the available amount of fish. At present information about the condition of the fish stocks is very limited. Several workers (eg Tampubolon 1982) have used the Schaefer version of the surplus production model to estimate maximum sustained yield from the pelagic fisheries of the Java Sea. This has been done for both total biomass and for selected species. While these analyses are extremely useful to the overall management of the pelagic resources of the Java sea, the real question concerning the management of the inshore fisheries is should certain fishing gear be encouraged or limited. The mini purse seine really needs to be considered in conjunction with the offshore seine nets since catches the same species (note however that it is likely that the percentage of Sardinella sirm is higher in offshore gear and the percent of other Sardinella is higher in the inshore mini purse seine).

While analysis using the surplus production models is useful it is hampered by the limited accuracy of the catch statistics in Indonesia. An additional problem occurs in the situation where catch per unit of effort and effort are not obtained independently (usually when total effort is calculated from catch per unit effort and total catch). In such a situation an artificial correlation between catch per unit effort and units of effort can be accidently introduced. This accidently correlation can be most easily avoided by using a one year time lag in the calculations (e. g. see Gulland 1983, pp 72 and 73).

Another useful approach for continued work in this area is the species by species analysis, using length frequency data, with the determination of which species are in need of decreased fishing pressure. Limitations of appropriate gear could then be taken. Workers at the BPPI have some interesting data concerning the major pelagic species.

Both the inshore payang and the liftnets need to be managed in relation to the abundance and migratory pattern of Stolephorus. Unfortunately there is very little information on this group of species in this area, and it is unlikely that there will be good information in the near future.

4.6 Significant Points of Importance to Management

1. Data for this fishery management unit are limited by several factors.

    1.1. The statistics system does not differentiate between mini purse seine and large purse seine.

    1.2. The statistics system does not differentiate between the payang and the offshore payang. It does not differentiate between the large and small payang.

    1.3. Data from liftnets may be incompletely reported.

2. The existing purse seine mesh size regulation is ignored. This is partly due to the fact that a larger mesh size causes the fish to get stuck in the net. It is unlikely that mesh size regulations would be of any use in this fishery.

3. Fish attraction devices are an important part of the fishery.

4. Light attraction is an important part of the fishery.

5. Catches from the mini purse seine and large purse seine and offshore payang are quite similar.

6. The catches from liftnets and payang are quite similar. Any regulation of liftnets should also consider the payang fishery.

7. In some cases large numbers of very small fish are caught. The fishery for "Teri Nasi" is an example. There is no evidence to show that these fish are just small species. They are juvenile anchovy (Stolephorus). The relation of the fishery for juveniles to the overall management of the fishery is not yet known.

4.7 Recommendations for the Management of Pelagic Fisheries

1. STABALIZE FISHERY. Until better data can be collected and analyzed it would be wise to attempt to stabalize this fishery at the current level of fishing units.

2. DEVELOP TECHNIQUES FOR LIMITING THE NUMBER OF FISHING UNITS. Future management will probably be most successfully done by limiting the number of fishing units rather than the gear design.

2.1. NEED VILLAGE SUPPORT. While gear limitation at the large scale level can be done through enforcement, gear limitation at the village level will probably have to have the support of the fishermen if it is to be successful.

2.2. INVESTIGATE LICENSING POSSIBILITIES. Limitations like those mentioned for the shrimp trammel net fishery should be investigated. For example, perhaps only people who already have liftnet should be allowed to have them during the next season. The existing fishermen then have an interest in enforcing the regulation. Different possibilities for limiting the fishery should be discussed now to allow for their rapid implementation when needed.

2.3. LIFTNET ZONES. It may be possible to control liftnets (if necessary) by permitting them only in certain areas.

3. SURPLUS PRODUCTION MODELS OF LIMITED USE. The data required for the Schaefer model is easy to collect, but the data available here is of limited accuracy. Any application of the Schaefer or other surplus production models should incorporate a one year time lag. All previous such studies should be recalculated using this method. By using the one year time lag, accidental correlations between catch per unit effort and fishing effort can be avoided.

4. ANALYSIS USING LENGTH FREQUENCY DATA. For the pelagic fisheries I would recommend the use of length frequency methods of estimating parameters for the dynamic pool models of fish yield. These methods can be applied to selected species. If a problem arises with one of the species then an appropriate management action (for example a limitation of licenses for a particular type of fishing gear) can be recommended. Care must be taken to assure that the length frequency samples are representative of all the fish in the population.

5. NEED BETTER DATA. The pelagic fisheries of northern Java produce most of Java's fish supply. As a consequence it is

necessary to collect better statistical data if we are to manage this fishery to produce the optimum food supply.

5.1. IMPROVE STATISTICAL DATA. Data for the various gear types needs to be kept separate and should be more carefully recorded. Much of this can be accomplished by better training of the statistical staff.

5.2. BETTER DATA ABOUT SPECIES COMPOSITION. If the length frequency methods of analyzing the status of various species is going to be used, then better data about the species composition of the various gears needs to be collected at regular intervals. Some of this data can be collected by the fishery statistics system, but it will need to be supplemented by work at BPPL and BPPI.

4.8 Literature Cited

Gulland, J. 1983. Fish stock assessment: a manual of basic methods. Volume 1 in the FAO/Wiley series on food and agriculture. John Wiley and Sons. 223p.

Subroto, Isom Hadi. 1975. Perikanan pelagis dan perkembangan kapal motor purse-seine yang mendaratkan hasilnya di Tegal. Marine Fisheries Research Report 2:102-129.

Tampubolon, Gomal. 1982. Analisa potensi penangkapan sumber perikanan di perairan pantai utara Jawa. 1982. Unpublished Report from Balai Penangkapan Pengembangan Ikan. Semarang, Indonesia. 16p + Figures and Tables.

Willoughby, N. G., Zarochman and A. Rosyid. 1984. Preliminary studies on the bagan (liftnet) fisheries of Jepara, Central Java. Oseanologi di Indonesia 17:13-24.

Zarochman, N. Lelea, and N. G. Willoughby. 1982. Perikanan bagan tancap lift net di sekitar perairan Jobokuto, Jepara. Summer Field Course Student Report - Proyek Kerjasama Universitas Diponogoro/Universitas New Castle.

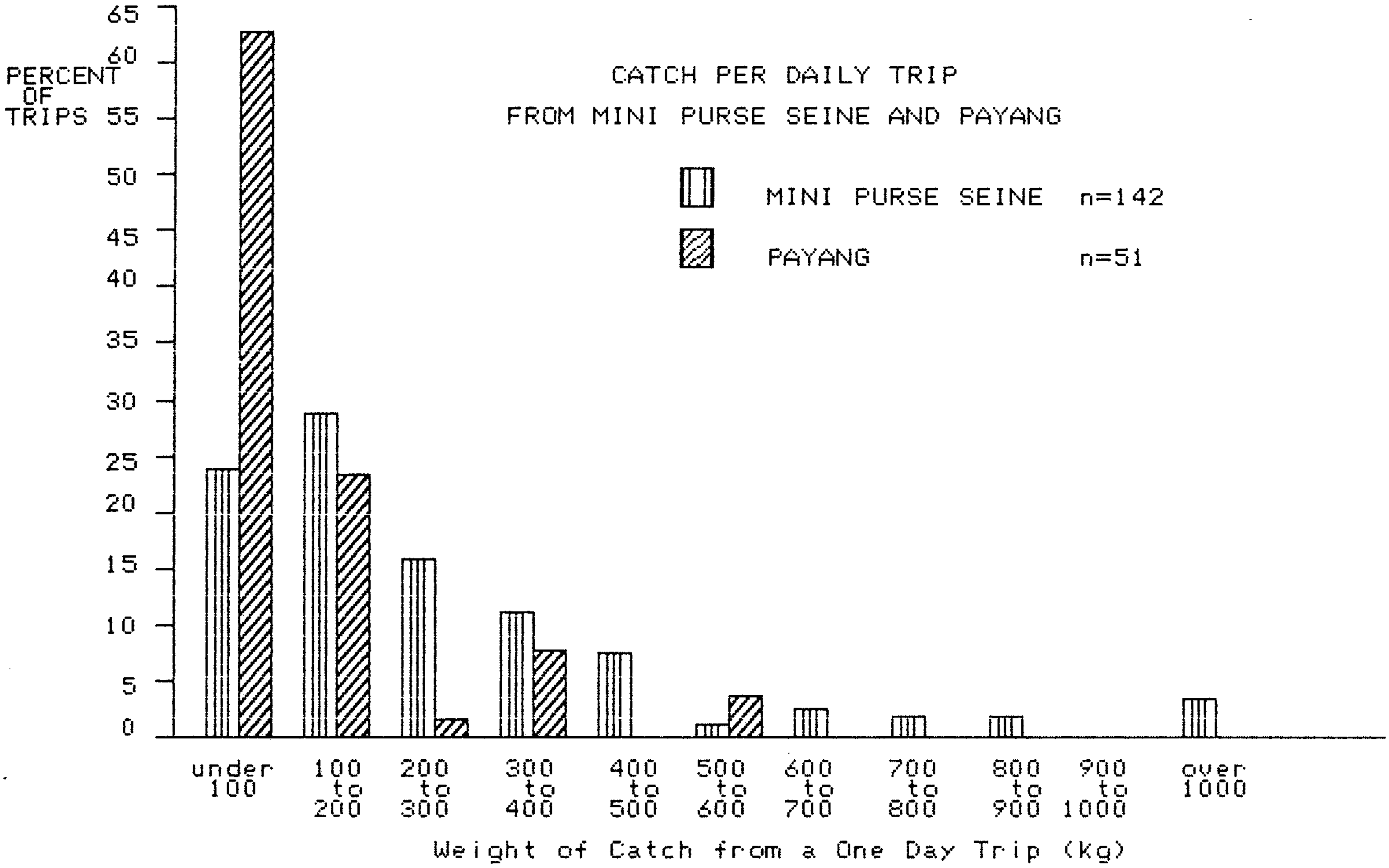
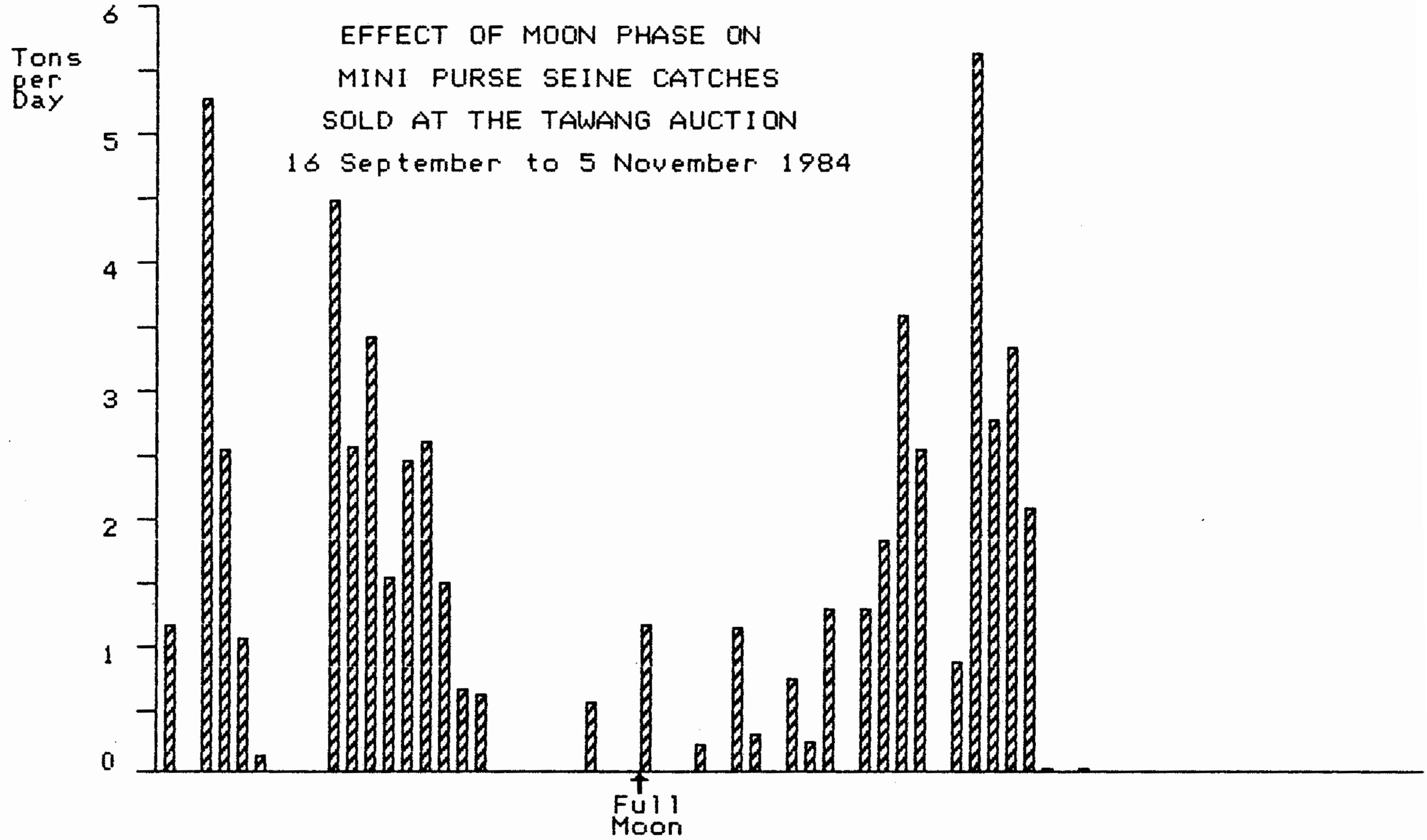
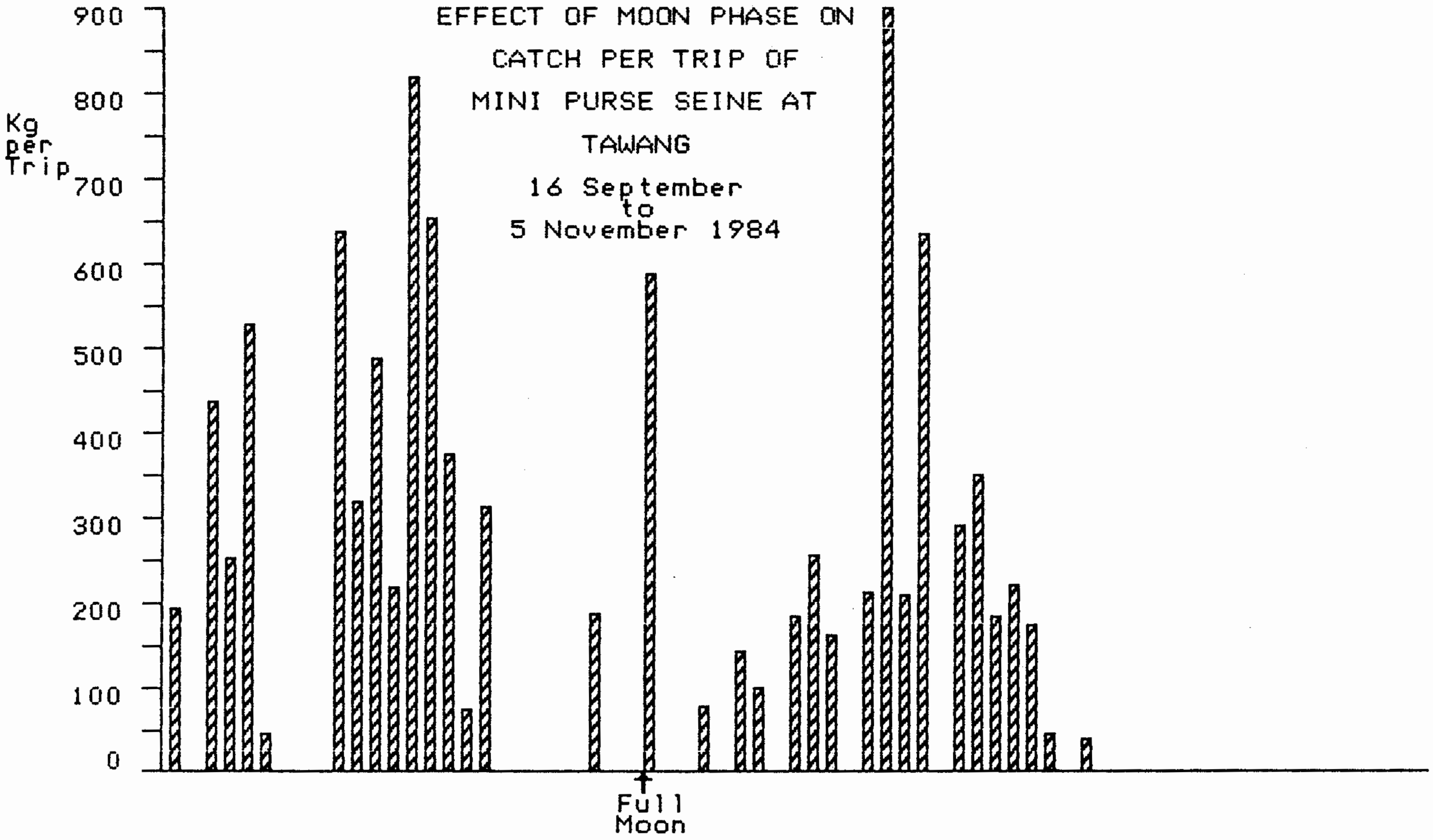
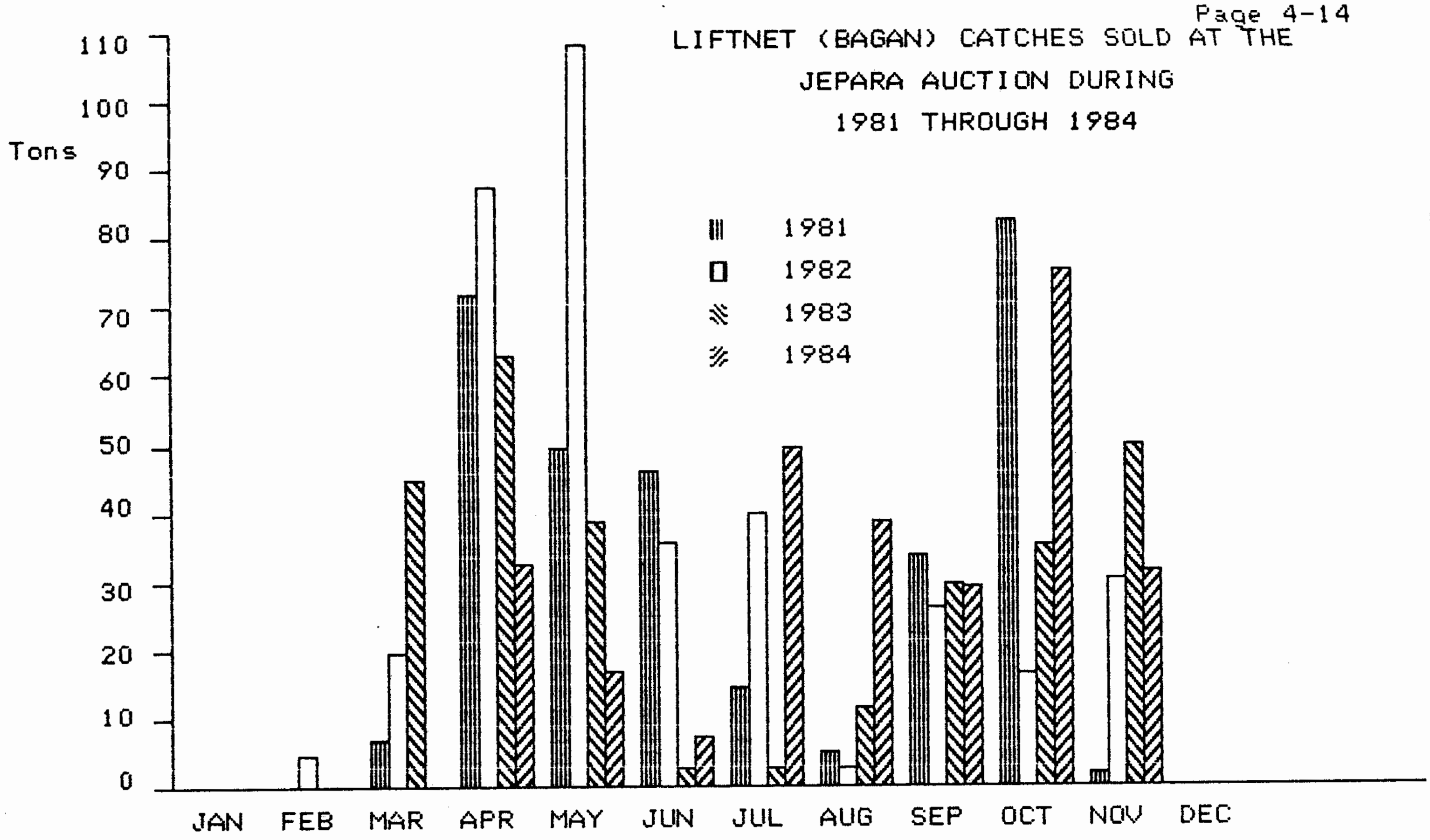

