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Biosocioeconomics of Fishing for Shrimp in Kuala Sepetang, Malaysia

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Biosocioeconomics of fishing for shrimp in Kuala Sepetang, Malaysia

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The shrimp fishery is one of the most important components of the marine capture fishery along the west coast of Peninsular Malaysia. Although the percentage of shrimp by weight in the total landings in this area is not high, shrimp are important to the capture fishery due to their high value. Kuala Sepetang, in the district of Larut-Matang, is one of the main shrimp landing centres in Perak. In 1992, a research project to assess the biosocioeconomics of the shrimp fishery in this area was implemented jointly by the Department of Fisheries, Malaysia, and the Bay of Bengal Programme (BOBP). The project involved biological and socioeconomic data-collection for a period of one year. The reporting was funded by the United Nations Development Programme.

The main objectives of this project were to analyze the relative perfomances of the different shrimp fishing gear, assess their biosocioeconomics and suggest optimum levels of exploitation of the resource. The findings of the project, it is hoped, will be useful in formulating future policy guidelines and management measures with regard to the exploitation of the limited shrimp resources. The methodologies used in this project will also help to improve the capabilities of national staff in future biosocioeconomic assessments.

The Bay of Bengal Programme (BOBP) is a multiagency regional fisheries programme which covers seven countries around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new technologies, methodologies and ideas to help improve the conditions of small-scale fisherfolk communities in member countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, and also by the UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

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1. *INTRODUCTION*

The shrimp fishery is one of the most important components of the marine capture fishery along the west coast of Peninsular Malaysia. Although the percentage of shrimp by weight in the total landings in this area is not high, shrimp are important to the capture fishery due to their high value. The total shrimp landings on the west coast of Peninsular Malaysia were 72,181 tin 1990 (Anon., 1991) and 66,625 t in 1991 (Anon., 1992), amounting to 14.1 per cent and 16.6 per cent of the total marine landings by weight. But their wholesale value was 40 per cent (RM 353.4 million*) and 39.5 per cent (RM 334.6 million) respectively.

Perak is the most productive state for shrimp on this coast. The total shrimp landings in the state in 1991 were 28,640 t, of which 26,706 t (93.25%) were penaeid shrimp. This amounts to nearly half the total shrimp and penaeid shrimp landings on the west coast of Peninsular Malaysia in 1991.

Kuala Sepetang, in the district of Larut-Matang, is one of the main shrimp landing centres in Perak. It is situated in an extensive mangrove area, which is said to be one of the best-managed mangrove forest systems in the region (Khoo, 1989). In 1992, a research project to assess the biosocioeconomics of the shrimp fishery in this area was implemented jointly by the Department of Fisheries, Malaysia, and the Bay of Bengal Programme (BOBP). The project involved biological and socioeconomic data collection for a period of one year.

The main objectives of this project were to analyze the relative performances of the different shrimp fishing gear, assess their biosocioeconomics and suggest optimum levels of exploitation of the resource. The findings of the project, it is hoped, will be useful in formulating future policy guidelines and management measures with regard to the exploitation of the limited shrimp resources. The methodologies used in this project will also help to improve the capabilities of national staff in future biosocioeconomic assessments.

The project, apart from carrying out biological analysis, also took into consideration the socioeconomics of the fishing community and of those involved in fishery-related activities. It is hoped that this approach will enhance the perspective of fisheries managers while formulating management policies.

Data-collection studies were carried out on the four major fishing gear types involved in harvesting the shrimp resources in the area. These are trawis (TWL), pushnets (PN), trammelnets (TRN) and bagnets (BN). All four fishing gear use mechanized vessels for fishing or transportation. TWL and PN are active fishing gear, whereas the other two are passive. The overall fishing area is quite limited in size, and so the different fishing gear for shrimp are interactive. All major fishing gear operating in this area were, therefore, investigated to give an overall picture of the shrimp resources off Kuala Sepetang.

A few large-size trawlers also operate in Kuala Sepetang, but these were not taken into account for the purpose of biological data analysis as they mainly target finfish. These trawlers should be regarded as 'fish trawlers' as distinct from 'shrimp trawlers', although the licenses issued to them do not categorize them so. These vessels are licensed to fish away from the coast and beyond the main shrimp fishing grounds. Landing of shrimp from these vessels can be considered as incidental. Fisherfolk operating these boats were, however, included in the socioeconomic data-collection to give a clearer picture of the fishing community.

Biological and socioeconomic data-collection, and part-processing of the collected data, was undertaken by a field biologist, a field economist and two field data-collectors who were employed specifically for this project. Their work was carried out under the guidance and supervision of staff from the Department of Fisheries (DOF), Malaysia, and consultants from BOBP.

* US $ 1 = Ringilt Malaysia 2.50 appx.

2. *METHODOLOGY*

2.1 *Bioeconomic data-collection*

Biological data collected from May 1992 to May 1993 included catch and species composition, length-frequency data of selected shrimp species, and prices of the various commercial categories of shrimp. Data were collected by sampling fishing vessels operating the different fishing gear. Fishing effort with different fishing gear was estimated. These data were then used to estimate production and revenue from the various fishing gear and the growth parameters of the selected shrimp species. Subsequently, this information was utilized to assess the shrimp stocks in the area. Details of the sampling procedures employed are given below.

CATCH AND SPECIES COMPOSITION DATA

Catch data were obtained from direct observations at landing centres as well as from records maintained at these centres. Catch data from records were used for periods when direct observations of the landings could not be made.

Shrimp catches landed by the vessels are usually sorted at sea into commercial categories. These categories are based on size and/or species of the shrimp. There are, however, some variations between categories for different fishing gear. Species composition by weight for each fishing gear was obtained by sampling these categories twice a month.

Apart from sampling the catches at the landing centres, species composition data were also collected on board fishing vessels, particularly trawlers and pushnetters. This enabled data-collection on by-catch not usually landed at the landing centres. By-catch of trammelnets are discarded at sea, so samples for species composition studies were requested and obtained from the operators of this gear. As operators of bagnets do not sort their catch at sea, species composition of the by-catch from this gear was obtained at the sorting sites.

By-catch sampling commenced much later than for shrimp, and its production, during months when data were not available, could only be estimated.

Prices of the various categories of shrimp and by-catch were obtained at the landing centres.

LENGTH-FREQUENCY DATA COLLECTION

Carapace length-frequency measurements of selected shrimp species were also carried out at the same time. The main species selected were Banana shrimp *(Penaeus merguiensis),* Jinga shrimp *(Metapenaeus affinis),* Yellow shrimp *(Merapenaeus brevicornis),* Rainbow shrimp *(Parapeneopsis scuiptilis)* and Spear shrimp *(Parapeneopsis hardwickii).*

The selection of these species was based on their abundance and their importance to the overall shrimp fishery in the study area. They are also representative of the major genera and sizes of shrimp found in the area. Manpower and time constraints did not permit more species to be investigated.

ESTIMATION OF FISHING EFFORT

Fishing effort with the various gear was obtained from interviews with the fishing gear-operators and shrimp-collectors as well as from direct observations of the vessels engaged in fishing. Direct observations of fishing effort using bagnets were not possible as this gear is operated off a small fishing village on an island some distance from Kuala Sepetang. Effort, therefore, had to be estimated based on interviews with the operators of this gear. Correct estimation of fishing effort is very important, as monthly production figures for each species are dependent on it.

2.2 *Bioeconomic analysis*

CATCH AND SPECIES COMPOSITION

Catch and species composition data were treated separately for each fishing gear due to the differences in fishing efficiency of each gear and the different criteria used for sorting the shrimp into various commercial categories.

Catch weights of each commercial shrimp category for each fishing gear type were pooled. The average catch rates (kg/vessel/day or kg/bagnet/day) of the respective categories were then computed. The values thus obtained were then multiplied by the estimated number of fishing vessels or bagnet operators operating each day and the number of fishing days per month to give monthly production of each shrimp category by gear.

The percentage composition by weight, of the sample, was used to estimate the composition by weight of each species in a category for the catch from the sampled vessel.

The values obtained from all sampled vessels for each month were then pooled to calculate the average percentage composition by weight of each species within each category. This was used to obtain the monthly production of the species composition within each category for each fishing gear.

The same procedure as mentioned above was also applied to the by-catch data of each gear to provide estimates of the production of each species found in this category.

LENGTH-FREQUENCY

The sample length-frequencies for each category were raised to the catch of the boat sampled and then raised to the total catch of the fleet at the centre.

The monthly length-frequency of each category caught by different fishing gear was again pooled to give the overall length-frequency distribution of each selected species. Estimates of growth parameters for each species are likely to be more accurate as the length-frequency data are representative of the entire population of the species.

GROWTH PARAMETERS, POPULATION ANALYSIS AND PREDICTIONS OF FUTURE YIELD AND VALUE

The monthly length-frequencies of each selected species were used to estimate their respective growth parameters, *i.e.* K and L, by using the ELEFAN I programme of the Compleat ELEFAN software package version 1.11.

The natural mortality (M) and fishing mortality (F) values for each species by gear and also for all gear combined were estimated by using the ELEFAN II programme. The same programme was also used to estimate the lengths at capture, L_{50} and L_{75}, and the recruitment patterns of the various selected species.

Estimates of the population sizes of the selected species were obtained by applying the back calculating method of the length-based Virtual Population Analysis routine (VPA II) in ELEFAN III to the catch-at-length data of these species.

Relative yield per recruit (Y/R) estimations were obtained by using the knife-edge selection method available in ELEFAN II. By applying the weighted price (RM/kg) of each species to their respective yield per recruit values, estimates of relative revenue per recruit were made.

A length-based Thompson and Bell analysis was also carried out for each fishing gear, using the Length-based Fish Stock Assessment (LFSA) software package. This analysis was done to forecast yield and revenue of the selected species for predicted changes in fishing effort, using inputs of growth parameters, maximum fishing mortality for each species for each fishing gear, recruitment size of each species for each fishing gear obtained from the individual VPA II analysis and prices for each length class.

A comparison was also carried out of the yield and revenue of *Penaeus merguiensis* caught by trawlers alongside other fishing gear and if pushnets and bagnets were banned.

2.3 *Socioeconomic data collection*

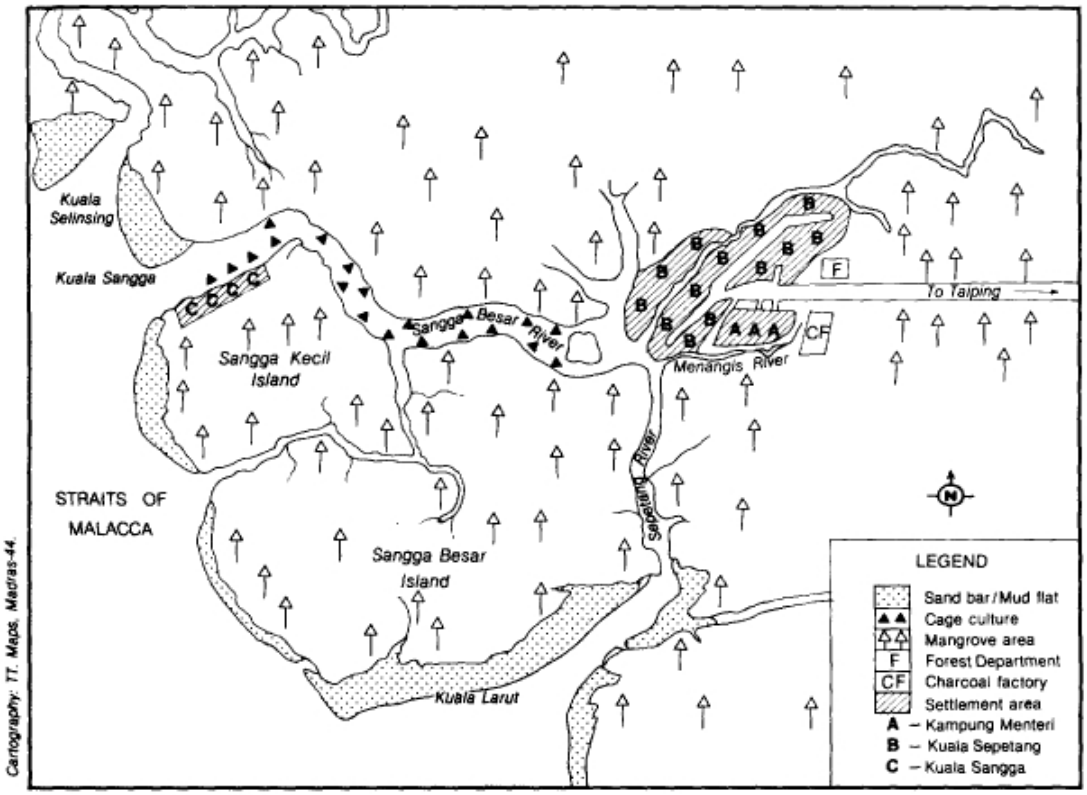
Before conducting a socioeconomic survey, a village profile study and a frame survey were carried out to identify the general characteristics of the area and the types of households in it. Based on their economic activities and ethnic groups, the area was geographically divided into three villages (see Figure 1),

- Kuala Sepetang,

  Kampung Menteri; and

- Kuala Sangga.

Fig 1. Map of study area in Malaysia, showing the three villages



A socioeconomic survey was conducted by sampling 21-26 per cent of the households in each village. The total number of households in each village and the number of samples taken for the survey are shown in Table 1.

Table 1: Distribution of total and sample households and population by village

Village	Estimated total households (HH)	Sample Households No.	%	Sample Population M	F	T	Avg. no. of persons per HH	Estimated total population M	F	T
Kuala Sepetaug	930	226	24	704	672	1376	6.1	2901	2769	5670
Kampung Menteri	200	42	21	139	138	277	6.6	662	658	1320
Kuala Sangga	50	13	26	48	43	91	7.0	185	165	350
Total/Overall	1180	281	24	891	853	**1744**	**6.2**	**3748**	**3592**	**7340**

The households in these villages were stratified according to their economic activities, *viz.:*

- fishing;
- fishery-related; and
- nonfishery.

A household could have one or more of these income-generating activities.

Fishing households were again stratified according to the types of fishing gear and class of fisherfolk, *i.e.* owner, crew.

A frame survey of the number of vessels and gear in the area was conducted and, based on this, a stratified random sampling survey, covering every fishing gear involved in shrimp fisheries in the area, was conducted from June 1992 to May 1993 to estimate

- operational costs,
- the sharing system, and
- income to owner, skipper and crew.

Incomes from the four fishing gear involved in the shrimp fishery were estimated from monthly production and recorded prices. Incomes from 'fish trawlers' were included to give a more complete picture of income derived from fishing and the interaction among the various fisheries in the area.

3. *BIOECONOMIC FINDINGS*

3.1 *Fishing effort*

The estimated fishing effort of most gear was fairly consistent throughout the study period. It was observed that a monthly average of 407 to 412 trawlers, 108 to 112 pushnet vessels and 99 to 102 trammelnet vessels operated per day (Table 2). Each trawler and trammelnet vessel was operated 19 to 21 days a month, while pushnet vessels were operated 12 to 14 days (Table 3). All fishing gear were used year-round.

Bagnets, however, showed Iwo distinct fishing seasons. During the lean season from April to September, fewer nets were operated per day. Fishing intensity was increased from October to March, which is the peak season. The average number of operations per month also showed a similar trend.

Table 4 shows the general characteristics of each of the **gear** used for fishing shrimp.

Table 2: Estimated number of fishing vessels/bags operating per day

Month	*TWL*	*PN*	TRN	BN
May '92	409	109	na	na*
June '92	408	109	99	260
July '92	41!	108	99	260
August '92	412	110	100	260
September '92	409	108	99	260
October '92	407	109	99	532
November '92	410	111	101	532
December '92	412	112	102	532
January '93	412	112	102	532
February '93	412	112	102	532
March '93	407	109	102	532
April '93	410	112	102	260
May '93	411	112	102	260
Mean	410	110	101	396

Table 3: Estimated number of days each gear operates

Month	*TWL*	*PN*	*TRN*	*BN*
May '92	20	13	na	na
June '92	20	13	20	4
July '92	21	14	21	4
August '92	21	14	21	4
September '92	21	12	21	4
October '92	20	13	20	6
November '92	20	13	20	6
December '92	20	13	20	6
January '93	19	13	19	6
February '93	21	13	21	6
March '93	21	13	21	6
April '93	21	14	20	4
May '93	21	14	20	4
Mean	20	**13**	**20**	5

Table 4: General characteristics of the gear involved in the shrimp fisheries

Month	*TWL*	*PN*	*TRN*	*BN*
Codend mesh size	2.5 cm	2.5 cm	na*	2.5 cm
Outer panel mesh size	na	na	5.0 cm	na
Inner panel mesh *size*	na	na	2.5 cm	na
No. of nets/panels/bags per operation	1 unit	1 unit	10 panels	12 bags
Width of mouth opening	lu m	7 m	na	7 m
Height of panel	na	na	3 m	na
Length of panel	na	na	100 m	na
Fishing depth (range)	15-17 m	2-3 m	6-8 m	4-5 m
Duration of towing/soaking time per operation	3 hrs.	30 min	90 min	12 hrs.
Number of operations per day	3	12	4	2
Duration for each trip (inclusive of travelling time)	15 hrs.	9 hrs.	8 hrs.	na
No. of crew members/vessel	2	2	2	1 or 2

Not available

3.2 *Catch rates*

The catch rates of the different gear are given in Tables 5a-d and the findings are discussed in the following pages.

Table 5a Average catch rates of trawlers (kg/vessel/day)

Main species/fish groups	*May 92*	*Jun 92*	*July 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Shrimp													
Jinga Shrimp	1054	969	2.15	7.37	0.89	21.04	3.73	2976	11.82	449	8.66	8.17	9.04
Yellow Shnmp	5.04	10.14	1595	11.74	6.83	15.24	3007	204	1007	577	1320	12.14	11.22
Spear Shrimp	8.85	210	152	630	21.96	2899	925	460	2453	2450	24.49	2193	2292
Rainbow Shrimp	265	442	3.13	1.35	239	2.38	5.89	268	3.18	280	3.42	3.08	3.07
Banana Shrimp	05	291	265	160	0.77	246	342	1.41	1.77	194	346	**3.05**	**3.03**
Others	4.67	13.45	4.85	7.18	1.16	006			0.77				
Total shrimp	**32.80**	**41.81**	**40.25**	**35.54**	**34.00**	**70.16**	**62.36**	**50.49**	**52.18**	**49.50**	**53.23**	**49.37**	**49.28**
By-catch													
Cardinal **fish**						**2003**	**11,44**	**3077**	**5.82**	**385**	**458**	**024**	**783**
Catfish						070	628	1.65	5.14	3.51	432	836	6.0!
Sole						599	3.52	3.08	3.42	4.44	527	787	783
Snails						22910		95.91	85.36	7723	9078	3074	27.5!
Gohy						6.11		7.98	10.77	6.20	10.59	10.02	11.60
Croaker						19.16	11.50	527	59.26	5.38	453	19.59	15.67
Mud crab						8220	40.87	1.48	342	5.08	2.62		
Cuttlefish						6.11	3,47	310	27.55	585	1777	12.09	
Anchovy (Th)						11.92	6.04	534	582	12.73	10.59	6.65	
Others						29.66	1377	8.21	12.82				
Total by-catch	**190.77**	**226.02**	**210.06**	**187.19**	**177.18**	**419.98**	**96.95**	**162.71**	**219.38**	**124.27**	**171.05**	**114.56**	**76.45**
TOTAL	**231.57**	**267.83**	**250.31**	**222.73**	**211.18**	**490.14**	**159.31**	**213.2**	**271.56**	**173.77**	**224.28**	**163.93**	**125.73**

Table Sb. Average catch rates of PN (kg/boat/day)

Shrimp													
Jinga shrimp	**7.01**	**885**	**7.50**	274	**4.26**	294	**2.82**	**16.68**	**14.36**	**14.11**	**17.27**	19.67	**19.59**
Yellow shrimp	**16.73**	**996**		23.16	21.10	2273	**30.50**	**1655**	**1846**	19.80	**18.63**	**22.27**	22.09
Rainbow **shrimp**	**7.24**	**416**	**2,74**	**329**	6.95	**6.20**	**4.63**	**439**	**4.11**	**3.72**	**2,34**	**4.60**	**4.11**
Banana shrimp	**11.85**	**1493**	2440	**18.70**	8.37	849	37.22	9.01	*558*	550	**6.44**	**617**	**628**
Others	**0.50**	**1.54**	**2.7!**	**020**									
Total shrimp	**43.33**	**39.34**	**47.35**	**40.09**	**40.68**	**40.36**	**75.17**	**46.63**	**42.51**	**43.13**	**44.68**	**52.71**	**52.07**
By-catch													
Glassfish			30.08	**0.14**	**1.24**	**170**	**20!**	**635**	**397**	**5.87**	**7.88**	**9.3!**	**798**
Halfbrak			2.10	1.44	966	10.12	5.83	0.67	1.41	067	**394**	**4,94**	**4,7!**
Puffers			0.65	0.86	569	889	99.2!	0.82	990	6.07	2.78	**5.70**	**7.26**
Ponyfish			2.90	1.91	7.11	14.41	733	1.41	047	5.82	506	**2.28**	
Scars			0.80	0.40	369	325	1.80	0.41	021	1.41	394	3.80	
Croaker			**6.38**	**3.83**	2467	20.68	12.23	348	0,64				
Anchovy (Th)			4,64	2.87	7.00	·	.	2.28	20.04	12.73	15.76	9.50	
Mullet			**0.94**	**0.48**	307	3.01	2.!!	0.38	1.19				
Others			**3.41**	**23.88**			**35.30**	**2.30**	3.66				
Tntal by-catch	**51.57**	46.40	51.82	35.89	**62.13**	**62.06**	**35.05**	**28.10**	**32.49**	**32.57**	**39.36**	**35.53**	**19.95**
TOTAL	**94.90**	**05.74**	**99.17**	**03.98**	**102.81**	**102.42**	**110.22**	**74.73**	**75.00**	**75.70**	**84.04**	**88.24**	**72.02**

