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TRAMMEL NET SHRIMP FISHERY OF JAVA, INDONESIA

by

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ABSTRACT

A trammel net fishery for shrimp developed in Indonesia after trawling was banned in late 1980 in response to complains from small scale fishermen. Between 6,000 and 8,000 trammel net boats are now fishing the 375 km northern coastline of Central Java which is a center of the new fishery. A typical trammel net catches 8 to 9 kg per daily trip. Although only 2 to 3 kg of the catch is shrimp, this results in a significantly improved daily income for the fishermen. Because of the social and economic conditions in small fishing villages in Java, the ban on trawling and the resulting trammel net fishery have had the desired effects : protection of the resource and an improved economic situation for small scale fishermen.

ABSTRAK

PERIKANAN UDANG DENGAN "TRAMMEL NET" DI JAWA, INDONESIA. *Perikanan udang dengan "trammel net" telah berkembang di Indonesia setelah penggunaan pukat (trawl) dilarang pada akhir tahun 1980 sebagai tanggapan atas keluhan nelayan kecil (small scale fishermen). Sekitar 6000–8000 perahu (trammel net) sekarang sedang beroperasi sepanjang 375 km di perairan pantai Jawa Tengah yang merupakan pusat kegiatan perikanan yang baru ini. Tiap "trammel net" menghasilkan tangkapan sebesar 8–9 kg per hari. Meskipun hanya 2–3 kg tangkapan yang berupa udang, namun hasil ini telah menaikkan secara nyata pendapatan harian para nelayan. Karena kondisi sosial ekonomi pedesaan nelayan di Jawa, pelarangan penggunaan pukat (trawl) dan pengembangan perikanan dengan "trammel net" telah menunjukkan pengaruh yang diinginkan yakni perlindungan sumberdaya dan perbaikan ekonomi bagi nelayan kecil.*

INTRODUCTION

The extensive trammel net fishery for shrimp is a relatively new development in Indonesian fisheries. Following the ban on trawling, which was first imposed in Javanese waters in October of 1980, there was a sharp increase in the numbers of alternate types of 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 375 km north coast of Central Java and 14,800 for Java's whole north coast (1000 km).

The high value of shrimp combined with the official Indonesia policy of increasing export earnings has turned increased attention to the shrimp fishery. Although catches of shrimp decreased substantially following the trawl ban, the reported catches in north Central Java have now increased to near or above pre-trawl ban levels (Fig. 1). Because of the large amounts of shrimp which could be caught by trawlers there is a continuing question as to whether the trawl ban should be lifted. The fishery of Java is particularly important because it is in an area of high human population where employment and other social and economic considerations significantly affect fishery management decisions.

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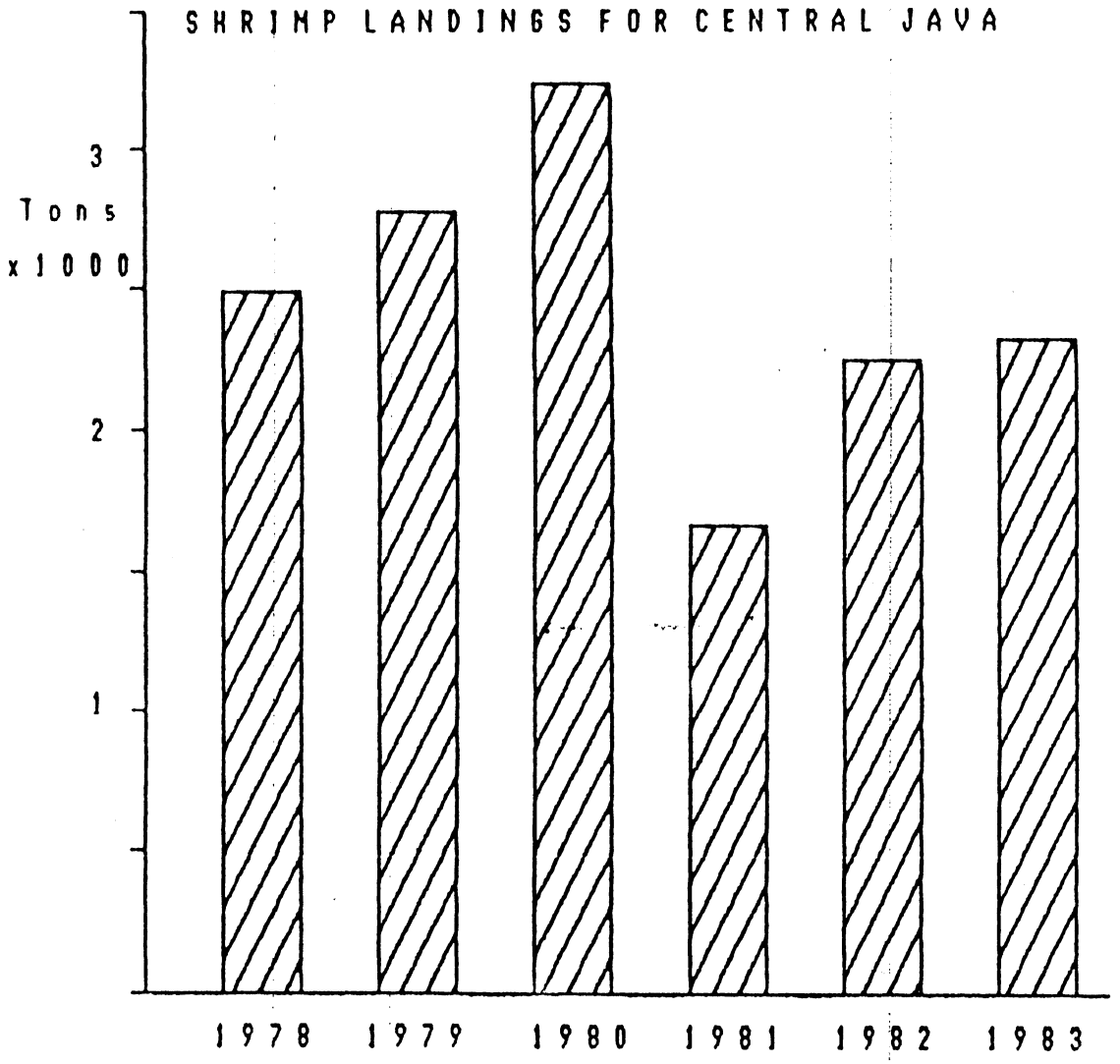

