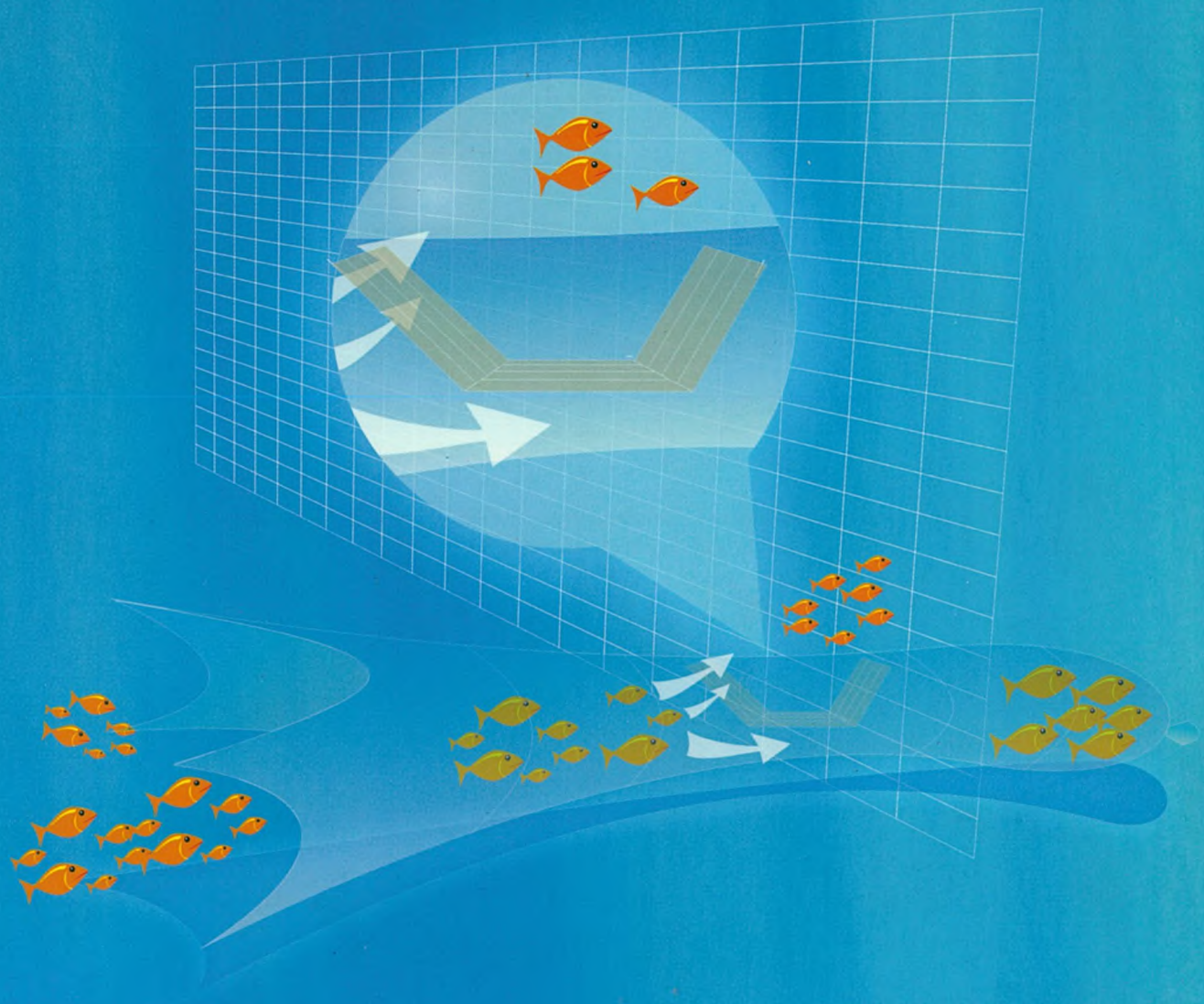
STUDY ON

JTEDs

JUVENILE AND TRASH EXCLUDER DEVICES IN MALAYSIA



SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
TRAINING DEPARTMENT

TD/RES/72

Study on Juvenile and Trash Excluder Devices (JTEDs) in Malaysia

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1. Introduction

It has been recognized for some time that trawling in shallow coastal waters has an adverse effect upon the bio-diversity of the areas and more directly catches the juveniles and immature fish seeking both food and protection in the target waters. There are several unanswered regional questions to which answers should be found. It has been found possible to selectively harvest target species, but where there is a diversity of target species, as there are in tropical waters, the identification of the most suitable Bycatch Reduction Devices (BRDs)/ Juvenile and Trash Excluder Devices (JTEDs) to conduct the selective harvesting has yet to be established. It may well be that a variety of selective devices should be used, but certainly the experimental approach will identify the best designs.

Today, more advanced fishing technology emphases is placed on the design of devices having the aim of selectively harvesting the target catch while at the same time reducing the level of undesirable catch in the form of juveniles, immature and trash fish. During 1998 and 1999, SEAFDEC Training Department carried out a series of experiments with varying degrees of success, in the Gulf of Thailand. These experiments investigated the use of shrimp trawls equipped with various types of Turtle Excluder Devices (TEDs). The preliminary results and conclusions from these experiments were reasonably good in terms of catching and release efficiency of economically important fish species. Comparing nets with and without TEDs tested the efficiencies of the designs.

During the year 2000, the study continued in other regional countries' waters when experiments of JTEDs were conducted in Brunei Darussalam. In these experiments the design of the devices had been refined and the results indicated an immediate and satisfactory improvement. In May 2001, JTEDs introduced into Vietnam in collaboration with RIMP of Vietnam. The experiment and demonstrations were carried out in Cat Ba Island in Hai Phong Province. To continue these activities Malaysia was selected as a country where the implementation of such devices can be beneficial. As DOF, Malaysia, also has a project on selective fishing gear in the West Coast of the Malaysian Peninsula.

The objectives are as follows; 1) to conduct experiments and evaluations on a new type of JTEDs for fish trawl net, 2) To evaluate and determine the catching and escapement levels efficiency of JTED designs, and 3) To promote the suitable JTEDs under the responsible fishing technology and practices program through training and demonstration to Malaysian fishermen.

This paper describes the results of the juvenile and trash fishes excluder device tests conducted aboard a Malaysian Fishing Trawler in cooperation with the Department of Fisheries, Malaysia. In particular, it provides estimates of Catch per Unit Effort (CPUE) of trawl fishery, catch composition in day and nighttimes, distribution of length-frequencies for the capture fishes and released fishes using different opening grid.

2. Materials and Methods

Experiments on JTEDs attached to fish trawl net were conducted in cooperation with the Department of Fisheries, Malaysia during 12 - 15 September 2001 in the waters off the coast of Alor Setar, Kedah State of Malaysia as seen in Fig. 1. Fig. 2 shows a local fishing trawler employed for the experiments.

Fig. 3 shows the fish trawl net which was employed in the experiment.

2.1 JTED Designs

The SEAFDEC/Training Department, having consideration to the efficiency of the escapement levels for small or juvenile/trash fishes, developed a new type of JTED which it was modified from the NOFI TRAOMSO A/S Sort-X system. Size of the JTED frame was 50 by 80 cm, three peices. The sorting grid, which cover 0.8 sq. meters were placed at angle attack in mouth of the codend part. Bar spacing of the sorting grid was 12 and 20mm. In the experiments, a cover net as the second codend was mounted on/ covering the device in order to compare the catch from both codends. Fig. 4 shows the installation and operation diagram of the JTEDs.

2.2 Experiment and Data Collection

Fishing experiment for the JTEDs were scheduled, and carried out during daytime from 09:00 - 16:00 hrs and in the nighttime from 19:00 -24:30 hrs in order to compare catch composition and testing the JTED for shrimp trawl operation. Two different bar spacing of 12 and 20mm were tested in both day and nighttime fishing.

One hour trawling with a towing speed of 4 to 5 knots was scheduled. Fishing depth, measured by sounding methods was in between 20 and 28 m.