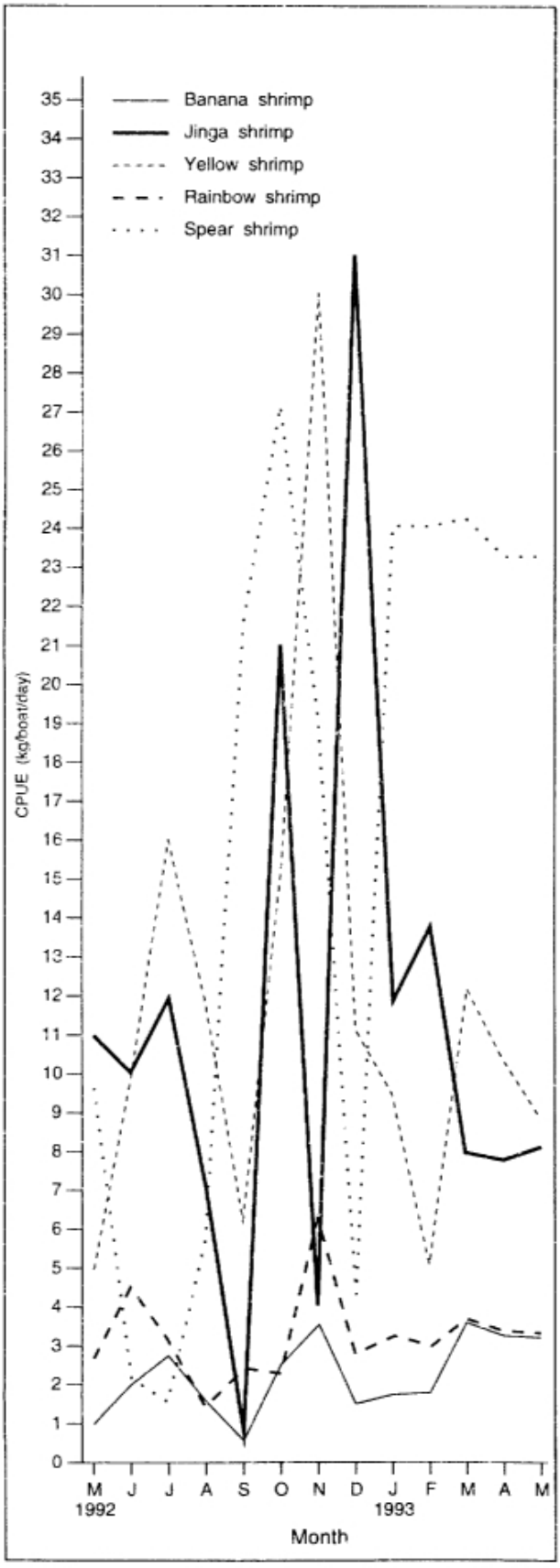
Table *5c.* Average catch rate by TRN (kg/boat/day)

Shrimp													
Jinga shrimp		**10.61**	**3.14**	**.49**	0.04	1.20	7.59	9.99	269	944	11.97	10.12	1636
Yellow shrimp		164	060	0.66	0.89	1.11	4.87	7.37	4.93	770	940	7.81	
Rainbow shrimp			042	0.15	2.15	0.55	5.85						
Banana shrimp		500	527	6.25	3.83	7.33	3.48	3.28	2.77	2.99	327	4.08	386
Total Shrimp		**17.25**	**9.51**	**0.55**	**6.91**	**10.19**	**21.77**	**20.64**	**20.39**	**20.21**	24.64	**22.01**	**20.22**
By-catch													
Cardinalfish			0.85	245	49!	170	2.19	1.28	2.39	0.76	1.18	1.15	1.67
Anchovy			0.13	0.36	0.74	023	0.27	0.3!	0.64	**0.9!**	**0.07**	**0.63**	**0.66**
Sole			**0.18**	**050**	1.03	029	0.4!	0,34	0.69	0.30	0.35	0.26	0.30
Sea snail,			003	9.09	0.17	0.04	0.10	0.08	0.16	0.15	015	0.12	3.90
Croaker			4.32	1230	24.43	850	9.74	519	10.10	5.30	634	7.38	4.29
Must crab			0.01	0.05	0.12	903	0.07	005	0.09	**006**	036		
Cuttlefish			0.13	0.32	**0.51**	**0.12**	0.14	0.3)	0.64	**053**	**0.57**	**0.15**	
Anchovy **St.)**			0.66	**1.87**	**3.71**	1.06	1.39	085	1.82	129	1.54	0.82	
Others			0.02	006		0,46		0.07	0.16	0.13	0.13	0.18	
Total hp-catch		**10.63**	**6.33**	**18.00**	**35.62**	**12.43**	**14.31**	**0.48**	**16.77**	**9.45**	**11.19**	**10.67**	**10.82**
TOTAL		**27.88**	**15.84**	**26.55**	**42.53**	**22.62**	**36.08**	**29.12**	**37.16**	**29.66**	**35.03**	**32.68**	**31.04**

Table Sd. Average catch rate by BN (kg/bag/day)

Shrimp													
Jinga shrimp		0.161	0.330	0.787	0549	1.051	**0736**	0900	**1.362**	**1.568**	**1.456**	**1.068**	**1.472**
Yellow shrimp		0.269	1.460	0.080	1.251	2.789	4,974	2.036	1.867	2.181	1.658	.344	0.073
Rainbow shrimp		0.074	0.390	0.244	0.400	1.203	0.944	**0.55!**	**0.073**	**0.101**			
Banana shtimp		0.442	**0.450**	0.406	0.333	0.696	0,814	0.675	0690	0.050	0.629	0.550	0.515
Others		0.423	0.095	0.086		0.870	0207						
Total **shrimp**		**1.369**	**2.725**	**2.413**	2.533	6.609	7.675	**4.162**	3.992	4.700	3.743	2.962	2.860
By-catch													
Sergestid shrimp		0.086		0.009			0.54!	0573	1.075	0.647	0.725	0.935	0.514
Cardinalfish				0.023		0.448	0.227	0.163	0.045	0.035	0.062	0.094	0.077
Catfish		0.014		0.002		026!	0.152	0.014	0.011	0.049	0.862	0111	0.146
Goby		0.028		0.093	0.969	1.088	0.474	0.672	0.206	**0.326**	0.099	0.087	0.137
Ponyfish		0.012		0.009	-	-	.	.	0.27!	0.399	0.149	0130	0.192
Squid		0.103		0.100	0.151	0.260	0.161	0362	0.449	0.686	**0.198**	**0.074**	
Croaker		0053		0.307		235!	1.302	**0.696**	0.442	**0.475**	**0109**	**0.039**	
Scorpionfish		0.0004		0.016				0.079	0.053	0.03!	0.068		
Cattlefish		0.024		1.021		0.634	0.412	**0.130**	**0.138**	0.166	0202		
Anchovy (St.)		**0.0299**		**0.102**	**0.151**	1.567	0.760	0.045	0.167	0.090	**0.339**	**0.253**	**0.262**
Anchovy (Th.)		0.041		0295	0.189		0.379	0602	0.337	0.835	0.216	**0.083**	
Goatflah		0.095		0.027	0.053	0.040		**0.036**	0.024				
Others		0.074		0.409	0.068		0.361	0.712	0.079	0.145	0.347	0.165	0644
Total by-catch		**0.554**	**na**	**2.413**	0.801	7.309	4.769	4.084	3.376	**3.743**	**2.586**	**1.979**	**1.972**
TOTAL		**1.923**	**2.725**	**4.026**	**3.334**	**13.998**	**12.444**	**8.246**	7.368	8.443	**6.329**	**4.941**	**4.832**

Fig 2. Average catch rates of selected species by TWL



TRAWLS (TWL)

The overall average catch rates (kg/vessel/day), *i.e.* combining shrimp and by-catch, ranged front 126 to 490. However, in most months, the catch rates were 210-280. The highest value was obtained in October 1992, while the lowest was in May 1993. The trend shown by the average catch rates of shrimp (kg/vessel/day) is quite similar to that of the overall average catch rates. The average catch rates of shrimp were between 33 and 70 kg/vessel/day (Table 5a). The peak in shrimp catch rates was also in October 1992, while the lowest value was recorded in May 1992.

Twelve species of penaeid shrimps were caught throughout the study period. However, only five species were consistently present every month and they shared quite different trends in their average catch rates. (Table 5a). These five species were those that had been chosen for length-frequency studies.

Banana shrimp catch rate peaked in July 1992, November 1992 and March 1993 (Figure 2). The catch rates remain relatively high alter the third peak. Although there appear to he fluctuations in the catch rates between months, the range of' these were quite narrow', *i.e.* between 1.1 and 3.5 kg/vessel/day, excluding the exceptionally low month of' September 1992.

Jinga shrimp showed two peaks in catch rates, *i.e.* in October and December 1992 (Figure 2). There may have been sampling errors in the month of November 1992, in which case the peak season would be October to January.

Yellow shrimp exhibited one major peak in November 1992 (Figure 2). There also appear to be two nimor peaks, in July 1992 and March 1993.

Rainbow shrimp showed two main periods when this species was more available to the trawlers, *i.e.* in June 1992 and November 1992 (Figure 2). The catch rates for most of the other months were quite consistent.

Spear shrimp the smallest-sized species aniong the five selected, showed adistinct peak in catch rates inOctober 1992 (Figure 2). The catch rates gradually dropped until December 1992 before increasing in January 1993. Subsequently, the catch rates remained relatively high until the end of the data-collection phase of the project.

PUSHNET (PN)

The combined shrimp and by-catch catch rates (kg/vessel/day) ranged from 72 to 103 (Table Sb). They were quite consistent throughout the study period, although there appeared to be a peak from September to November 1992.

The average catch rates of shrimp were also quite consistent, with most months having 40-50 kg/vessel/day. A peak catch rate of 75 kg/vessel/day was recorded in November 1992, which greatly contributed to the high combined catch rate for that month (Table Sb).

Eight penaeid shrimp species were caught by the pushnets. Four of the selected species were generally present every month (Table Sb). Spear shrimp were present only in June 1992.

Banana shrimp showed two distinct peaks in their average catch rates, *i.e.* in July and November 1992 (Figure 3). The average catch rates from December 1992 to May 1993 were relatively much lower.

The catch rates of Jinga shrimp also showed a peak in July 1992 (Figure 3). The catch rate dropped and remained at a lower level up to November 1992, before showing a big increase in December. The catch rates subsequently remained at a relatively high level until the end of the data-collection period.

Yellow shrimp catch rates showed a peak in November 1992 (Figure 3). The catch rates for most of the other months were generally quite consistent.

The catch rate of Rainbow shrimp was relatively high at the start of data-collection, which was in May 1992 (Figure 3). It then showed a rapid decrease before again peaking in September 1992. Subsequently, the catch rates showed a generally declining trend.

Fig 3. Average catch rates of selected species by PN

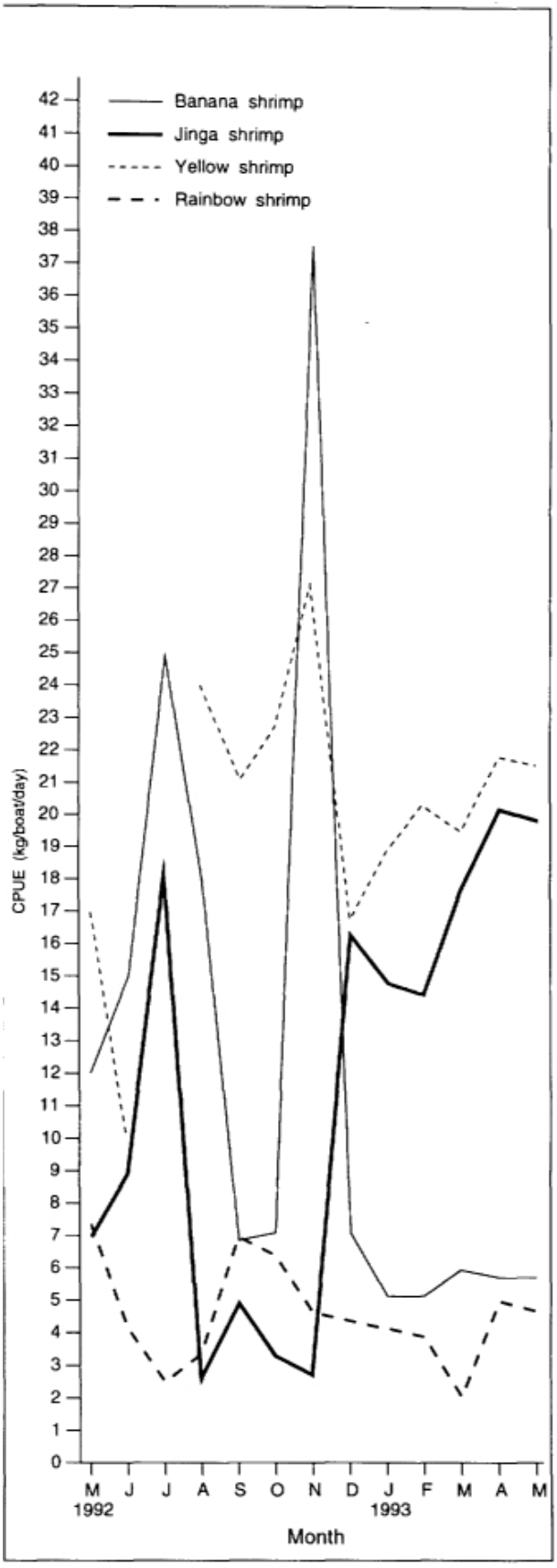
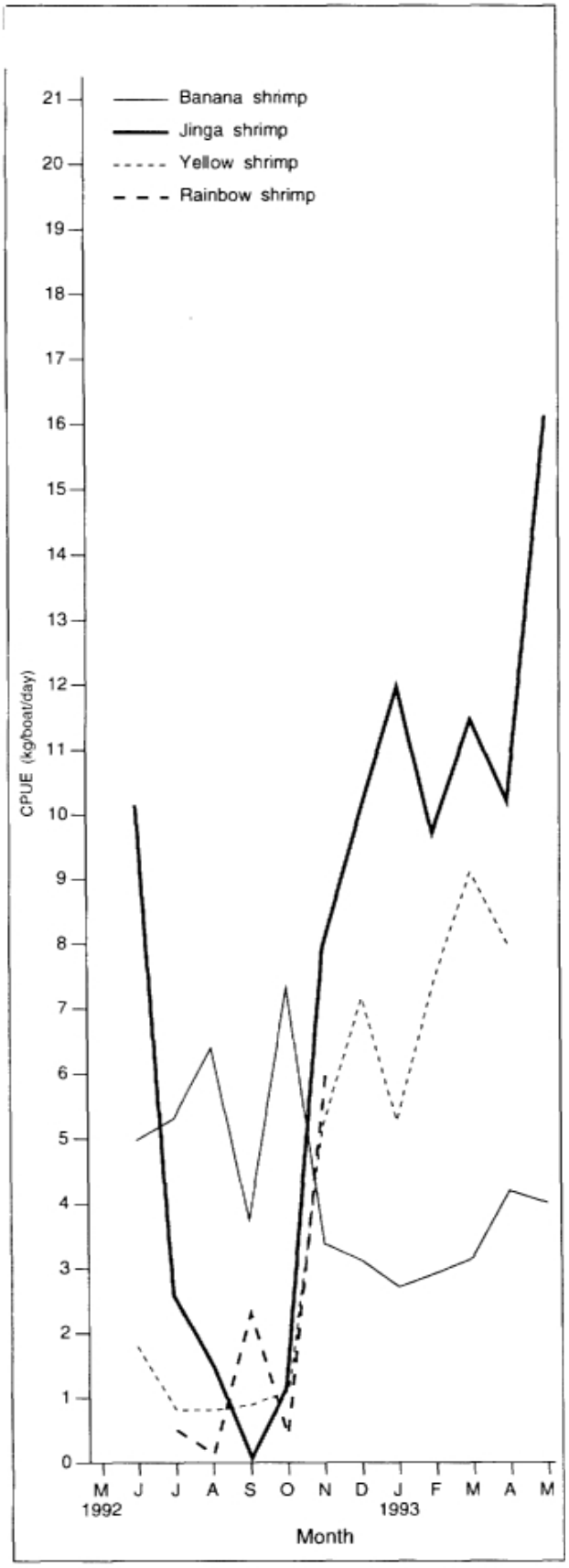


Fig 4. Average catch rates of selected species by TAN



TRAMMELNET (TRN)

Being a selective gear, the combined average catch rates of trammelnets were considerably lower than the two gear mentioned earlier. They ranged from 16-43 kg/vessel/day (Table 5c). The highest catch rate recorded was in September 1992, when by-catch formed the bulk of the landings.

The average catch rates of shrimp dropped from June to September 1992 before increasing again. From November 1992 until the end of data-collection, the average rates were generally 20-22 kg/vessel/ day (Table 5c). Only four species of penaeid shrimp were landed by this gear and they were all selected species. Spear shrimp was again not landed (Table 5c).

Among the four species caught, Rainbow shrimp was found only from July to November 1992 (Figure 4).

Banana shrimp catch rates were relatively higher between June and October 1992, except in September when the catch rate dropped to 3.8 kg/vessel/ day (Figure 4). Similar figures were obtained for the other months when data were available.

The catch rates of Jinga shrimp showed a gradual decline from June to September 1992 before showing an increasing trend until January 1993 (Figure 4). The catch rates for subsequent months were generally consistently high.

Yellow shrimp had low catch rates from June to October 1992 before showing an increase (Figure 4). The catch rates from November 1992 were much higher than the earlier period.

Rainbow shrimp were found for only five months. The catch rates were generally low from July to October before increasing sharply in November 1992 (Figure 4). Surprisingly, this species was not present in the catches in subsequent months.

BAGNET (BN)

The combined average catch rates of this gear ranged from 2 to 14 kg/bag/day (Table 5d). The catch rates gradually increased from June 1992 before peaking in October and November that year. The catch rates then gradually decreased until the end of data-collection.

The catch rates of shrimp exhibit a similar trend to that shown by the combined catch rates. Eight species of penaeid shrimps were caught by this gear. However, only Banana shrimp, Jinga shrimp and Yellow shrimp were consistently found in the catches (Table Sd).

Banana shrimp appeared to be more abundant in bagnets from October 1992 to May 1993 (Figure 5). Although present in the earlier months, their catch rates were relatively less.

The catch rates of Jinga shrimp showed a gradually increasing trend from June 1992 to February 1993 before they declined slightly (Figure 5).

Yellow shrimp showed an increasing trend in catch rates from August to November 1992 before showing a sharp drop in December (Figure 5). The catch rates showed a slow declining trend in subsequent months.

The catch rates of Rainbow shrimp peaked in October 1992 and then showed a declining trend until January 1993 (Figure 5). This species was not found in the bagnet catches from March 1993 until the end of data-collection.

The different trends in catch rates by different gear for certain species may be due to the different migration patterns of these species as they grow.

Fig 5. Average catch rates of selected species by BN

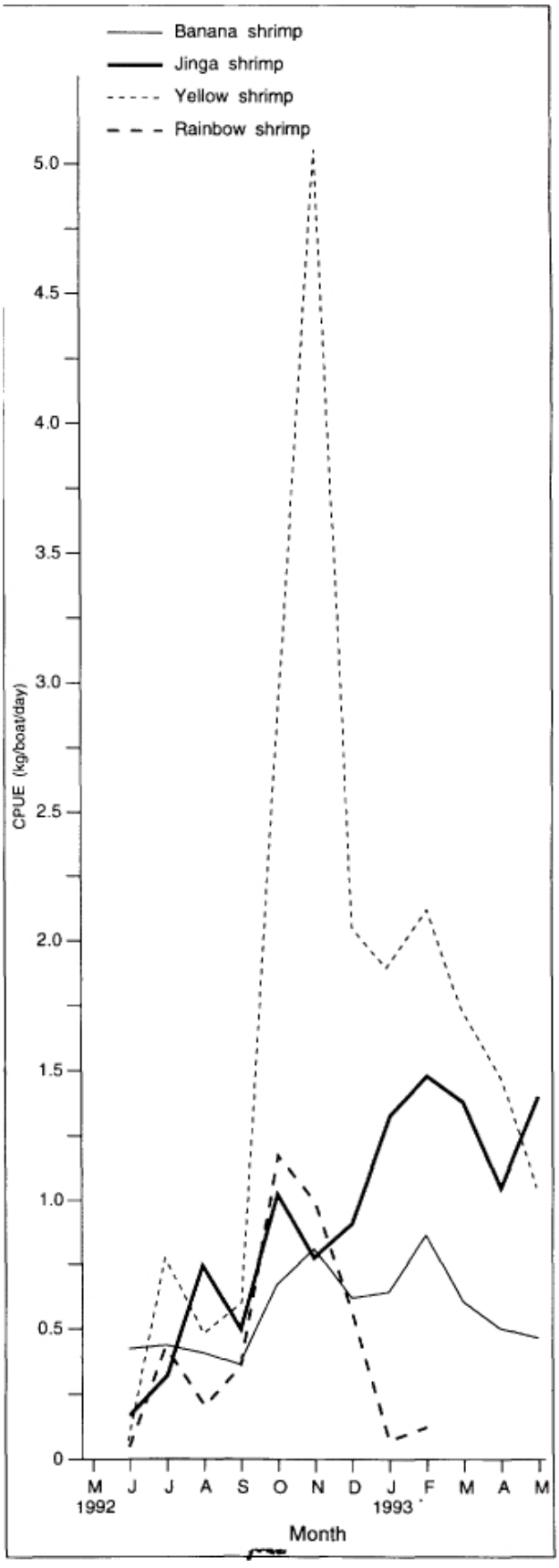
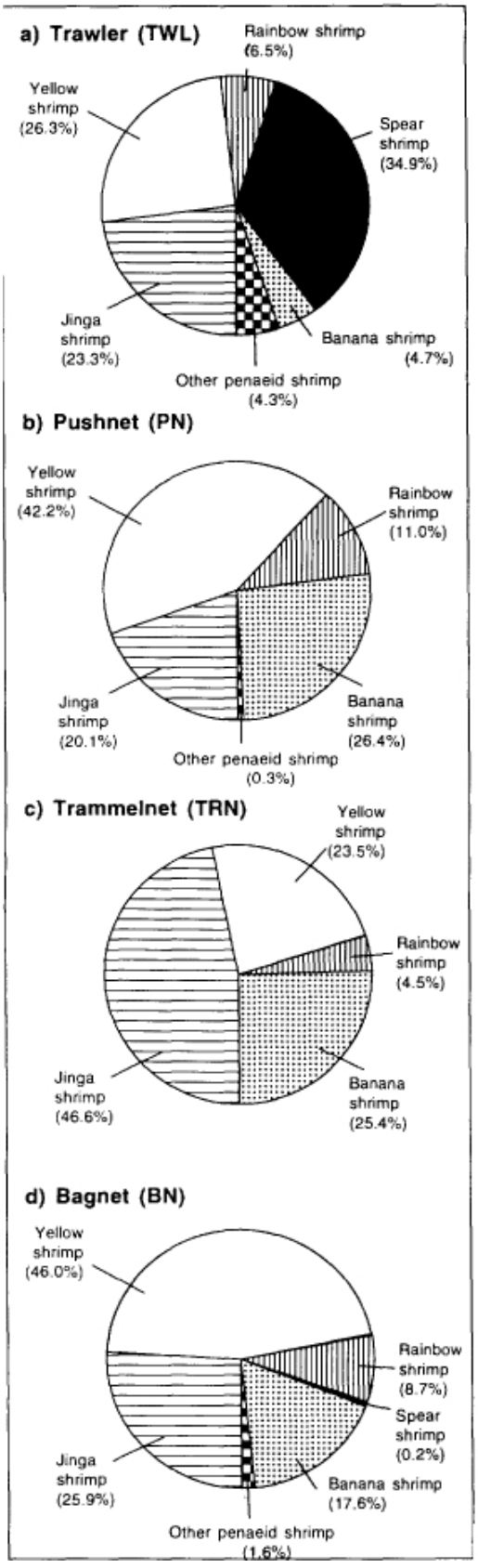


Fig 6. Species composition of penaeid shrimp landings by gear



3.3 Species composition

Although the different fishing gear caught similar types of shrimp, the percentage compositions by weight of this catch were quite different.