Figure 1. Shrimp landings from the north coast of the province of Central Java, Indonesia. Trawling in this area was banned in October of 1980. Catches after this date are primarily from trammel nets.

METHODS

Information from 215 trammel net boats was collected at several villages along the northern coast of Central Java between April and November 1984 (Fig. 2). In general the fish from such boats are not sold at the government run auction places although the shrimp usually are. Therefore we examined the catch at each boat when it first landed. Data about the fish catch were collected at the boat but the shrimp data (for the same boats) were usually collected 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.

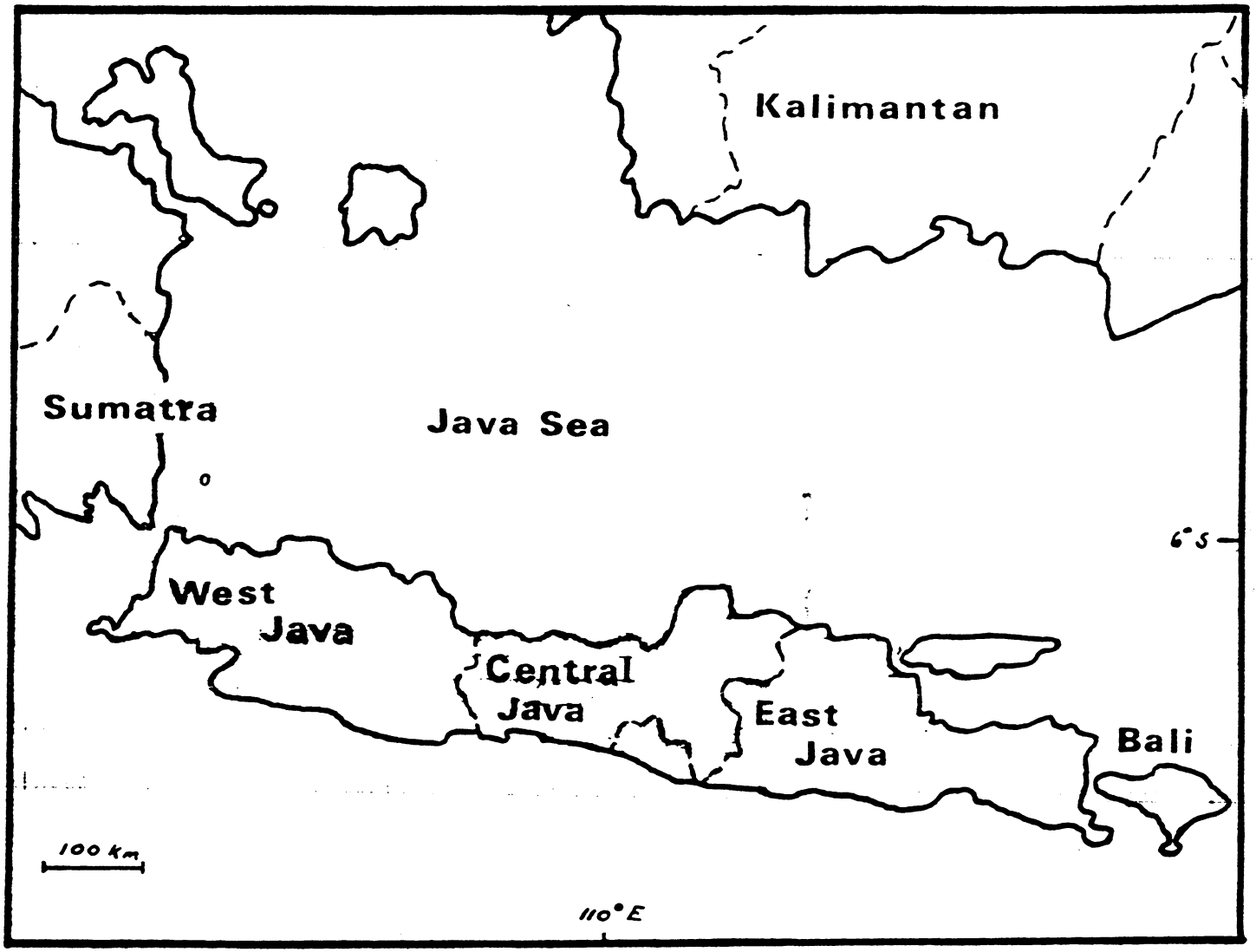

Figure 2. Java and adjacent areas. Information reported here is based on data from the central part of Java's north coast, including the province of Central Java, the eastern part of West Java, and the western part of East Java.