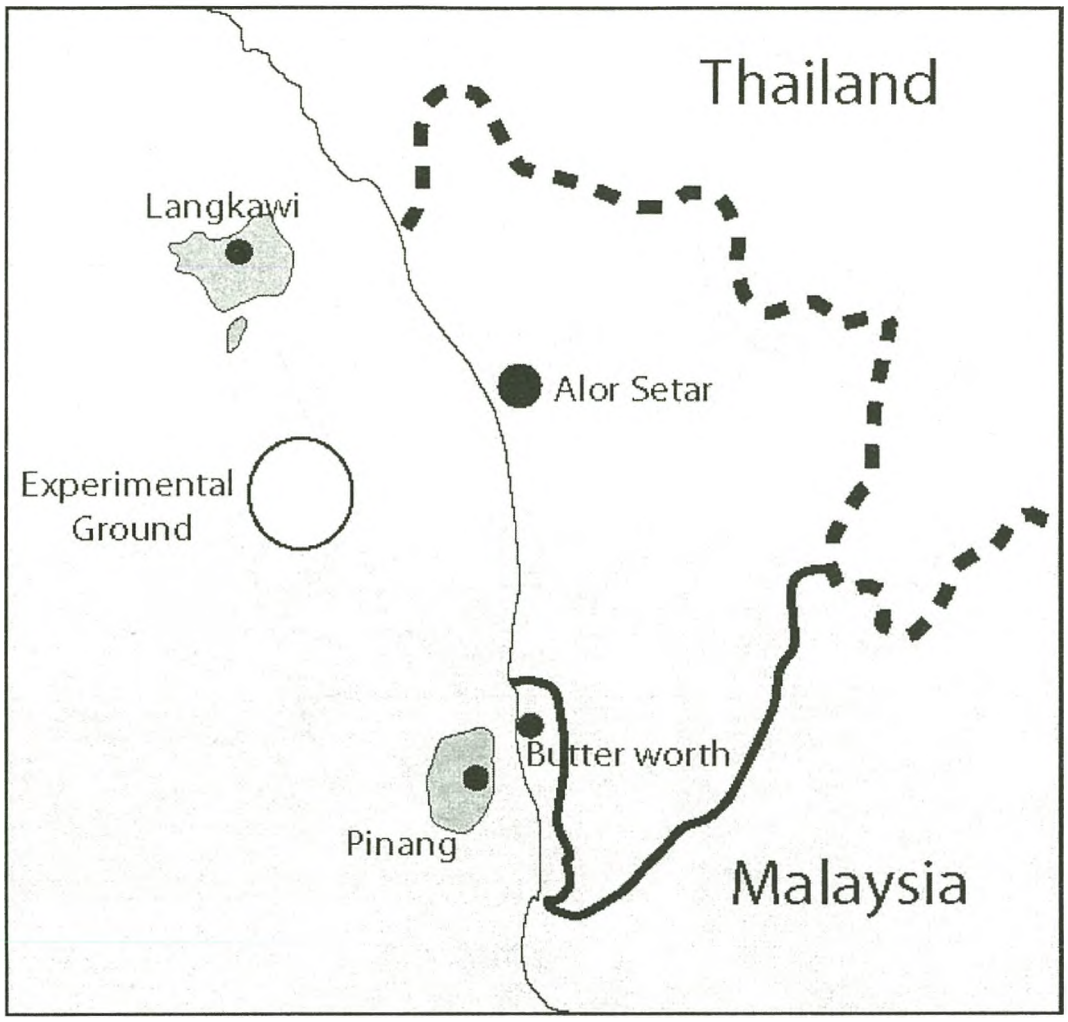


Fig. 1. Experimental ground during 12 - 15 Sepetmber 2001.