The most abundant shrimp species in TWL was Spear shrimp. The TWL catch of this species made up almost 35 per cent of the total shrimp catch by weight (Figure 6a).

Yellow shrimp, with a little over 42 per cent of the total shrimp catch, was the most dominant species for PN (Figure 6b). Spear shrimp, which was the most dominant species in the TWL, was practically nonexistent in the pushnet catch.

Only four species formed the bulk of TRN catches and the most dominant was Jinga shrimp, which formed almost 47 per cent of the total shrimp catch (Figure 6c).

The largest part of the BN shrimp catch was Yellow shrimp with 46 per cent (Figure 6d).

The differences in the species composition by weight when using different fishing gear are indicative, by and large, of the different areas in which these gear operate, although there is some overlap. TWL, PN and BN have similar codend mesh sizes and, should they operate in the same areas, their respective species compositions would be very similar. While PN and BN have strong similarities in their shrimp species composition, these were quite different from the percentage composition in the TWL fishery, particularly when it came to Spear shrimp. The different species composition pattern shown by TRN can be attributed to the more selective nature of this gear, apart from differences in fishing grounds. One of the common features found in all the gear was that the genus *Metapenaeus* formed the bulk of their respective catches.

3.4 Production and revenue

Since the fishing effort using different gear was fairly uniform throughout the study period, production trends are a reflection of their respective catch rates. Total production, revenue and numbers caught for each fishing gear are given in Table 6.

Table 6: Total production and revenue of selected species by gear type

Species	*TWL*	*PN*	*TRV*	*BN*
Banana shrimp				
Production (t)	232	221	105	5
Numbers caught	28,665,390	53,961,629	5,569,790	1,665,059
Revenue (RM)	3,871,816	1,736,008	1,904,654	62,186
Jinga shrimp				
Production **(t)**	1,143	169	193	8
Numbers caught	311,245,741	55,967,509	20,251,658	3,336,075
Revenue (RM)	6,434,325	909,719	1,516,198	56,571
Yellow shrimp				
Production (t)	1,288	356	97	14
Numbers caught	327,822,234	137,737,714	9,136,848	6,983,986
Revenue (RM)	7,825,278	1,134,612	757,055	94,968
Rainbow shrimp				
Production **(t)**	317	92	19	3
Numbers caught	69,591,695	17,936,914	1,890,222	568,671
Revenue (RM)	1,635,340	255,142	147,753	14,753
Spear shrimp				
Production (t)	1786	0.8	-	0.7
Revenue (RM)	2,985,898	223	-	790

Appendices 1-IV (a and b) give details of monthly production and **revenue of TWL, PN, TRN, BN** for shrimp, finfish and by-catch. It should be noted that revenue figures for finfish and by-catch are only estimates, as not all catch is sold.

Figures 7a-d, on the next page, show specieswise production of each fishing gear by numbers, weight and revenue. The figures are accompanied by the points to note for four of the selected species.

BANANA SHRIMP

The three most significant fishing gear are TWL, PN and TRN. The TWL catch is about the same as the PN catches in terms of weight, but PN capture larger numbers, indicating smaller sizes. Though the total revenue from this species is the highest for TWL **(RM 48 million), TRN catches** have the best price/kg due to the larger size of shrimp caught by this gear.

JINGA SHRIMP

TWL is the major harvester of this species in terms of production by numbers, weight and revenue. TRN produces more than PN.

YELLOW SHRIMP

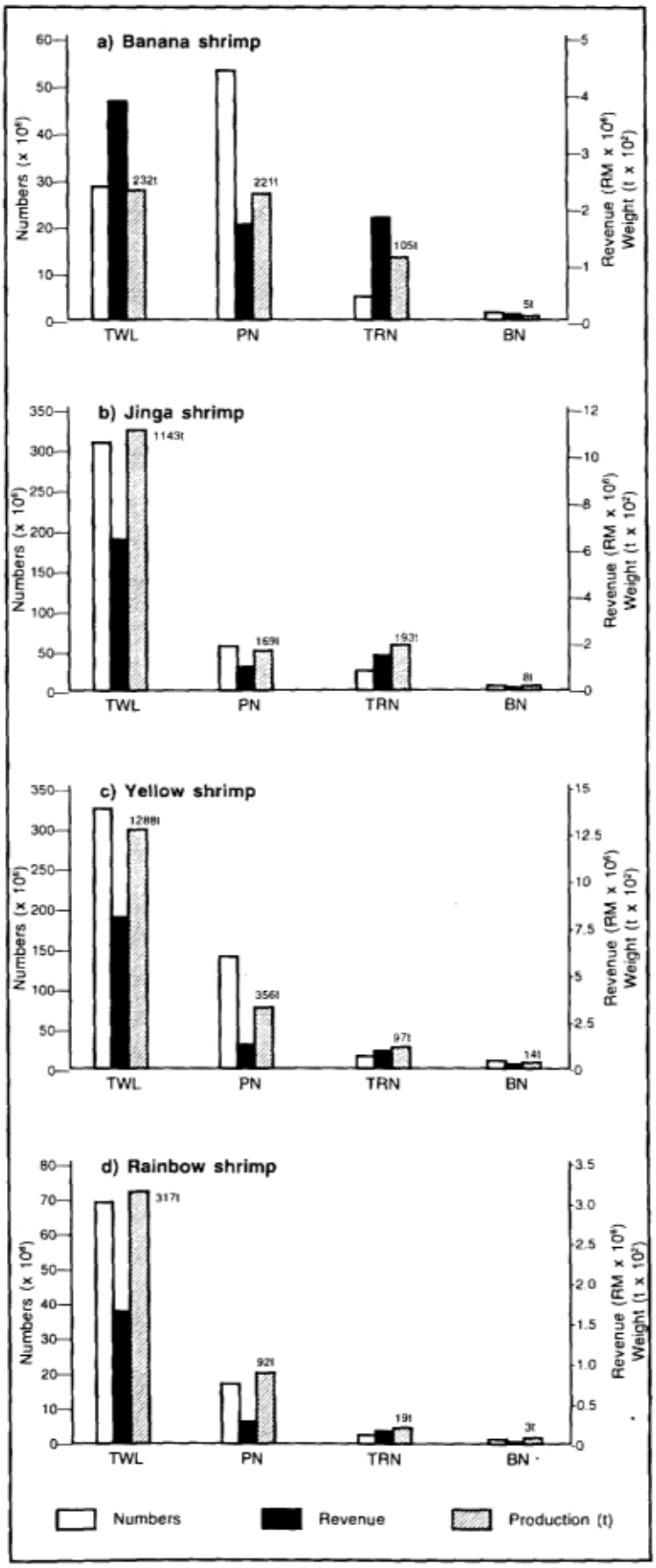
TWL again accounts for a major portion of production and value. TRN produces less than PN.

RAINBOW SHRIMP

Similar trends as Yellow shrimp.

The high production by TWL can be attributed to the relatively large size of the trawler fleet and the higher catch rates. The high catch of Banana shrimp post-larvae (PL) by PN is due to the fact that this gear is operated in the mangroves and nearshore, which is the habitat for juveniles. TRN, though ranking third in respect of production, gets the best price/animal due to the relatively larger size of the animal.

Fig 7. **Production (weight & number) and revenue from various gear for selected species**



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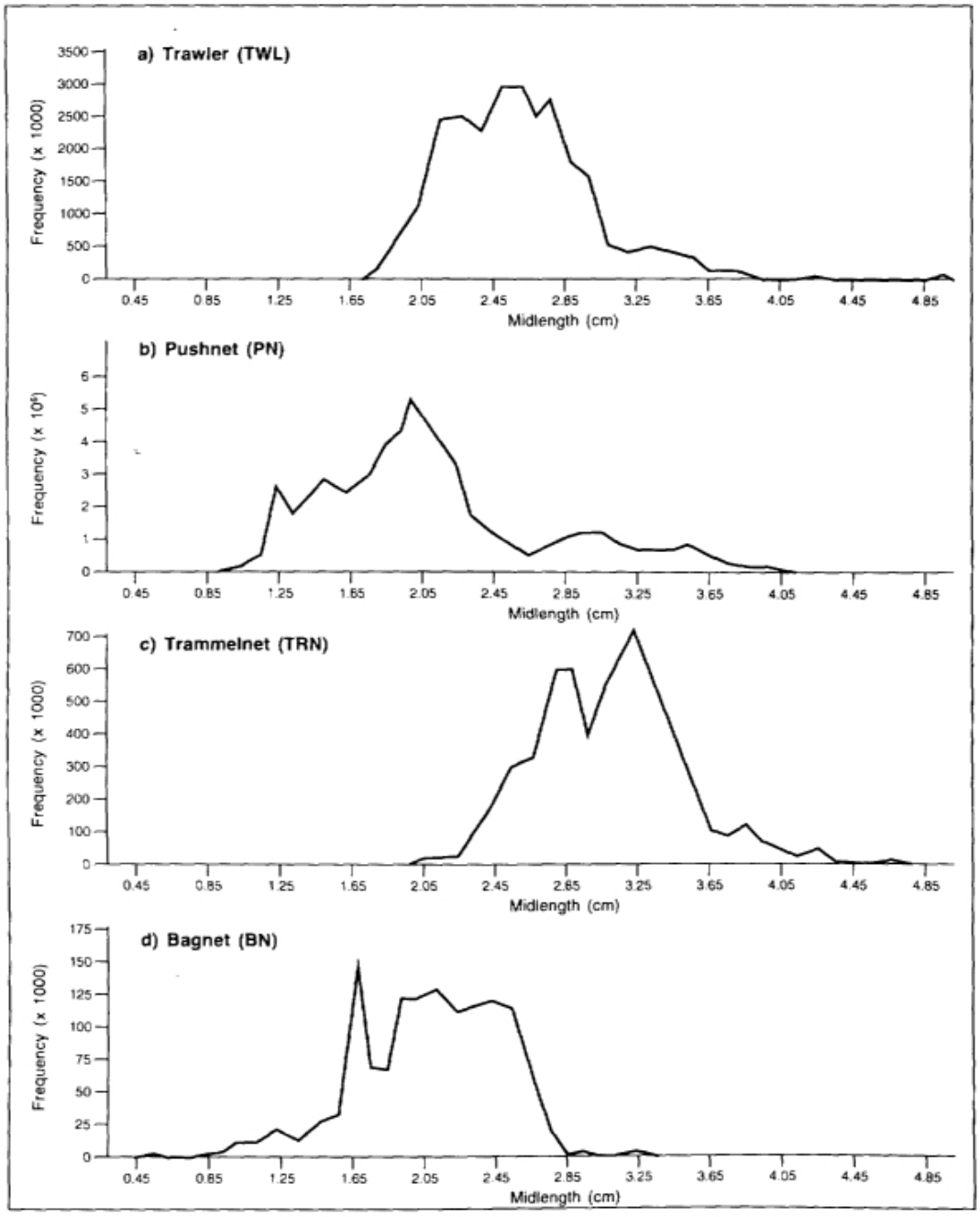
3.5 Size composition

Size distribution of the five selected species differs with each fishing gear (Figures 8 to 12). Mid carapace-length is used as a measure of size. The main findings are:

BANANA SHRIMP

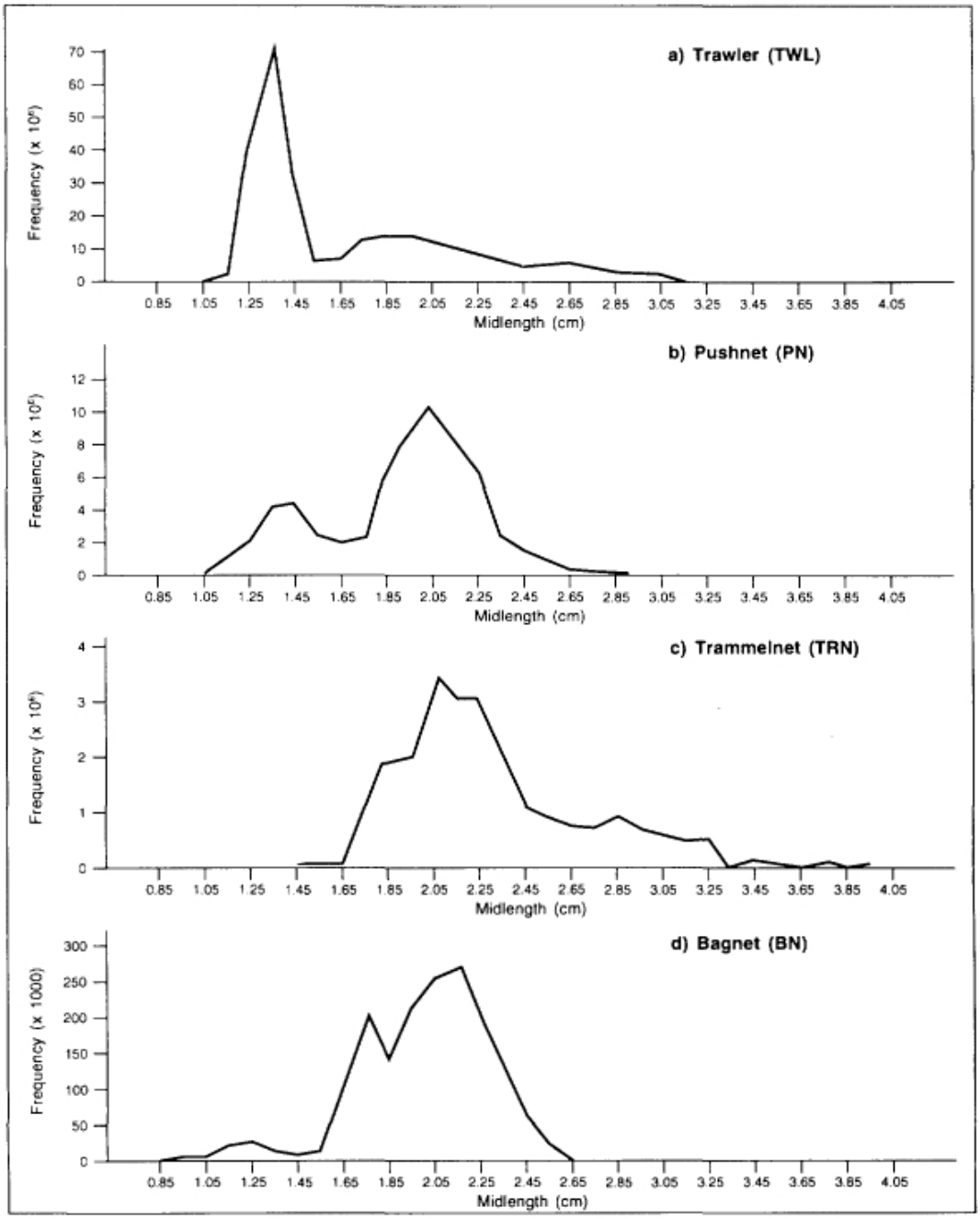
Length at first capture is about 8 mm for PN and BN, 18mm for TWL and about 20 mm for TRN (Figure 8). The modal lengths for TRN and TWL are about 32 mm and 25 mm respectively. Shrimp of lengths between 20 and 24 mm are caught by all gear.

Fig 8. Catch at length by different gear for Banana shrimp



TWL, PN and BN first capture this species at about 10 mm, though a few smaller ones are caught by BN (Figure 9). It is interesting to note that while PN, TRN and BN display similar modes of about 20 mm, the value is much less for TWL (13 mm).

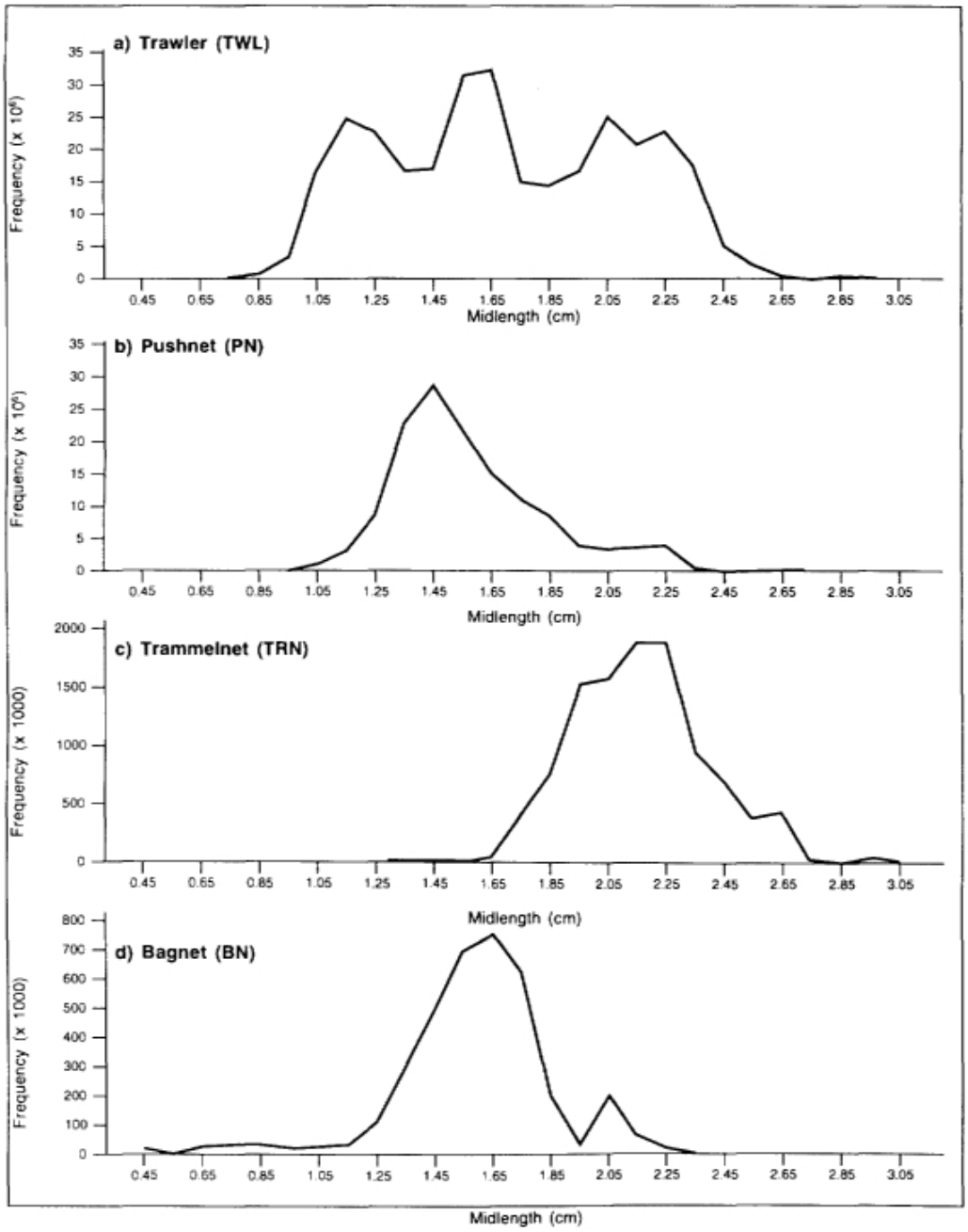
Fig 9. Catch at length by different gear for Jinga shrimp



YELLOW SHRIMP

BN catches this shrimp from lengths as low as 5 mm, though the modal length is about 16 mm (Figure 10). TWL catches vary in lengths from 8 to 28 mm, PN catches from 10 to 24 mm with a modal length of 15 mm and TRN catches the larger animals from 15 to 30 mm.