Additional data were obtained from official auction place records at selected villages. Data from the auction places, with few exceptions, include only the shrimp catches, because most of the fish from the trammel nets are not sold there. Also, in some cases, small shrimp catches from several boats are combined for sale at the auction. In other cases small shrimp catches are sold outside the auction.

Official fishery statistics were also consulted. Although these are readily available in Indonesia, their accuracy is limited especially when dealing with small scale fishing gear (DUDLEY & HARRIS 1984; DUDLEY 1985).

FISHING GEAR

The typical trammel net is 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 and have an inner mesh panel of 4.4 cm stretched mesh and outer panels of 10 to 20 cm mesh. These mesh sizes vary considerably. 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.

An unusual aspect of the fishery is that the trammel nets are fished in an active (rather than passive) manner by setting the nets on the bottom and pulling them in like a boat 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 during each daily trip.

In addition to the trammel net, there are some other small scale methods of catching shrimp. The most often mentioned of these is the "klitik" net which is a fine mesh, fine twine, loosely hung, monofilament gillnet. These nets are not nearly as common as the trammel net. Our limited information about them indicated they are not very effective in catching shrimp. BARUS & NASUTION (1983) have described the design of some of the small scale shrimp gears in the Cirebon area of northern Java.

For several reasons the number of shrimp nets is probably not accurately reported in the official statistics. In some areas the trammel net is incorrectly recorded as "klitik" and in other areas all trammel nets and "klitik" are recorded as gillnets. Also, because this is an expanding fishery, the currently available statistics (usually a few years old) are insufficient for an accurate assessment of the current number of shrimp nets. The most recent (1982) official estimate for Central Java is 6,500 trammel nets while the value given for the whole north coast is 14,800. Probably 6,000 t0 8,000 units for Central Java would be a realistic estimate for 1985.

CATCHES

Data which we collected revealed an average catch per trip of 8.5 kg of which an average of 30% or 2.55 kg was shrimp (Table 1, Fig. 3 and 4). However, our data may underestimate the shrimp catch slightly because our sampling was only from May through November and usually higher catches are obtained in December and January.