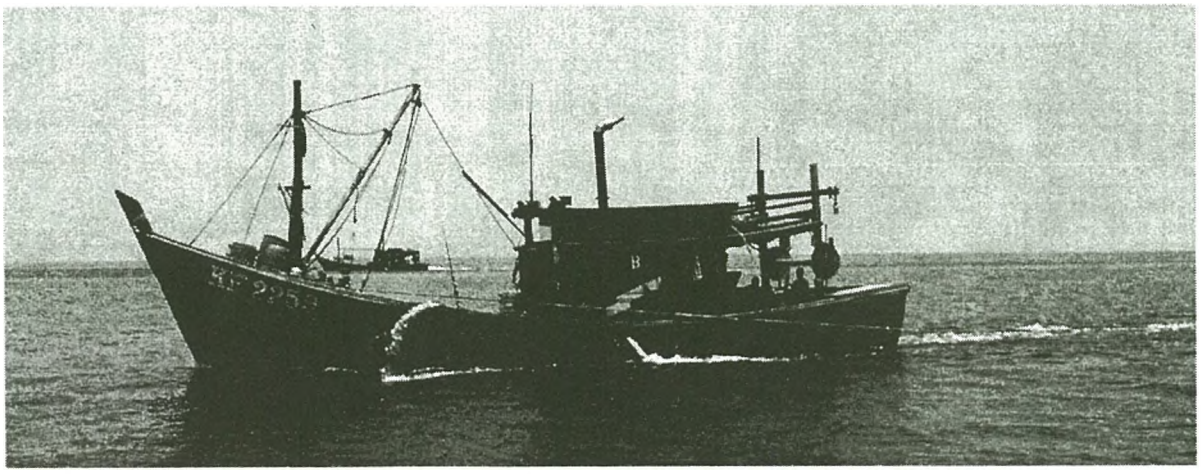


Fig. 2. Local fishing boat used for the experiment

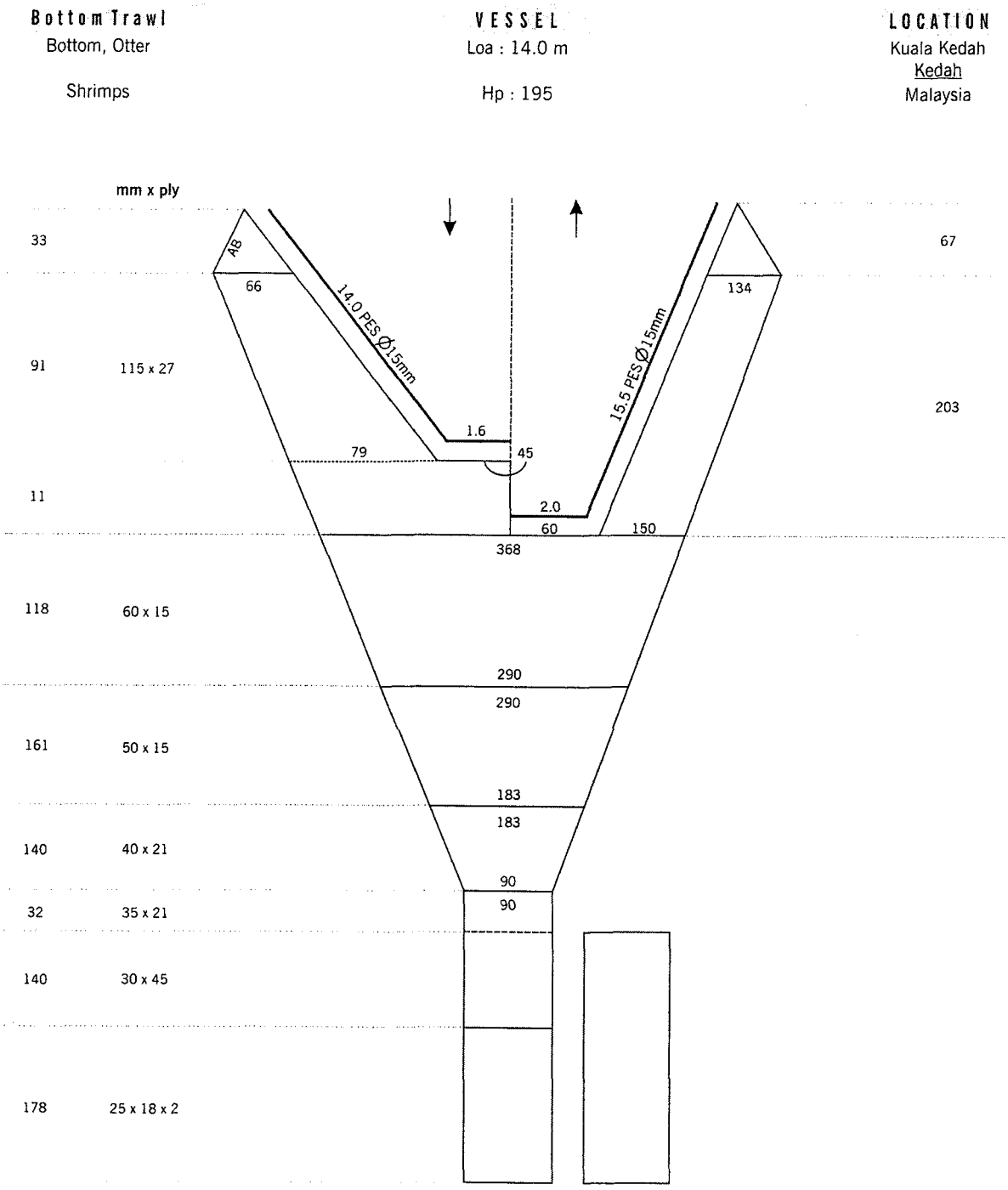


Fig. 3. Diagram of fish trawl net used in the experiment

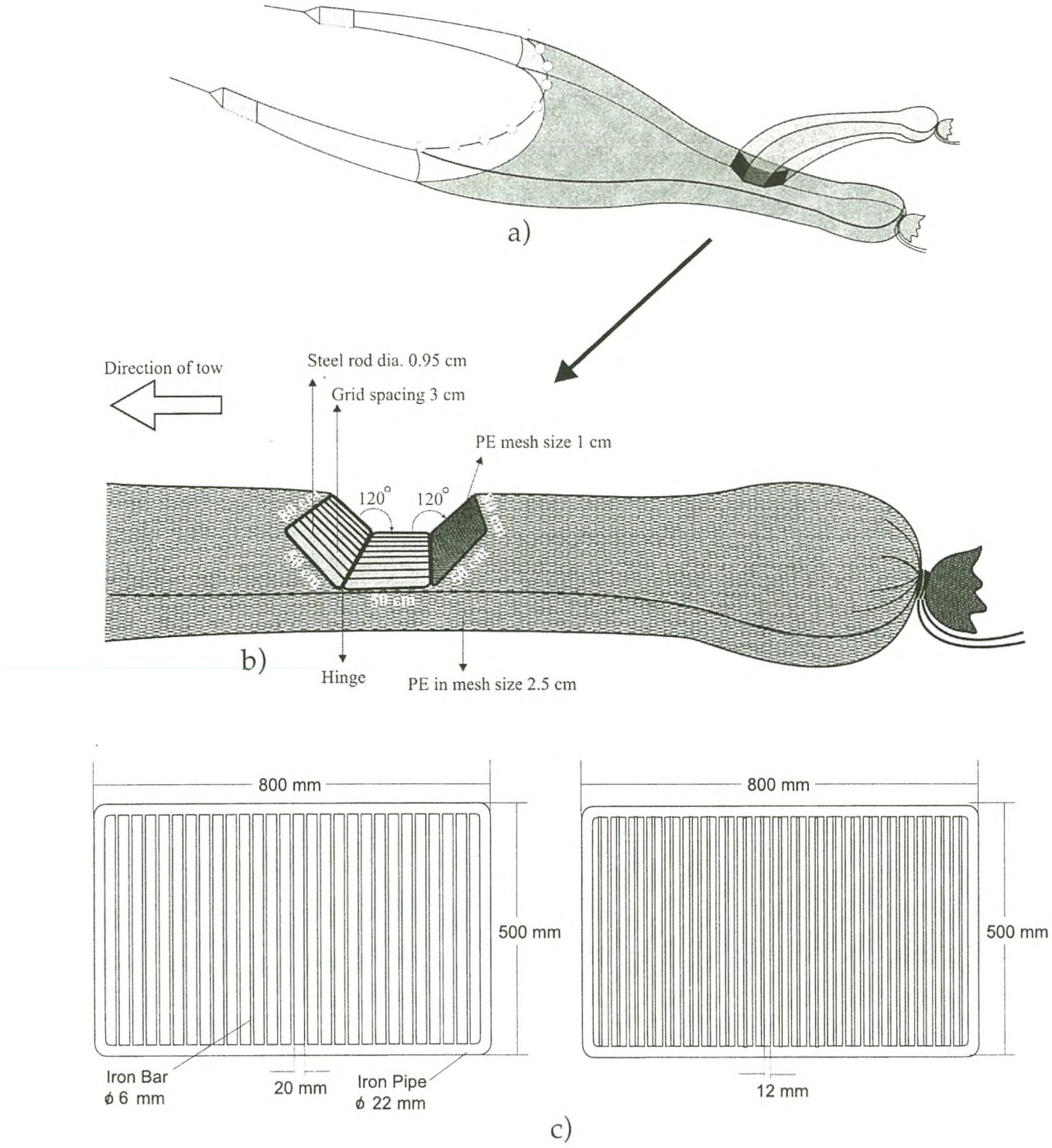


Fig. 4. A diagramatic representation of the new JTED showing the cover net for experiment (a) and installation of the JTED into the codend part (b). c) showing the dimensions of the JTEDs having defferent bar spacing of 20mm and 12mm.

Catch data, by total weight taken from the codend and the covernet were recorded. For species identification, samples were randomly drawn from each haul. They were sorted by species and group. Each group or species were weighed in grams and individually measured to the fork length for determination of the length-frequency of the catch from both codends.

2.3 Data Analysis

All catch data from each cruise were determined into percentage of catch composition and catch per unit effort (CPUE in kg/hr). Due to the size the compositions of populations fished, escapement levels determined experimentally differ, thus the estimated escapement-at-length are applied to length frequencies of commercial catches. Estimates of "escapement" were calculated as the weight or number of fish in the covernet compared to the total caught in the covernet and codend.

Length-frequencies of all economically important species, and trash fishes obtained from both covernet and codend were analyzed in relation to the percentage escapement.

3. Results and Discussions

Table 1 shows the general information from the experiment. A total of 12 fishing operations for two different bar spacing of JTEDs and different mode of time were carried out. Due to the rough sea conditions for the last day operation, data are not used into consideration in this paper.

3.1 CPUE and Catch Composition

From Table 1, the catch per unit effort (CPUE) in the experimental ground are between 27.54 and 48.93 kg/h/haul in daytime and 31.69 -35.11 kg/h/haul in the nighttime operations. An attempt has been made in Fig. 5 to express the abundant distribution of the resources in term of CPUE in the experimental ground. The figure also indicates no difference in amount of catch between day and nighttime trawling at the same area.

Appendix 1 shows the total catch composition by group (by percentage of total weight) of each trawling both in day and nighttime operations.

Table 1 General information of the experimental study on the JTEDs attached to the fish trawl net during 12 - 15 September 2001 in the waters off Alor Setar, Kedah State, Malaysia.

No.	Date	Time	Position		Course	Depth (m)	Type of JTEDs	Mode of Time	Sea Condition	Total Catch (kg)
			Lat (N)	Long (E)						
1	12/9/00	9:50	06° 01.63	100° 10.95	30	22	20mm	Day	clam	47.98
2	12/9/00	11:15	05° 58.35	100° 09.26	30	25	20mm	Day	clam	27.54
3	12/9/00	13:40	06° 05.35	100° 09.75	30	20 - 25	20mm	Day	clam	48.93
4	13/9/00	10:30	06° 01.98	100° 09.71	206	22	12mm	Day	clam	30.8
5	13/9/00	12:05	06° 02.21	100° 07.06	246	24	12mm	Day	clam	31.58
6	13/9/00	14:25	06° 04.81	100° 07.67	340	24	12mm	Day	clam	35.15
7	14/9/00	19:35	06° 06.41	100° 11.52	320	23 - 24	12mm	Night	clam	35.11
8	14/9/00	21:35	06° 04.41	100° 08.83	170	24 - 26	12mm	Night	clam	32.45
9	14/9/00	23:00	06° 01.89	100° 07.33	232	16 - 28	12mm	Night	clam	31.69
10	15/9/00	20:25	06° 05:40	100° 13.12	320	23 - 24	20mm	Night	rough/rain	?
11	15/9/00	22:10	06° 07:50	100° 10.69	170	24 - 26	20mm	Night	rough/rain	?
12	15/9/00	23:35	06° 08.87	100° 08.29	232	16 - 28	20mm	Night	rough/rain	?