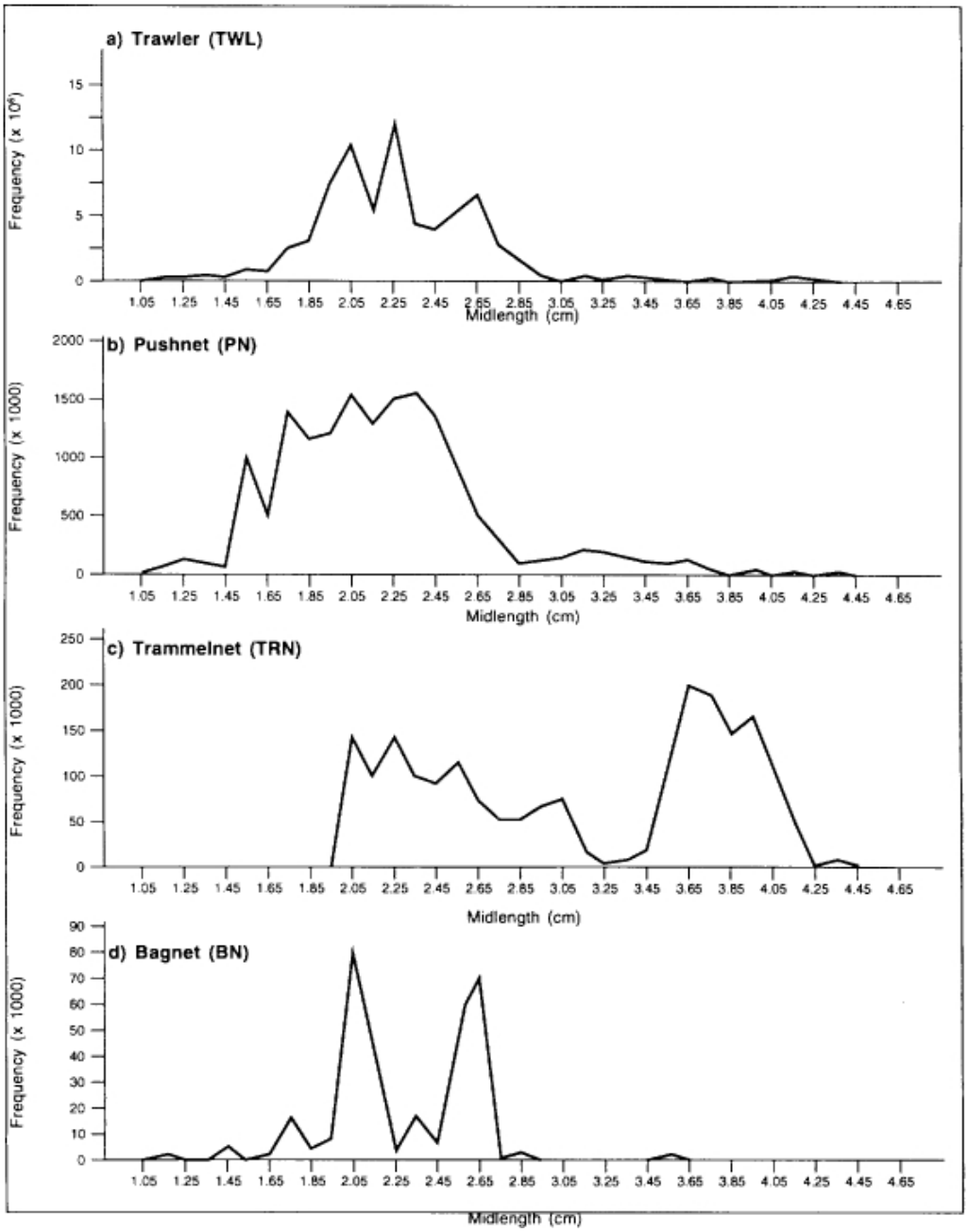
Fig 10. Catch at length by different gear for Yellow shrimp



RAINBOW SHRIMP

This species occurs in smaller numbers than the others in the catch of all the fishing gear studied. The many peaks in Figure 11 may be due to sampling errors which were magnified in the process of raising the values to the total catch. Length at first capture is about 10 mm for TWL, PN and BN, with maximum lengths upto about 30 mm. TRN, as may be expected, catches the larger sizes upto 42 mm.

Fig 11. Catch at length by different gear for Rainbow shrimp

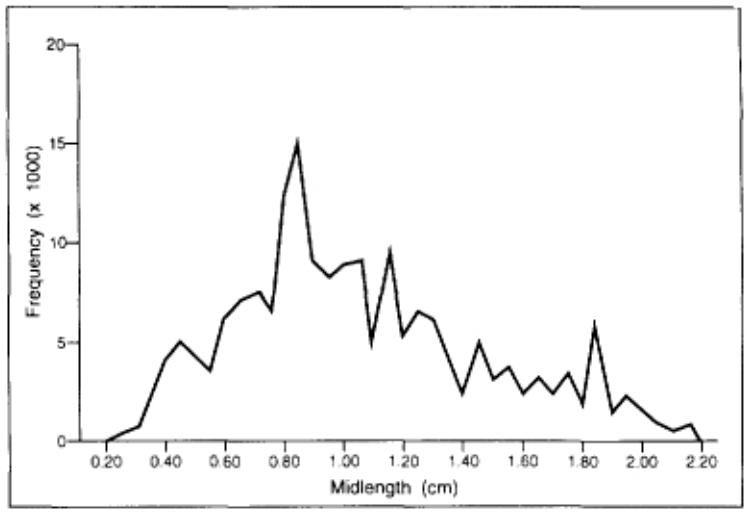


SPEAR SHRIMP

This species occurs mainly in TWL catches, with a length at first capture of about 2 mm, a modal length of 9 mm and sizeable quantities upto 22 mm (Figure 12).

3.6 *Growth parameters and recruitment pattern*

Fig 12. Catch at length from sampled trawlers for Spear shrimp



The growth parameters of the selected species were determined using the ELEFAN I programme of the Compleat ELEFAN software package. The pooled catch-at-length data from all the gear were used in the analysis.

As evident from earlier discussions, the different fishing gear were exploiting the same stocks of shrimp. In some cases, these gear were harvesting different life-stages of the same species. By pooling the catch-at-length data from these gear, a wider range of sizes was obtained, thus giving better estimates of growth parameters. Table 7 summarizes these parameters and the estimated time of spawning of the different cohorts of each species. The table also includes natural and fishing mortalities (M and F), exploitation rates (E) and mean lengths at capture (L_{50} and L_{75}) which were based on the growth parameters of the cohort with the higher goodness-of-fit index (Rn) of the selected species. The exception to this was Spear shrimp, where the cohort with the lower Rn was used, as this cohort exhibited a better recruitment pattern, probably because of the differences in the strength of the two cohorts.

Table 7: Growth parameters (La & K), natural mortality (M) and estimated spawning period of selected species based on pooled data of all gear and fishing mortalities (F), mean length at 0.5 (L_{50}) and 0.75 (L_{75}) and probability of capture and exploitation rates (E), according to gear types

	Cohort 1	*Cohort 2*	***Gear ripe:*** *TWL*	*PN*	*TRN*	*BN*	*All gear*
Banana shrimp			F	2.520	0.829	1.746	8.867	2.500
Lα	5 480	5.500	E	0.527	0.268	0.436	0 797	0.525
K	0.670	0.900	L_{50}	2.307	1.348	2.798	2.122	2.154
Rn	0 180	0.109	L_{75}	2.498	1.548	3.011	2.289	2,505
M	2 263		Lc/Lα	0.421	0.246	0.511	0 387	0.393
M/K	3,378		Mean F	1.332	1.323	0 576	0.994	0.389
Spawning	January	October	Mean E	0 370	0.369	0203	0.305	0.147
Jinga shrimp			F	1.914	8,363	0 972	4.618	3.386
Lα	4 520	4.560	E	0.398	0743	0.251	0615	0.539
K	0.900	0900	L_{50}	I 959	2.008	1.847	1.889	1.844
Rn	0.217	0.138	L_{75}	2.172	2.185	2.013	2 003	2.034
M	2 896		Lc/Lα	0433	8444	0409	0.418	0408
NI/K	3.218		Mean F	3.133	2.274	1.326	2350	1 055
Spawning	January	July	Mean E	0.520	0,440	0.314	0.448	0.267
Yellow shrimp			F	1.524	1.782	1 445	2.386	2396
Lα	3.300	3.240	*E*	0.356	0,393	0.344	0.464	0.465
K	0.730	0.660	L_{50}	1.536	1.316	2029	1.462	1.935
Rn	0.106	0.103	L_{75}	1.702	1,471	2.206	1.632	2.113
M	2757		Lc/Lα	0.465	0399	0615	0.443	0.586
M/K	3.777		Mean F	0904	1.361	1.074	1.095	0,393
Spawning	November	July	Mean E	0247	0.331	0.280	0284	0 125
Rainbow shrimp			F	2.255	0.837	3.495		1.933
Lα	5.160	5.090	E	0.456	0,237	0565		0.418
K	0.850	0.820	L_{50}	1.753	1,570	3670		1.804
Rn	0.158	0.150	L_{75}	1.913	1.747	3843		2.119
M	2,689		Lc/Lα	0340	0,304	0.711		0.350
M/K	3.164		Mean F	I 224	1,082	1.385		0.966
Spawning	March	October	Mean E	0313	0.287	0.340		0,264
Spear shrimp			F	0.735				
Lα	2.350	2470	E	0203				
K	0.655	0690	L_{50}	1731				
Rn	0.179	0.165	L_{75}	1.829				
M	2881		Lc/Lα	0.737				
M/K	4,398		Mean F	0.701				
Spawning	January	September	Mean E	0.196				

Note: F & E obtained from catch curve routine *in* ELEFAN II Mean F & Mean E obtained from VPA II routine n ELEFAN III Rn (goodness-of-fit index) = $=10^{(ESP/ASP)}/10$

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Analysis of the length-frequency data of the selected species indicated two recruitments per year for each selected species. This implied two peak spawning seasons in a year, which is quite normal for penaeid shrimp in tropical waters.

By extrapolating the growth curves suggested by ELEFAN I, the two peak spawning seasons of each species was estimated (Table 7). There appeared to be some slight differences in the growth parameters of the different cohorts of the same species when the best growth curves were obtained. This may be due to sampling errors or the pooling of male and female shrimp data. There is also a possibility that the differences are valid and are due to environmental factors which may affect the growth of these shrimp.

3.7 Population sizes and fishing mortalities

The results obtained from the VPA II analysis are summarized in Table 8, which shows the estimated population at the size of entry into a fishery, the size at entry and the total catch by each gear of the selected species (except for Spear shrimp). In some species, the analysis of the pooled data gave a carapace-length at entry into a fishery which was different from that for the first gear to recruit these shrimp. This may be due to different length-intervals being used in the separate analysis.

Table 8: Estimated population (numbers x 106) at size of entry (carapace-length, cm) into the different fisheries and the total catch (numbers x 106)

Species / *Gear:*	*TWL*	*PN*	*TRN*	*BN*	*All fisheries combined*
Banana shrimp					
Carapace-length	1.8	1.0	1.8	0.5	0.4
Population	1,427,634	296,309	163,108	427,975	4,591,930
Total catch	528,842	109,312	33,107	130,580	673,589
Jinga shrimp					
Carapace-length	0.8	1.0	1.4	0.8	0.8
Population	4,398,178	4,015,133	269,494	524,194	4,977,210
Total catch	2,285,396	1,765,866	84,627	234,814	1,329,109
Yellow shrimp					
Carapace-length	0.8	1.0	1.3	0.4	0.4
Population	11,261,394	8,055,947	525,994	1,958,130	20,601,995
Total catch	2,780,565	2,662,887	147,475	556,786	2,568,581
Rainbow shrimp					
Carapace-length	1.1	1.0	2.0		1.0
Population	2,601,860	295,390	1,339		2,949,140
Total catch	813,885	84,766	455		779,399

The fishing mortalities and the exploitation rate which were obtained from the catch curve of ELEFAN II, and the mean F and mean E, which were obtained from VPA II of the ELEFAN III programme, are to be found in Table 7.

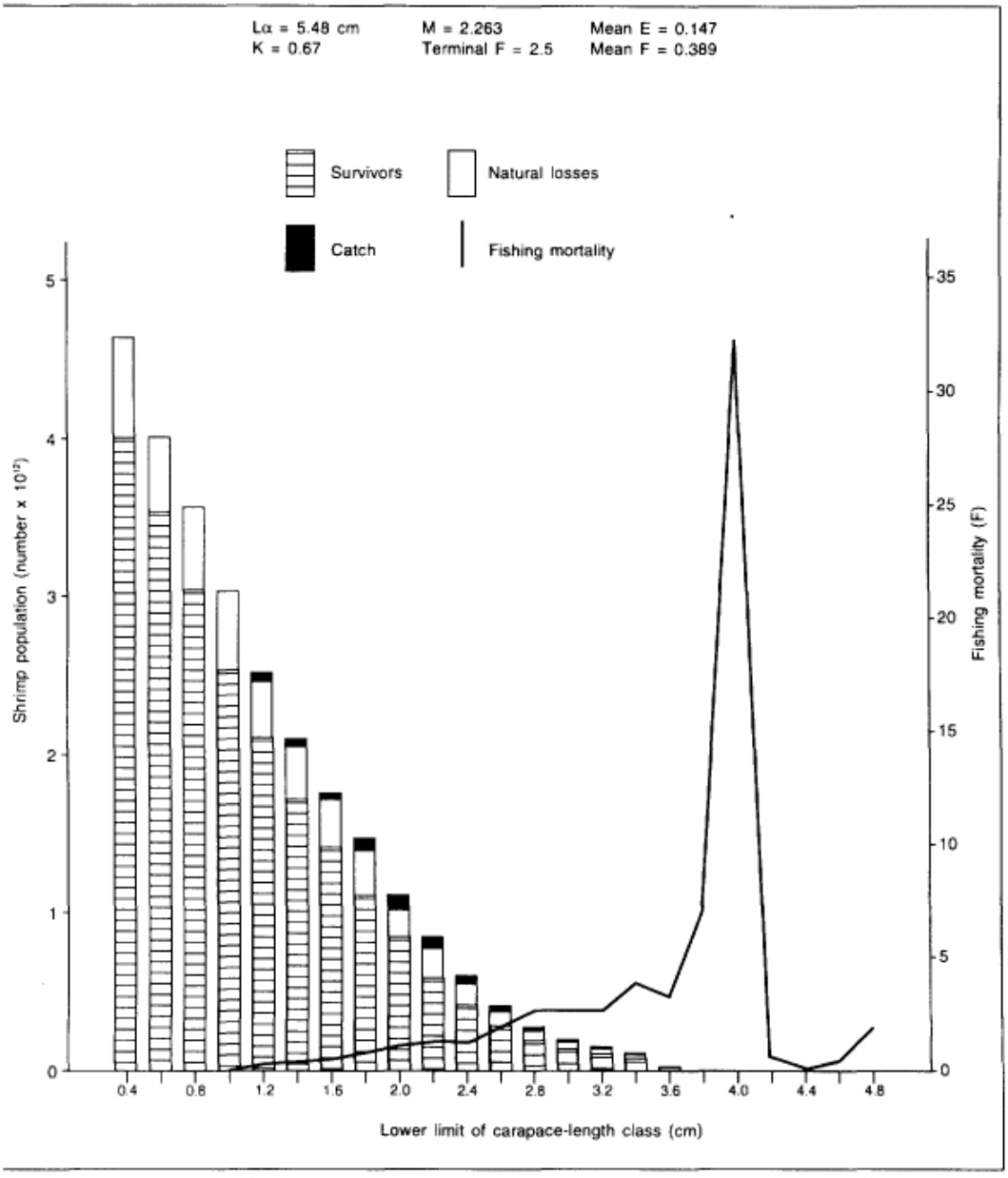
Brief discussions on each of the selected species, regarding their respective population sizes and fishing mortalities, are presented in the pages that follow. Spear shrimp is not discussed as this species was not caught in three of the gear exploiting the shrimp resources in this area.

It should be noted that the analysis assumes the natural mortality of each species to be constant throughout the different length classes.

BANANA SHRIMP

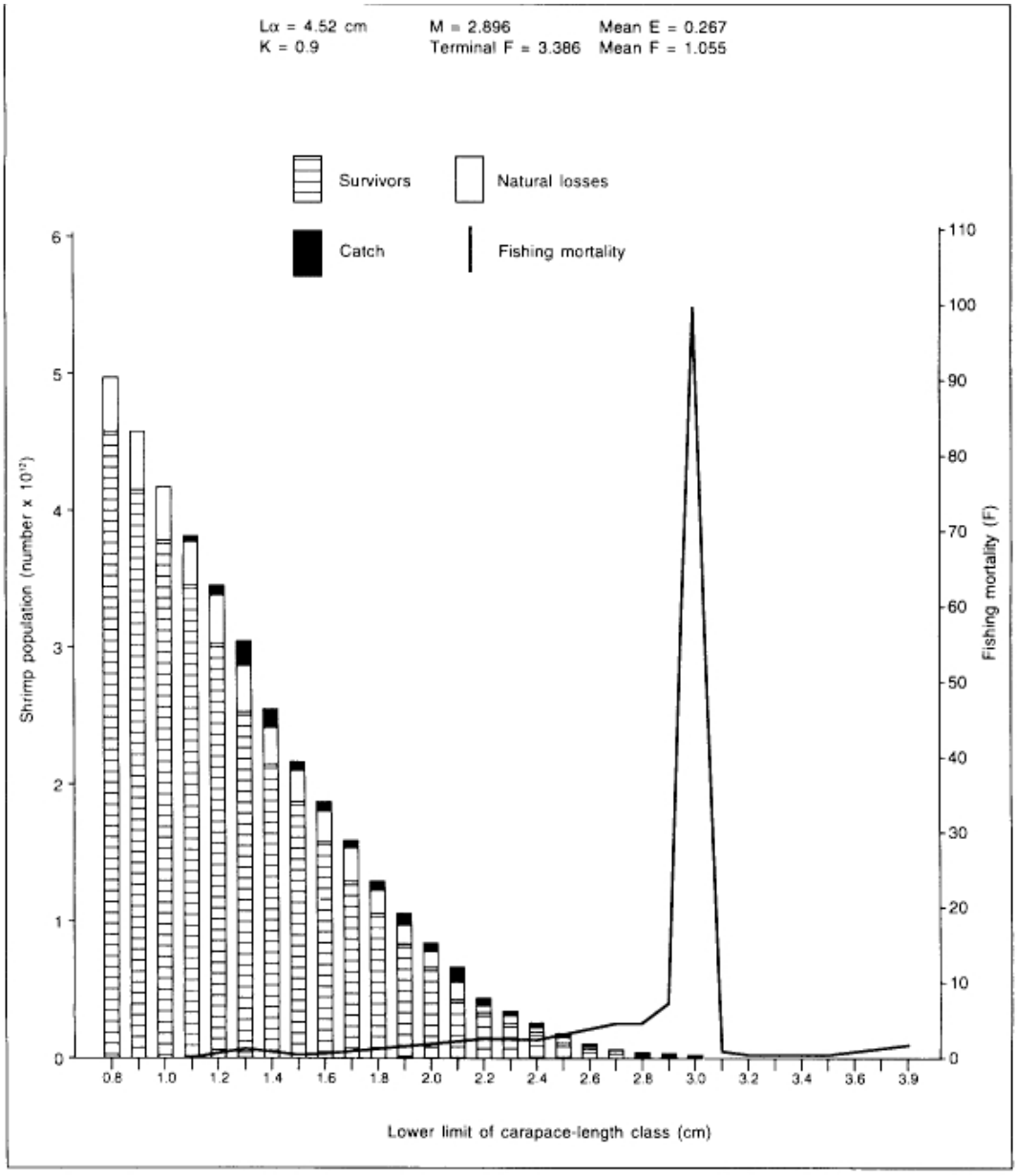
The VPA analysis of the pooled data of this species indicated a population size of about 4.6 x 10^{12} at a carapace length of 4-5 mm (see Figure 13), which was the size of entry into BN. Catches were small and the fishing mortality was quite low among the smaller-sized shrimp. For carapace-lengths of about 13 mm, F was 0.2 although the shrimp of this species started to be recruited into the PN fishery at 10 mm carapace-length. When these shrimp reached carapace-lengths of 18-20 mm, at which size they started to be recruited into the TWL and TRN fishery, their population size was estimated to be 1.45 x 10^{12}, which was 31.5 per cent of the initial population. F at this size class, when all gear were exploiting the species, was estimated to be about 0.7.

Fig 13. Length-structured Virtual Population Analysis of Banana shrimp



The population size of this species at 8 mm carapace-length was estimated to be 4.98 x 10^{12}. (Figure 14). At this size, these shrimp started to he recruited by TWL and BN, although the catch and, consequently, the fishing mortality were very low. PN began to recruit these shrimp at carapace-lengths of 10-11 mm. At this stage, F was still very low, *i.e.* about 0.01. There appeared to be a big increase in F to 1.2 when these shrimp attained carapace-lengths of 12-13 mm. When the fourth gear, *i.e.* the TRN, began to exploit this species at around 14-15 mm carapace-length, **F** was estimated to be approximately 1.4. At this size, the population size of the species was estimated to be 2.5 x 10^{12}, which is 50 per cent of the initial population.