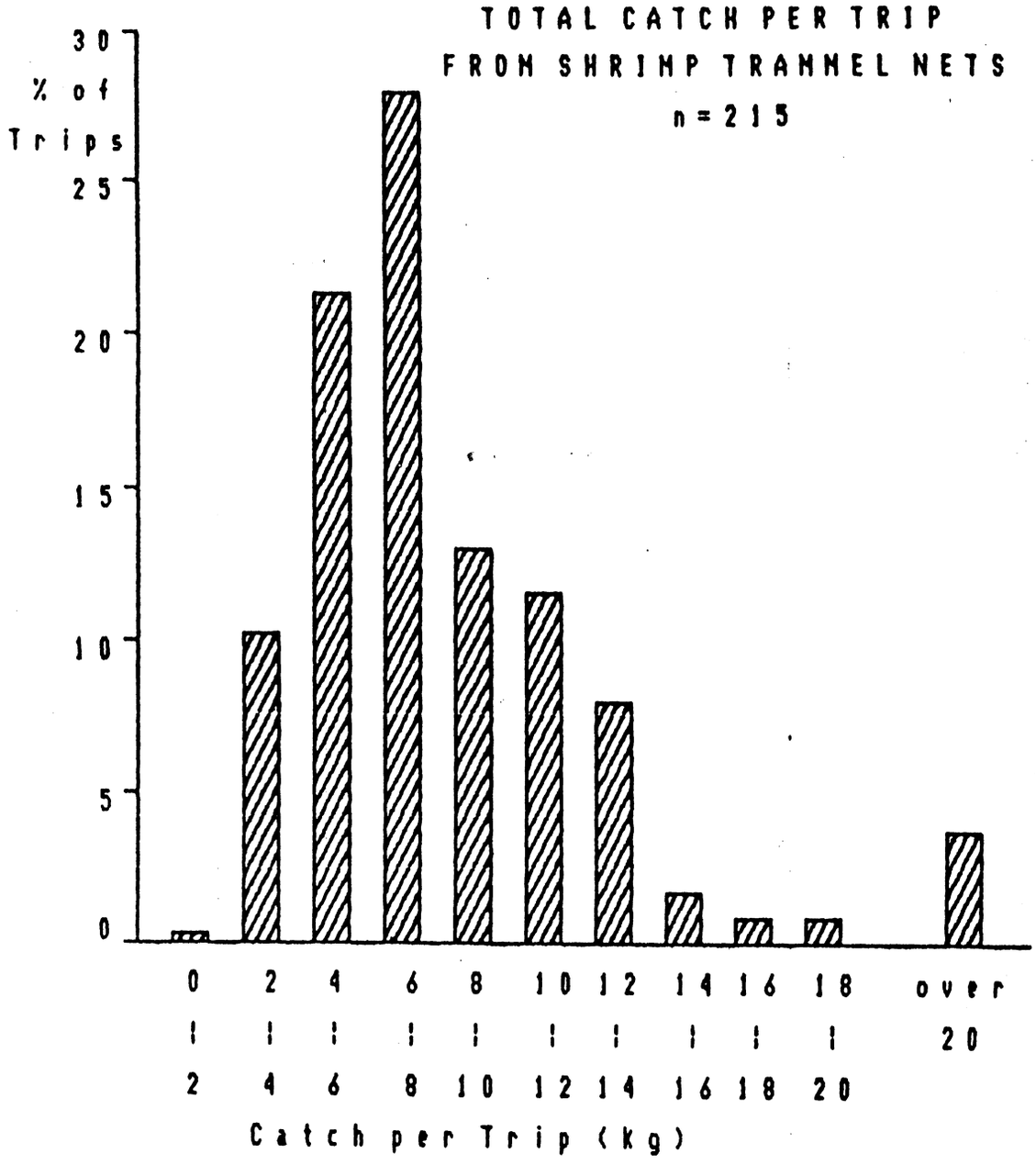

Figure 3. Distribution of total catch per trip from shrimp trammel nets sampled by field staff during 1984. The mean catch was about 8.5 kg per day. Composition of the catches is given in Table 1.

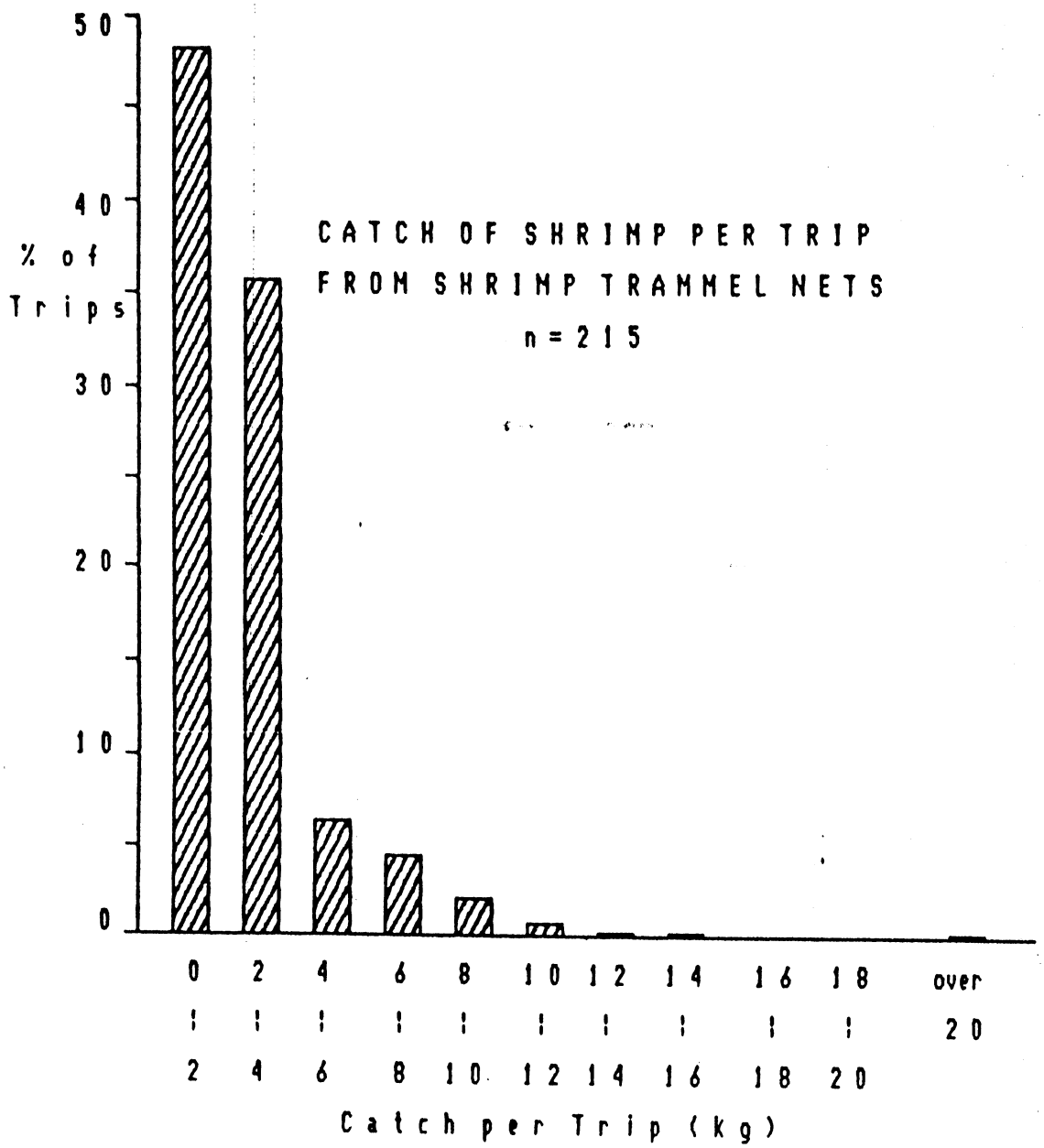

Figure 4. Distribution of catch of shrimp per daily trip as determined from field samples. The mean daily catch is about 2.5 kg.