CATCH PER DAILY TRIP
FROM MINI PURSE SEINE AND PAYANG
MINI PURSE SEINE n=142
PAYANG n=51
PERCENT OF TRIPS
65
60
55
50
45
40
35
30
25
20
15
10
5
0
under 100
100 to 200
200 to 300
300 to 400
400 to 500
500 to 600
600 to 700
700 to 800
800 to 900
900 to 1000
over 1000
Weight of Catch from a One Day Trip (kg)

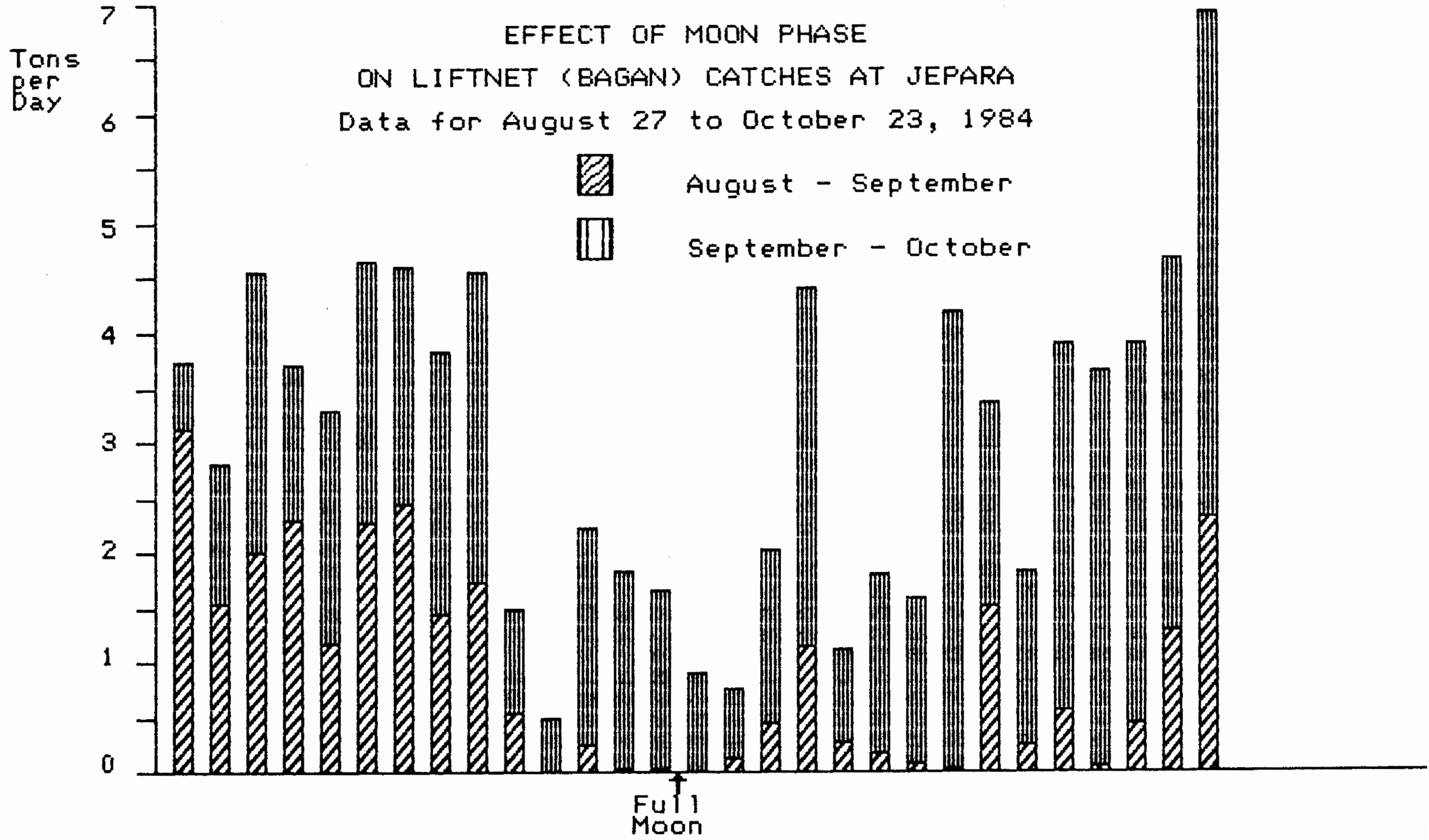
Figure 4.1





Figures 4.2 and 4.3



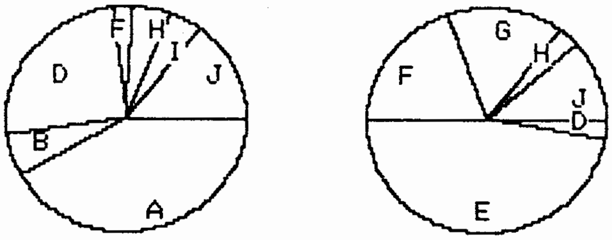


Figures 4.4 and 4.5

SPECIES COMPOSITION IN THE CATCHES OF FOUR TYPES OF PELAGIC FISHING GEAR

NEAR SHORE PELAGIC GEAR

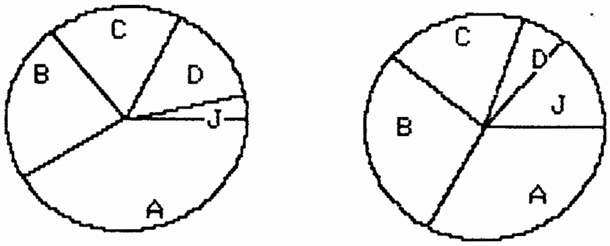
MINI PURSE SEINE PAYANG



	PURSE SEINE	MINI PURSE SEINE	PAYANG	OFFSHORE PAYANG
A Sardinella (CLUPSA)	41.6%	41.9%	-	33.0%
B Decapterus (CARADE)	23.0	5.7	-	27.9
C Selar (CARASE)	17.8	-	-	19.8
D Rastrelliger (SCOMRA)	14.4	25.7	3.2%	5.9
E Stolephorus (ENGRST)	-	-	47.5	-
F Trichiuridae (TRIC)	-	3.2	19.4	-
G Scomberomorus (SCOMSC)	-	-	15.4	-
H Dussumeria (CLUPDU)	-	4.9	3.2	-
I Squids (LOLI)	-	3.9	-	-
J Other	3.2	14.7	11.3	13.4

OFFSHORE PELAGIC GEAR

PURSE SEINE OFFSHORE PAYANG



A COMPARISON OF SPECIES COMPOSITION
IN THE CATCHES OF
BAGAN AND PAYANG

		Bagan	Payang
A	Stolephorus (ENGRST)	64.5	47.5
B	Sardinella (CLUPSA)	4.3	-
C	Ambassis (CENTAM)	7.5	-
D	Leiognathidae (LEIO)	4.4	-
E	Dussumeria (CLUPDU)	3.5	3.2
F	Squids (LOLI)	5.4	-
G	Trichiuridae (TRIC)	-	19.4
H	Scomberomorus (SCOMSC)	-	15.4
I	Rastrelliger (SCOMRA)	-	3.2
J	Other	10.4	11.3

Figure 4.7

Table 4.1. Species composition data collected from 142 mini purse seine along the north coast of Java between May and October 1984. The catch from an average net was 293.6 kg.