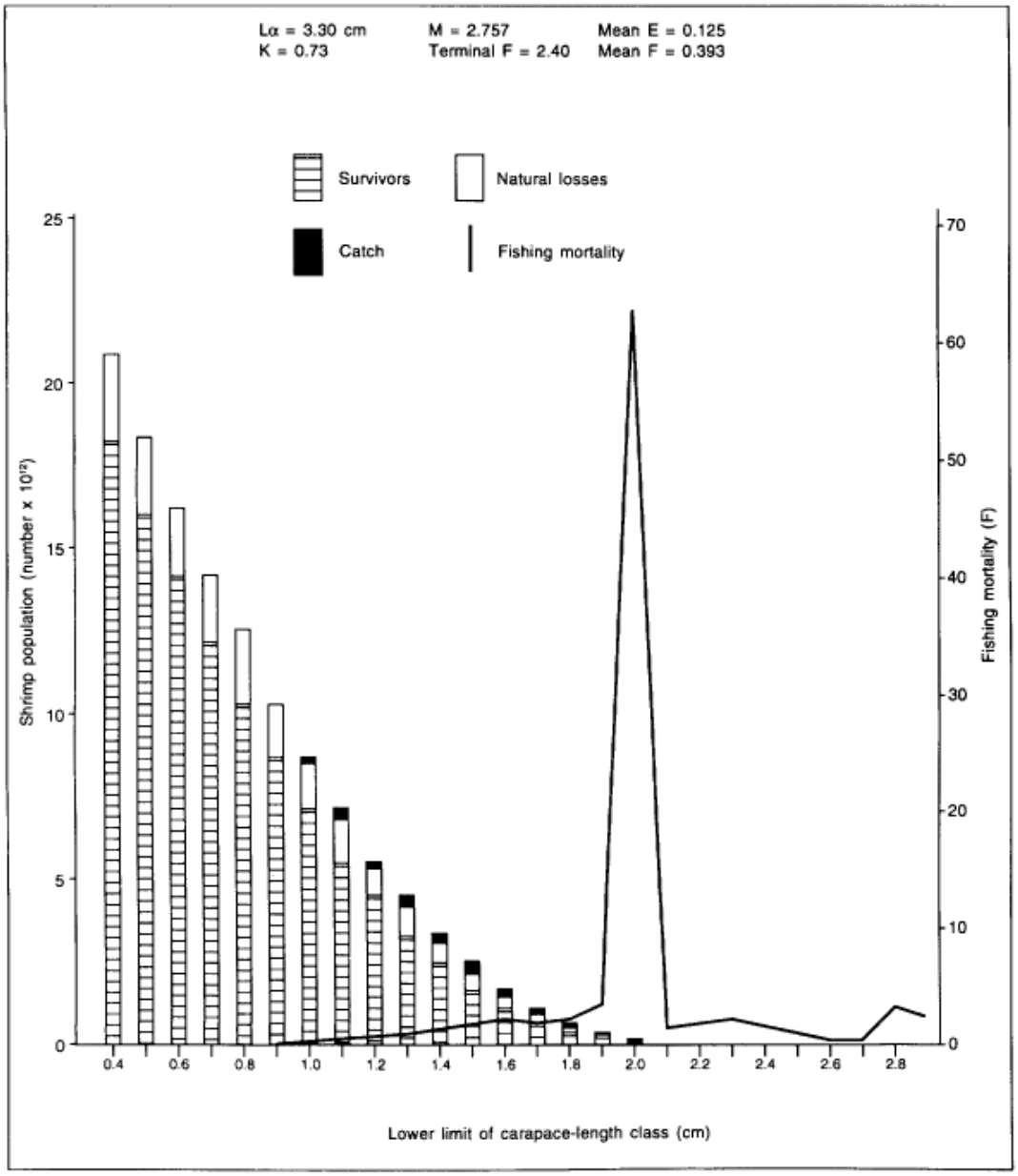
Fig 14. Length-structured Virtual Population Analysis of Jinga shrimp



YELLOW SHRIMP

The population of this species at the carapace-length class of 4-5 mm was estimated to be 20.6 x 10^{12} (Figure 15). This was the size of first entry into BN, the first gear to exploit these shrimp. The fishing mortality at this length was estimated to be .0001 and, thus, the catch here was very low. TWL, the second gear to catch these shrimp, began to recruit them at a carapace-length class of 8-9 mm. Here, too, the catch was very low, with F estimated at 0.01. The third gear to catch this species was PN at the carapace-length class of 10-11 mm. F here was estimated at 0.3, while the population at this length class was estimated at about 8.55 x 10^{12}, or 41.5 per cent of the starting population at the size of first entry into a fishery. TRN, the last gear to exploit these shrimp, did so at the carapace-length class of 13-14 mm. At this size, F was estimated to be 1.0, while the population was estimated at around 4.57 x 10^{12}, which was 22 per cent of the population size at 4-5 mm and 53.5 per cent of the population at the carapace-length class of first entry into PN.

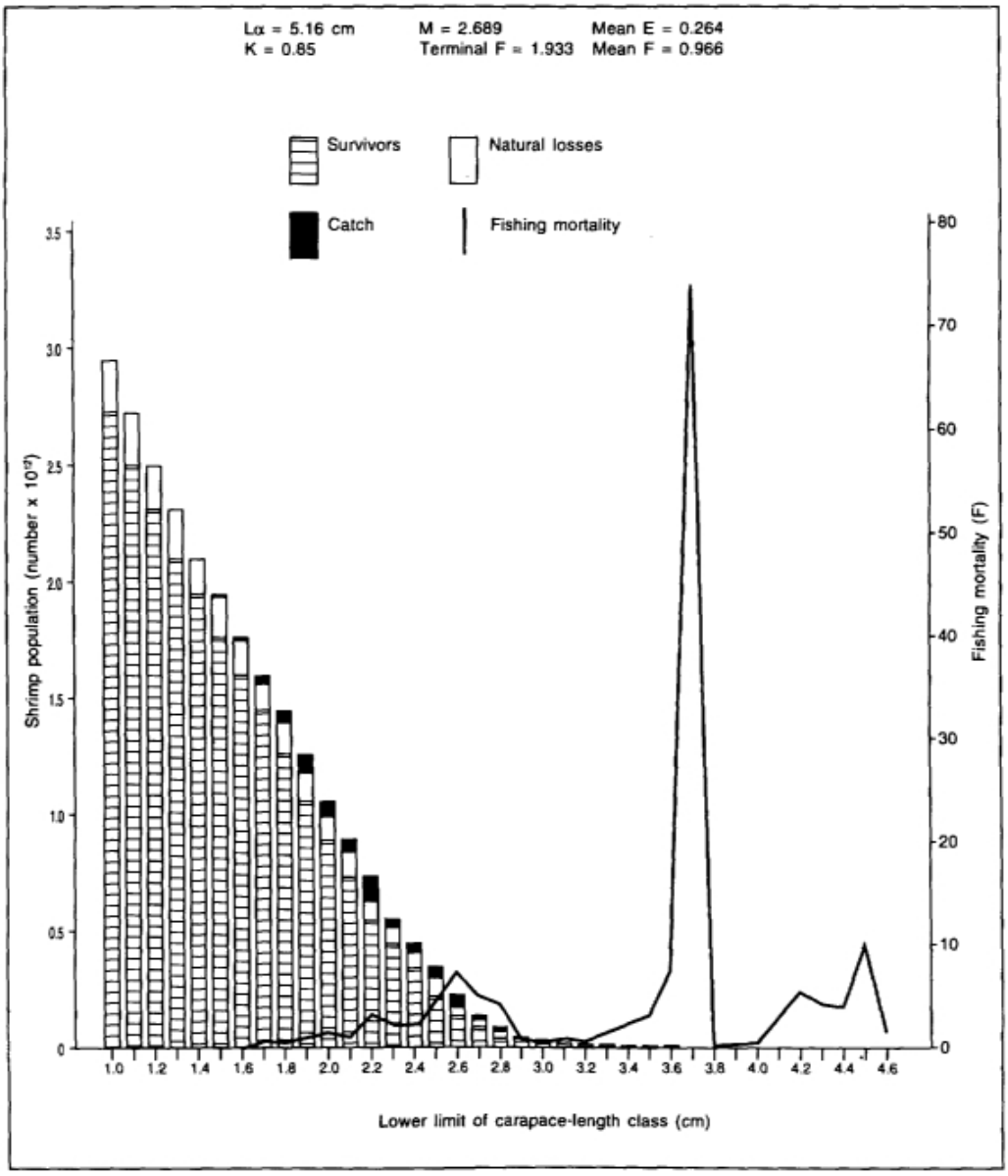
Fig 15. Length-structured Virtual Population Analysis of Yellow shrimp



RAINBOW SHRIMP

The smallest size at which this species was caught was about 10 mm carapace-length and the population at that size was estimated at 2.95 x 10^{12} (see Figure 16). Although these shrimp were also found in the BN catches, the quantity was estimated to be very small and did not exhibit a reasonably good length-frequency distribution. Thus, BN was not considered in the analysis of this species. The first gear to actively exploit this species was PN and it did so at the carapace-length mentioned above. The fishing mortality at this stage was estimated at 0.002. The second gear was the TWL, which started to recruit these shrimp at a slightly larger size, *i.e.* at 11-12mm carapace-length. The population at this size was estimated at 2.73 x $\mathbf{10^{12}}$ and F, at .02, was still very low. The last gear to recruit these shrimp was the TRN at 20-21 mm carapace-length. By then, the population size was estimated at about 1.08 x 10^{12}, or 36.7 per cent of the population at first entry into a fishery. At this stage, F appeared to have increased greatly, to 2.9.

Fig 16. Length-structured Virtual Population Analysis of Rainbow shrimp



3.8 *Relative yield, revenue and biomass per recruit analysis*

This analysis was done to compare the differences in the relative yield/recruit (Y/R) and revenue/ recruit (V/R) of the selected species by using the various gear (see Figures 17 to 20 in the pages that follow). The analysis gives an indication of the gain or loss by using a particular gear. The exploitation rates at the maximum relative yield per recruit and at 50 per cent of unexploited biomass are give in Table 9.

Table 9: Exploitation rates, E, **for maximum yield per recruit (Y/R) and at 50% residual biomass for selected species by gear**

Gear:	*TWL*	*PN*	*TRN*	*BN*
Species				
Banana shrimp				
E at maximum Y/R	0.860	0.528	1.000	0.778
E at 50% of unexploited biomass	0.354	0.261	0.360	0.306
Jinga shrimp				
E at maximum Y/R	0.863	0.892	0.806	0.826
E at 50% of unexploited biomass	0.356	0.360	0.302	0.351
Yellow shrimp				
E at maximum Y/R	1.000	0.868	1.000	1.000
E at 50% of unexploited biomass	0.375	0.351	0.423	0.367
Rainbow shrimp				
E at maximum Y/R	0.661	0.601	1.000	
E at 50% of unexploited biomass	0.320	0.307	0.405	

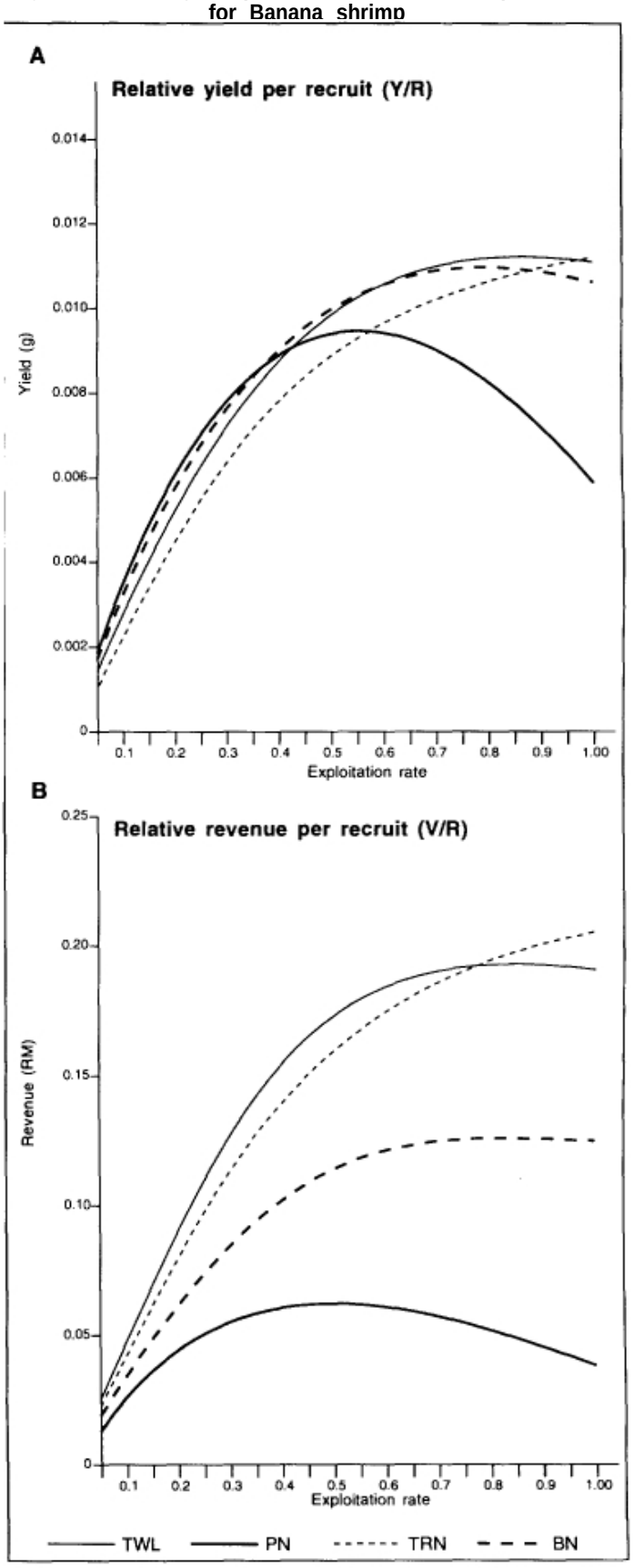
BANANA SHRIMP

Among the four gear that exploit this species, PN appears to have the lowest value of exploitation rate at maximum Y/R (0.53) (see Figure 17a). It also has the lowest maximum Y/R. This may indicate that the gear is relatively more damaging to this species when compared to the other gear.

The most efficient gear in terms of conservation of this species appears to be TRN, as the exploitation rate at maximum Y/R for this gear is 1.0, which is typical for such a highly selective gear. Following TRN are the TWL and BN. The exploitation rates of both TRN and TWL, at 50 per cent of the unexploited biomass, are also very similar.

When relative revenues/recruit (V/R) are considered, PN again reaches the optimum exploitation rate earlier than the other gear, and at a much lower maximum *V/R* (Figure l7b). BN appears to have the next lowest maximum Y/R and is followed by TWL and TRN, the latter showing that it yields the best value for this species.

Fig 17. Relative yield per recruit and revenue per recruit for Banana shrimp

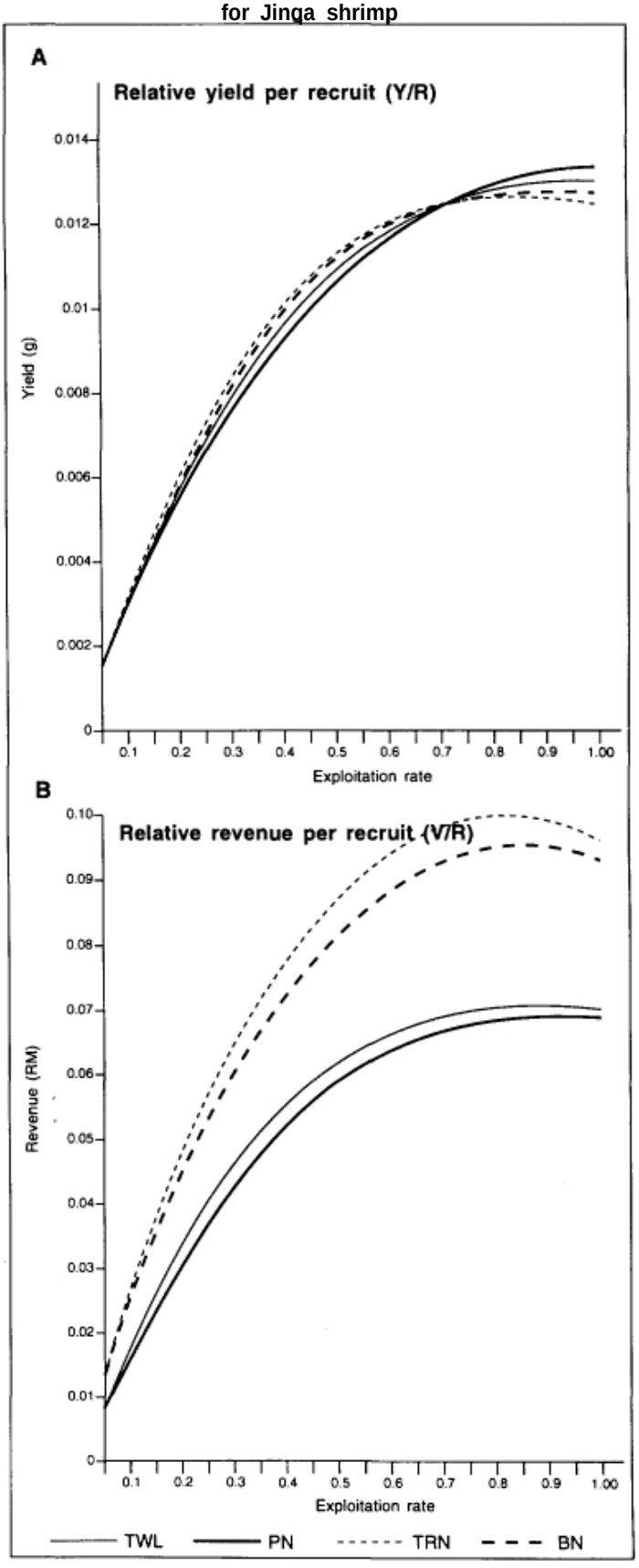


JINGA SHRIMP

There appears to be very small differences among the values of the exploitation rates at maximum Y/R for all four gear (Figure 18a). The same is true when the exploitation rates at 50 per cent unexploited biomass are considered. This may imply that all four gear have more or less the same effect on the conservation of this species.

However, it appears that TRN has the best maximum V/R among all four gear, followed by BN, TWL and PN (Figure 18b). The V/R curve for BN may be misleading, as the weighted average price (RM/kg) of this species may have been overestimated by including in the calculation the higher revenue from dried shrimp of this species.

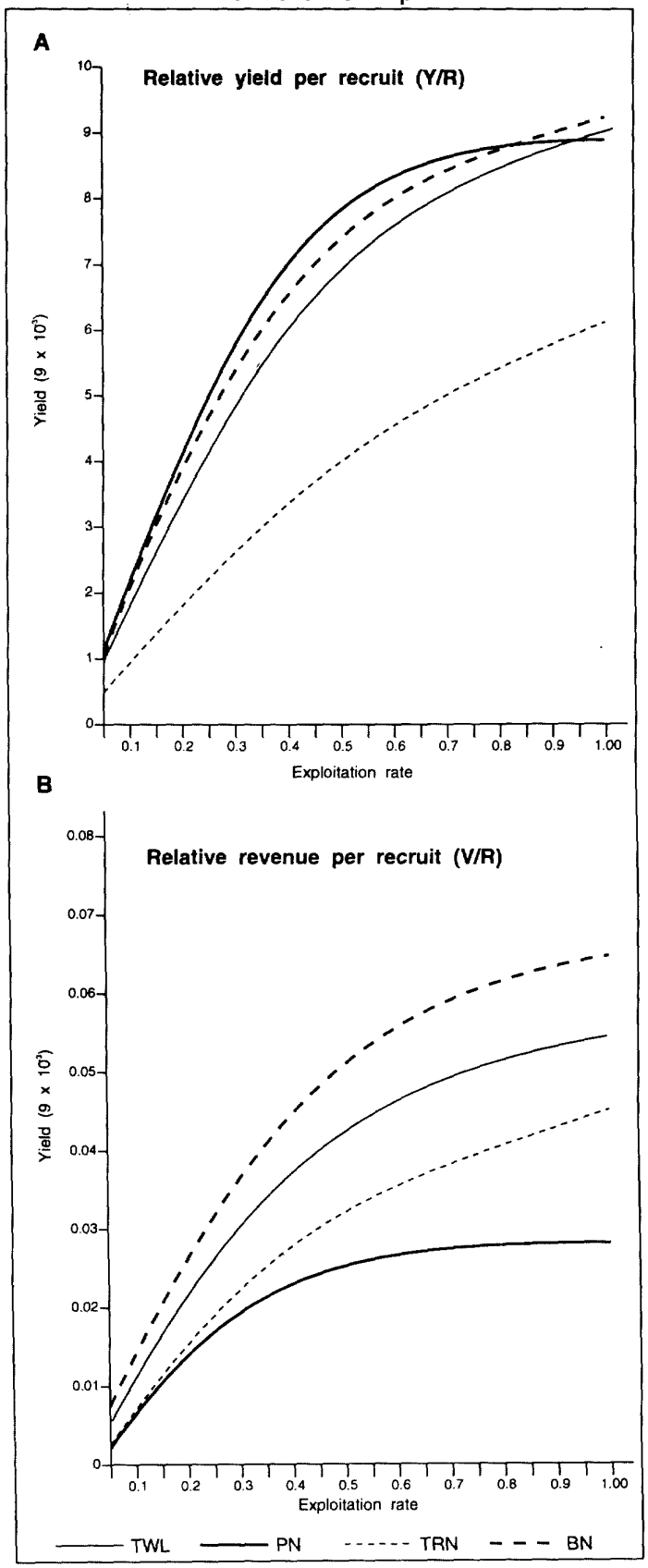
Fig **18. Relative yield per recruit and revenue per recruit for Jinga shrimp**



YELLOW SHRIMP

Once again, PN reaches the optimum exploitation rate earlier than the other gear (Figure 19a), implying that this gear is the least efficient in terms of conservation of this species. The analysis for this species also showed that each of the other three gear have an optimum exploitation rate of 1.0, implying that at the maximum Y/R, fishing mortality, F, is equal to total mortality, Z. Thus, for comparison purposes, the Y/R at the exploitation rate of 0.5 was considered for these three gear. It appears that at this level of exploitation, BN gives the best V/R, followed by TWL and TRN. However, TRN has the highest value for exploitation rate at 50 per cent of the unexploited biomass, which may suggest that this gear is the least damaging to this species.

Fig 19. Relative yield per recruit and revenue per recruit for Yellow shrimp

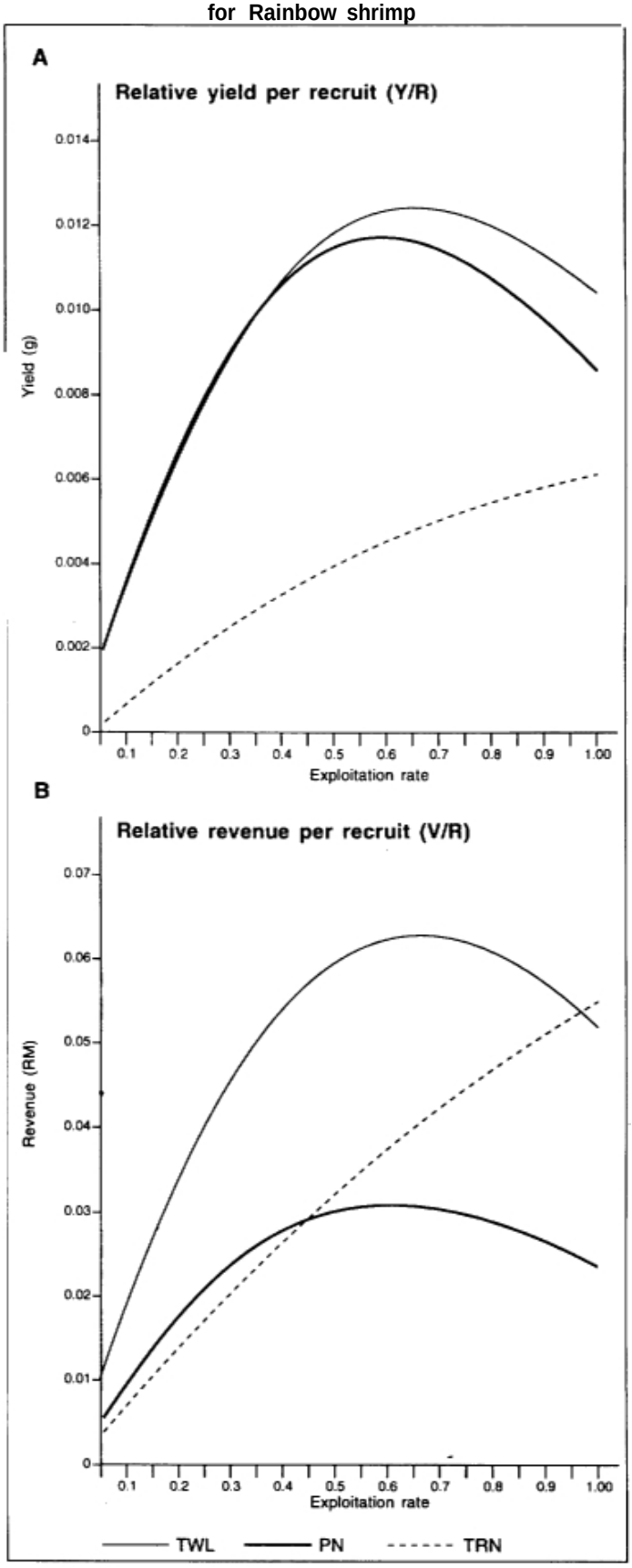


RAINBOW SHRIMP

The Y/R of TWL and PN for this species appears to be very similar up to a level of exploitation of approximately 0.4 (Figure 20a). The optimum exploitation rate for PN is 0.6, while that for TWL is slightly higher at 0.66. TWL appears to have a slightly higher maximum Y/R than PN. TRN again reaches maximum Y/R at the maximum exploitation rate. The exploitation rate at 50 per cent of the unexploited biomass too is higher than for the other two gear.