Table 1. Composition of trammel net catches based on data collected from 215 nets along the north coast of Java between May and October 1984. The catch from an average net was 8.47 kg. Identification categories were selected based on observations of the field staff's ability to consistently identify each group correctly. Shrimp identified as *Penaeus merguiensis* include *P. indicus*.

Fish Group	Percent of Total Catch	Average Catch kg		Lengths or number per kg			Percent Occurrence
		Weight	Percent	Mean	Min	Max	
				Number per kg			
Penaeidae	30.24%						
P. merguiensis	28.81	2.535	29.92	38.0	6.0	81.0	95
P. monodon	0.23	0.026	0.30	14.3	6.0	20.0	13
other	1.20	0.100	1.18	–	–	–	4.7
				Lengths			
Fish and other	69.76%						
Leiognathidae	29.49	2.258	26.65	9.9	5.0	15.0	87
Sciaenidae	17.89						
Otolithes	2.14	0.143	1.69	12.7	10.0	18.0	8.3
other	15.75	1.357	16.02	16.6	6.0	22.0	66
Synodontidae	2.04	0.164	1.93	21.1	13.0	30.0	15
Nemipteridae	2.03	0.222	2.62	13.4	6.0	20.0	27
Ariidae	1.94	0.201	2.37	19.4	6.0	50.0	27
Theraponidae	1.61	0.128	1.51	14.1	8.0	20.0	15
Cynoglossidae	1.54	0.138	1.63	17.0	12.0	23.0	18
Platycephalidae	1.36	0.112	1.32	21.4	11.0	30.0	21
Clupeidae	1.25						
Anodontostoma	1.18	0.083	0.98	13.8	10.0	18.0	5.6
Sardinella	0.11	0.014	0.16	16.0	14.0	18.0	1.4
Ilisha	0.03	0.002	0.02	12.0	12.0	12.0	0.5
other	0.03	0.005	0.06	18.0	18.0	18.0	1.3
Mullidae	1.23	0.128	1.51	11.7	6.0	14.0	11
Squids (Loligo)	1.17	0.092	1.08	11.0	9.0	13.0	11
Lactariidae	0.80	0.065	0.77	13.2	6.0	18.0	9.8
Rays	0.78	0.065	0.76	22.5	10.0	99.0	6.9
Trichiuridae	0.62	0.075	0.89	43.5	31.0	60.0	9.3
Carangidae	0.75						
Scomberoides	0.02	0.002	0.02	20.0	20.0	20.0	0.5
Seleroides	0.35	0.027	0.32	13.8	10.0	18.0	2.3
other	0.38	0.039	0.46	13.8	10.0	18.0	3.7
Plotosidae	0.35	0.025	0.30	30.1	18.0	50.0	4.2
Engraulidae	0.33						
Thryssa	0.33	0.035	0.42	16.3	12.0	18.0	4.7

Muraenesocidae	0.22	0.021	49.3	0.25	25.0	80.0	3.3
Tetradontidae	0.64	0.043	0.50	15.4	10.0	19.0	7.4
Sillaginidae	0.47	0.030	0.35	20.3	17.0	25.0	4.7
Polynemidae	0.16	0.019	0.22	16.6	14.0	20.0	2.3
Sharks	0.16	0.011	0.13	–	–	–	0.9
Scombridae	0.14						
Rastrelliger	0.11	0.011	0.13	17.0	14.0	20.0	0.9
other	0.03	0.002	0.02	17.0	17.0	17.0	0.5
Mugilidae	0.12	0.006	0.08	–	–	–	0.5
Psettodidae	0.10	0.008	0.10	17.0	9.0	25.0	2.7
Gerridae	0.05	0.006	0.07	13.0	10.0	16.0	0.9
Crabs	0.03	0.003	0.04	–	–	–	0.5
Priacanthidae	0.02	0.001	0.02	12.0	12.0	12.0	0.5
Triacanthidae	0.00	0.000	0.00	–	–	–	0.5
Other	2.38	0.272	3.21	–	–	–	47

Catch per trip, for shrimp only, can also be calculated from auction place records, but probably results in an overestimate. 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 Figs. 5 and 6.

Official statistics do not give catch per unit effort information but this can also be derived from them. The total catch from shrimp trammel nets for north Central Java is almost 21,000 tons for 1982. This amounts to a production per unit (official number of units is 6,277) of 3.3 tons per year. If we assume 20 trips per month then this would imply a catch per trip of 13 kg. Even if all the fish as well as the shrimp were included in the data, this value seems high when compared to our data.

BARUS & NASUTION (1983) reported catches from trammel nets of 14 kg of fish plus 4 to 5 kg of shrimp per day. This information was probably derived from auction place records and also seems high although it may be representative of catches during the peak season.

A reasonable way to estimate total catch would be to assume a catch of 2.5 kg of shrimp per trip 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 6,000 and 8,000 units fishing, we get a catch estimate of 4,500 to 6,000 tons of shrimp from shrimp trammel nets. This is slightly higher than the official values. The same technique can be used to estimate total catch including fish. Using the 8.5 kg per trip figure from our data gives an estimated total catch from shrimp trammel nets of between 12,200 and 16,300 tons per year for Central Java.