Name of Fish Group	Percent of Total Catch	Average Catch Kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
CLUPSA	41.93	99.521	33.89	14.9	11.0	19.0	113
SCOMRA	25.74	83.148	28.32	16.6	11.0	22.0	97
CARADE	5.73	2.798	0.95	15.8	15.0	16.0	5
CLUPDU	4.94	10.805	3.68	15.1	9.0	18.0	41
LOLI	3.97	19.493	6.64	13.3	12.0	15.0	45
TRIC	3.17	19.589	6.67	48.6	15.0	70.0	40
SCOMSC	2.36	7.198	2.45	43.1	20.0	70.0	31
CARAME	2.13	11.084	3.77	15.5	9.0	25.0	19
CARASE	1.98	4.133	1.41	19.2	15.0	23.0	16
CLUP	1.56	6.182	2.11	11.1	7.0	18.0	29
SPHY	1.44	7.857	2.68	27.3	15.0	35.0	24
CARASC	0.84	0.378	0.13	18.0	15.0	21.0	2
CLUPAN	0.82	7.063	2.41	16.8	14.0	22.0	10
FORM	0.74	3.724	1.27	18.3	12.0	27.0	6
CARASL	0.71	2.498	0.85	12.7	11.0	18.0	14
LEIO	0.53	2.097	0.71	9.0	6.0	12.0	18
STROPA	0.36	0.837	0.29	15.4	14.0	17.0	5
ENGRST	0.21	0.745	0.25	7.0	7.0	7.0	5
SCOMEU	0.17	0.726	0.25	30.7	28.0	32.0	3
LACT	0.12	0.239	0.08	17.3	15.0	20.0	4
CHIR	0.06	1.322	0.45	28.0	15.0	45.0	4
CARA	0.06	0.273	0.09	15.5	14.0	17.0	2
RAY	0.05	0.213	0.07	40.0	40.0	40.0	2
ENGRTH	0.05	0.203	0.07	14.0	14.0	14.0	2
ISTI	0.05	0.188	0.06	-	-	-	1
SCOMSL	0.05	0.230	0.08	15.0	15.0	15.0	1
SCIA	0.03	0.087	0.03	14.8	12.0	20.0	4
ARII	0.01	0.018	0.01	13.0	13.0	13.0	1
MULL	<.01	0.016	0.01	14.0	14.0	14.0	1
THER	<.01	0.030	0.01	16.0	16.0	16.0	1
OTHER	0.21	0.953	0.32	10.0	10.0	10.0	13

Table 4.2. Species composition data collected from 51 "payang gemplo" along the north coast of Java between May and October 1984. The catch from an average net was 123.71 kg. The "payang gemplo" are pelagic seine nets with large mesh (up to 35 cm) in the wings and small mesh (as small as 2 mm) in the bag.

Name of Fish Group	Percent of Total Catch	Average Catch Kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
ENGRST	47.53	47.756	38.60	5.8	3.0	8.0	42
TRIC	19.37	17.804	14.39	58.1	40.0	70.0	13
SCOMSC	15.36	22.491	18.18	49.6	35.0	80.0	15
CLUPDU	3.20	5.622	4.54	9.9	4.0	15.0	16
SCOMRA	3.16	3.835	3.10	11.9	9.0	17.0	7
LEIO	2.80	7.228	5.84	7.0	4.0	12.0	18
CARAME	1.81	2.344	1.90	16.1	15.0	19.0	8
FORM	1.74	4.166	3.37	29.7	24.0	35.0	3
STROPA	0.87	2.833	2.29	18.9	15.0	25.0	8
CARASL	0.86	1.689	1.36	7.5	6.0	8.0	5
CLUP	0.78	2.662	2.15	9.1	6.0	14.0	12
ENGRTH	0.63	0.930	0.75	11.0	9.0	15.0	4
MYSI	0.48	0.585	0.47	1.5	1.0	2.0	2
ARII	0.36	0.351	0.28	30.0	30.0	30.0	1
CARA	0.27	0.893	0.72	21.8	12.0	46.0	6
SCIA	0.17	0.658	0.53	16.3	8.0	25.0	4
NEMI	0.09	0.248	0.20	16.7	12.0	20.0	3
CHIR	0.08	0.303	0.25	35.0	35.0	35.0	1
CARASE	0.08	0.243	0.20	20.0	20.0	20.0	1
LACT	0.06	0.078	0.06	14.5	14.0	15.0	2
CENTAM	0.06	0.118	0.10	6.0	6.0	6.0	1
THER	0.05	0.146	0.12	14.0	14.0	14.0	1
OTHER	0.18	0.725	0.59	-	-	-	5

Table 4.3. Species composition data collected from 7 fixed liftnets ("bagan tancap") from the north coast of Central Java in May and June 1984. The catch from an average net was 33.4 kg.

Name of Fish Group	Percent of Total Catch	Average Catch kg		Lengths			Number of Nets
		Weight	Percent	Mean	Min	Max	
ENGRST	78.13	23.019	68.92	5.4	4.0	7.0	5
LOLI	7.26	4.128	12.36	9.0	6.0	12.0	4
CLUPDU	4.06	.835	2.50	9.0	7.0	12.0	3
TRIC	3.20	1.960	5.87	31.0	30.0	32.0	2
LEIO	0.85	.177	0.53	11.0	11.0	11.0	1
CLUP	0.21	.608	1.82	12.0	12.0	12.0	1
CARAME	1.07	1.543	4.62	9.5	7.0	12.0	2
CLUPSA	2.56	.617	1.85	-	-	-	1
OTHER	2.65	.511	1.53	-	-	-	2

Table 4.4. Summary of catch data for major pelagic fishing gear. See text for method of calculation. Data for purse seine from Tampubolon (1982).

Fishing Gear	Estimated Number of Units	Estimated Catch per Day (Kg)		Number of Days	Estimated Catch (tons)		
		Mean	Adjusted a		Low	High	Official
Purse Seine	450	480		240000 b	51840		57844 c
Mini Purse Seine	350	294	200	144-180	10080	18522	none d
Payang	500	123	100	180-240	9000	14760	8109
Bagan	1900	50	25	105-181	4987	17195	3097

a. See text for reasons for adjustment.
b. Total number of days for all units.
c. This figure includes both mini and regular purse seine.
d. There are no separate statistics for mini purse seine.

Table 4.5. Overall relative fishing power (RFP) on a per day basis and on a yearly basis. Values used for total catch were intermediate values taken from the previous table.

Gear	Catch per Day (Kg)	RFP (Day)	Catch per Unit per Year (Tons)	RFP (Year)
Purse Seine	480	1.000	115.20	1.000
Mini Purse Seine	200	0.417	34.29	0.297
Payang	100	0.208	22.00	0.191
Bagan	25	0.052	5.26	0.046

Table 4.6. Relative fishing power for four pelagic fishing gear types and four species groups which showed significant overlap between two or more gear types.

	Purse Seine	Mini Purse Seine	Payang	Bagan
Yearly Catch per Unit (tons)	115.20	34.29	22.00	5.26
Sardinella *				
Percent	41.60	41.90		
Catch (tons)	47.92	14.37		
RFP	1.00	0.30		
Decapterus				
Percent	23.00	5.70		
Catch (tons)	26.50	1.95		
RFP	1.00	0.07		
Rastrelliger				
Percent	14.40	25.70	3.20	3.20
Catch (tons)	16.59	8.81	0.70	0.17
RFP	1.00	0.53	0.04	0.01
Stolephorus				
Percent			47.50	64.50
Catch (tons)			10.45	3.39
RFP			1.00	0.32

* There is some evidence which suggests that different species of Sardinella are found in the purse seine and mini purse seine because of the differences in the fishing ground.

Chapter 5

SHRIMP TRAMMEL NET FISHERY

The extensive trammel net fishery for shrimp is one of the newest developments in Indonesian fisheries. Following the ban on trawling, which was imposed in October of 1980, there was a sharp increase in the numbers of alternate shrimp gear. The trammel net became the most successful and most popular alternative, and by 1982 the official statistics listed 6,500 trammel nets for the north coast of Central Java and 14,800 for the whole north coast. The high value of shrimp combined with the desire for Indonesia to increase export earnings has turned increased attention on the shrimp fishery. The relative costs and benefits of the trammel nets versus a return to trawling must be considered as a part of this management plan.

Although catches of shrimp decreased substantially following the trawl ban, shrimp catches in northern Java have now apparently increased to near or above pre trawl ban levels (Figure 5.1).

While this fishery management unit is concerned primarily with the management of the inshore shrimp fishery, it must also consider the effect of this fishery on other fishes and fisheries. Only about 30 percent of the catch is shrimp. Also, there are some other types of fishing gear which catch shrimp and these need to be included as well.

5.1 Methods of data collection

Data concerning shrimp fishing gear and catch were collected at several villages along the northern coast of Central Java. At most locations much of the fish from these types of gear is not landed at the auction. Therefore we collected the data directly from each boat as it landed. Often this ment getting the finfish data from the boat and the shrimp data (for the same boats) at the auction place. For each daily trip information about the size of the boat, size and number of nets, and the number of settings was also recorded.

Data was also obtained from auction place books at the Villages of Wedung in the Demak district, the village of Tawang in the Kendal district, and the village of Tanjung Sari in the Pemalang District. Data from the auction places, with few exceptions, includes only the shrimp catches, because much of the fish from the trammel nets is sold outside the auction place. Also, in some cases, small shrimp catches from several boats may be combined for sale at the auction.

5.2 Comments About the Fishery

The dominant fishing gear for shrimp is the trammel net. These are composed of 8 to 20 pieces of 25 meter net with a typical boat having a net composed of 12 to 13 (average 12.6) pieces. The nets are between 1.5 and 3 meters deep. The nets typically have an inner mesh panel of 4.4 cm (1.75 inch) mesh and outer panels of 10 to 20 cm mesh. These mesh sizes vary quite a bit. In some cases inner meshes are as small as 2.5 cm. While the vast majority of the shrimp trammel nets are made from multifilament nylon, some are made from very fine monofilament.

The trammel nets are fished in an active manner by setting the net on the bottom and pulling it in like a seine. According to the fishermen each setting may take 20 to 40 minutes. From our data we found that an average of 5.2 settings are made per day.

There are several similar types of gear used to catch shrimp as well. The most often mentioned of these is the "klitik" net which is a fine mesh, fine twine, losely hung, monofilament gillnet. These nets do not seem to be common as the trammel net and are not as effective in catching shrimp.

5.2.1 Number of Nets

In some areas the trammel net is called "klitik" and in other areas all trammel nets and "klitik" are recorded as gillnets. The result is that the official statistics do not give an accurate estimate of the number of shrimp nets. Also, because this is an expanding fishery, the statistics from a few years ago are insufficient for an accurate assessment of the current number of shrimp nets. The most recent (1982) official estimate for Central Java is 6500 trammel nets while the value given for the north coast is 14800. Probably 6000 to 8000 units for Central Java would be a realistic assumption.

5.3 Catches from trammel net

5.3.1 Total Catch and Shrimp Catch Data

Official statistics list the catch from shrimp nets for northern Central Java as almost 21000 tons for 1982. This amounts to a production per unit of 3.3 tons per year (Table 1.2). If we assume 20 trips per month then this would imply a catch per trip of 13 kg. Central Java statistics for 1982 list 19 kg per trip. Both these values are too high, compared to our data, even if all the fish as well as the shrimp were included in the data.

Data which we collected revealed a average catch per trip of 8.5 kg of which and average of 30 percent or 2.55 kg was shrimp (Table 5.1 and Figures 5.2 and 5.3). However, our data may underestimate the shrimp catch slightly because our sampling was only from May through November.

For this type of gear usually only shrimp catches are recorded at the the auction places. Also, it is common for small catches to be combined outside the auction and later resold at auction. As a consequence the catch per trip calculated from the auction data is for shrimp only and is usually overestimated. Catches recorded at the Tanjung Sari auction for 1981 through 1984 give a shrimp catch per trip of 4.9 kg. The seasonal trend in total landings and catch per trip at Tanjung Sari are given in Figures 5.4 and 5.5. The season of the best catches is from October through January.

A reasonable way to estimate total catch would be to assume a catch of shrimp per trip of 2.5 kg during March through September and a higher catch per trip of 4 kg for October through February. If we assume a value of 20 trips per month and between 6000 and 8000 units fishing, we get an catch estimate of 4500 to 6000 tons of shrimp from shrimp trammel nets. This is higher than the official values. The total catch including fish (using the 8.5 kg per trip figure) is between 12200 and 16300 tons.

5.3.2 Species Composition

In general the auction places record only the shrimp landings since the fish caught in the shrimp gear is usually sold outside the auction. As a consequence there is no species composition data available from the auction places. The BPPI field staff collected species composition data from 215 trammel nets. Although they were unable to reliably distinguish between Penaeus indicus and P. merguiensis, the data collected gave a good estimate of the relative composition of shrimp and fishes in the nets.

The most common fish groups were the Leiognathidae (29.5%) and Sciaenidae (17.9%). Shrimp made up 30.2 percent of the catch. The remaining 22.4 percent was composed of over 22 families of fish and invertebrates, but none of them contributed more than 2 percent of the overall catch. Of course in a single net some of the less common groups are abundant (Table 5.1).

Penaeus monodon were not very common in the nets we examined. Large, live P. monodon have a very good market as brood stock for shrimp hatcheries.

5.4 Resource Availability

Several projects have been carried out to assess the demersal fish stocks of Java's north coast. These studies have included both the use of surplus production models, and the use of the swept area method employing research trawlers. Studies of Dwiponggo (1978) and Sujastani (1978) indicated that the demersal fishery was overexploited by the trawler fleet. Martosubroto (1982) reported that the overexploited area was more restricted, and was limited to the north coast of central Java and part of East Java. All studies agreed however that the central part of the north coast was, at that time, overexploited both for fish and shrimp. Martosubroto (1982) reported a MSY for this area at 50 to 51 thousand tons for all demersal resources and 3,200 tons for shrimp.