PN appears to have the lowest optimum exploitation rate for maximum V/R and its maximum V/R is also lower than the other two gear (Figure 20b). TWL has a lower optimum exploitation rate than TRN, but a higher maximum V/R. When the V/R at 0.5 exploitation rate is compared, TWL has the highest V/R, followed by TRN, which, in turn, is closely followed by PN.

Fig 20. Relative yield per recruit and revenue per recruit for Rainbow shrimp



3.9 *Thompson and Bell analysis for long-term forecast*

Figure 21 (on facing page) shows the results of the mixed species analysis of the individual gear. In these analyses, Banana shrimp, Jinga shrimp and Yellow shrimp were common in all gear. Rainbow shrimp was included in the analysis of all gear except BN, as the catch of this species in this gear was quite negligible. Spear shrimp was included in the analysis of TWL. It should be noted that the results given by these analyses are relative and not absolute.

The analysis for TWL indicates that the present level of fishing effort, *i.e.* where the fishing mortality factor, X, is equal to 1.0, is still below that giving the maximum sustainable yield (MSY), at which X = 5.5. It suggests that it is possible to increase the present level of exploitation. Similarly, the analysis suggests that the present level of effort by TWL is still below the optimum effort for the maximum sustainable economic yield (MSE), which is at X = 2.0. The residual biomass at the level of optimum fishing mortality factor, *i.e.* at maximum yield, is 35 per cent, which indicates that there is no serious risk of residual overfishing. However, the economic yield at MSY will be reduced by about 9 per cent.

The optimum level of fishing effort for PN is estimated to be 3.5 times that of the present effort. Thus,it appears that there is still scope for increasing the present effort. However, in terms of MSE, the present rate of fishing mortality is closer to that of the optimum level, at X = 1.8. This is probably due to this gear catching a lot of smaller-sized shrimp, whose values are low, especially when compared to older and bigger specimens. The residual biomass when the fishing mortality factor is at the optimum level is 26 per cent, which is about the percentage generally considered the minimum residual biomass required for replenishment of penaeid shrimp stocks. The value at this level of fishing mortality factor will, however, drop by about eight per cent.

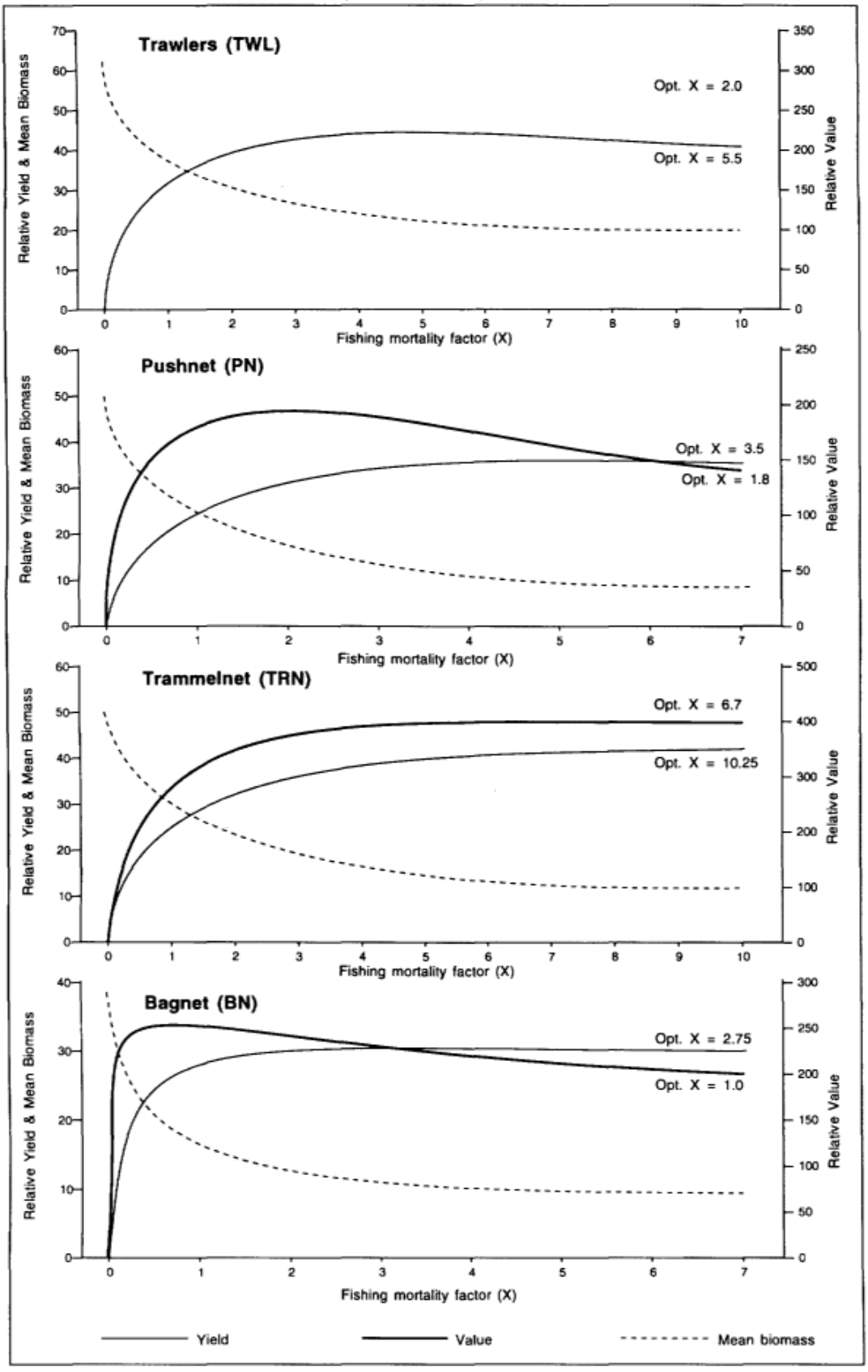
It appears that the present level of the TRN fishing effort is still far below that of the optimum level for MSY, at X = 10.25, and for MSE, at X = 6.7. This is probably due to the high selectivity of this gear, which catches large-sized and more valuable shrimp, especially when compared to PN. The residual biomass at optimum fishing effort is 25 per cent. As mentioned earlier, this is just about the required minimum percentage. However, the decline in value at this level is very small, *i.e.* approximately 0.5 per cent.

The present effort of BN is still below the optimum level for MSY at X = 2.75. However, the optimum effort for MSE has already been reached. The residual biomass at the optimum fishing mortality factor is 31.4 per cent, while the value at this level will be decreased by eight per cent.

TRN and PN show relatively lower residual biomass than TWL and BN. In the case of PN, this is probably due to the large amount of smaller-sized shrimp being caught by this gear. For TRN, the relatively lower residual biomass is probably due to the reduction of the population by natural causes during the long period of growth prior to recruitment by this gear which catches larger-sized shrimp.

To demonstrate by example, the effects of interactive fishing upon the same shrimp stock but at different life stages, an analysis was also carried out to study the effect on the TWL catch of Banana shrimp **IF** PN and BN were not allowed to exploit this species. TWL was selected for this analysis because it is by far the most numerous fishing gear in this area and, thus, contributes the largest component of the total fishing effort. Banana shrimp was selected for this analysis because this species has the highest average price among the main species caught by TWL. The elimination of BN and PN was considered because these gear start to exploit this species at a much smaller size when compared to TWL. Besides, PN is also an illegal gear. Jinga shrimp, Yellow shrimp and Rainbow shrimp were not included in this analysis because TWL starts to recruit these species at similar or smaller sizes than PN.

Fig 21. Thompson and Bell long-term forecast for combined selected species with all four gear operating



The result of this analysis (Figure 22) shows that both MSY and MSE for this species caught by TWL increase by 20 per cent when PN and BN are not operating, while having a higher residual biomass.

4. ECONOMICS OF SHRIMP FISHING

4.1 Costs and earnings

The monthly costs and earnings for the various types of gear are shown in Appendices I-IV. Generally, it appears that all the fishing gear studied are profitable throughout the year, even after taking into account fixed costs. Although all of them give positive net earnings throughout the year, certain months do exhibit a better performance than others.

The annual costs and earnings of the various gear are detailed in Figure 23. TWL yields the highest net annual earnings (RM 19,750), while BN yields the lowest (RM *5,445).* Revenue from by-catch has been included in the calculation of earnings for TWL, even though some shrimp trawl fishermen discard their by-catch at sea. However, even if revenue of by-catch is excluded from the calculation, TWL is still profitable yielding positive net annual earnings.

To compare the economic performance of the various gear, the benefit-cost ratio, annual rate of return on investment, Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated and the results are shown in Table 10.

Fig 22. Thompson and Bell long-term forecast on the relative yield, mean blomass and value of Banana shrimp by TWL with (A) all other gear operating and (B) no pushnet and bagnet operating

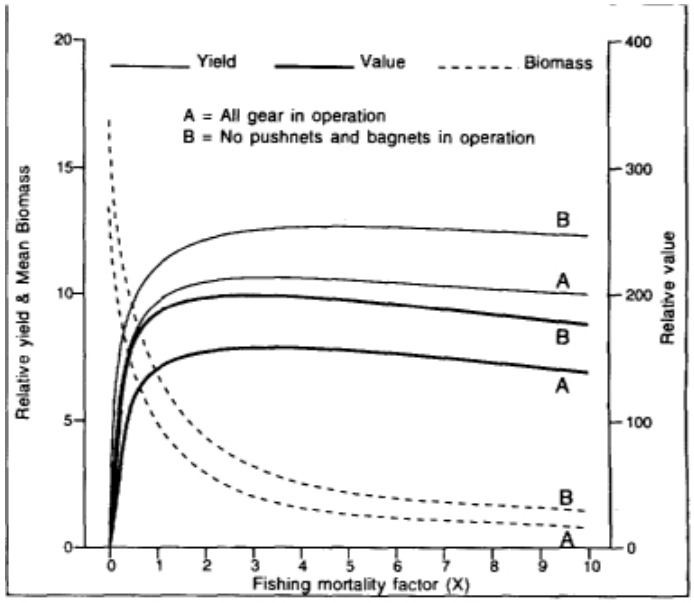


Fig 23. Annual costs and earnings for all gear

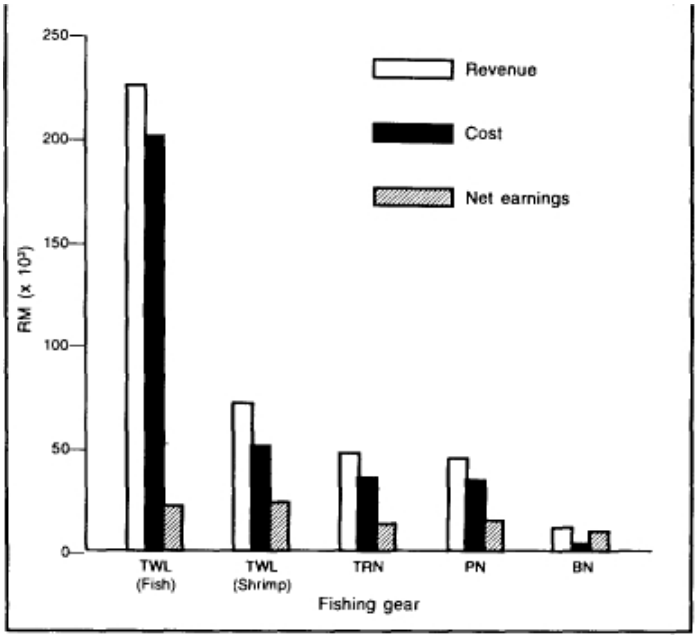


Table 10: Cost of investment, benefit-cost, annual rate of return on investment, Internal Rate of Return (IRR) and Net Present Value (NPV) by types of gear

indicator	*Fish trawler*	*Shrimp trawler*	*Trammel-net & boat*	*Push-net & boat*	*Bag net & boat*
Cost of investment (RM)	57,380	30,760	14,560	10,770	11,230
Benefit-cost ratio	1.09	1.36	1.30	1.37	3.03
Annual rate of return on inVestment (%)	31.6	64.2	69.2	97.8	48.5
IRR (%)	39.4	73.1	79.0	107.0	57.7
NPV (RM)	106,956	133,617	68,813	74,147	35,553

Generally, all the gear studied exhibit good economic performances. However, some economic performance indices, such as benefit-cost ratio and IRR, can be misleading and should be used in relation with other estimates such as net earnings and NPV, as suggested by Sivasubramaniam (1991). For example, BN yields the lowest net earnings, but it gives the highest benefit-cost ratio as it operates at a very low cost. TWL gives the highest NPV, at RM 133,617. Due to its low investment cost, PN yields the best annual rate of return on investment and IRR. However, PN is an illegal gear under the present Fisheries Act (1985), its operations having been banned following objections to its use by other traditional fishermen and cockle culturists in the area. This is because the PN is operated in shallow coastal waters as well as in estuarine areas full of mangrove vegetation, its areas of operation being limited to these because it cannot be operated in waters deeper than 3 m.

4.2 Share system

A system of sharing earnings with crew exists in all the fisheries studied. However, the share system varies with each gear type. The number of persons operating each gear and the percentage of share by types of gear are shown in Table 11.

Table 11: Share system

Function	Fish TWL		Shrimp TWL		TMN		PN		BN	
	No. of persons	% share*	No. of persons	% share*	No. of persons	% share*	No. of persons	% share*	No. of persons	% share*
Owner/Skipper share†	1	30	1	30	1	30	1	30	1	100
Ordinary crew share	2	30	1	27	1	30	1	30	0	0
Total persons operating	3	60	2	57	2	60	2	60	1	100
Vessel share	—	40	—	43	—	40	—	40	—	—
Total share	—	100	—	100	—	100	—	100	—	100

* Percentage share of net revenue, i.e. Gross Revenue - Cost of diesel and ice

† Owner may also be the skipper

All TRN and BN are operated by owners, while the rest are either owner-operated or otherwise.

The fish trawlnet is usually operated by three persons, while the shrimp TWL, TRN and PN are operated by two. The BN is usually operated by the owner alone and, at times, with the help of a family member. The TRN is operated by the owner with the help of one crew. The fish TWL, shrimp TWL and PN can either be owner-operated or otherwise. If it is operated by the owner, he will get a share of 30 per cent in addition to a vessel share of 40-43 per cent. Sharing is done after deducting costs of fuel and ice from gross revenue.

Table 12 shows average income of owner, skipper and crew for each fishing gear.

Table 12: Average incomes by types of gear and functions in vessel **(RM)**

Gear	Function	Jun 92	Jul 92	Aug 92	Sep 92	Oct 92	Nov 92	Dec 92	Jan 93	Feb 93	Mar 93	Apr 93	May 93	Total	Average
Fish TWL	Owner operator's Income	2434	2454	2474	4914	4904	5004	4854	4224	2074	984	2254	2504	40,078	3340
	Owner nonoperator's income	995	1015	1035	2425	2413	2515	2365	2091	84!	545	813	065	18.122	1510
	Skipper's income	439	1439	1439	2489	2489	2489	2489	2133	233	1439	1439	1439	21,956	1830
	Crew'sincome	719	719	719	1244	1244	1244	1244	1067	617	719	719	719	10.974	915
Shrimp TWL	Owner operator's income	2334	2385	1989	1039	4092	4746	**2894**	4061	3150	3908	3618	3813	38,029	3189
	Owner nonoperalor's income	1112	1189	955	400	2198	259!	1482	2186	1654	2070	1886	2027	19,750	648
	Skipper's income	1222	1196	1834	639	1694	2155	1412	875	1496	1838	1732	1786	18.279	1523
	Crew's income	1100	1077	93!	576	1704	1940	1271	1688	1346	1054	1559	1607	16.453	1371
TRN	Owner operator's income	2166	1097	1154	644	1409	2188	1976	1829	1971	2414	2088	842	20.778	1732
	Crew's Income	1098	621	837	425	75!	1078	999	927	984	1180	1050	954	10,794	892
PN	Owner operator's inconse	1369	1416	1857	1353	1544	3004	1647	1355	304	1734	2203	2153	28,939	1745
	Owner nonoperator's income	03!	705	945	653	765	603	819	657	64!	868	1140	1105	10,532	878
	Crew's income	736	711	912	706	779	1401	828	098	663	866	063	1048	10.407	867
BN	Owner operator's Income	806	642	248	648	530	424	116	282	319	29!	565	574	5445	454

It can be seen that none of the fishermen in the area are below the cut-off poverty income of 370 RM/month, On an average, the owner of any type of gear, except BN, receives more than 1,000 RM/month, while crew get a monthly income of more than RM 800. Figures 24-27 below show the monthly incomes of owner, skipper and crew for each type of fishing gear. TWL is the most rewarding gear, yielding the highest income to owners, with an average of over 3,000 RM/month, while BN fishermen are the lowest income group, averaging less than 500 RM/month.

Fig 24. Owner's income for all gear (when owner is an active fisherman)

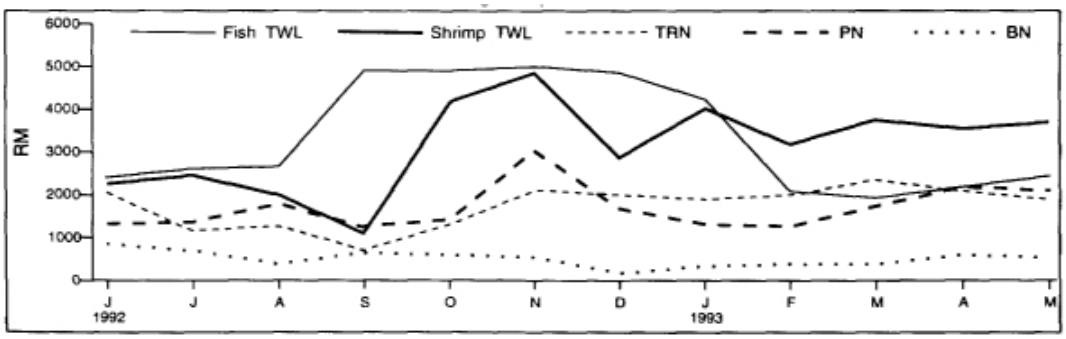


Fig 25. Owner's income for all gear (when owner does not join in the fishing operation)

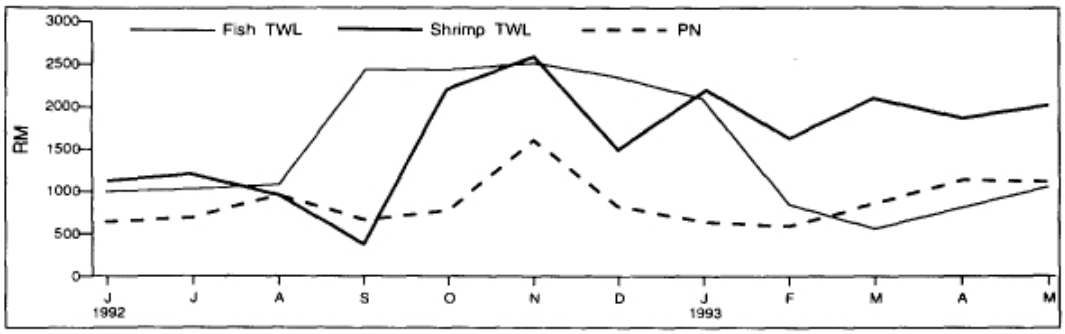


Fig 26. Skipper's income for all gear

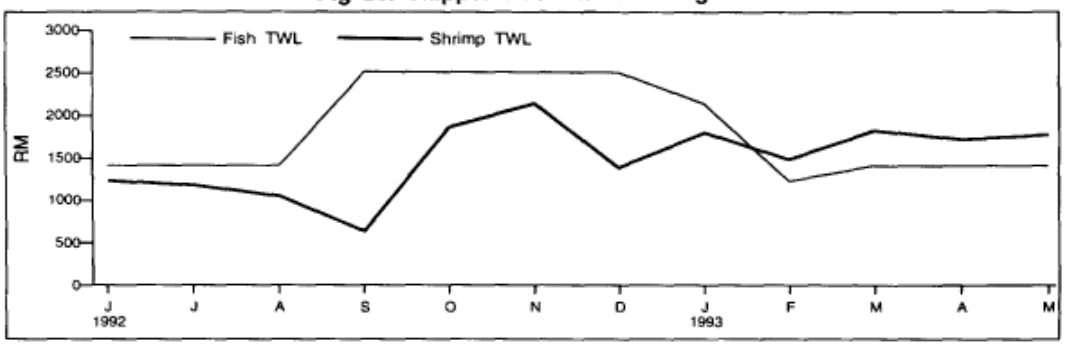
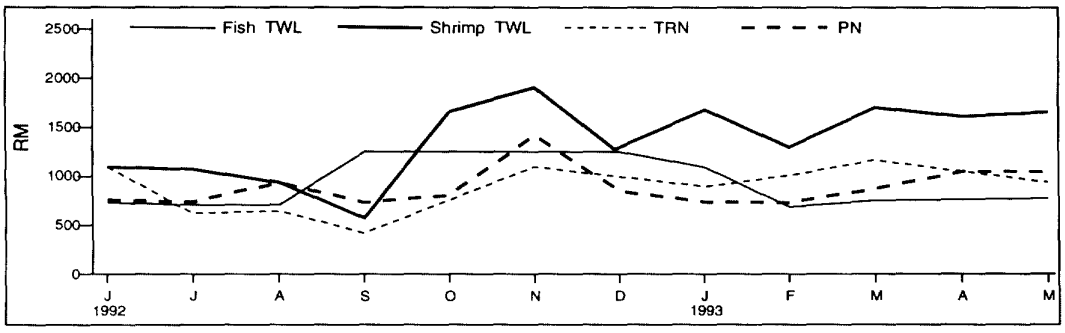


Fig 27. Crew's income for all gear



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5. SOCIOECONOMIC FINDINGS

5.1 *Village profile*

Kuala Sepetang is a coastal village situated along the west coast of Peninsular Malaysia in Perak State. It is connected by road to the nearest town, Taiping, about **15** km away. Kampung Menteri is situated adjacent to Kuala Sepetang and is easily accessible by road. Kuala Sangga is located along the coast of Sangga Kecil Island, which is about three nautical miles from Kuala Sepetang and can only be reached by boat.