CATCH COMPOSITION

Fish from trammel nets are not sold at the auctions so there is no species composition data available from the auction place records. Although the system for collecting catch statistics does include provisions for determining species composition, these data are not reported in the national level statistics. The statistics available at the local

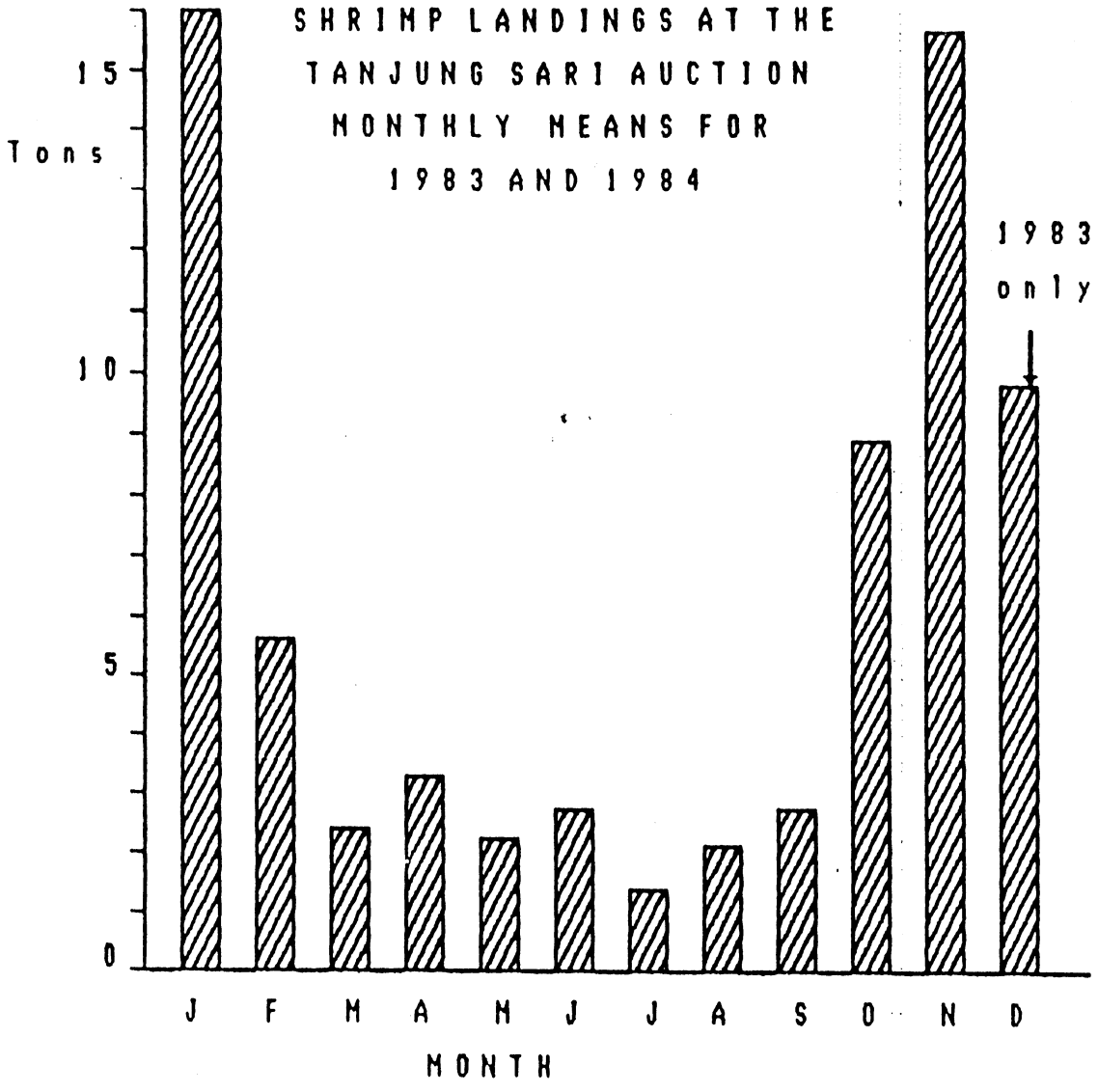

Figure 5. Total shrimp landings at the government auction place at the village of Tanjung Sari in the eastern part of the province of West Java. Shown here are the mean monthly landings for 1983 and 1984. For December, only the 1983 data was available.