Although the data is limited, Martosubroto and Badrudin (1982) reported that the trawl ban has resulted in an increased catch rates of research trawlers.

5.5 Relative Benefits of Trammel Nets Versus Trawl

The trammel net fishery developed as a consequence of the trawl ban which was first fully instituted in late 1980. The ban on trawling resulted from conflicts between the trawlers and the more traditional small scale fishermen. Any management actions within the shrimp gear fishery management unit should include an assessment of the relative costs and benefits of trawling or its continued prohibition.

5.5.1 Relative Catch Rates

Surprisingly there is relatively little information about the species composition of the trawl fishery. Although there is an abundance of information about the species composition of research trawlers, because of the large mesh sizes used, the catches are not representative of those from shrimp trawlers.

Data for 1980 gives the trawl catch as 17,021 tons and the total shrimp catch for the same year is 3283 tons. If we assume that about 80 percent of the shrimp catch was from trawls, then the percent composition of the trawl catch would have been 15.4 percent shrimp. However, data from Semarang based trawlers for 1977 showed that about 5.4 percent of the catch was shrimp (Beck and Sudradjat 1978). If we assume that the percent of shrimp in the former north coast trawlers was between 5 and 15 percent then we can calculate the relative effect of the two types of fishing gear (Table 5.2).

In general the shrimp from the nets we examined were relatively large (mean of 38 per kg). While there is no redily available comparative study with trawl catches here, it is likely that this size is larger than that caught by the trawlers. It is also true that some deeper water shrimps caught by the trawlers are not now caught by the trammel nets. This is the case with the Cilacap shrimp fishery on the south coast of Java (Naamin and Martosubroto 1984).

Using these very rough figures we see that a trawler will catch the the same catch as 24 to 34 trammel net boats if the total catch is used as the basis of calculation. Since the trammel nets catch a larger proportion of shrimp the result if only the shrimp catch is used as the basis of calculation is quite different. In that case a trawler would catch the same amount of shrimp as 3.6 to 14 trammel net boats.

It is also necessary to point out that the trawlers caught some fish which are not caught by the trammel nets and perhaps are not caught in large numbers by other gear either. Dwiponggo (1984) pointed out that the total landings of certain demersal species have decreased considerably since the trawl ban.

5.5.2 Effect on Employment

If the above assumptions are reasonable then the effect of the two different types of shrimp gear on employment can be estimated. The trawlers employed about 10 (7 to 12) persons and the trammel net boats 3. From the point of view of the total catch the 10 people on each trawler are the equivalent of 72 to 102 people fishing trammel nets. If we consider only shrimp then the difference is less. The 10 workers on the trawler are equal to between 10.6 and 42 people fishing trammel nets.

We would thus conclude that the trawl ban has increased employment for fishermen. An additional factor is that many of the ex-trawlers were converted to purse seiners which employ substatially more crew (up to 30). The purse seiners usually fish farther from shore and thus do not conflict directly with the small scale fishermen. Additional fishermen were absorbed into the fishery by the trammel net boats and by the increased numbers of offshore purse seine.

5.5.3 Other Economic and Social Factors

Another factor which may be important in the management of the shrimp fishery is the question of who is making the profit. If one of the goals of the Directorate General of Fisheries is to increase the economic status of the fishing communities then this question must be considered.

Previously the trawlers landed their catch at major landing places and the shrimp buyers congregated there. Now the situation is quite different. The buyers are forced to go to the small landing places to find shrimp, and many of these small villages are becoming shrimp production centers. Even though a trammel net boat may catch only 2 or 3 kg of shrimp per day this means a sale of at least Rp4000 to Rp8000 (about US$4.00 to 8.00). The larger catches during the peak season can bring a single boat over Rp100,000 for a good days catch. In a society where Rp700 to Rp1000 is a typical daily wage the influx of the shrimp trade to a village must have a substantial impact. Shrimp fishing certainly brings in more income than other forms of fishing, and the capital outlay is usually less. The trawl ban has undoubtedly increased the economic well being of the small scale fisherman.

5.5.4 Comments About the By-Catch Excluder Device

With the above comments in mind we can assess the potential of using trawlers equiped with a by-catch excluder device. The purpose of such a device is to allow the trawler to catch shrimp while permitting a portion of the fish and other organisms to escape. It is important to note that the by-catch excluder cannot solve the basic conflict between the small scale fishermen and the trawlers. Both trawler fishermen and non-trawler fishermen are trying to catch shrimp. While there were other aspects to the conflict, the point is that the excluder device, although useful for protecting fish stocks, is not an appropriate solution for situation on the north coast of Java.

5.5.5 The Trawl Ban in Other Areas

Although the trawl ban seems to be very useful in Northern Java, it is possible that conditions in other parts of Indonesia may make a ban on trawling unnecessary. Unfortunately Indonesia's fishery enforcement capability is limited and there is no guarantee that trawlers from other areas will not fish in closed waters. In fact it was this very situation which forced the expansion of trawling restrictions in the first place.

Nevertheless there are some reports that the trammelnet is not very effective in some areas. In Bengkulu Province, for example, large numbers of marine catfishes (Ariidae) make trammelnet fishing for shrimp rather difficult. In the future when enforcement capability has been strengthened limited trawling could be reintroduced in appropriate areas.

5.6 Significant Points of Importance to Management

1. The catch of the trammel nets is somewhat different from that of the trawler. The trammel nets are less efficient. The trammel net seems to catch a larger percentage of shrimp however. There are certain species of shrimp and fish which the trammel nets do not catch but which were previously caught by the trawlers.

2. The continued use of trammel net boats provides more employment and more income to the small fishing villages than if the trawl ban were lifted.

3. The size of the shrimp in the trammel nets is relatively large.

4. Some species of shrimp, which live in deeper waters are probably not caught by the trammel nets.

5. It is possible that the ban on trawling has decreased the supply and increased the price of the small demersal fishes (Leiognathidae and other groups). It is likely that the demersal resources, perhaps even those relatively close to shore, are now underexploited. However, there is only limited data to support the idea that the trawl ban has caused a significant increase in the abundance of demersal fishes. If the trawl ban did not cause a significant increase in demersal resources, then the fishery was probably not overexploited at the time the ban was instituted.

6. At selected locations there may be an opportunity to develop a fishery for Penaeus monodon spawners to supply shrimp hatcheries.

5.7 Recommendations

1. CAREFUL EXPANSION. The trammel net shrimp fishery can probably be expanded somewhat, but this must be done with caution. Data on the number of fishing units is probably less reliable than for other fishing gear. Also it is likely that the fishery is not as dependent on loans as are some of the other fisheries. Thus expansion is likely to continue even without government support. In fact probably no government support for development of this fishery is needed.

2. PREPARE FOR STABILIZATION. Plans should be formulated now for the stabilization of the fishery. This will be a very difficult task. The shrimp are valuable and everyone would like to catch them.

> 2.1. It is very unlikely that gear modifications will be appropriate controlling measures. However, additional data should be collected to investigate the usefulness of limiting the length of trammel nets which could be used by a given boat. It might also be useful to investigate the effect of different mesh sizes.
>
> 2.2. Limitations on the size of boats using trammel nets should also be considered.

2.3. Some type of limitation on the numbers of fishing gear will have to be instituted in the future. Since enforcement capability for small scale fisheries is limited, it will be necessary to have the support of the fishing communities for any limiting regulations or actions to be effective.

2.4. Such limitations might include limiting shrimp fishing rights to people from the village, or limiting shrimp fishing rights to people who already own shrimp fishing gear.

3. KEEP PRESENT MESH SIZE. At present the size of shrimp are relatively large. The mesh sizes used and the fishing technique apparently does not capture excessive numbers of small shrimp. Not only is this good from a resource management point of view, but the larger shrimp bring a better price and are a more valuable export commodity. Shrimp gear with small mesh sizes should be discouraged.

4. KEEP TRAWL BAN IN NORTHERN JAVA. The trawl ban has been very useful in helping the small scale fishermen in northern Java. The ban on trawling should be kept. Not only has the ban helped the small scale fishermen catch more shrimp, it has also improved the marketing situation. Trawling in adjacent areas should also be banned until adequate enforcement can be provided.

5. IMPROVE SHRIMP HANDLING AND QUALITY CONTROL. Because shrimp catches are now landed at many small villages, the maintainence of product quality after landing may be more difficult. Assistance to fishermen, cooperatives, traders and processors may be needed to improve quality.

6. INCREASE SURVEY AND RESEARCH EFFORTS. The shrimp fishery is Indonesia's most valuable fishery. The shrimp fishery of Java's north coast is particularly valuable. In order to better understand and manage this fishery better data needs to be made available. It is a fishery that is rapidly changing so the official statistics are often out of date. Some of the components of increased data collection and analysis should be:

6.1. Better identification of the shrimp species in the catches.

6.2. Careful monitoring of the catch per unit of effort including any changes in the type and design of gear used.

6.3. Collection of data concerning the number of shrimp per kg on a regular basis.

6.4. The above might be best accomplished by selecting certain representative villages as "shrimp monitoring villages."

6.5. This supplementary data could be collected by one or two workers assigned to this task.

5.8 Literature Cited

Beck, U., and A. Sudradjat. 1978. Variations in size and composition of demersal trawl catches from the north coast of Java with estimated growth parameters for three important food-fish species. Contribution of the Demersal Fisheries Project. Special Report. Marine Fisheries Research Institute, Jakarta.

Dwiponggo, A. 1978. Status perikanan demersal diperairan pantai Laut Jawa, potensi dan tingkat pengusahaanya. Contribution to the Symposium of the Modernization of Small Scale Fisheries. Jakarta. June 1978.

Dwiponggo, A. 1984. Notes on the demersal fishery of the Java Sea and population parameters of some demersal species. Paper presented to the Indopacific Fisheries Council Standing Committee on Resources, Research and Development. August 1984. Jakarta.

Martosubroto, P. 1982. Fishery dynamics of the demersal resources of the Java Sea. Doctoral Dissertation. Dalhousie University, Halifax, Canada. 238p.

Naamin, N., and P. Martosubroto. 1984. Effect of Gear Changes in the Cilacap shrimp fishery. Paper presented to the Indopacific Fisheries Council Standing Committee on Resources, Research and Development. August 1984. Jakarta.

Sujastani, T. 1978. Penghitungan besarnya stock sumber-sumber perikanan di Laut Jawa berdasarkan data statistik perikanan daerah. Contribution to the Symposium on Modernization of Small Scale Fisheries. Jakarta. June 1980.