Most houses in the three villages are semi-permanent structures, because all land in these villages has been leased from the Government. All three villages have public telephones, public health clinics and schools up to primary level. The nearest secondary education facility is in Simpang, about 9 km from Kuala Sepetang, on the road to Taiping. There is a post and telegraph office, a finance company and two fishermen's cooperative societies in Kuala Sepetang. These two cooperative societies provide credit and marketing services to fishermen in the three villages. There are also various types of shops in Kuala Sepetang catering to the fishing and basic needs of the people in the three villages. All households in Kuala Sepetang and Kampung Menteri are supplied with fresh water and electricity. However, these public amenities are not available in Kuala Sangga, and households here have to depend on rainwater, for consumption, and power generators for electricity. There are good bus and taxi services from Kuala Sepetang to Taiping.

There are about 930 households in **Kuala** Sepetang, 200 in Kampung Menteri and 50 **in** Kuala Sangga. Their population is estimated at 5,670, 1,320 and 350 respectively. The sampling found that the average number of persons per household is 6.1 in Kuala Sepetang, 6.6 in Kampung Menteri and 7 in Kuala Sangga. The majority (66 per cent) of the households have 6 to 8 persons (Table 13). The population of Kuala Sepetang and Kuala Sangga is Chinese, while Kampung Menteri's is Malay.

Table 13: Distribution of households (HH) by size of family

Persons/ HH	*Kuala Sepetang*	*Kampung Menteri*	*Kuala Sangga*	*Total*
<	1	0	0	
3 - 5	66	12	1	79
6 - 8	153	22	11	186
9 - 11	6	6	1	13
>11	0	2	0	2
Total	226	42	13	281

The ratio of males to females is almost 1 1 for all villages. The composition of dependent children under 15 years of age AND aged people (55 years and above) is highest in Kuala Sepetang (50%), followed by Kampung Menteri (45%) and Kuala Sangga (34%) (see Table 14). Children under 15 years of age accounted for 41 per cent of the total population and the average number of children per household was 2.6. Most (78%) of the aged male population are still actively engaged in some income-generating activities.

Table 14: Distribution of population by age group and sex

	Kuala Sepetang			*Kampung Menteri*			*Kuala Sangga*			*Total*		
Age Group	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*
0 - 6	128	106	234	14	19	33	6	3	9	148	128	276
7 - 15	190	164	354	30	39	69	10	11	21	230	214	444
16 - 20	50	84	134	26	20	46	6	8	14	82	112	194
21 - 30	97	94	191	22	17	39	13	7	20	132	118	250
31 - 40	72	86	158	19	15	34	3	5	8	94	106	200
41 - 50	88	87	175	14	14	28	5	8	13	107	109	216
51 - 54	22	14	36	3	3	6	5	0	5	30	17	47
55 & above	57	37	94	Il	11	22	0	1	1	68	49	117
Total	704	672	1376	139	138	277	48	43	91	891	853	1744

The ratio of working to nonworking population is 1 2 (see Table 15 below). The schoolgoing population forms the majority (48%) of the nonworking population. The unemployment rate is low among males (only 0.2%). However, among women it is quite high (17%), but most of those unemployed are actually housewives performing daily household chores.

Table 15: Distribution of working and nonworking population by sex

	Kuala Sepetang			*Kampung Menteri*			*Kuala Sangga*			*Total*		
Activity	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*
Working population												
Fishing	183	0	183	63	0	63	22	0	22	268	0	268
Fishery-related	37	0	37	0	0	0	9	0	9	46	0	46
Nonfishery	131	98	229	16	15	31	1	0	1	148	113	261
Subtotal	**351**	**98**	**449**	**79**	**15**	**94**	**32**	**0**	**32**	**462**	**113**	**575**
Nonworking population												
In school	225	216	441	45	54	99	11	9	20	281	279	560
Not in school (children aged below 16 years)	116	90	206	8	14	22	5	5	10	129	109	238
Aged (55 years & above)	10	37	47	5	11	16	0	1	1	15	49	64
Unemployed (16-54 years)	2	231	233	2	44	46	0	28	28	4	303	307
Subtotal	**353**	**574**	**927**	**60**	**123**	**183**	**16**	**43**	**59**	**429**	**740**	**1,169**
Total	**704**	**672**	**1,376**	**139**	**138**	**277**	**48**	**43**	**91**	**891**	**853**	**1,744**

The majority (61%) of the population out of school have education up to primary level (see Table 16 below). This is mainly due to the availability of education up to primary level within the villages. The illiteracy rate is low in these villages, with only about four per cent of the population being illiterate. About ten per cent of vessel-owners are illiterate, while for the crew it is less than one per cent. There is no university graduate from these villages and the highest educational level ever attained by anyone is Form Six, or 13 years of formal schooling.

Table 16: Distribution of population by educational levels and sex

	Kuala Sepetang			*Kampung Menteri*			*Kuala Sangga*			*Total*		
Activity	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*
Preschool children	115	90	205	8	14	22	5	3	8	128	107	235
School population												
Kindergarten	13	16	29	6	5	11	1	0	1	20	21	41
Primary	128	117	245	18	25	43	10	8	18	156	150	306
Lower secondary	62	49	111	12	13	25	0	1	1	74	63	137
Upper secondary/ vocational	21	32	53	9	9	18	0	0	0	30	41	71
From six/pre-u/tech	1	2	3	0	2	2	0	0	0	1	4	5
Subtotal	225	216	**441**	**45**	54	99	**11**	**9**	20	281	279	560
Out-of-school population												
No formal education	17	30	47	1	7	8	4	6	10	22	43	65
Primary	227	212	439	51	38	89	27	25	52	305	275	580
Lower secondary	114	122	236	32	24	56	1	0	1	147	146	293
Upper secondary/ vocational	6	2	8	1	1	2	0	0	0	7	3	10
From six/pre-U/tech	0	0	0	1	0	1	0	0	0	1	0	1
Subtotal	364	366	730	86	70	156	32	31	63	482	467	949
Total	**704**	**672**	**1,376**	**139**	**138**	277	**48**	**43**	**91**	**891**	**853**	**1,744**

Fishing is the primary income-generating activity in the villages, accounting for 71 per cent of the total income and creating about 47 per cent of the total employment in the villages (Tables 17 to 19). Overall, 64 per cent of the households in these villages are involved in fishing, with 22 per cent being solely dependent on it.

Table 17: Percentage of income contribution by economic activities in the villages

Activity	*Percentage of income*			
	K. Sepesang	*Kg. Menteri*	*K. Sangga*	*Overall*
Fishing	70	84	70	71
Fishery-related	10	1	30	10
Nonfishery	20	15	0	19
Total	**100**	**100**	**100**	**100**

Table 18: Distribution of working population by main occupation

Occupation	*Kuala Sepetang*		*Kampung Menteri*		*Kuala Sangga*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Fishing								
Fisherman/Owner-operator	60	13.4	3	3.2	11	34.4	74	12.9
Fisherman/Owner-nonoperator	31	6.9	0	0.0	0	0.0	31	5.4
Fisherman/Skipper	26	5.8	0	0.0	0	0.0	26	4.5
Fisherman/Crew	66	14.7	60	63.8	11	34.4	137	23.8
Subtotal	**183**	**40.8**	**63**	**67.0**	**22**	**68.8**	**268**	**46.6**
Fishery-related								
Fish dealer/Towkay	18	4.0	0	0.0	0	0.0	18	3.1
Fish transporter	3	0.7	0	0.0	0	0.0	3	0.5
Aquaculturist	4	0.9	0	0.0	9	28.1	13	2.3
Salt supplier	1	0.2	0	0.0	0	0.0	1	0.2
Ice supplier	1	0.2	0	0.0	0	0.0	1	0.2
Commission agent	10	2.2	0	0.0	0	0.0	10	1.7
Subtotal	**37**	**8.2**	**0**	**0.0**	**9**	**28.1**	**46**	**8.0**
Nonfishery								
Nonfishery business	53	11.8	11	11.7	0	0.0	64	11.1
Construction labourer	10	2.2	0	0.0	0	0.0	10	1.8
Factory worker	65	14.5	17	18.1	0	0.0	82	14.3
Retailer	25	5.6	0	0.0	0	0.0	25	4.3
Shopowner	5	1.1	1	1.1	0	0.0	6	1.0
Government staff	3	0.7	2	2.1	1	3.1	6	1.0
Private sector staff	67	14.9	0	0.0	0	0.0	67	11.7
Other	1	0.2	0	0.0	0	0.0	1	0.2
Subtotal	**229**	**51.0**	**31**	**33.0**	**1**	**3.1**	**261**	**45.4**
Total	**449**	**100**	**94**	**100**	**32**	**100**	**575**	**100**

Table 19: Distribution of households by types of economic activities

Household	*Kuala Sepetang*		*Kampung Menteri*		*Kuala Sangga*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Fishing only	47	20.8	10	23.8	5	38.5	62	22.1
Fishing & Fishery-related	23	10.2	1	2.4	7	53.8	31	11.0
Fishing & Nonfishery	45	19.9	23	54.8	0	0.0	68	24.2
Fishing,Fishery-related & Nonfishery	13	5.8	5	11.9	0	0.0	18	6.4
Fishery-related only	15	6.6	0	0.0	1	7.7	16	5.7
Fishery-related & Nonfishery	16	7.1	0	0.0	0	0.0	16	5.7
Nonfishery only	67	29.6	3	7.1	0	0.0	70	24.9
Total	**226**	**100**	**42**	**100**	**13**	**100**	**281**	**100**

About 59 per cent of the fishing households are vessel-owner households, while 41 per cent are labour households (Table 20). There are more owner households than labour households in Kuala Sepetang and Kuala Sangga, whereas in Kampung Menteri almost all fishing households are labour households. Around 36 per cent of the households in these villages are not involved in fishing.

Table 20: Distribution of fishing vessel-owner households (HH) and fishing labour households by types of gear operated

Gear operated	*Kuala Sepetang*			*Kampung Menteri*			*Kuala Sangga*			*Total*		
	Owner HH	*Labour HH*	*Total HH*	*Owner HH*	*Labour HH*	*Total HH*	*Owner HH*	*Labour HH*	*Total HH*	*Owner HH*	*Labour HH*	*Total HH*
FishTWL	2	2	4	0	0	0	0	0	0	2	2	4
Shrimp TWL	39	20	59	0	0	0	0	0	0	39	20	59
TMN	31	11	42	0	1	1	4	1	5	35	13	48
PN	12	0	12	3	35	38	0	0	0	15	35	50
BN	1	0	1	0	0	0	7	0	7	8	0	8
Fish & Shrimp TWL	1	2	3	0	0	0	0	0	0	1	2	3
Shrimp TWL & PN	1	0	1	0	0	0	0	0	0	1	0	
PN&TMN	4	0	4	0	0	0	0	0	0	4	0	4
TMN&ShrimpTWL	0	2	2	0	0	0	0	0	0	0	2	2
Total	**91**	**37**	**128**	**3**	**36**	**39**	**11**	**1**	**12**	**105**	**74**	**179**

The majority of the fishing households in Kuala Sepetang are involved in shrimp trawling, while in Kuala Sangga, more than half are engaged in bagnetting. Almost all fishing households in Kampung Menteri are involved in push-netting. About six per cent of the vessel-owner households operate at least two types of fishing gear and all these households are in Kuala Sepetang.

About 23 per cent of the yessel-owner households own more than one vessel. The majority of them are from Kuala Sepetang (Table 21). Most of these owners do not go fishing and are usually involved in fish trading and marketing *(i.e.* act as fish dealers or *towkays).*

Generally, family members or relatives are used as crew. However, pushnet owners from Kuala Sepetang hire crew from Kampung Menteri while they themselves merely act as fish dealers or *towkays.*

Table 21: Distribution of households by fishing asset (vessel-ownership)

No. of vessels	*Kuala Sepetang*		*Kampung Menteri*		*Kuala Sangga*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
One	69	75.8	2	66.7	10	90.9	81	77.1
Two	19	20.9	1	33.3	1	9.1	21	20.0
Three	3	3.3	0	0.0	0	0.0	3	2.9
Total	91	100	3	100	11	100	105	100

About 15 per cent of the total population are involved in fishing. Of the total fishing population, 28 per cent are owner-operators, 11 per cent owners, 10 per cent skippers and 51 per cent crew (refer Table 18). About half the fishing population in Kuala Sepetang are involved in shrimp trawling, while in Kampung Menteri almost the whole fishing population use pushnets (Table 22). The majority of the fishing population in Kuala Sangga use bagnets.

Table 22: Number of fishing vessel-owners **and fishing labourers by types of gear operated**

Gear operated	*Kuala Sepetang*			*Kampung Menteri*			*Kuala Sangga*			*Total*		
	Owner	*Labour*	*Total*	*Owner*	*Labour*	*Total*	*Owner*	*Labour*	*Total*	*Owner*	*Labour*	*Total*
FishTWL	2	7	9	0	0	0	0	0	0	2	7	9
Shrimp TWL	39	57	96	0	0	0	0	2	2	39	59	98
TMN	31	27	58	0	1	1	4	4	8	35	32	67
PN	12	0	12	3	59	62	0	0	0	15	59	74
BN	1	1	2	0	0	0	7	5	12	8	6	14
Fish & Shrimp TWL	1	0	1	0	0	0	0	0	0	1	0	
Shrimp TWL & PN	1	0	1	0	0	0	0	0	0	1	0	1
PN&TMN	4	0	4	0	0	0	0	0	0	4	0	4
Total	91	92	183	3	60	63	11	11	22	105	163	268

5.3 Fishery-related activities

About 29 per cent of the total households are involved in fishery-related activities excluding active fishing. Fishery-related activities contribute only about ten per cent of the total income and eight per cent of the employment in the villages. Even though only a small proportion of the population are involved in these activities on a full-time basis, many fisherfolk are involved in these activities on a part-time basis. Boat-owners who are nonoperators also carry out fishery-related activities, with the majority of them being involved in fish trading or marketing. Fishery-related activities that are commonly carried out in the villages include aquaculture, fish trading! marketing and processing.

Around six per cent of the households are aquaculturists, with almost half of these in Kuala Sangga and the rest in Kuala Sepetang. Most of the culturists in Kuala Sangga are also bagnet operators and the by-catch (trash fish) caught in their nets is used as feed for the fish cultured in cages. Apart from brackishwater cage culture, there are also some cockle-rearing activities in Kuala Sepetang. Most of the aquaculture activities in these villages are family-oriented enterprises.

Fish trading and marketing activities are mostly handled by Chinese *towkays* in Kuala Sepetang. About 85 per cent of the fishing households sell their catch to the fish *towkays.* Besides marketing, these *towkays* also provide advances and credit to the fishing households. Some 11 per cent of the households sell their catch in Kuala Sepetang to the commission agents of processing plants. Even though there are two fishermen's cooperative societies in Kuala Sepetang, only a few households sell their catch through them. This is mainly due to the lower prices offered by the cooperatives compared to the offers of the *towkays.*

In about 70 per cent of the fishing households, womenfolk are involved in fish-processing. Most of the processed products are for personal consumption. Only about 11 per cent of the fishing households are involved in fish-processing on a commercial basis. Household processing mainly comprises of salting and drying of shrimp and finfish not sold out in fresh form. There are three shrimp-processing plants in Kuala Sepetang, each employing 30-50 workers. These plants clean and freeze, or dry, for export, shrimp procured locally as well as from fishermen in Penang, about 100 km away. Trash fish is either sold to fish culturists or discarded at sea. Some trawl fishermen discard their by-catch at sea, as they feel the income from their main catch is more than sufficient for their needs. Trash fish is not processed, as there is no fishmeal plant nearby.

5.4 Nonfishery activities

Many of the households in the villages are also involved in nonfishery activities. However, there are very limited options for such activities in these villages — wage labour in factories or processing plants or in construction, retailing and trading and salaried employment. There is no agricultural activity in any of them, as suitable agricultural land is not available in these coastal villages.

5.5 Household income structure

The frequency distribution of households by annual income levels and types of economic activities are shown in Table 23. All fishing households are above the poverty line. Almost all fishing households earn more than 10,000 RM/annum. In fact, all households earning more than 40,000 RM/annum are fishing households. The lower income households are those that are solely dependent on nonfishery or fishery-related activities. Overall, less than one per cent of the households in these villages are living below the poverty line and all of them are nonfishing households with only one working member.

Table 23: Distribution of households by annual income levels and types of economic activities

Household	*Annual income (RM)*								
	<4,440*	4,441-7,500	7,501 - 10,000	10,001 - 15,000	15,001 - 20,000	20,001 - 30,000	30,001 - 40,000	> 40,000	Total
Kuala Sepetang									
Fishing only	0	0	0	5	6	10	21	5	47
Fishing + FR	0	0	0	0	3	2	6	12	23
Fishing + NP	0	0	1	0	5	18	5	16	45
Fishing + FR + NF	0	0	0	0	1	4	2	6	13
FRonly	0	4	5	3	2	1	0	0	15
FR+NF	0	0	5	6	4	1	0	0	16
NF only	1	12	19	16	14	5	0	0	67
Subtotal	**1**	**16**	**30**	30	35	**41**	**34**	**39**	**226**
Kampung Menteri									
Fishing only	0	0	0	7	0	1	2	0	10
Fishing + FR	0	0	0	1	0	0	0	0	
Fishing + NF	0	0	0	8	2	9	3	1	23
Fishing + FR + NP	0	0	0	2	0	2	0	1	5
NFOnly	1	0	0	1	0	0	1	0	3
Subtotal	1	0	0	19	2	12	6	2	42
Kuala Sangga									
Fishing Only	0	2	0	0	0	2	1	0	5
Fishing+FR	0	0	0	2	3	0	0	2	7
FROnly	0	0	0	1	0	0	0	0	
Subtotal	0	2	0	3	3	2	1	2	13
Total	2	18	30	52	40	55	41	43	281

FR - Fishery-related; NF - Nonfishery; * - Poverty line

The average annual household income by types of economic activities are summarized in Table 24. It is observed that the higher income households are fishing households that are involved in other economic activities as well. The richest households are those of fish *towkays* who, besides receiving income from their fishing vessels, also earn a good income from their marketing activities. Households that are involved in only fishery-related or nonfishery activities earn less than RM 12,000 per annum. Households in Kuala Sepetang have the highest average annual income (RM 24,551) and are followed by Kuala Sangga (RM 21,578) and Kampung Menteri (RM 19,729). Overall, the average annual income is 23,693 RM/household, which is about five times above poverty level.

Table 24: Average annual household incomes by types of economic activities

Household	*Average annual income (RM)*			
	K. Sepetang	*Kg. Menteri*	*K. Sangga*	*Overall*
Fishing only	30,025	15,623	16,912	26,645
Fishing + FR	38,842	12,807	26,366	35,185
Fishing + NF	34,580	21,604	—	30,191
Fishing + FR + NP	39,074	23,777	—	34,825
FR only	11,287	—	11,400	11,294
FR + NF	13,605	—	—	13,605
NP only	11,834	14,600	—	11,953
Overall	24,551	19,729	21,578	23,693

FR - Fishery-related; NF - Nonfishery

Table 25 shows the average annual income of fishing households by types of gear operated. It is observed that trawl-owner households have the highest income, while bagnet-owner households have the least. On an average, a fishing asset-owner household receives a total annual income of RM 36,141, while a fishing labour household receives 21997 RM/annum. These incomes are total household incomes and include income from nonfishing activities too.

Table *25:* **Average annual incomes of fishing households (HH) by types of gear operated**

Gear operated	*Average annual income (RM)*							
	Kuala Sepetang		*Kampung Menteri*		*Kuala Sangga*		*Overall*	
	Owner HI!	*Labour HH*	*Owner HR*	*Labour HR*	*Owner RH*	*Labour HH*	*Owner HH*	*Labour HH*
Fish TWL	46,048	37,643	—	—	—	—	46,048	37,643
Shrimp TWL	47,231	25,110	—	—	—	—	47,231	25,110
TMN	29,304	16,711	—	12,024	39,899	21,408	30,515	16,711
PN	29,328	—	28,719	19,618	—	—	29,206	19,618
BN	9,Q45	—	—	—	12,588	—	12,145	—
Fish & Shrimp TWL	56,832	44,398	—	—	—	—	56,832	44,398
Shrimp TWL & PN	39,882	—	—	—	—	—	39,882	—
PN & TMN	40,187	—	—	—	—	—	40,187	—
TMN & Shrimp TWL	—	28,790	—	—	—	—	—	28,790
Overall	38,033	24,532	28,719	19,407	22,519	21,408	36,141	21,997

5.6 Credit facilities and savings

About 38 per cent of the vessel-owners have used their own money for the purchase of vessels, while the rest obtained some loans to part-finance their purchases. These loans are often taken from towkays or local acquaintances and are generally below RM 10,000. Even though there are many financial institutions in the surrounding areas (especially in Taiping), very few people are able to obtain loans from these institutions due to insufficient collateral. They face difficulties in pledging such assets as houses, because all land in the area belongs to the government. None of these institutions will accept the fishing licence or the right to fish as collateral for loans. Fisherfolk also prefer to obtain loans from *towkays* as they can usually arrange for more flexible repayment.