Fig.6 shows the catch composition by group (by percentage of total weight) between the daytime and nighttime operations. Comparison between day and nighttime operation found that the percentage of catch composition are clearly different. Percentage of trash fishes, pelagic species and cephalopod group in daytime trawling are higher than in the nighttime. The amount of catch for pelagic species, especially in daytime is about 7 times higher than nighttime trawling. In contrast, demersal species found at nighttime is about 3 times higher than in daytime trawling. For large shrimp such as Peneus sp. are found both in day and nighttime, however there are many small shrimps such as metapeneus and tachypeneus in nighttime trawling only.

Commercial species mostly found in this experimental ground are *Rastrelliger brachysoma, R. kanagarta, Atule mate, Upeneus sulphureus, Selaroides leptolepis, Nemipterus sp., Priacanthus macracanthus,* large shrimp (*Peneus sp*), *Loligo sp* and *Sepioteuthis sp.* Fig. 7 shows the photograph and commercial name of the commercial species found in this study.

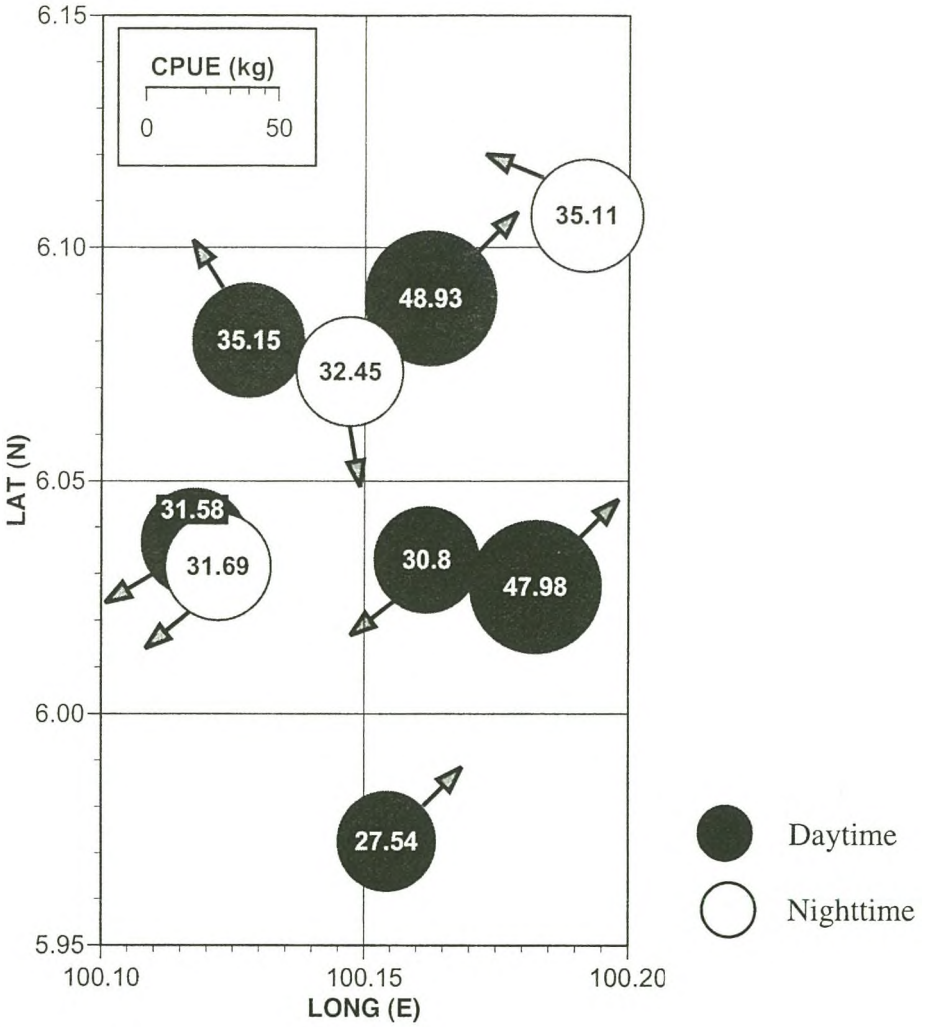


Fig. 5. Distribution of the CPUE in the experimental ground. Arrows represent the direction of trawling.

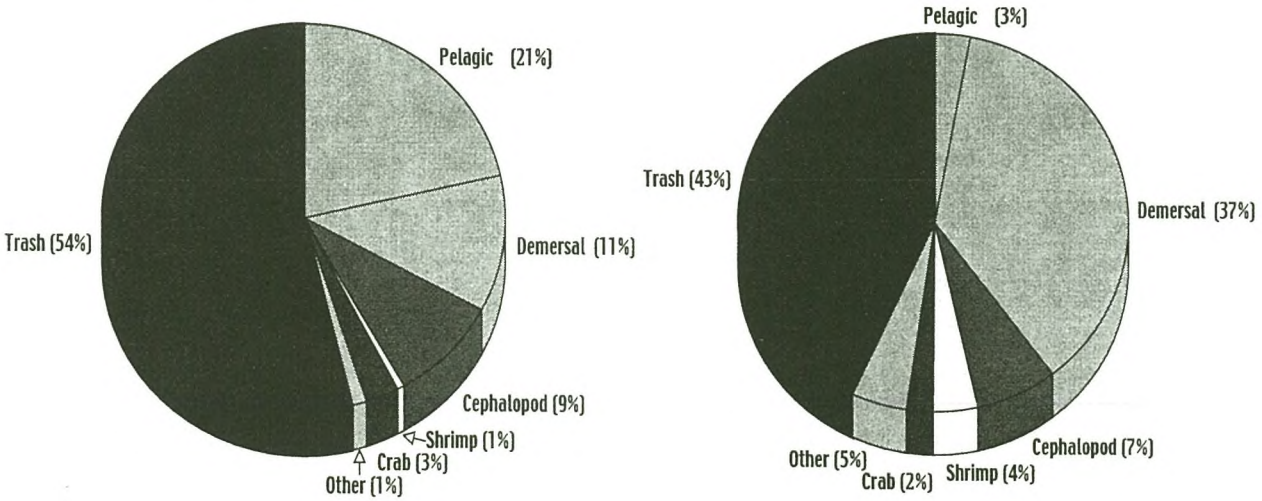


Fig. 6. Catch composition by group (by percentate of total weight; a) daytime and b) night time operation.

3.2 Escapement Levels

The catch composition by group (by weight) from both codends and the escapement levels for each target group for different bar spacing of JTEDs are shown in Appendix 2.

The escapement levels of each target group in daytime trawling between 20 mm and 12mm bar spacing have been compared without consideration of the size of escaped fishes in Fig. 7. The difference escapement levels between the two bar spacing size are relatively great at the larger bar spacing not only for the trash fishes group but also others target group. About 73% of total catch were released by JTED with the 20 mm of bar spacing, and about 35% escapement levels for the 12 mm bar spacing. Trash fish group represents the highest escapement levels which are about 87% and 70% for both 20mm and 12mm bar spacing of JTEDs. Averaged 63% and 44% of the pelagic fish and shrimp are released by 20mm bar spacing JTED, respectively. About 2-3% of the total catch is crab such as swimming crab, in which 100% of them are found in the codend.

From only the escapement levels results without consideration of the escaped fish size, it is a difficult question to decide that which JTED having a suitable bar spacing.