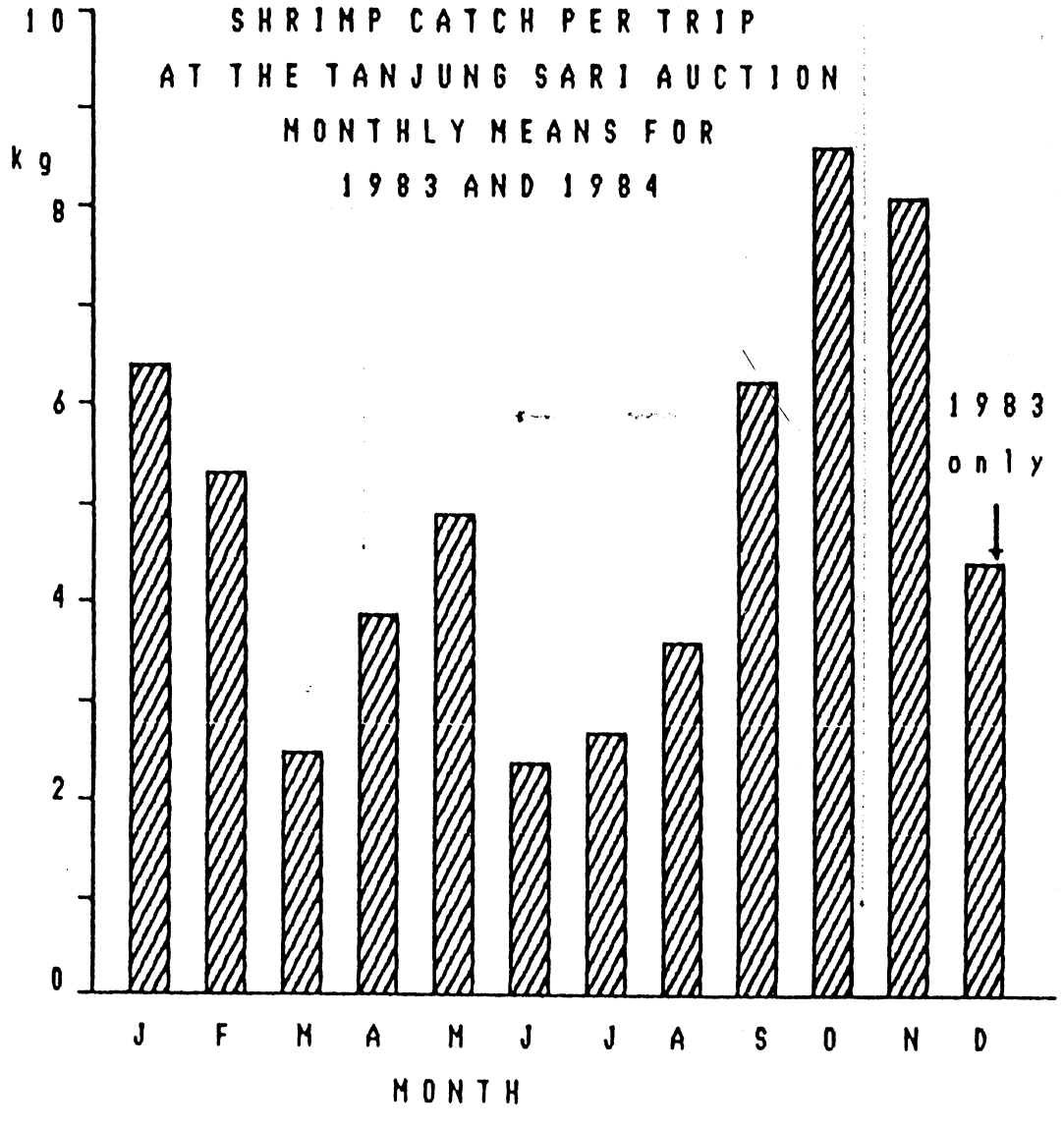

Figure 6. Catch per daily trip based on data from the government auction at the village of Tanjung Sari. These are mean values for 1983 plus 1984 with the exception of the December data. Calculations based on auction place records probably overestimate catch per trip due to the under-reporting of small catches.

(district) level are of limited use because they are based on a relatively small sample size.

Data resulting from our sampling revealed that the most common fish groups were the Leognathidae (29.5%) and Sciaenidae (17.9%). Shrimp made up 30.2% of the catch. The remaining 22.4% was composed of over 22 families of fish and invertebrates, but none of them contributed more than 2% of the overall catch. Of course in a single net some of these less common group may be abundant (Table 2).

Most of the shrimp catch consists of *Penaeus merguiensis* with some *P. indicus*. *Penaeus monodon* were not very common in the nets we examined although they previously formed a small but significant part of the trawl catch.

Table 2. A comparison of the fishing power of trawl and trammel nets on a yearly basis. Catch estimates for trawlers are based on fishery statistics. Those of trammel nets are based on our data and from auction places and national statistics as explained in the text.

	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

MANAGEMENT CONSIDERATIONS

Resource Surveys

Several projects have been carried out to assess the demersal fish and shrimp 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 maximum sustained yield for this area at about 50,000 tons for all demersal resources including 3,200 tons of shrimp.

Although the data are limited, MARTOSUBROTO & BADRUDIN (1982) reported that the trawl ban has resulted in increased catch rates from research trawlers. This would be expected if the previous trawl fishery were having a significant impact on the fish resources. However, the evidence is by no means conclusive. Because of the continued anti-trawling attitude among the small scale fishermen, even activities of government operated research trawlers are severely restricted.

Trawl vs Trammel Net

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. Management actions directed at the shrimp fishery should include an assessment of the relative costs and benefits of trawling or its continued prohibition.

In general shrimp from the nets we examined were relatively large (mean of 38 per kg, heads on). While there is no readily available comparative study with trawl catches here, it is likely that this size is larger than that caught by the trawlers. NAAMIN & MARTOSUBROTO (1984) reported that the size of shrimp landed at Cilacap (on Java's south coast) increased after trawling was banned. Some deeper water shrimps caught by the trawlers are not now caught by the trammel nets. This is also the case with the Cilacap shrimp fishery (NAAMIN & MARTOSUBROTO 1984).