There are very few investment opportunities in these villages, as there is little agricultural potential and government is also at present limiting new entry into fishing in order to conserve the resources. There is also very limited potential for further trading and retailing activities, as there are enough such services in the area to cater for the needs of the local people. The only investment opportunity may be aquaculture, but this too is limited, due to lack of suitable sites. Excess incomes of most households are saved either at home, in banks or, for the Malays in Kampung Menteri, invested in the form of shares in the national trust fund.

5.7 Effects of management measures on the fishing community

The Thompson and Bell long-term forecast analysis of the biological results and the discussions of the results suggest positive effects for shrimp trawlers by eliminating pushnets and bagnets. However, the adverse effects of such measures on the fishing community will also have to be looked into. It is estimated that should measures be taken to eliminate pushnets and bagnets, and assuming that the fisherfolk involved are not able to find any suitable employment in the short-term, some 35 per cent of the total fishing households will be affected (31% using pushnets and 4% using bagnets) (Table 26). Some 21 per cent of the total fishing households will fall below poverty income, with seven per cent having no income at all as they are totally dependent on fishing. About three-quarters of these poor households are labour households. These two fishing methods employ many crew who will also be unemployed if such a management measure is taken.

Table 26: Number of fishing households and fishermen affected if PN and BN are prohibited

Gear	*Household affected*				*Fishermen affected*		
	No income	*Below poverty income*	*Above poverty income*	*Total*	*Owner*	*Crew**	*Total*
Kuala Sepetang							
Pushnet	1	3	13	17	17	0	17
Bagnet	0	1	0	1	1	1	2
Kumpung Menteri							
Pushnet	10	21	7	38	3	59	62
Kuala Sangga							
Bagnet	2	0	5	7	7	5	12
Overall							
Pushnet	11	24	20	55	20	59	79
Bagnet	2	1	5	8	8	6	14
Total	**13**	25	25	**63**	**28**	**65**	**93**

* All bagnet labourers are from the owner's family members.

Note: Total fishing households surveyed = 179; Total fishermen surveyed = 268

6. CONCLUSIONS AND RECOMMENDATIONS

- With the exception of bagnets, there appears to be no seasonality in the fishing pattern of the other gear and the fishing effort does not fluctuate during the year.

- The most productive gear for penaeid shrimp in terms of catch weight is the shrimp trawl (TWL).

- The most abundant shrimp species in terms of catch weight is Spear shrimp, landed almost exclusively by trawlers.

- Of the main species found in this area, Banana shrimp appears to be the most valuable, fetching the highest average price, especially for large-sized specimens.

- Pushnets (PN) catch the highest number of Banana shrimp. They also appear to catch a high proportion of juveniles or young shrimp in their landings of this species, thus suggesting that exploitation of this resource with this gear is not optimum in terms of value.

- The shrimp resources in the Kuala Sepetang area may be able to withstand some increase in fishing pressure.

- Further studies should be conducted over a longer period to verify the results from the biological analysis, which were based on a one-year sampling programme. This is especially so since penaeid shrimp are short-lived animals. Other parameters, such as the length at first maturity of the major species, need to be looked into.

- Shrimp fishing, with all the fishing gear studied, exhibits good performance and economical viability. However, factors such as fishing efficiency and effects on the resource should be taken into consideration when discussing economic performances.

- Shrimp trawling (TWL) yields the highest net annual earnings, while bagnetting (BN) yields the lowest. Pushnetting (PN) gives the highest ARR and IRR. However, under the present Fisheries Act, the use of the pushnet is illegal. The trammelnet (TRN) is a very encouraging gear, as it gives a high return on investment and IRR.

- Fishing is the primary income-generating activity in the villages. There are very few nonfishing options available to the fisherfolk. There is not much potential for agriculture.

- None of the fishing households is below the poverty line. In fact, they are the richer households in the villages. The lower income households are those that are solely dependent on nonfishery or fishery-related activities.

- Some shrimp trawl fishermen discard their by-catch at sea as they are able to obtain adequate income from their main catch alone. There is also no trash fish processing in these villages. For better utilization of by-catch, some form of small-scale trash fish processing should be introduced in these villages. Apart from reducing wastage, this will help to further increase the incomes of the fisherfolk. At present, the volume of trash fish caught by these villages may not be able to sustain any large-scale fishmeal plant.

- Due to insufficient collateral, fishing households face difficulties in obtaining loans from financial institutions. However, these households can easily obtain advances and credit from fish *towkays,* who usually offer flexible repayment arrangements. There are very few new investment options and, therefore, excess incomes of most households are saved either at home, in banks or invested in shares in the national trust fund.

- The present status of shrimp resources in this area appears to be satisfactory and is likely to sustain the livelihood of the local fisherfolk. Further improvement to their fishing income may

be possible through restrictions on such gear as are relatively less efficient in terms of resource conservation, as for example, pushnets and bagnets.

- Before introducing any restriction on these gear or strictly enforcing regulations to eliminate illegal gear, alternative income-generating activities will have to be provided to the fisherfolk involved, to compensate them for their losses. In view of the limited alternatives available in the fishery-related and nonfishery sectors in these villages, one of the options available is to encourage them to take to one of the other fishing methods that is less damaging to the resource.

- Trarnme!net fishing is very encouraging, as it exhibits good economic performance and is the least damaging gear. Bagnet and pushnet fishermen can easily take to this fishery as it does not require much investment. Existing bagnet and pushnet vessels can be used for trammelnetting, greatly reducing the cost of investment thereby.

- With better management of the resources through the restriction of the more damaging gear and by limiting further entry into the fishery, recruitment will increase for less destructive gear like trammelnets. Although the increase in terms of number of shrimp available to these gear may not be very high, due to natural mortality taking its toll, the loss in numbers will be compensated for by an increase in biomass and, consequently, value.

- Legalising pushnets by imposing certain regulations, such as fishing areas and fishing time, to overcome management problems posed by this gear, may not be feasible as this gear can fish only in shallow and restricted areas and enforcing regulations may be a problem.

- The option to ban fishing during the spawning seasons of the shrimp may not be practical, as different species spawn at different times.

- The status of shrimp resources in Kuala Sepetang suggests that there is no urgent or pressing need for any nevi management measures to be taken.

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APPENDIX I

A. Monthly production by trawlers (tonnes)

Species	*May 92*	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	8.62	16.40	22.87	13.88	6.61	20.04	28.04	11,60	13.85	16.80	29.58	26.26	26.13
Jinga shrimp	72.24	79.10	104.91	63.78	7.64	171.27	30.55	245.25	92.52	125.36	74.02	70.32	78.01
Yellow shrimp	41.20	77.45	137.68	101.54	58.69	124.05	246.58	99.23	78.82	49.94	112.82	104.56	96.82
Rainbow shrimp	21.69	36.08	27.01	11.66	20.51	19.40	48.32	22.12	24.93	24.26	29.20	26.55	26.52
Spear shrimp	72.36	17.12	13.09	54.53	188.63	235.91	157.85	37.89	192.36	211.97	209.35	197.46	197.79
Other penaeid shrimp	38.35	109.76	35.78	56.19	9.93	.	.	-	.	.	-.		
Other shrimp	3.39	12.70	6.11	5.93	.	4.17	.	.	6.00	-.			
Finfish	.	.	-	.	-	608.78	356.31	467.44	733.09	312.54	426.37	540.15	422.48
Others	1625.97	1844.35	1813.05	1619.53	1521.83	3443.03	1870.00	1656.71	3285.70	1765.06	1313.09	1440.20	1154.76
Total	1897.78	2198.25	2160.45	1927.04	1813.85	4610.50	2737.64	2540.24	4427.28	2505.95	2194.44	2405.49	2002.51

B. Monthly revenue from trawlers (RM)

Species	*May 92*	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May93*
Banana shrimp	137,891	270,626	365,954	228,984	109,123	-330,671	462,622	191,390	228,517	277,280	502,896	446,429	457,323
Jisga shrimp	468,886	508,228	637,723	438,863	57,315	377,425	229117	893,356	649,471	850,385	592,191	562,560	637,691
Yellow shrimp	216,012	440,321	495,256	579,380	360,060	849,232	1,540,333	499,076	492,619	318,833	786,630	725,256	738,282
Rainbow shrimp	109,298	208,891	94,074	60,111	120,335	88,076	241,585	110,606	124,646	121,294	160,612	146,011	159,098
Spear shrimp	101,308	27,396	18,324	87,250	301,812	361,282	252,560	60,628	307,773	339.158	387,305	365,294	375,808
Other penaeid shrimp	53,685	175,617	50,086	91,004	15,885	.	.	.			.	.	.
Other shrimp	4,739	20,3I7	8,551	9,489	.	100,133	.	.	1,801	.	.	.	.
Finfi.sh	.	.	.	.	·	53,104	106,894	140,232	219,928	108,935	127,911	162,044	147,868
By-catch	406,493	461,088	453,263	404,883	380,459	.	.	.	.	.			
Others	.		·	.	.	701,535	447,287	261,994	294,801	213,644	310,699	133,875	83,113

C. Costs and earnings with fish TWL

Cost *and* *earnings (RM)*	*Jun 92*	*July 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*fan 92*	*Feb 92*	*Mar 92*	*Apr 92*	*May 92*	*Total*	*Average*
Revenue	17,500	7,500	17,500	2l,000	21,000	21,000	21,000	18,000	15,000	17,500	17,500	7,500	222,000	18,500
Costs*														
Diesel	12,705	2,705	l2,705	12,705	12,705	12,705	12,705	10,890	10,890	12,705	12,705	l2,705	148,830	12,403
Labour	2,877	2,877	2,877	4,977	4,977	4,977	4,977	4,266	2,466	2,877	2,877	2,877	43,902	3,659
Maintenance	420	400	380	390	400	300	450	250	300	870	600	350	5,110	426
Others	20	20	20	20	20	20	20	20	20	20	20	20	240	20
Total operating cost	16,022	16,002	15,982	18,092	18,102	18,002	18,152	**15,426**	13,676	16,472	16,202	15,952	198,082	16,507
Gross earnings	1,478	1,498	1,518	2,908	2,898	2,998	2,848	2,574	1,324	1,028	1,298	1,548	23,918	1,993
Depreciation	483	483	483	483	483	483	483	483	483	483	483	483	5,796	483
Net earnings	995	**1,015**	**1,035**	2,425	2,415	2,515	2,365	2,091	841	545	815	1,065	18,122	1,510

*All fish trawlhet operators use Refrigerated Sea Water (RSW)

D. Costs and earnings with shrimp TWL

Cost and *earnings (RM)*	*Jan 92*	*July 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 92*	*Feb 92*	*Mar 92*	*Apr 92*	*May 92*	*Total*	*Average*
Revenue	5,178	5,166	4,612	3,288	7,412	8,278	5,807	7,307	6,141	7,252	6,926	7,105	74,472	6,206
Costs*														
Diesel	1,104	1,178	1,164	1,157	1,100	1,093	1,100	1,057	1,155	1,125	1,153	1,153	13,539	1,128
Labour	2,322	2,273	1,965	1,215	3,598	4,095	2,683	3,563	2,842	3,492	3,291	3,393	34,732	2,894
Maintenance	381	267	269	257	257	240	283	242	231	306	337	273	3,343	279
Others	10	10	10	10	10	10	10	10	10	10	10	10	120	10
Total operating cost	3,817	3,728	3,408	2,639	4,965	5,438	4,076	4,872	4,238	4,933	4,791	4,829	51,734	4,311
Gross earnings	1,361	1,438	1,204	649	2,447	2,840	1,731	2,435	1,903	2,319	2,135	2,276	22,738	1,895
Depreciation	249	249	249	249	249	249	249	249	249	249	249	249	2,988	249
Net earnings	1,112	1,189	955	400	**2,198**	2,591	1,482	2,186	**1,654**	2,070	1,886	2,027	19,750	1,646

· All shrimp trawlnet operators use Refrigerated Sea Waner (RSW)

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APPENDIX II

A. Monthly production by pushnets (tonnes)

Species shrimps	*May 92*	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	16.79	21.15	36.89	28.80	10.85	12.03	53.71	13.11	8.12	8.01	9.13	9.67	9.85
Jinga shrimp	9.93	12.54	3.56	4.22	5.52	4.17	4.07	6.39	20.91	20.55	25.04	30.84	30.72
Yellow shrimp	23.70	13.97	26.46	35.66	27.34	32.20	44.01	24.28	26.88	28.83	26.40	34.92	34.64
Rainbow shrimp	1026	5.89	4.14	5.07	9.0)	8.79	6.68	24.09	5.99	5.42	3.31	7.21	6.45
Spear shrimp	-	0.08	-	-		-	-	-				-	
Other penaeid shrimp	0.71	2.10	0.25	-		-	-			--			
Other shrimp	-	-	0.29	0.31	-	-	-		-	-	-		
Finfish	-	-	74.84	21.74	80.54	87,94	50.59	41.89	48.56	47.41	55.78	55.53	31.30
Others	73.07	65.75	6.57	35.46		-	30.07	50.64	34.67	10.62	29.86	36.35	49.06
Total	134.46	121,48	153.01	131.27	133.26	145.13	189.13	160.40	145.13	120.83	149.53	174.72	172.74

B. Monthly revenue from pushnets (RM)

Species shrimps	*Ma)' 92*	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	45,854	170,928	211,820	213,316	104,532	121,407	326,439	111,427	76,711	79,152	99,820	109,682	110,714
Jinga shrimp	49,221	49,591	7,336	14,657	19,097	20,712	20,345	97,386	104,549	102,729	137,728	169,605	168,982
Yellow shrimp	94,514	46,832	31,635	103,213	93,920	128,275	169,120	95,291	76,466	73,187	87,131	115,245	114,297
Rainbow shrimp	34,695	21,206	15,484	17,738	31,543	28,992	22,048	21,088	19,753	17,885	11,600	25,245	22,562
Spear shrimp	-	223	-		-		-				--		
Other penaeid shrimp	1,976	5,661	381	-	-						-	--	
Other shrimp	-	-	437	1,061								--	
Fisfish	-	-	31,208	10,869	40,268	25,658	15,178	12,179	14,438	14,223	13,945	13,931	7,824
By-catch	18,267	16,437			-		-		-			--	
Others	-		351	16,994	-	-	-	387	131	--			

C. Costs and earnings with pushnets

Cost and earnings (RM)	*Jun 92*	*July' 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 92*	*Feb 92*	*Mar 92*	*Apr 92*	*May 92*	*Total*	*Average*
Revenue	2,825	2,775	3,442	2,679	2,989	5,064	3,151	2,701	2,593	3,282	3,954	3,923	39,378	3,282
Costs														
Diesel	332	368	364	313	356	357	357	339	345	357	368	387	4,243	354
Ice	33	39	39	34	37	37	34	37	39	39	42	42	452	38
Labour	1,476	1,421	1,823	1,399	1,558	2,802	1,656	1,395	1,325	1,732	2,126	2,096	20,809	1,734
Maintenance	263	152	181	190	183	175	195	183	153	196	188	203	2,262	189
Others	5	5	5	5	5	5	5	5	5	5	5	5	60	5
Total operating cost	2,109	1,985	2,412	1,941	2,139	3,376	2,247	1,959	1,867	2,329	2,729	2,733	27,826	2,319
Gross earnings	716	790	1,030	738	850	1,688	904	742	726	953	1,225	1,190	11,552	963
Depreciation	85	85	85	85	85	85	85	85	85	85	85	85	1,020	85
Net earnings	631	705	945	653	765	1,603	819	657	641	868	1,140	1,105	10,532	878

APPENDIX III

A. Monthly production by trammelnets (tonnes)

Species	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	9.89	0.96	13.12	7.95	14.52	7.00	6.69	5.36	6.40	7.01	8.33	7.87
Jinga shrimp	21,00	6.53	3.13	0.07	2.38	15.33	20.37	24.60	20.23	25.63	20.65	33.37
Yellow shrimp	3.25	1.42	1.39	1.86	2.19	9.84	15.03	9.56	16.66	20.14	15.93	
Rainbow shrimp	-	0.86	0.31	4.47	1.10	11.82	-	-	-			
Other penaeid shrimp	-	0.03	0.09	-	-	-	-	-	-			
Fisfish	-	2.83	36.93	72.63	24.28	28.42	16.50	30.95	18.77	22.42	21.20	14.13
Others	21.05	0.32	0.85	1.49	0.31	0.49	0.79	1.56	1.46	1.56	0.55	7.96
Total	55.19	32.95	55.83	88.48	44.78	72.89	59.38	72.04	**63.53**	76.75	66.66	63.32

B. Monthly revenue from trammelnets (RM)

Species	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	202,788	202,692	236,124	139,163	261,360	125,938	120,360	96,512	113,639	122,659	145,775	137,643
Jinga shrimp	189,024	49,000	21,927	585	19,051	122,679	162,966	196,808	156,782	192,224	154,911	250,240
Yellow shrimp	29,235	10.640	9,705	14,860	17,521	78,707	120,277	76,493	129,115	151,032	119,469	
Rainbow shrimp	-	6,472	2,177	35,781	8.761	94,562	-	-	-			
Other penaeid shrimp	-	9	27	-	-	-	-	-	-			
Finfish	-	3,840	11,047	21,713	7,269	8,482	4.920	9,232	5,211	5.571	5,300	3.532
By-catch	5,263	-	-	-	-	-	-	-				
Others	-	105	290	523	110	189	266	522	454	424	137	1,990

C. Costs and earnings with trammelnets

Cost and earnings (RM)	Jan *92*	*July 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 92*	*Feb 92*	*Mar 92*	*Apr 92*	*May 92*	*Total*	*Average*
Revenue	4.306	2,755	2.813	2,148	3,172	4.263	4,008	3,721	3,973	4,627	4,172	3,857	43,815	3,651
Costs														
Diesel	550	586	590	628	572	574	580	540	592	588	574	578	6,952	579
Ice	96	101	101	103	96	96	98	93	103	105	100	100	1,192	99
Labour	2.196	1,241	1,273	850	1,502	2,156	1,998	1,853	1,967	2,360	2.099	1,907	21,402	1,784
Maintenance	254	209	190	206	202	185	213	191	182	198	219	242	2,491	208
Olhers	10	10	10	10	10	10	tO	10	10	10	10	10	120	0
Total operating cost	3,106	2,147	2,164	1,797	2,382	3,021	2,899	2,687	2,854	**3,261**	**3,002**	2,837	32,157	2,680
Gross earnings	1,200	608	649	351	790	1,242	1,109	1,034	1,119	1,366	1,170	1.020	11,658	972
Deprecialion	132	132	132	132	132	132	132	132	132	132	132	132	1.584	132
Net earnings	**1,068**	**476**	**517**	**219**	**658**	**1,110**	**977**	902	987	1,234	1,038	888	10,074	840

* **All trammelnets are** operated by owners themselves with another crew **on** board.

APPENDIX IV

A. Monthly production by bagnets (tonnes)

Species	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oci 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	1.082	0.510	0.200	0.412	0.313	0.280	0.347	0.369	0.410	0.393	0.436	0.418
jinga shrimp	0.394	0.459	0.470	0.679	0.473	0.253	0.462	0.721	0.757	0.911	0.847	1.193
Yellow shrimp	0.660	1.584	0.876	1.547	1.262	1.712	1.046	0.988	1.052	1.038	1.066	0.707
Rainbow shrimp	0.182	0.478	0.159	0.495	0.545	0.325	0.283	0.039	0.049	-	-	-
Speat shrimp	-	-	-	-	0.045	0.021	-	-	-	-	-	-
Other penaeid shrimp	0.252	0.104	0.008	-	0.065	0.051	-	-	-	-	.-	
Other shrimp	0.994	0.002	0.064	-	0.281	0.186	0.294	0.569	0.312	0.454	0.742	0.416
Finfish	**0.758**	-	0.885	0.784	2.908	.260	1.489	0.907	1.082	0.915	0.750	1.182
Others	0.563	-	1.397	0.205	0.997	0.475	0.428	0.555	0.475	0.329	0.194	0.114
Total	**4.898**	**4.052**	**4.058**	**4.123**	**6.890**	**4.562**	**4.350**	**4.847**	**4.137**	**4.039**	**4.035**	**4.031**

B. Monthly revenue from bagnets (RM)

Species	*Jun 92*	*Jul 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 93*	*Feb 93*	*Mar 93*	*Apr 93*	*May 93*
Banana shrimp	9,170	3,254	1,160	2,391	5,004	4,482	4,936	5,905	6,560	6,092	6,760	6,472
Jinga shrimp	3,181	3,755	2,584	5,463	1,748	1,760	2,617	6,011	6,955	7,166	6,919	8,411
Yellow shrimp	4,087	12,991	5,241	13,636	12,383	13,832	3,479	5,562	6,030	5,940	6,280	5,507
Rainbow shrimp	1,041	1,359	1,326	1,237	5,018	3,238	1,009	232	293	-	-	-
Spear shrimp	-	-	-	-	541	249	-	-	-	-	-	-
Other penaeid shrimp	206	1,251	763	-	782	606	-	-	-	-	-	
Othershrimp	8,180	I	6	-	3,369	56	88	171	94	123	200	112
Finfish	319	-	205	235	872	369	418	250	309	20)	188	319
Others	25	-	323	62	123	68	123	115	139	113	40	

C. Costs and earnings with bagnets

Cost and earnings (RM)	*Jun 92*	*July 92*	*Aug 92*	*Sep 92*	*Oct 92*	*Nov 92*	*Dec 92*	*Jan 92*	*Feb 92*	*Mar 92*	*Apr 92*	*May 92*	*Total*	*Average*
Revenue	1,012	880	452	886	790	651	334	482	537	517	785	802	8,128	677
Costs														
Diesel	18	18	18	18	28	28	28	28	28	28	18	18	276	23
Ice	4	4	4	4	6	6	6	6	6	6	4	4	60	5
Maintenance	74	106	72	106	116	83	74	56	74	82	88	96	1,027	86
Others	10	10	10	10	10	10	10	10	10	10	10	10	120	10
Total operating cost	106	138	104	138	160	127	118	100	118	126	120	128	1,483	**124**
Gross earnings	906	742	348	748	630	524	216	382	419	391	665	674	6,645	*554*
Depreciation	100	100	100	100	100	100	100	100	100	tOO	100	100	1,200	100
Net earnings	806	642	248	648	530	424	116	282	319	291	565	574	5,445	**454**

* All bagnets are operated by owners themselves

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