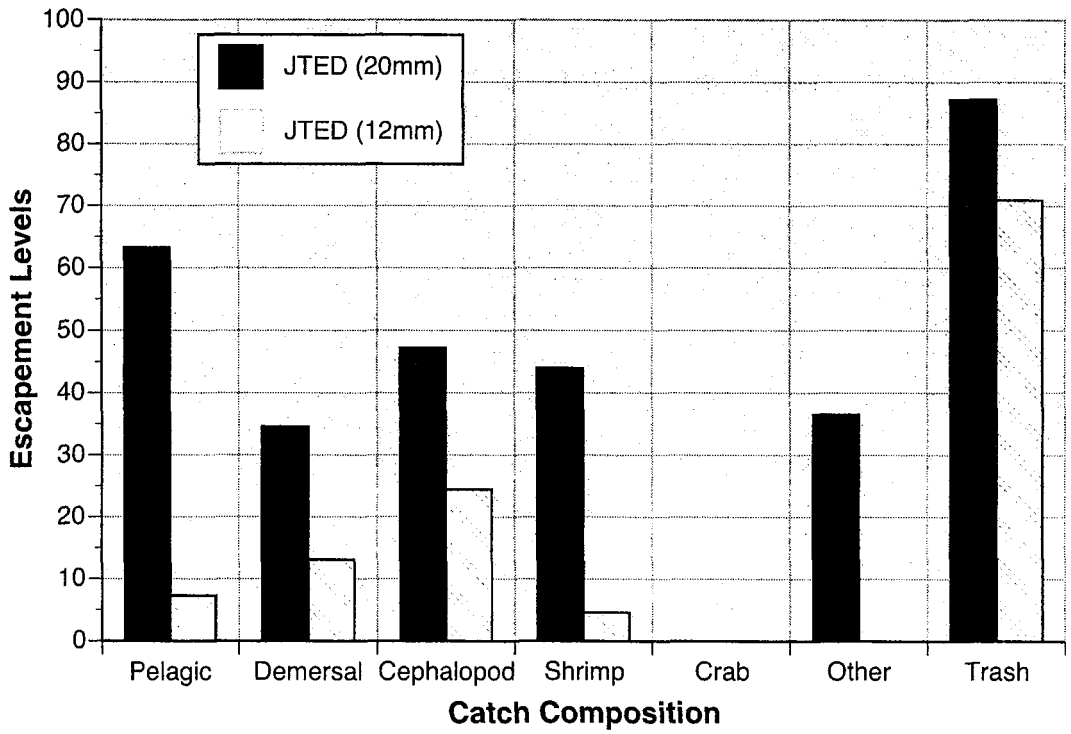


Fig. 7. Escapement levels of different sorting grid size between 20mm and 12mm in daytime trawling.

3.3 Length Frequency of Catch and Escapement Levels

Length frequency of the catch found in the codend and cover net for different bar spacing of 20mm and 12mm will be very useful data to decide the size bar spacing of JTED. The results from comparative study of the length frequency of some commercial or dominant species such as *Rastrelliger brachysoma, R. kanagarta, Atule mate, Upeneus sulphureus, Selaroides leptolepis, Nemipterus sp., Priacanthus macracanthus,* large shrimp (*Peneus sp*), *Loligo sp* and *Sepioteuthis sp.* which are caught from experimental trawling with different bar spacing of JTED are shown in Fig. 8 - 17.

Fig. 8 and 9 show the relationship between the length frequency and percent of escapement levels of the *Rastrelliger brachysoma* and *R. kanagarta.* The fork length of *Rastrelliger brachysoma* found during this period are varied from 120 -170mm. The result of escapement levels indicate that 100% of the *Rastrelliger brachysoma* size larger than 120mm will be caught by 12mm bar spacing JTED. In contrast, about 40% of the *Rastrelliger brachysoma* can escape when using the 20mm bar spacing JTED. The 12mm bar spacing JTED show high efficiency in catching medium and larger size (>120mm) of *Rastrelliger brachysoma* both in day and nighttime trawling.

Consideration of the *Rastrelliger kanagarta,* having the fork length varied from 60 - 100 mm, the escapement level is expected to be high in order to save the juvenile size (less than 100mm). From the escapement results, there are no significant difference for the 12mm and 20mm bar spacing JTEDs. 50% of these escaped through sorting grid.

Fig. 10 show the relationship between the length frequency and percent of escapement levels of the *Nemipterus sp.* The fork length of this species varied from 30 - 230 mm. The escapement result of the 12mm bar spacing JTED show very good in selecting the large size of *Nemipterus sp* (> 110mm) and released the small size during daytime trawling. For nighttime trawling with 12mm JTED, about 45% of smaller size of fishes (<110mm) still existed in the codend, this is because of they live near by the bottom and may directly pass through the codend not through sorting grid.

The same escapement results of *Atule mate, Selaroides leptolepis* and *Upeneus sulphureus* are show in Fig. 11, 12 and 13, respectively.

The dominant species for trash fishes group was *Siganus sp.* Fig. 14 the relationship between the length frequency and percent of escapement levels of the *Siganus sp.* All juvenile stage size smaller than 70mm of the Siganus were found during the exsperiment.

Larger than 70% of all the catch were released through sorting grid.

Many squid and cuttle fishes were also found especially in daytime trawling. Fig. 15 show the relationship between the mantle length and escapement levels of the squid. The squid found in this area were from 30 - 140 mm mantle length. 80% of the total catch escaped through the 20mm bar spacing JTED and about 50% could escape through the 12mm JTED in day time trawling. It is probaly the squid vertically move to the upper layer at night, therefore, less squid were caught from the experiments.

For the cuttle fishes, Fig. 16 show the escapement levels related to the size of the cuttle fishes which were varied from 50 - 290mm mantle length. Using of the 20mm JTED could release about 65% of the 50 - 130 mm cuttle fishes. For the 12mm JTED, only cuttle fishes smaller than 100mm could escape however there were very few in number.

Large shrimp such as *Peneus merguiensis* and *P. semisulcatus* caught from this exeprimental ground were varied from 100 - 200mm length. Fig. 17 shows the escapement results of the shrimp for the 12mm JTED, there is no significant difference in catching of the large shrimp between the day and nighttime trawling. It is indicate that only about 5 % of the total large shrimp could escape from the sorting grid of 12mm bar spacing and about 95% of the shrimp (>100mm) were caught in the codend. In case of the 20mm bar spacing JTED, some large shrimp (upto 190mm length) could escape. This showing the efficiency in size selecting of the sorting grid of 12mm JTED.

During nighttime trawling, small shrimps such as *Metapeneus ensis, M. lysianass, M. brevicornis, Metapenaeopsis stridulans,* and *Trachypenaeus fulvus* were mostly found eventhough large in number but small by total weight. Fig. 18 show the length frequency of small shrimps,*Metapeneus ensis, Trachypenaeus fulvus* and others samll shrimps. For the shrimp trawl operated during night time, selective device for these species may need to develop in order to increase the selecting efficiency.

Other species found at nighttime were *Priacanthus macracanthus* and *Pomadasys sp.* Fig. 19 show the relationship between the fork length and escapement levels found that more than 95% of the *Priacanthus macracanthus (>100mm* fork length*)* were in the codend. In additon for the Pomadasys sp, due to the small size having fork length from 30 - 80mm, about 30% of total fishes could escape.