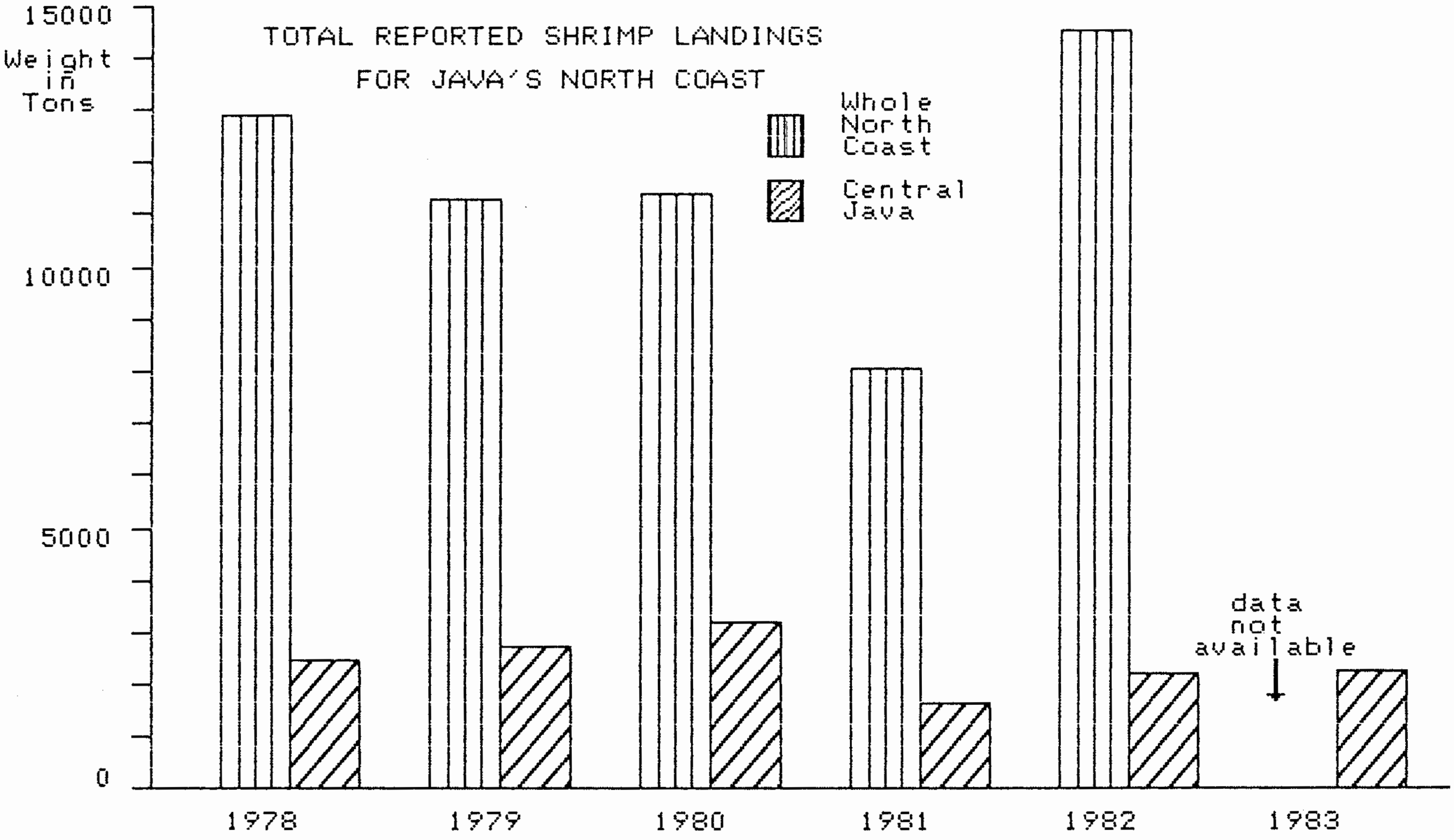
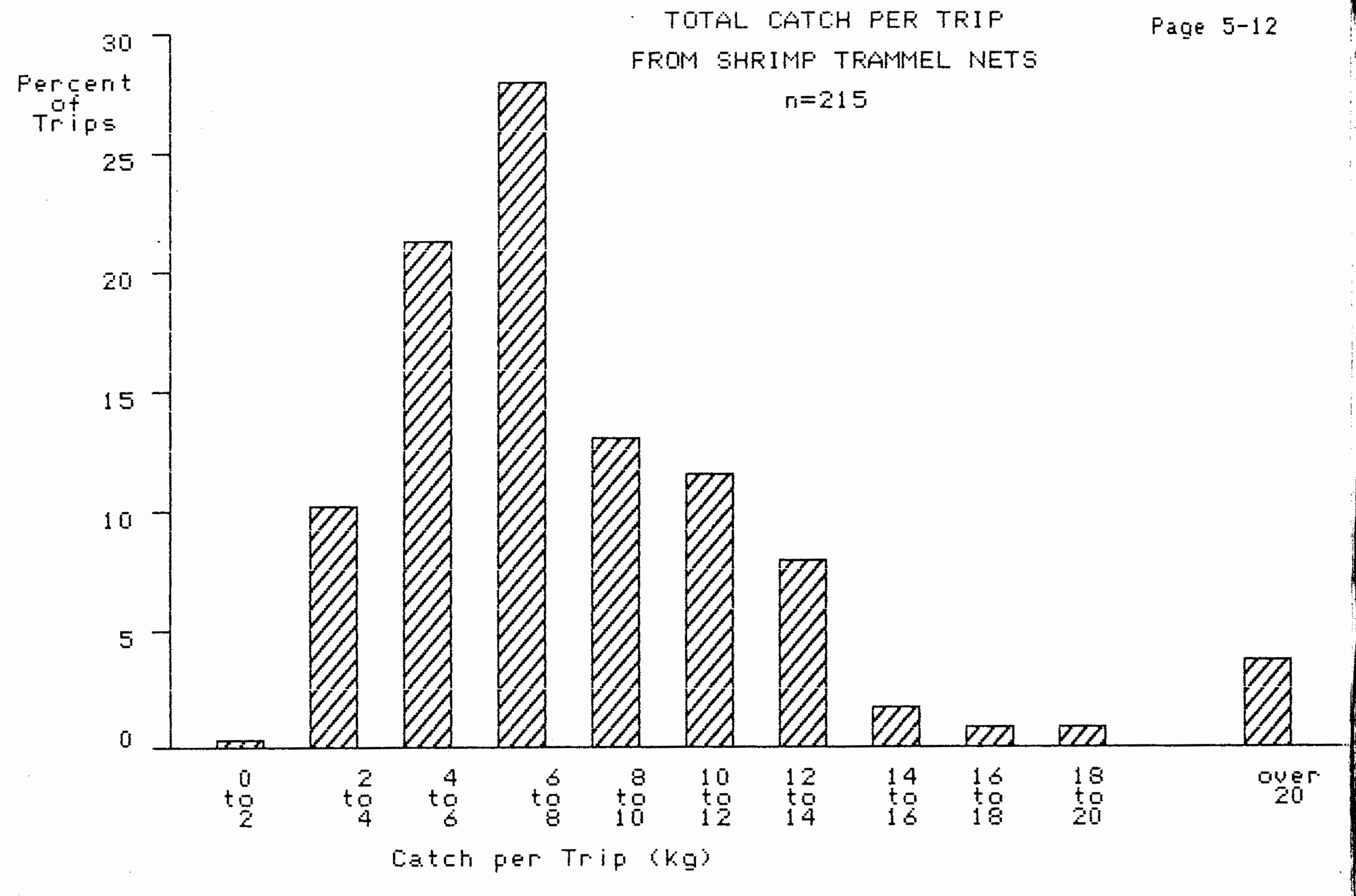
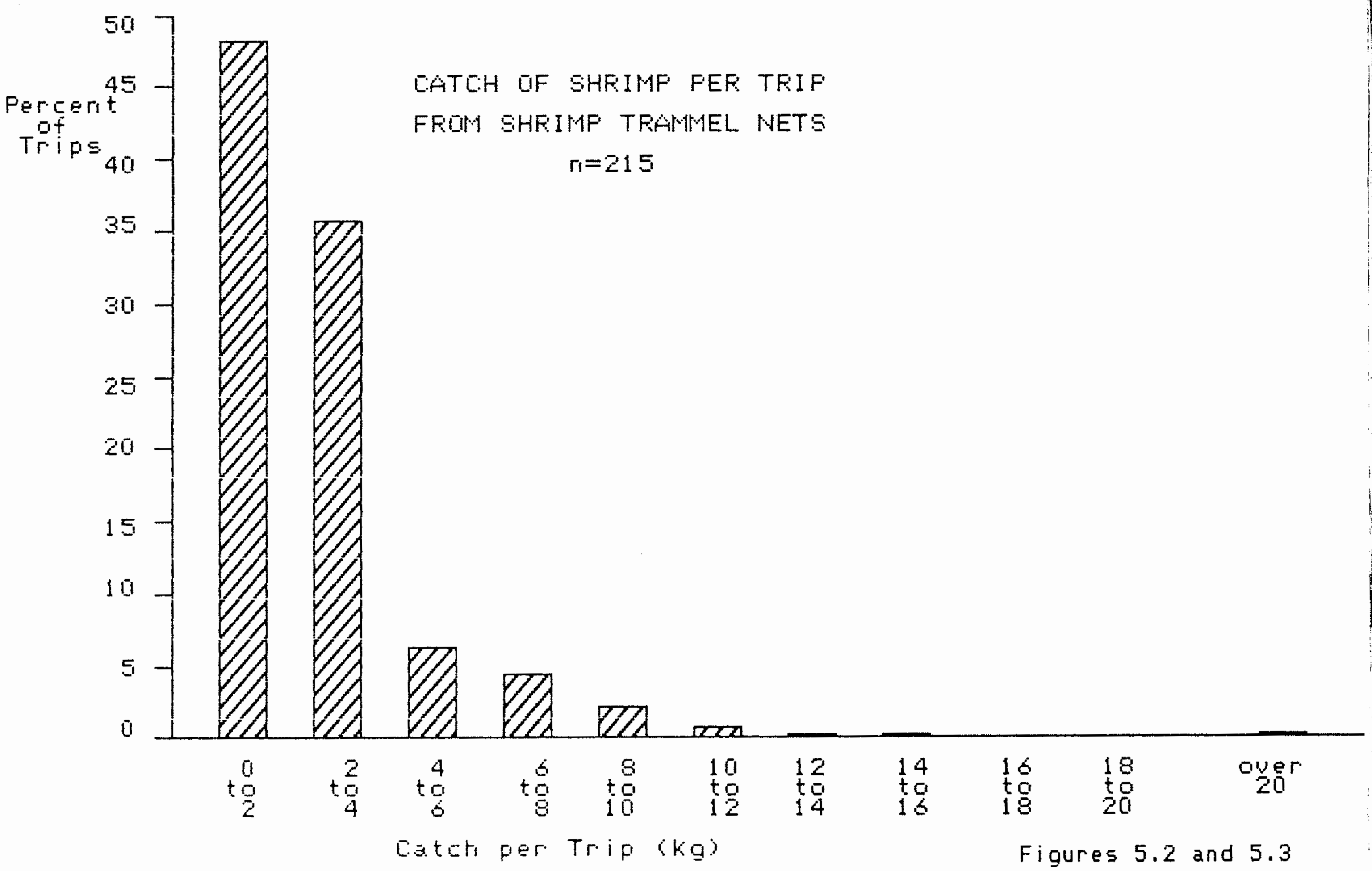
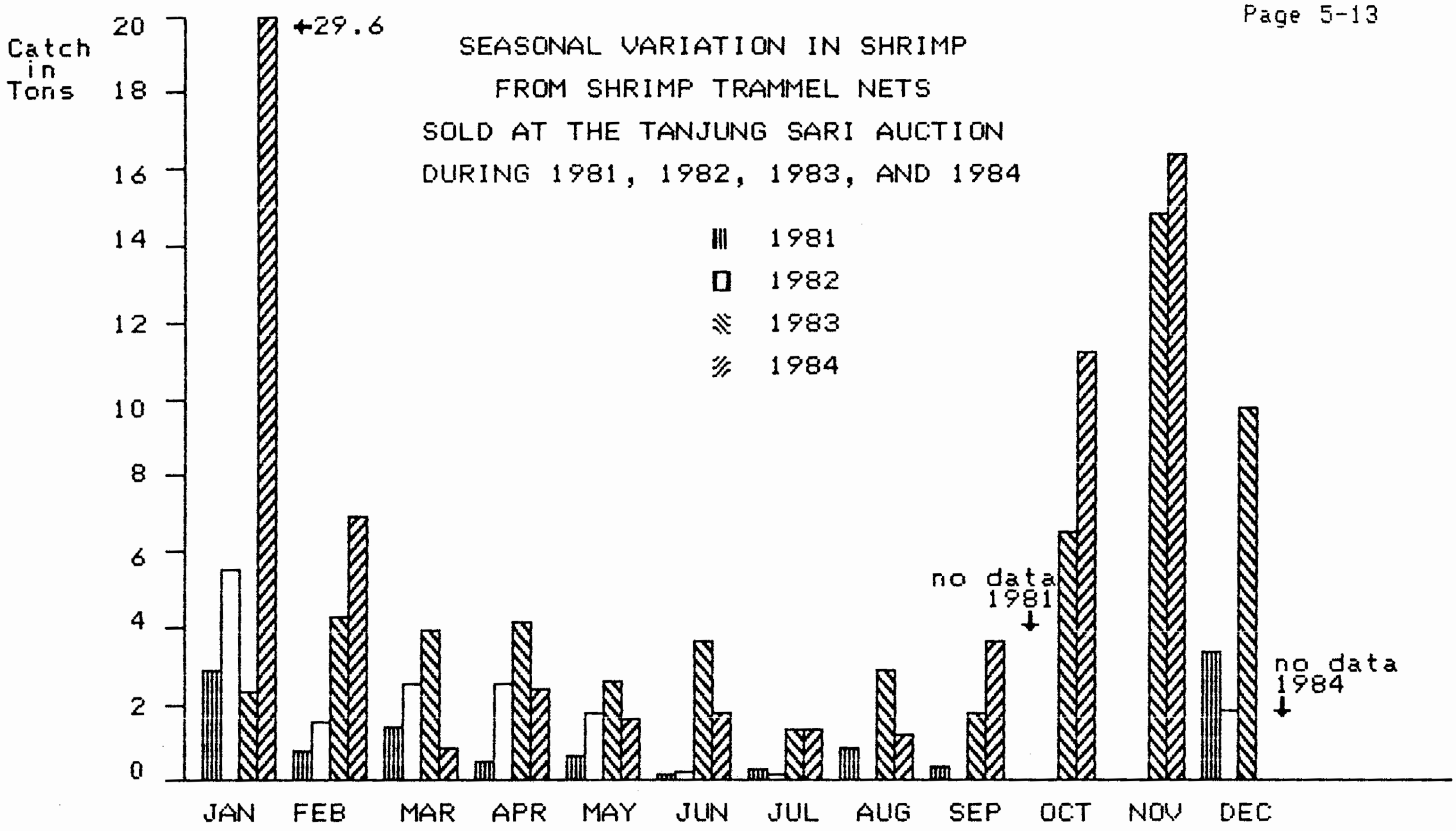

TOTAL REPORTED SHRIMP LANDINGS
FOR JAVA'S NORTH COAST
Weight in Tons
15000
10000
5000
0
Whole North Coast
Central Java
data not available
1978
1979
1980
1981
1982
1983