Trawlers caught some fish which are not caught by the trammel nets and perhaps are not now caught in large numbers by other gear either. DWIPONGGO (1984) pointed out that the reported total landings of certain demersal groups had decreased considerably. From 1980 to 1981 for example, the reported catches of Leognathidae decreased from 5,800 tons to 1,900 tons (landed on the north coast of Central Java). The Sciaenidae, Mullidae and Synodontidae also decreased substantially.

Surprisingly there is relatively little information about the species composition from the trawl fishery. Although there are species composition data from research trawlers, the catches are not representative of those from shrimp trawlers because of the large mesh sizes used. Data from Semarang based commercial trawlers for 1977 showed that on an annual basis 5.4% of the catch was shrimp (BECK & SUDRADJAT 1978). Official statistics for 1980 for Central Java give the trawl catch as 17,021 tons and the total shrimp catch for the same year is 3,283 tons. If we assume that about 80% of the shrimp catch was from trawls, then the percent composition of the trawl catch would have been 15.4% shrimp. This is probably a high estimate.

Using these very rough figures we see that a trawler will have the same total catch as 24 to 34 trammel net boats. Since the trammel nets catch a larger proportion of shrimp the result if only the shrimp catch is used as the basis of comparison is quite different. In that case a trawler would catch the same amount of shrimp as 3.6 to 14 trammel net boats (Table 2).

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 catch the equivalent of 72 to 102 people fishing with trammel nets. If we consider only shrimp then the difference is less: the 10 workers on the trawler catch the same amount of shrimp as 10.6 to 42 people fishing trammel nets.

In addition many of the ex-trawlers were converted to purse seiners which employ substantially more crew (up to 30). The purse seiners usually fish farther from shore and thus do not conflict directly with the small scale fishermen. It is likely that fishermen from the banned trawl vessels were reabsorbed into the fishery by the trammel net boats and by the increased numbers of offshore purse seiners.

One of the goals of the Indonesian Directorate General of Fisheries is to improve the economic situation of the small fishing communities. Previously the trawlers landed their catches 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 have become 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 Rp 6,000 to Rp18,000 (about US$6.00 to $18.00). A large catch during the peak season might bring a single boat as much as Rp100,000 for a one day trip. In a society where Rp700 to Rp1,000 is a typical daily wage the influx of the shrimp trade to a village has had a substantial impact. Shrimp fishing certainly brings in more income than other forms of fishing, and the capital outlay is relatively low.

Some have suggested that trawlers equiped with a by-catch excluded device (BED) could be allowed to fish in areas where trawling is now forbidden. The purpose of the BED is to allow the trawler to catch shrimp while permitting a portion of the fish and other organisms to escape. However, the by-catch exluder 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 between small scale and trawler fishermen, the point is that the excluder device, although useful for protecting fish stocks, is not an appropriate solution to problems posed by the possible reintroduction of trawling on the north coast of Java.

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 or impractical. Unfortunately Indonesia's fishery enforcement capability is limited and there is no guarantee that trawlers from other areas would not fish in closed waters. In fact it was that very situation which forced the expansion of trawling restrictions in the first place.

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

POSSIBILITIES FOR FUTURE MANAGEMENT

The Trawl Ban

The ban on trawling has allowed the small scale fishermen catch more shrimp and has increased their income. It seems reasonable that the ban on trawling should be continued. Trawling in adjacent areas should also be banned until adequate enforcement can be provided.

In addition to the major effects of the trawl ban there are some other points of interest. Shrimp caught in trammel nets are initially in better condition than those caught in trawls. Because shrimp catches are now landed at many small villages, the maintenance of product quality after landing may be more difficult. Assistance to fishermen, cooperatives, traders and processors may be needed to ensure the quality of the final product.

Also, 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). This might have adversly affected the availability of cheap fish products. It is likely that the demersal fish resources, perhaps even those relatively close to shore, could be exploited more fully. However, there are 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.

Some species of shrimp are not at present, caught by the trammel nets. *Penaeus monodon* is one of these. Large, live *P. monodon* have a very good market as brood stock for shrimp hatcheries. At selected locations there may be an opportunity to develop a fishery for live *Penaeus monodon* if the appropriate fishing technique can be developed. Use of trammel nets in deeper water is a possibility.

Regulating Effort

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.

Plans should be formulated now for the stabilization of the fishery. This will be a very difficult task, given the lack of enforcement capability.

It is rather 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. Limitations on the size of boats which can use trammel nets could also be considered.

Some type of limitation on the numbers of fishing gear will have to be instituted in the future but it will be necessary to have the support of the fishing communities

for any limiting regulations or actions to be effective. Such limitations might include limiting shrimp fishing rights to people from each village, or limiting shrimp fishing rights to people who already own shrimp fishing gear.

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.

Research and Information Needs

In order to better understand and manage this fishery, better data are necessary. It is rather unlikely that the official statistics will produce data of the accuracy needed for detailed analysis. Because the fishery is rapidly changing the official statistics are often out of date. Supplemental information needs to be collected. Better indentification of the shrimp species in the catches would be useful. At present no reliable seperation of *Penaeus merguiensis* and *P. indicus* is made. Collection of data concerning the number of shrimp per kg on a regular basis would be helpful too, as would better information about catch per unit of effort.

In prohibiting trawling the substantial benefit seems to have reached the small scale fishermen, but to continue this benefit, to prevent the resource from being over exploited again continuing management is necessary.

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