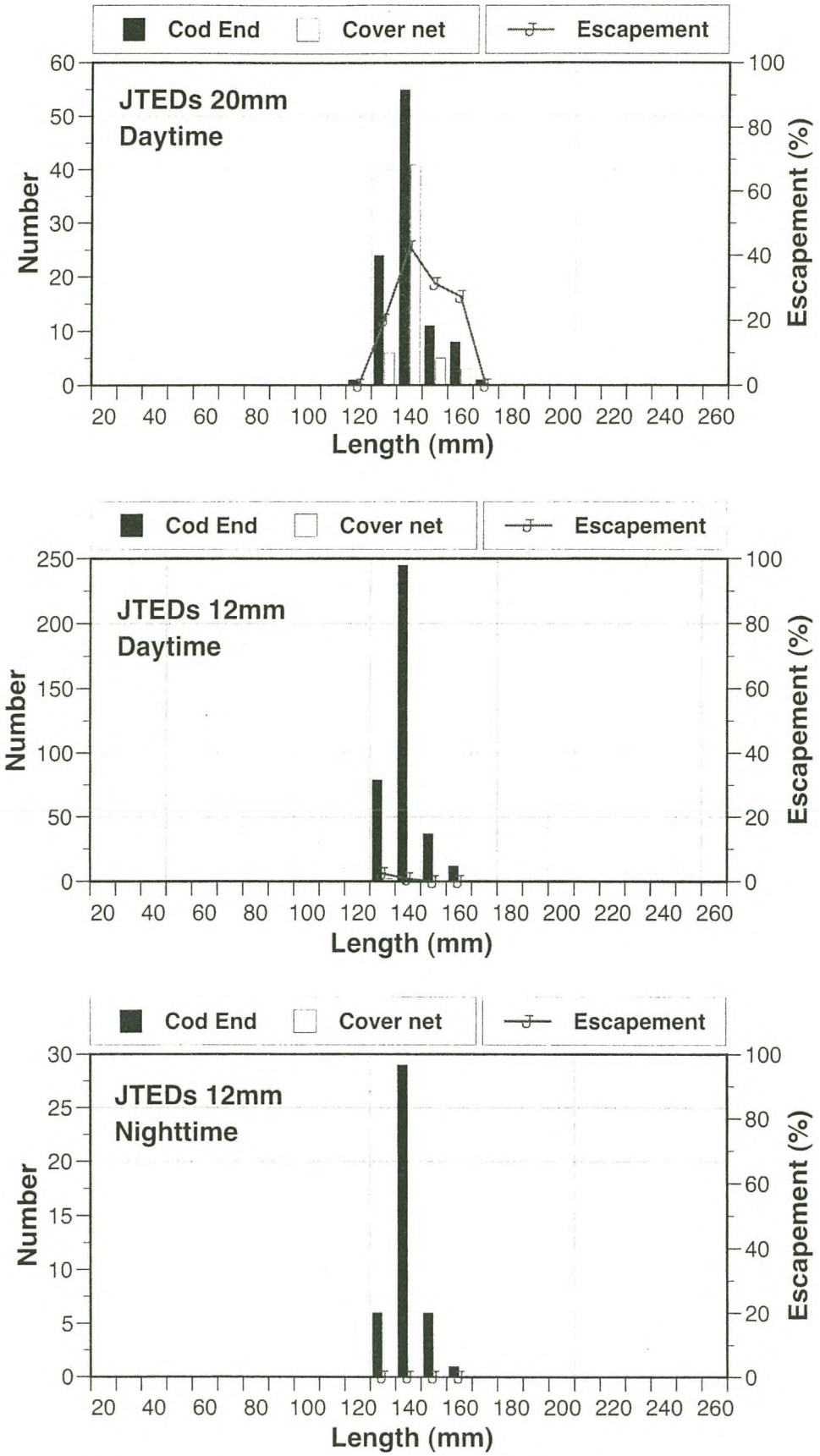


Fig. 8. Relationship between fork length and percent of escapement of the *Rastrelliger brachysoma* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

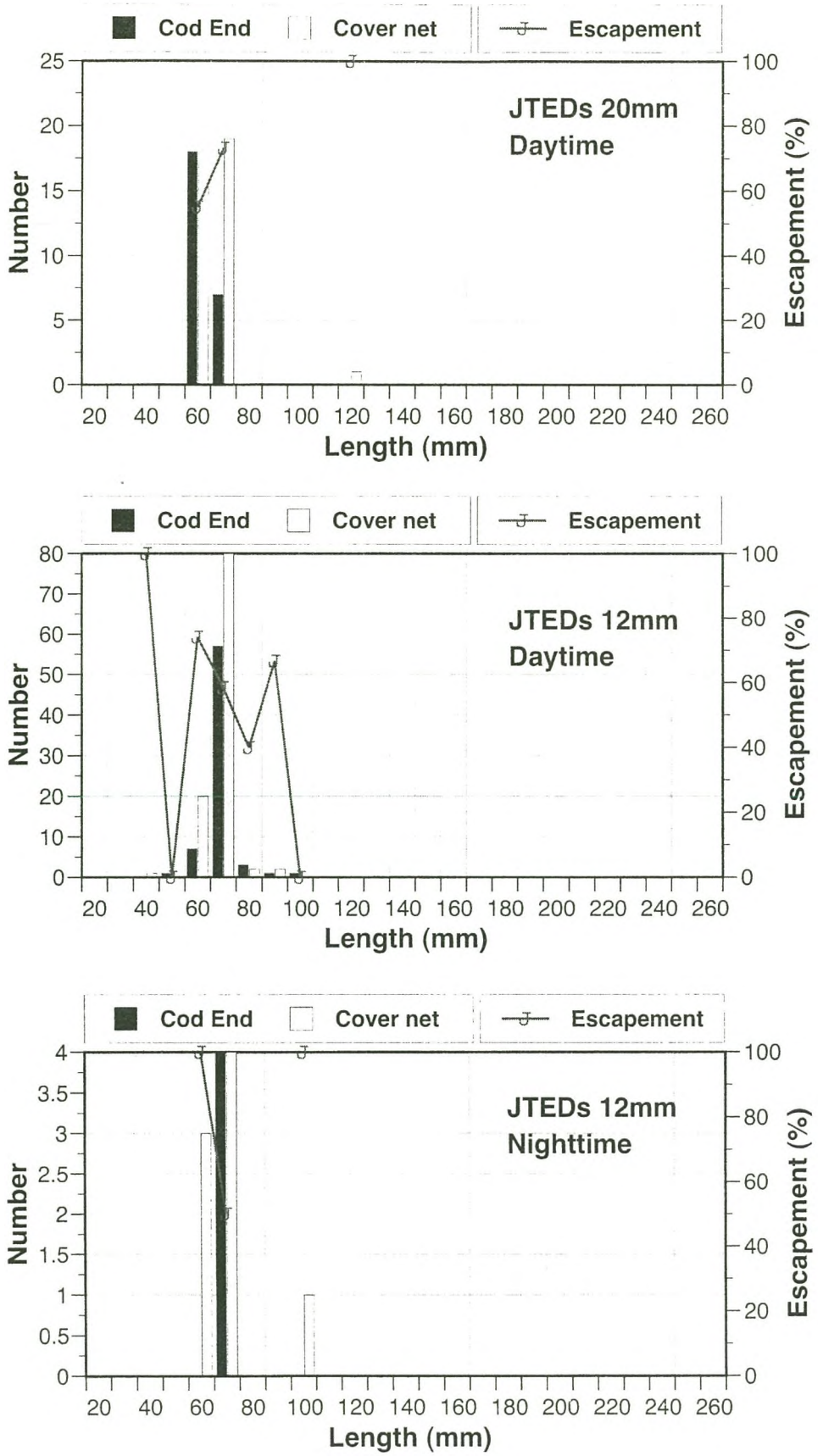


Fig. 9. Relationship between fork length and percent of escapement of the *Rastrelliger kanagarta* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