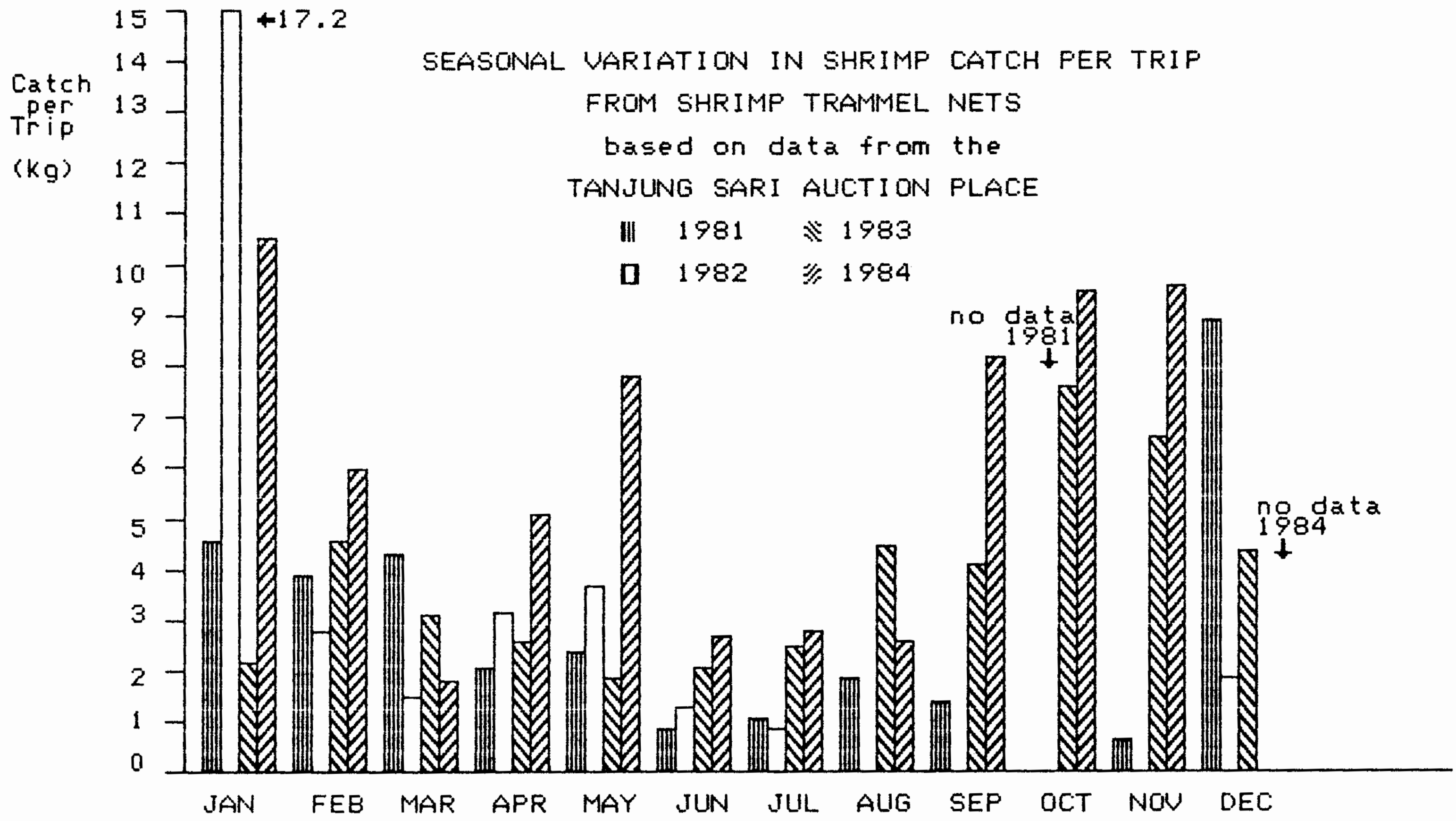
Figure 5.1





Figures 5.2 and 5.3





Figures 5.4 and 5.5

Table 5.1. Species composition data collected from 215 trammelnets along the north coast of Java between May and October 1984. The catch from an average net was 8.47 kg. The fine multi-filament nylon nets have 4.4 cm mesh with outer panels of 14 to 18 cm mesh. They are set, on the average, 5.5 times per day and are made up of 12.5 pieces of 25 meter net.

Name of Fish Group	Percent of Total Catch	Average Catch kg		Lengths or number per kg			Number of Nets
		Weight	Percent	Mean	Min	Max	
				Number per kg			
Penaeidae 30.24%							
PENAME *	28.81	2.535	29.92	38.0	6.0	81.0	205
PENAMO	0.23	0.026	0.30	14.3	6.0	20.0	29
PENA	1.20	0.100	1.18	-	-	-	10
				Lengths			
Fish and other 69.76%							
LEIO	29.49	2.258	26.65	9.9	5.0	15.0	187
SCIA	15.75	1.357	16.02	16.6	6.0	22.0	141
SCIAOT	2.14	0.143	1.69	12.7	10.0	18.0	18
SYNO	2.04	0.164	1.93	21.1	13.0	30.0	32
NEMI	2.03	0.222	2.62	13.4	6.0	20.0	58
ARII	1.94	0.201	2.37	19.4	6.0	50.0	59
THER	1.61	0.128	1.51	14.1	8.0	20.0	32
CYNO	1.54	0.138	1.63	17.0	12.0	23.0	39
PLAT	1.36	0.112	1.32	21.4	11.0	30.0	46
MULL	1.23	0.128	1.51	11.7	6.0	14.0	23
CLUPAN	1.18	0.083	0.98	13.8	10.0	18.0	12
LOLI	1.17	0.092	1.08	11.0	9.0	13.0	24
LACT	0.80	0.065	0.77	13.2	6.0	18.0	21
RAY	0.78	0.065	0.76	22.5	10.0	99.0	15
TRIC	0.62	0.075	0.89	43.5	31.0	60.0	20
CARA	0.38	0.039	0.46	13.8	10.0	18.0	8
PLOT	0.35	0.025	0.30	30.1	18.0	50.0	9
CARASL	0.35	0.027	0.32	13.8	10.0	18.0	5
ENGRTH	0.33	0.035	0.42	16.3	12.0	18.0	10
MURA	0.22	0.021	0.25	49.3	25.0	80.0	7
TETR	0.64	0.043	0.50	15.4	10.0	19.0	16
SILL	0.47	0.030	0.35	20.3	17.0	25.0	10
POLY	0.16	0.019	0.22	16.6	14.0	20.0	5
SHARK	0.16	0.011	0.13	-	-	-	2
MUGI	0.12	0.006	0.08	-	-	-	1
CLUPSA	0.11	0.014	0.16	16.0	14.0	18.0	3
SCOMRA	0.11	0.011	0.13	17.0	14.0	20.0	2
PSET	0.10	0.008	0.10	17.0	9.0	25.0	6
GERR	0.05	0.006	0.07	13.0	10.0	16.0	2
CLUP	0.03	0.005	0.06	18.0	18.0	18.0	3
CLUPIL	0.03	0.002	0.02	12.0	12.0	12.0	1
SCOM	0.03	0.002	0.02	17.0	17.0	17.0	1
CRAB	0.03	0.003	0.04	-	-	-	1
PRIA	0.02	0.001	0.02	12.0	12.0	12.0	1
CARASC	0.02	0.002	0.02	20.0	20.0	20.0	1
TRIA	0.00	0.000	0.00	-	-	-	1
OTHER	2.38	0.272	3.21	-	-	-	102

* Note: Field identification was insufficiently accurate to reliably distinguish between P. merguiensis and P. indicus.

Table 5.2. A comparison of the fishing power of the trawl and trammel net on a yearly basis. By these calculations a trawler is the equivalent of between 24 and 34 trammel net boats if the comparison is based on the total catch. If the comparison is based only on the shrimp catch, then a trawler is the equivalent of between 3.6 and 14 trammel net boats. These comparisons do not consider the economics of fishing the two types of vessels nor the question of who will benefit from the catch.

	Tons per Unit per Year		Relative Fishing Power	Relative Fishing Power
	Trawler	Trammel Net	Trammel/Trawl	Trawl/Trammel
Total Catch				
Low Estimate	50.0	2.04	0.0408	24.5
High Estimate	70.0		0.0291	34.3
Catch of Shrimp				
Low Estimate	2.7	0.75	0.0714	3.6
High Estimate	10.5		0.2777	14.0

Chapter 6

THE FISHERY STATISTICS SYSTEM

Because one of the major sources of information for fishery management is data from the fishery statistics system, a study of that system was carried out in order to provide recommendations for improvement. Throughout this entire two year study comments and information were collected concerning the system. In August and September a short-term consultant was brought to Indonesia to assist in a more intensive investigation of the strengths and weaknesses of the existing system.

The system now used in Indonesia to collect fishery statistics was designed by Yamamoto (1980) as part of an FAO project and is described in a series of books published by the Directorate General of fisheries. I have included herein a very brief summary of those portions of the system most useful to fishery managers for those readers not familier with it. A more detailed review of the statistics system was provided in a previous report (Dudley and Harris 1984). Following the submission of that report, additional work was done to assess the accuracy of data from the system.

6.1 Summary of Indonesia's Fishery Statistics System

The whole system is very dependent on the collection of data within each district (Kabupaten). Each district files quarterly reports on fish production with the provincial fisheries office. These quarterly reports are in turn compiled from data collected at quarterly or monthly or in some cases weekly intervals. Only the quarterly reports are forwarded to the provincial level. Any more specific data must be obtained at the district level or directly from the fish auction places.

The primary components of the system are displayed in Figure 6.1. I will not describe the forms here, but will explain the basic approach to the collection and compilation of the data. Three types of surveys are carried out with a fourth series of forms providing additional necessary data:

1. Survey of Major Landing Places (L-2 Survey). This survey is the basis for collecting data from major landing places which are defined as locations at which more than 50 percent of the fish for the district are landed.

If a fish auction place is present the total weight of fish sold at the auction place is the basis of the monthly estimates. The estimate is based on the catch sold at auction multiplied by a correction for fish not sold at auction. This correction is obtained by collecting data from sample boats during each week of the month and determining by interview how much of the catch is sold at auction and how much is sold elsewhere, eaten, taken home and so forth. The boats sampled should include boats which land at auction as well as those which do not.

If no fish auction place is present then the monthly estimates are calculated directly from the data taken from the sample boats taking into account the number of boats landing per day and the number of days in the month.

Species composition should be determined by examining the catch of the sample boats.

2. Survey Fishing Villages (L-3 Survey). For catches not landed at the major landing place a sample of fishing villages is carried out. Villages to be sampled are supposed to be selected randomly with the probability of the selection proportional to the size of the village.

The estimate at a sample village is done quarterly and is based on a)the number of each type of fishing gear in the village, b)the number of trips made per quarter, and c)the catch per trip for the gear in question.

If an auction place is present the catch per trip is taken from the auction place data. If no auction place is present then the catch per trip is based on interviews with a sample fishermen.

The estimates for catch in the sample villages is then expanded to the whole district by using a ratio of the numbers of each gear type in the sample villages to the number in all villages.

3. Reports from Fishing Companies (L-1 Survey) This survey is a direct report of total catch by major fishing companies.

4. Information about numbers of boats, fishing households and fishing gear. A series of forms is used to enumerate the numbers of fishing households (rumah tangga perikanan RTP), boats and numbers of each type of fishing gear in the district as well as in each sample village. Originally this data was taken from official census figures, but many of the districts have there own sources of data about these numbers.

6.2 Field Review of the Statistics System

During August and September 1984 a detailed field review of the system was carried out in Central and West Java by myself and Ken Harris of the United States National Marine Fisheries Service. The procedure during the review was to examine the enumeration, estimation and reporting forms at a sample of districts in the two provinces. We also discussed the procedures with the district and provincial fisheries personnel. These findings were reported previously (Dudley and Harris 1984) but the major findings are repeated here.

6.2.1 General Comments

Considering that the statistical system was first implemented in 1976, we were impressed with the amount and accuracy of data now obtained from the system. We feel that, within the constraints of the Indonesian situation, an excellent job has been done in collecting, compiling and reporting the fishery statistics.

However, because of limitations of training, budget, and numbers of personnel assigned to the fishery statistics positions, there is still room for significant improvement.

6.2.2 Types of Problems

The types of problems which we encountered can be conveniently divided into three categories: 1)departures from specified sampling procedure, 2)simple computational errors, and 3)systematic errors.

6.2.3 Problems with Sampling Procedure

By sampling procedure we mean the procedures specified by Yamamoto in the original design of the statistical system. These procedures were set up to assure that the data collected would be representative. Departures from the specified procedures may cause significant errors.

6.2.3.1 Counting of Boat Arrivals

At all locations counting of boat arrivals at the major landing place (form SL-4) is not being done correctly. In no case were boats actually counted by the enumerator. The numbers of boats arriving were always collected from the auction place or police records. In most cases we expect that boats not arriving at the auction place are not counted properly. We emphasize that ALL boats arriving at the major landing place should be counted and listed on SL-4. Any of these boats might be later be sampled using form SL-5.

If only boat arrivals recorded at the auction place are used, then only these boats will be sampled with SL-5. We expect that the catch per unit effort will be over estimated and that the number of trips made will be underestimated. The amount of error will depend on the differences between the boats landing at the auction place and those not landing there.

If it is impossible for the enumerator to actually count all boats, then a serious effort must be made to collect data from all possible sources on boat arrivals. All boats, including those which do not go to the auction place must be subject to sampling.

6.2.3.2 Collection of Data from Sample Trips

At all locations the enumerator does not examine the catch, but rather gets the catch information for form SL-5 from the auction place books. This means that the enumerator is not the person who identifies the fish or determines the weight.

Also, in many cases only data from the auction place books was entered on SL-5. Often there was no information about the sale of fish directly to the buyer, fish eaten on the boat, or fish taken home by the crew. The statistical system is designed to account for these fish, but only if the data is entered on form SL-5. By not entering this data correctly the total catch is underestimated.

6.2.3.3 Source of Numbers of Sample Trips

We were not sure how the average number of trips per unit was being estimated for part one of form SL-6. This information should be collected by interviewing a random sample of fishermen, but we suspect that it is usually taken from a nearby auction place. We cannot predict the effect of this procedure. However, the data from the auction place in a smaller village is probably not representative of the fishermen in the whole village. We strongly suggest that the data be collected as described by the statistical system.

6.2.3.4 Selection of Sample Villages and Major Landing Places

There seems to be an underlying misunderstanding of what constitutes a major landing place. A major landing place is not the fish auction place. Rather, the major landing place is a location where large amounts of fish (more than 50% of the catch for the district) are landed. This location usually includes an auction place, but the sampling procedure requires that data from outside the auction place be collected.

We found two serious departures from the specified sampling procedure in the selection of major landing places and sample villages.

We found that in some areas the sample villages were not selected with a probability proportional to size. In this area apparently sample villages were assigned one to each sub-district, which is convenient, but is not according to design. This may not have serious effects on the resulting statistics.

We also found that in some areas the major landing place was also sampled as a sample village. We were rather puzzled by this procedure. We were not able to determine how the two samples (from the L-2 and L-3 surveys) were kept separate. The local personnel usually attempted to explain the way in which this was done, but we still feel that this procedure results in double sampling of information from the major landing place. If this procedure is to be continued, then very detailed and specific instructions need to be given regarding the method for separating the two survey techniques.

6.2.4 Simple Computational Errors

We realize that there will always be some errors in computation resulting from simple mathematical errors. These errors are potentially some of the most serious if they are not noticed. Incorrect recording of the names of fishing gear, for example, is quite common. Because much of the data are recorded from the auction place records, it is also important that those also be recorded properly. It is unlikely that these types of errors will be eliminated easily, but careful checking of the of the statistical forms by the district supervisor will help to find where they are occuring.