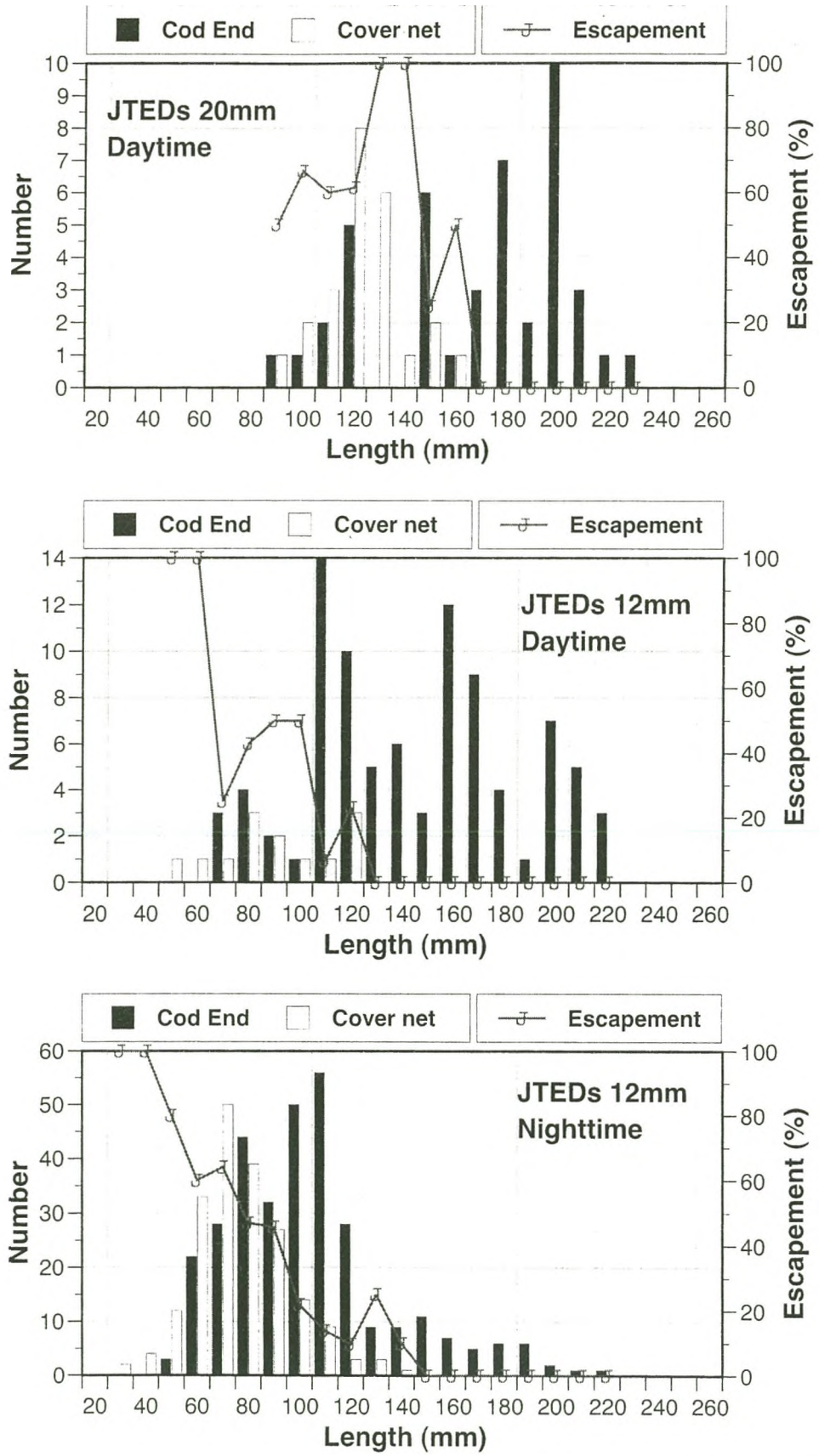


Fig. 10. Relationship between fork length and percent of escapement of the *Nemipterus sp.* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

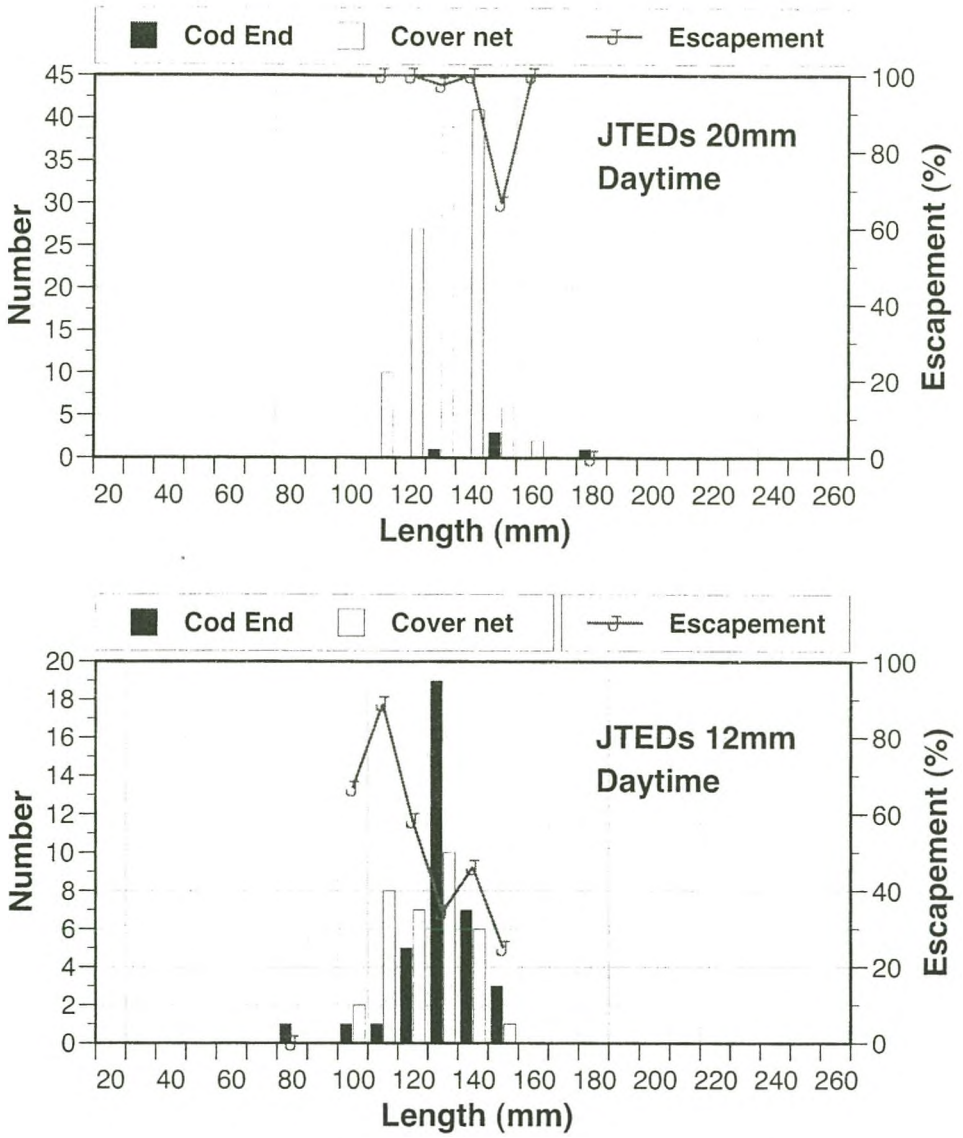


Fig. 11. Relationship between fork length and percent of escapement of the *Atule mate* from daytime trawling using 12mm and 20 mmof JTEDs.

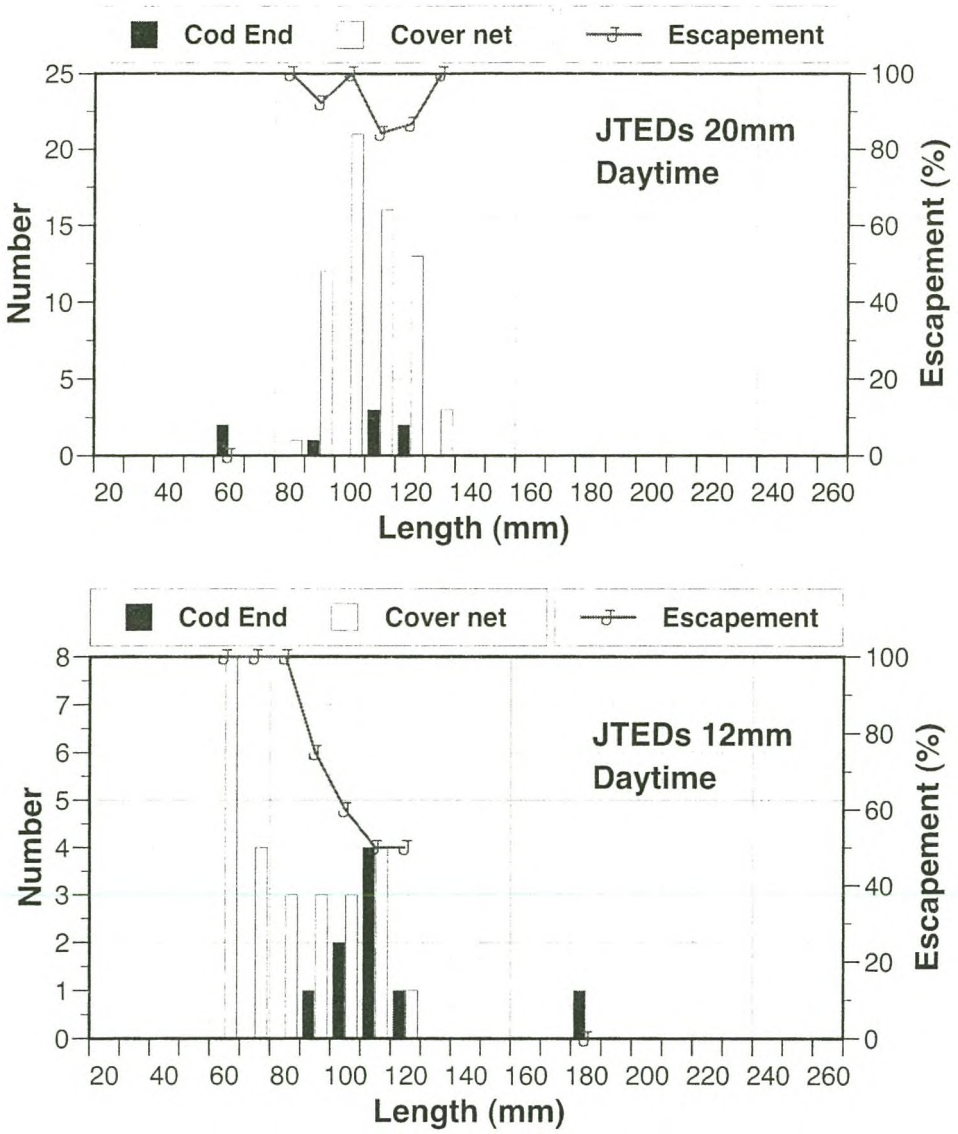


Fig. 12. Relationship between fork length and percent of escapement of the *Selaroides leptolepis* from daytime trawling using 12mm and 20 mmof JTEDs.