It is possible to eliminate some of these errors by providing better instruction for filling out the forms and by providing better training for the enumerators and estimators. This is best done by discovering which part of the forms are creating the most confusion. Some examples are given in the statistics system report (Dudley and Harris 1984).

6.2.5 Possible Systematic Computational Errors

Systematic errors in a statistical system are perhaps the most serious. By this we mean a calculation which is always done in an incorrect manner.

6.2.5.1 Calculation of "R" on Form EL-3

We are concerned that the raising factor "R" used on the village sample compiling form (EL-3) may not be calculated correctly. As specified in the survey design there are two possible methods of calculation which can be used here. The first uses numbers of fishing households. The second, suggested at the bottom of form SL-3, uses numbers of fishing gear of the type for which the form is being used. We strongly suggest this second procedure if the necessary data are available.

Both these methods use the following ratio:

> T/S where T=the Total number of units in the Kabupaten minus those at the major landing place, and S=the number of units in the sample village.

It is very important to realize that T, the total should be the total for all villages NOT included in the major landing place. If fishing gear or fishing households for the major landing place are also included, then a significant overestimate of catch from the EL-3 form will result. In general this error will be larger for Kabupatens with a large major landing place.

> That is T=Total number of units in the Kabupaten which are not at the major landing place.

> Take for example a Kabupaten where about 75% of the fishing gear of one type is landed at the major landing place. Assume that about half of the rest of that fishing gear is sampled with form SL-6 at the sample villages. In such a case, if the wrong total is used, the catch on that EL-3 will be overestimated by 400 percent.

Thus, it is very important to be sure that these totals are correct. We suspect that sometimes they are not.

6.3 Computer Mini-Model

Because there are many small errors which can effect the accuracy of the data from the statistical system, it is difficult to predict the overall effect of these errors. Some will cause an underestimate of total catch while others will cause an overestimate. In order to more accurately determine the overall effects of these errors I developed a computer model of the statistics system.

6.3.1 Design of the Mini-Model

The model was designed to mimic the collection of data in a typical district (Kabupaten). Three different fishing gears are assumed to exist in the district, but they are distributed differently among the villages and the major landing place. Fishing gear A is evenly distributed between the major landing place and the villages while gear B is found mostly at the major landing place. Gear C is more common in the villages (Table 6.1).

A short MBASIC program was written to calculate the results of various combinations of input data. The data entered is similar to what the enumerators would write on the sampling forms (SL-2, SL-3, SL-5, SL-6) in the field. The program then calculates the results which would appear on the district reporting form (LL-3) for that quarter.

By using the model we can examine the effect of various inaccuracies in data collection on the results produced by the statistics system. In table 6.2 I have summarized the probable accuracy of the data required for the completion of the survey (SL) forms.

The program was run seven times for each of the three fishing gears. During the first run of the program the assumed correct values were entered. For tests 1 through 5 a single input item was changed. For test number 6, data from the most likely field situation was entered. For all experimental runs of the program, calculations were made using both the correct and incorrect raising factor for the village sample data ("R" from form EL-3). The input data for each computer test are listed in tables 6.3 through 6.5.

One of the basic assumptions of the model is that the statistics system as designed by Yamamoto is being followed, even though there are some inaccuracies in data collection. If the data is collected in a completely different manner, is merely made up, or is not recorded at all, then the model is invalid as a measure of the accuracy of the system. From the results of our review of the statistics system it seems apparent that, at least in Java, reasonable attempts are being made to follow the design of the statistics system.

6.3.2 Results from the Mini-Model

The results from the model are shown for each fishing gear (Tables 6.6 through 6.8) and for the whole district (Table 6.9).

It is quite obvious that in all situations the use of the incorrect raising factor results in a very significant overestimate of the catch. This error is largest in situations where most, but not all, of a particular fishing gear is found at the major landing place. The error is smallest in cases where the fishing gear is primarily in the sample villages. The error will be zero when none of the fishing gear is at the major landing place. This may be the case for certain small scale gears in some districts.

If the raising factor is calculated correctly the results are within 20 percent of the true values for all situations examined by the model. The largest errors occur in tests 1, 3, and 5. Test 1 examined the effect if data from the major landing place (form SL-5) did not properly list fish caught but not sold at auction. Of course this caused a larger error for fishing gear B which is found mostly at the major landing place.

Test 3 investigated the effect if boats arriving at the major landing place were not counted properly. This produced the largest error when a large proportion of the fishing gear is found at the major landing place. However, it is important to note that Test 3 also assumes that "simple estimation" is used to expand the data from the sample days to the total month. In most situations in Central and West Java this is NOT the method which is used. Instead "ratio estimation" is used. In this method the catch from the auction place is corrected for catch sold outside the auction. The number of boats landing is not used in the calculations (see the results of Test 2). Therefore, if ratio estimation is used (on form EL-2) then the number of boats arriving at the major landing place is not very important to these calculations.

Test 5 investigated the effects if the number of trips per quarter at the sample villages is overestimated by 20 percent. Of course this has the most effect on fishing gear C which is most plentiful in the villages rather than at the major landing place.

In Test 6 the combined effect of several of these inaccuracies was examined. Test 6 caused a significant underestimate of catch from the major landing place, but also caused a significant overestimate of catch from the village survey (Table 6.9). The overall result for the test district was a relatively small underestimate of catch. However, note that for fishing gear B a significant underestimate occurred. For gear C a significant overestimate occurred. Thus in a district with much of the gear at a major landing place we might expect catches to be overestimated, but if much of the gear is in the villages we would expect the catches to be underestimated.

The mini-model indicates that the first priorities for improving the statistics system should be:

1. Make sure "R" on EL-3 is calculated correctly.

2. Make sure that non-auction catches at the major landing place are included on form SL-5.

3. Try to get good estimates of number of trips made per quarter in the sample villages (form SL-6).

4. It is important to note that the types of errors the mini model examined are those that might occur even if all the statistical workers were attempting to do a good job. Careless errors, recording false information, or not collecting the data according to the proper procedure will cause greater errors in the final statistical reports. The only way these errors can be eliminated is for the district workers to do a better job and for the provincial workers to help them with proper training and supervision.

6.4 Recommendations for Improving the Statistics System

1. TRAINING PROGRAMS AND WORKSHOPS.

1.1. Training programs in the form of workshops, or visits by a training staff to the kabupatens, should be encouraged. One of the current weaknesses of the system is the lack of contact between the field and the provincial and national offices. The Directorate General of Fisheries should be very careful in assuring that the people attending the training courses/workshops be the same people who actually work with the statistics system.

1.2. Training programs for the field enumerators are essential for improved operation of the system. Many of the problems we found with the system were due to misunderstandings at the enumerator level. These programs should stress the design of the system and especially the proper use of the survey forms.

1.3. Because the proper operation of the statistics program is dependent on the estimation done at the district office, training programs for the district workers responsible for completing the estimation and reporting forms is essential. These training programs/workshops should include an abundance of actual work in filling out example forms of different types. Emphasis should be on the estimation forms (especially the correct calculation of "R" on EL-3). Some attention should also be given to the checking of the survey forms turned in by the enumerators.

2. PERIODIC INSPECTION OF FIELD PROCEDURES. A periodic review of the data collection, estimation and reporting procedures should be made by the national and provincial fisheries statistics staff. We feel that field inspections of the Kabupaten office and fish landing sites would be very helpful in improving the operation of the statistics system.

2.1. The purpose of the field inspections would be twofold: first to make sure that the procedures are being carried out correctly, and second to show the field workers that their jobs are important to the provincial and national offices.

2.2. The recommended procedure for the field inspections was included in the statistics report (Dudley and Harris 1984) and is not included here.

3. IMPROVE STATUS OF STATISTICS WORKERS. Many of the people who are collecting fishery statistics for Indonesia also have many other jobs. Although severe budgetary limitations exist, the job of the enumerators and other workers should be given a higher status. If possible, the statistics personnel should have more direct contact with the provincial and national fishery statistics offices.

3.1. The Directorate General of Fisheries should employ a qualified fisheries statistician. This person should be responsible for the direction of the national fisheries statistics program. This person should be responsible for the periodic review and update of the methodology of the standard system of fishery statistics. This person should have the qualifications which were listed in the statistics report.

3.2. Because the whole system is very dependent on the data collected by the enumerators, everything possible should be done to improve the status of the enumerator's position. At present the enumerator usually has many other jobs in addition to data collection, and the salary for data collection is very low (about four percent of the total salary). The Directorate General of Fisheries should explore every possible means of improving the status of the enumerator's job.

4. PERIODIC REVIEW AND POSSIBLE ADJUSTMENT OF SAMPLING DESIGN. At intervals the design of the statistical system should be reviewed and adjustments made to improve the accuracy of the information obtained from it.

4.1. For example, it may be necessary to change a major landing place or to select new sample villages. Also, the major gear types at a given location may change from time to time.

4.2. As a part of such periodic reviews the original survey form data (SL forms) from selected Kabupatens should be reviewed and analyzed to determine the proper sample sizes required to obtain the necessary precision of the estimates. For example, it may be necessary to sample more villages, or more boats on a sample day.

4.3. Such investigations should be carried out by the national fishery statistician or by the fisheries staff in cooperation with a qualified statistician.

5. IMPROVE COORDINATION WITH OTHER DATA COLLECTION SYSTEMS. There are several other fishery and related agencies which collect statistical data about the fisheries of Indonesia. Although the needs of these different agencies are different, better coordination between them is needed.

5.1. Much of the data for these agencies is being collected from the same source: the auction place records. An unnecessary duplication of effort is occuring at the auction places resulting in more work for the auction place staff and less accurate information for everyone. In some cases the auction place staff are filling out three different forms for monthly reports to three different agencies. The reports all contain the same information.

5.2. Much of the information collected by the other divisions of the Directorate General of Fisheries can be more closely coordinated with the fishery statistics system. For example, when a worker from the Directorate goes to the field the work should be done in conjunction with the enumerator. In fact an offer should be made to help the enumerator in return for his assistance.

5.3. The standard statistical system provides only a small part of the data necessary for planning and carrying out fishery management programs, but the close coordination of it with other necessary management, planning and research studies will improve the overall management of fisheries in Indonesia.

6.5 Literature Cited

Direktorat Jenderal Perikanan. 1980. Ketentuan kerja pengumpulan, pengolahan, dan penyajian data statistik perikanan. Buku I - IV. Departmen Pertanian, Jakarta, Indonesia.

Dudley, R. G., and K. C. Harris. 1984. Field review of the standard system of fishery statistics for Indonesia with recommendations for its improved operation. A report to the Directorate General of Fisheries, Indonesia as part of the USAID Small Scale Fisheries Development Project. 40p.

Yamamoto, Tadashi. 1980. A standard statistical system for current fishery statistics in Indonesia. A report prepared for the fisheries development and management project, Indonesia. Rome, FAO, 1980. FI:DP/INS/72/064, Field Document 7. 79p.

Figure 1. Some major components of the standard system for fishery statistics.

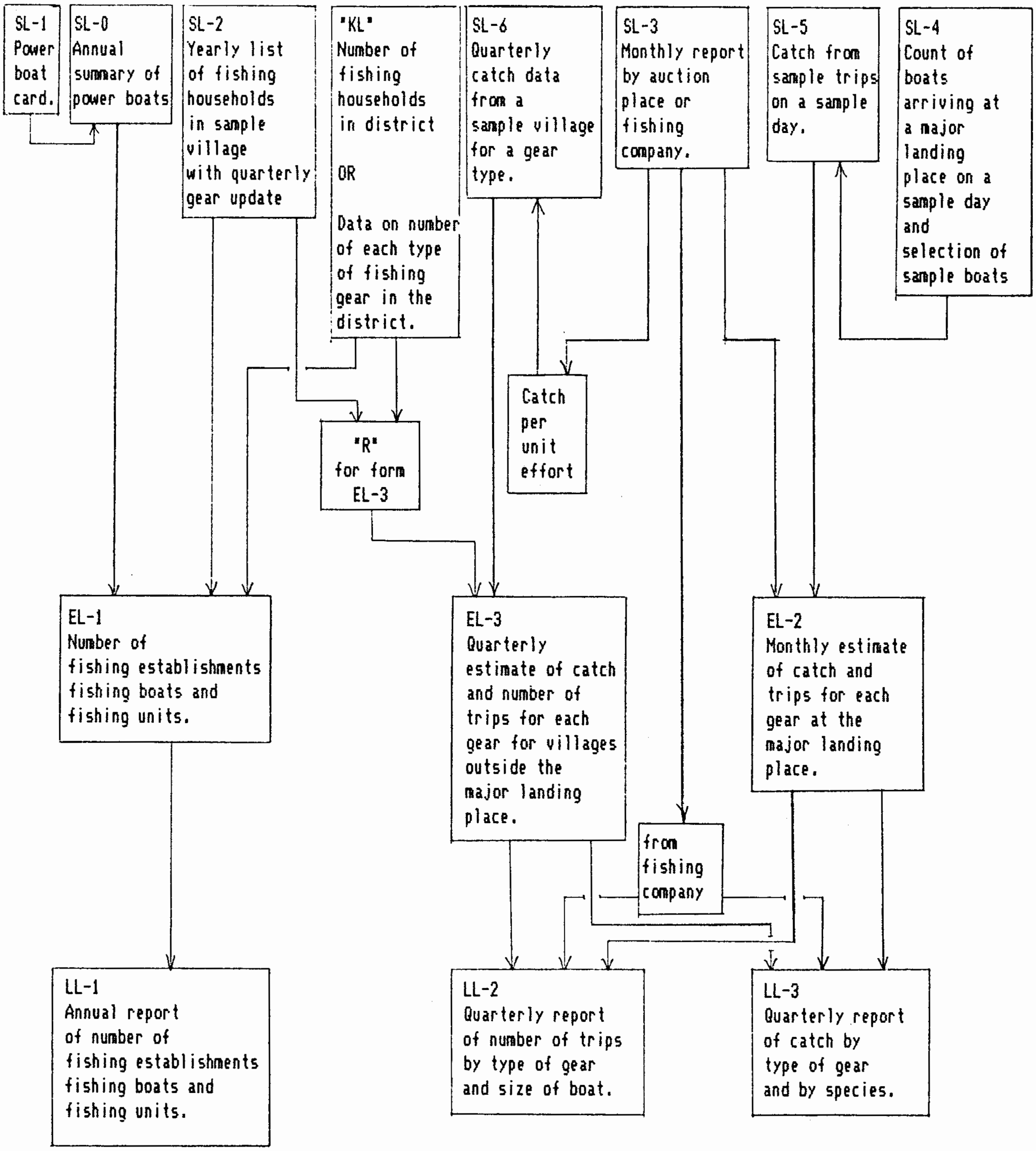


Figure 6.1

Table 6.1. Assumptions made concerning the hypothetical fishing gear in a typical district as used in the computer mini-model of the fishery statistics system.

	Total Fishing Units				Actual Catch		
	District	Major Landing Place	Villages	Sample Villages	District	Major Landing Place	Villages
Fishing Gear A	500	250	250	100	1650	900	750
Fishing Gear B	500	450	50	25	1770	1620	150
Fishing Gear C	500	100	400	160	1560	360	1200

Note: The true catch per unit effort for all fishing gear was 50 kg/day at the major landing place and 40 kg/day at all other locations.

Table 6.2. Summary of comments about the probable accuracy of data collected at the district level and used in the Indonesian fishery statistics system.

TYPE OF DATA	SUMMARY COMMENTS ABOUT THE ACCURACY OF DATA WHICH ARE USED IN THE STATISTICS SYSTEM
Data from SL-2 etc	
Number of RTP/Fishing Gear	
in the Kabupaten	Probably underestimated especially if data from the 1973 census KL is still used
in the sample villages	Probably alright
Fraction of RTP/Fishing Gear at the major landing place.	Probably slightly overestimated
Data from SL-3	
Total catch for the quarter	Probably alright
Number of trips	Probably alright (However Auction place data probably overestimates the CPUE used on SL-6)
Data from SL-5	
Data from sample boats:	
catch sold at auction	Probably alright
total catch	Underestimated 1)Because fish sold outside auction not recorded 2)Boats landing outside auction not sampled
Number of boats sampled	Alright (but biased toward boats with good catches)
Total number of boats landing	Underestimated
Data from SL-6	
Average trips per quarter	Maybe overestimated (only successful fishermen interviewed)
Fraction of fish sold (.8, .9 etc)	Maybe overestimated
Auction present? (y/n)	
If no auction place:	
Number of trips from interview	??
Catch per quarter from interview	??
Information on EL-3	
Raising factor on EL-3	Probably calculated incorrectly.

Table 6.3. Input data for a Mini-model of the fishery statistics system in a single district (Kabupaten) for one quarter. This is input data for hypothetical FISHING GEAR A.

INPUT DATA (weights in kg)	Assumed "Correct" Values	Test Values for Hypothetical Fishing Gear A					
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Data from SL-2 etc							
Number of Fishing Gear							
in the Kabupaten	500				450		450
in the sample villages	100						
at the major landing place	250						
Fraction of RTP/Fishing Gear at the major landing place.	0.50						
Data from SL-3 (Combined data for one quarter)							
Total catch for the quarter	750000						
Number of trips	15000						
CPUE from SL-3 data	50						
"Correct" CPUE for SL6	40				50		48
Data from SL-5 (Combined data for one month)							
Data from sample boats:							
catch sold at auction	250						
total catch	300	250					250
Number of boats sampled	5						
Total number of boats landing	167		134	134			134
Data from SL-6							
Average trips per quarter	60					72	72
Fraction of fish sold (.8, .9 etc)	0.8						0.9
Auction present? (y/n)	Y						
If no auction place:							
Number of trips from interview	60						
Catch per quarter from interview	2400						
Information for EL-2							
1)Ratio estimation	X						
2)simple estimation				X			

Note: Assumptions for Test 6 are:

1) Numbers of Fishing gear are underestimated by 10 percent.
2) Catch per trip in village samples is overestimated by 20 percent.
3) Catch sold outside of auction at the major landing place is not recorded properly (on form SL-5).
4) The number of boats arriving at the major landing place is underestimated by 20 percent.
5) The number of trips per quarter in the sample villages is overestimated by 20 percent.
6) The fraction of fish sold at auction in the sample villages is recorded as 0.9 when it is really 0.8.

Table 6.4. Input data for a Mini-model of the fishery statistics system in a single district (Kabupaten) for one quarter. This is input data for hypothetical FISHING GEAR B.

INPUT DATA (weights in kg)	Assumed "Correct" Values	Test Values for Hypothetical Fishing Gear B					
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Data from SL-2 etc							
Number of Fishing Gear							
in the Kabupaten	500				450		450
in the sample villages	25						
at the major landing place	450						
Fraction of RTP/Fishing Gear at the major landing place.	0.90						
Data from SL-3							
(Combined data for one quarter)							
Total catch for the quarter	1350000						
Number of trips	27000						
CPUE from SL-3 data	50						
"Correct" CPUE for SL6	40				50		48
Data from SL-5							
(Combined data for one month)							
Data from sample boats:							
catch sold at auction	250						
total catch	300	250					250
Number of boats sampled	5						
Total number of boats landing	300		240	240			240
Data from SL-6							
Average trips per quarter	60					72	72
Fraction of fish sold (.8, .9 etc)	0.8						0.9
Auction present? (y/n)	Y						
If no auction place:							
Number of trips from interview	60						
Catch per quarter from interview	2400						
Information for EL-2							
1)Ratio estimation	X						
2)simple estimation				X			

Note: Assumptions for Test 6 are:
1) Numbers of Fishing gear are underestimated by 10 percent.
2) Catch per trip in village samples is overestimated by 20 percent.
3) Catch sold outside of auction at the major landing place is not recorded properly (on form SL-5).
4) The number of boats arriving at the major landing place is underestimated by 20 percent.
5) The number of trips per quarter in the sample villages is overestimated by 20 percent.
6) The fraction of fish sold at auction in the sample villages is recorded as 0.9 when it is really 0.8.

Table 6.5. Input data for a Mini-model of the fishery statistics system in a single district (Kabupaten) for one quarter. This is input data for hypothetical FISHING GEAR C.

INPUT DATA (weights in kg)	Assumed "Correct" Values	Test Values for Hypothetical Fishing Gear C					
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Data from SL-2 etc							
Number of Fishing Gear							
in the Kabupaten	500				450		450
in the sample villages	160						
at the major landing place	100						
Fraction of RTP/Fishing Gear at the major landing place.	0.20						
Data from SL-3							
(Combined data for one quarter)							
Total catch for the quarter	300000						
Number of trips	6000						
CPUE from SL-3 data	50						
"Correct" CPUE for SL6	40				50		48
Data from SL-5							
(Combined data for one month)							
Data from sample boats:							
catch sold at auction	250						
total catch	300	250					250
Number of boats sampled	5						
Total number of boats landing	67		53	53			53
Data from SL-6							
Average trips per quarter	60					72	72
Fraction of fish sold (.8, .9 etc)	0.8						0.9
Auction present? (y/n)	Y						
If no auction place:							
Number of trips from interview	60						
Catch per quarter from interview	2400						
Information for EL-2							
1)Ratio estimation	X						
2)simple estimation				X			

Note: Assumptions for Test 6 are:
1) Numbers of Fishing gear are underestimated by 10 percent.
2) Catch per trip in village samples is overestimated by 20 percent.
3) Catch sold outside of auction at the major landing place is not recorded properly (on form SL-5).
4) The number of boats arriving at the major landing place is underestimated by 20 percent.
5) The number of trips per quarter in the sample villages is overestimated by 20 percent.
6) The fraction of fish sold at auction in the sample villages is recorded as 0.9 when it is really 0.8.

Table 6.6. Data resulting from a Mini-model of the fishery statistics system in a single district (Kabupaten) for one quarter. These are the results for hypothetical fishing gear A.

RESULTING OUTPUTS (weights in tons)	Assumed "Correct" Values	Results for Hypothetical Fishing Gear A Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
R ratio on EL-3	2.50	2.50	2.50	2.50	2.25	2.50	2.25
Incorrect R ratio	5.00	5.00	5.00	5.00	4.50	5.00	4.50
Catch Resulting from Major Landing Place Data							
Total Catch from EL-2	900.0	750.0	900.0	723.6	900.0	900.0	750.0
Catch Resulting from Sample Village Data							
Total Catches from EL-3							
using incorrect R	1500.0	1500.0	1500.0	1500.0	1687.5	1800.0	1728.0
using correct R	750.0	750.0	750.0	750.0	843.7	900.0	864.0
Percent error caused by R	100.00	100.00	100.00	100.00	100.01	100.00	100.00
TOTAL CATCH FOR KABUPATEN							
Totals from LL3							
using incorrect R	2400.0	2250.0	2400.0	2223.6	2587.5	2700.0	2478.0
using correct R	1650.0	1500.0	1650.0	1473.6	1743.7	1800.0	1614.0
Percent error (using correct R)	0	-9.09	0	-10.69	5.68	9.09	-2.18
Total percent error (including incorrect R from EL-3)	45.5	36.4	45.5	34.8	56.8	63.6	50.2

Table 6.7. Data resulting from a Mini-model of the fishery statistics system in a single district (kabupaten) for one quarter. These are the results for hypothetical fishing gear B.

RESULTING OUTPUTS (weights in tons)	Assumed "Correct" Values	Results for Hypothetical Fishing Gear B Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
R ratio on EL-3	2.0	2.0	2.0	2.0	1.8	2.0	1.8
Incorrect R ratio	20.0	20.0	20.0	20.0	18.0	20.0	18.0
Catch Resulting from Major Landing Place Data							
Total Catch from EL-2	1620.0	1350.0	1620.0	1296.0	1620.0	1620.0	1350.0
Catch Resulting from Sample Village Data							
Total Catches from EL-3							
using incorrect R	1500.0	1500.0	1500.0	1500.0	1687.0	1800.0	1728.0
using correct R	150.0	150.0	150.0	150.0	168.7	180.0	172.8
Percent error caused by R	900.00	900.00	900.00	900.00	900.00	900.00	900.00
TOTAL CATCH FOR KABUPATEN							
Totals from LL3							
using incorrect R	3120.0	2850.0	3120.0	2796.0	3307.5	3420.0	3078.0
using correct R	1770.0	1500.0	1770.0	1446.0	1788.7	1800.0	1522.8
Percent error (using correct R)	0	-15.25	0	-18.31	1.06	1.69	-13.97
Total percent error (including incorrect R from EL-3)	76.3	61.0	76.3	58.0	86.9	93.2	73.9

Table 6.8. Data resulting from a Mini-model of the fishery statistics system in a single district (Kabupaten) for one quarter. These are the results for hypothetical fishing gear C.

RESULTING OUTPUTS (weights in tons)	Assumed "Correct" Values	Results for Hypothetical Fishing Gear C Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
R ratio on EL-3	2.50	2.50	2.50	2.50	2.25	2.50	2.25
Incorrect R ratio	3.13	3.13	3.13	3.13	2.18	3.13	2.18
Catch Resulting from Major Landing Place Data							
Total Catch from EL-2	360.0	300.0	360.0	286.2	360.0	360.0	300.0
Catch Resulting from Sample Village Data							
Total Catches from EL-3							
using incorrect R	1500.0	1500.0	1500.0	1500.0	1687.5	1800.0	1728.0
using correct R	1200.0	1200.0	1200.0	1200.0	1350.0	1440.0	1382.4
Percent error caused by R	25.00	25.00	25.00	25.00	25.00	25.00	25.00
TOTAL CATCH FOR KABUPATEN							
Totals from LL3							
using incorrect R	1860.0	1800.0	1860.0	1786.2	2047.5	2160.0	2028.0
using correct R	1560.0	1500.0	1560.0	1486.2	1710.0	1800.0	1682.4
Percent error (using correct R)	0	-3.85	0	-4.73	9.62	15.38	7.85
Total percent error (including incorrect R from EL-3)	19.2	15.4	19.2	14.5	31.3	38.5	30.0

Table 6.9. Results of a Mini-model of the fishery statistics system in a a single district including data from three different fishing gears. Resulting fish catch estimates are shown for a variety of possible sampling situations. "Test 6" illustrates the most likely outcome.

RESULTING OUTPUTS (weights in tons)	Assumed "Correct" Values	Results for Hypothetical District					
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Correct Results							
Data from Major Landing Place	2880.0						
Data from Other Villages	2100.0						
TOTAL	4980.0						
Results using incorrect "R"							
Data from Major Landing Place	2880.0	2400.0	2880.0	2305.8	2880.0	2880.0	2400.0
Percent error	0	-16.7	0	-19.9	0	0	-16.7
Data from Other Villages	4500.0	4500.0	4500.0	4500.0	5062.5	5400.0	5184.0
Percent error	114.3	114.3	114.3	114.3	141.1	157.1	146.9
TOTAL	7380.0	6900.0	7380.0	6805.8	7942.5	8280.0	7584.0
Percent error	48.2	38.6	48.2	36.7	59.5	66.3	52.3
Results using correct "R"							
Data from Major Landing Place	2880.0	2400.0	2880.0	2305.8	2880.0	2880.0	2400.0
Percent error	0	-16.7	0	-19.9	0	0	-16.7
Data from Other Villages	2100.0	2100.0	2100.0	2100.0	2362.4	2520.0	2419.2
Percent error	0	0	0	0	12.5	20.0	15.2
TOTAL	4980.0	4500.0	4980.0	4405.8	5242.4	5400.0	4819.2
Percent error	0	-9.6	0	-11.5	5.3	8.4	-3.2

Note: Assumptions for Test 6 are:

1) Numbers of Fishing gear are underestimated by 10 percent.
2) Catch per trip in village samples is overestimated by 20 percent.
3) Catch sold outside of auction at the major landing place is not recorded properly (on form SL-5).
4) The number of boats arriving at the major landing place is underestimated by 20 percent.
5) The number of trips per quarter in the sample villages is overestimated by 20 percent.
6) The fraction of fish sold at auction in the sample villages is recorded as 0.9 when it is really 0.8.