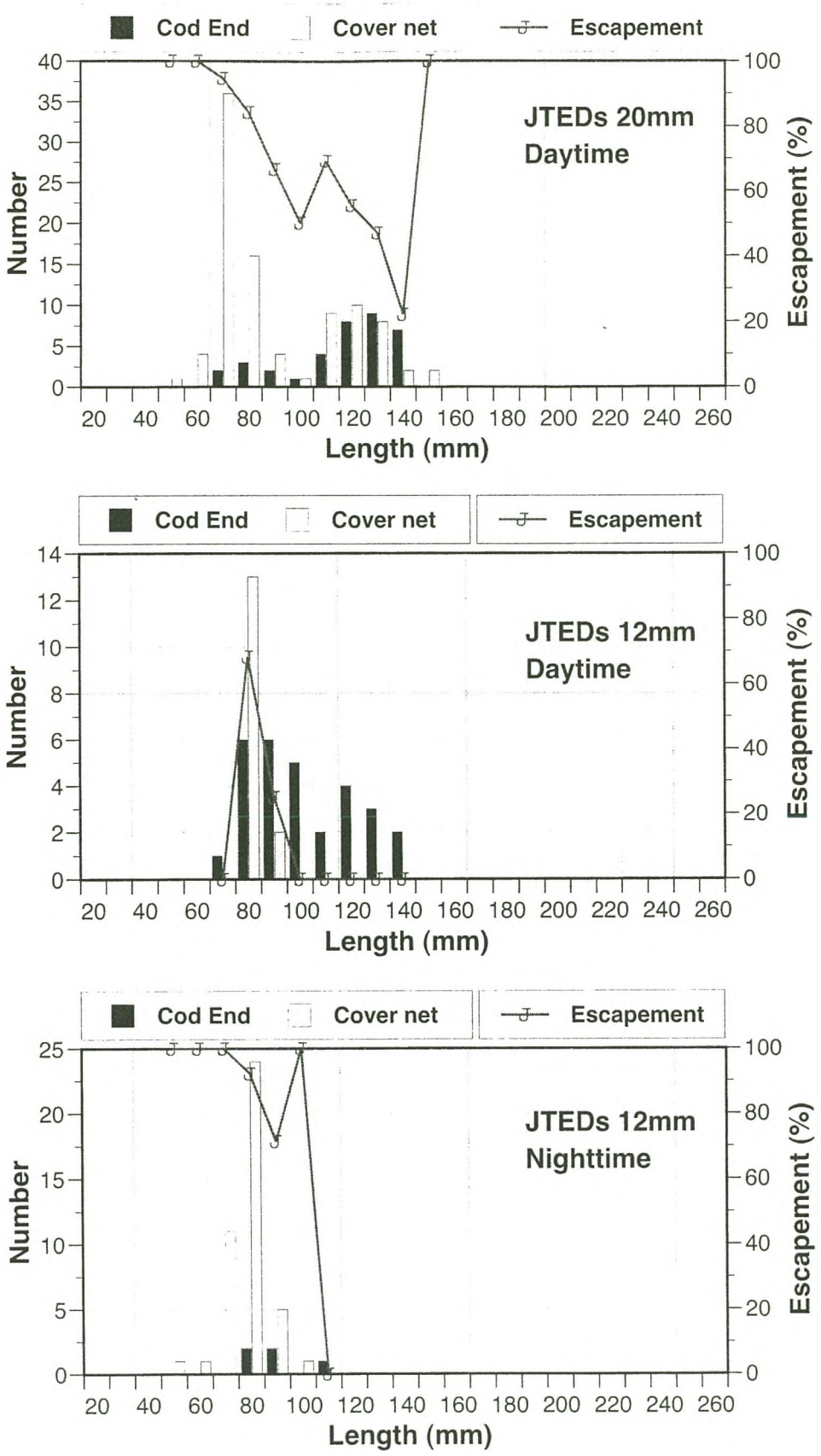


Fig. 13. Relationship between fork length and percent of escapement of the *Upeneus sulphureus* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

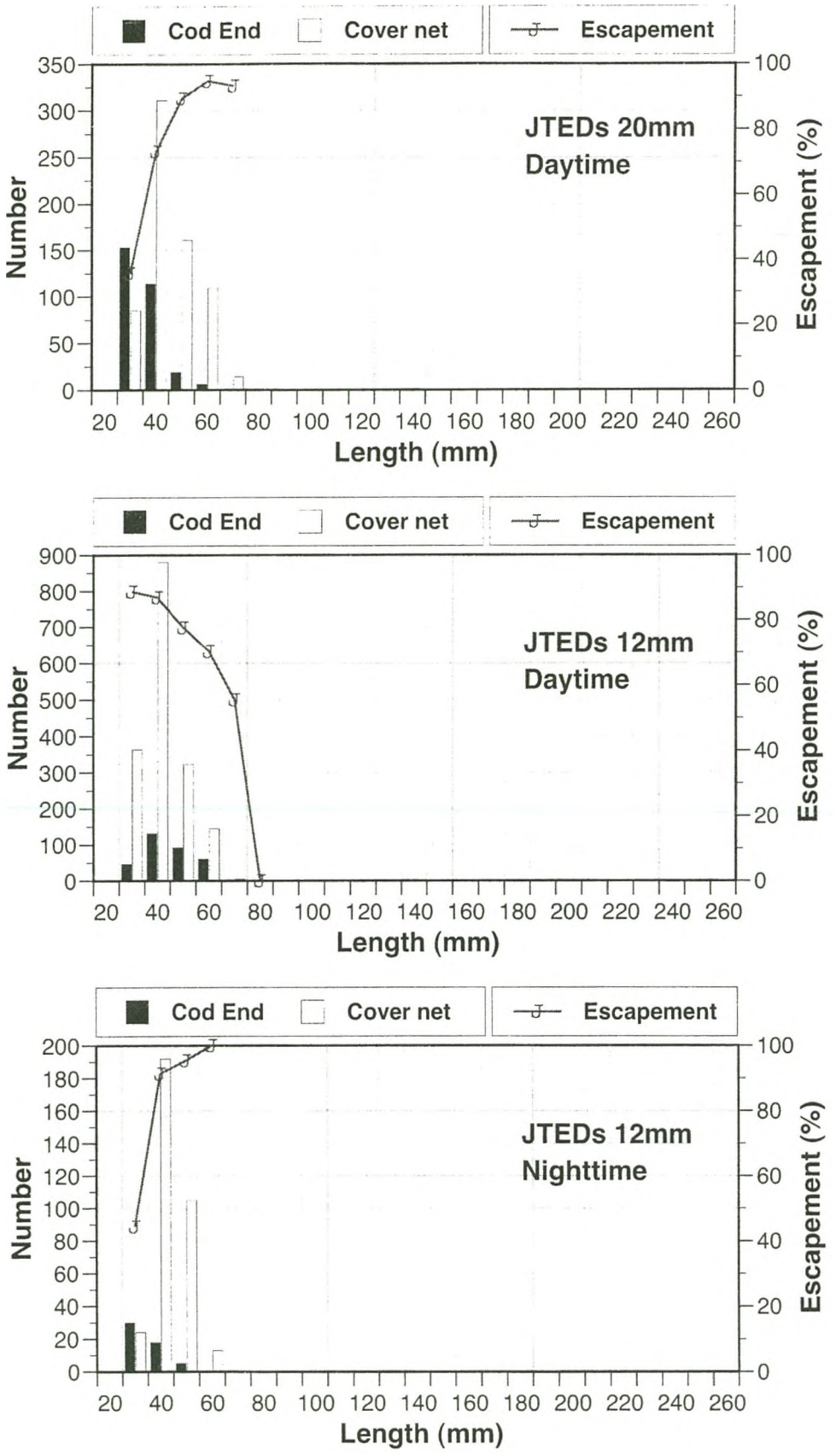


Fig. 14. Relationship between fork length and percent of escapement of the *Siganus sp.* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

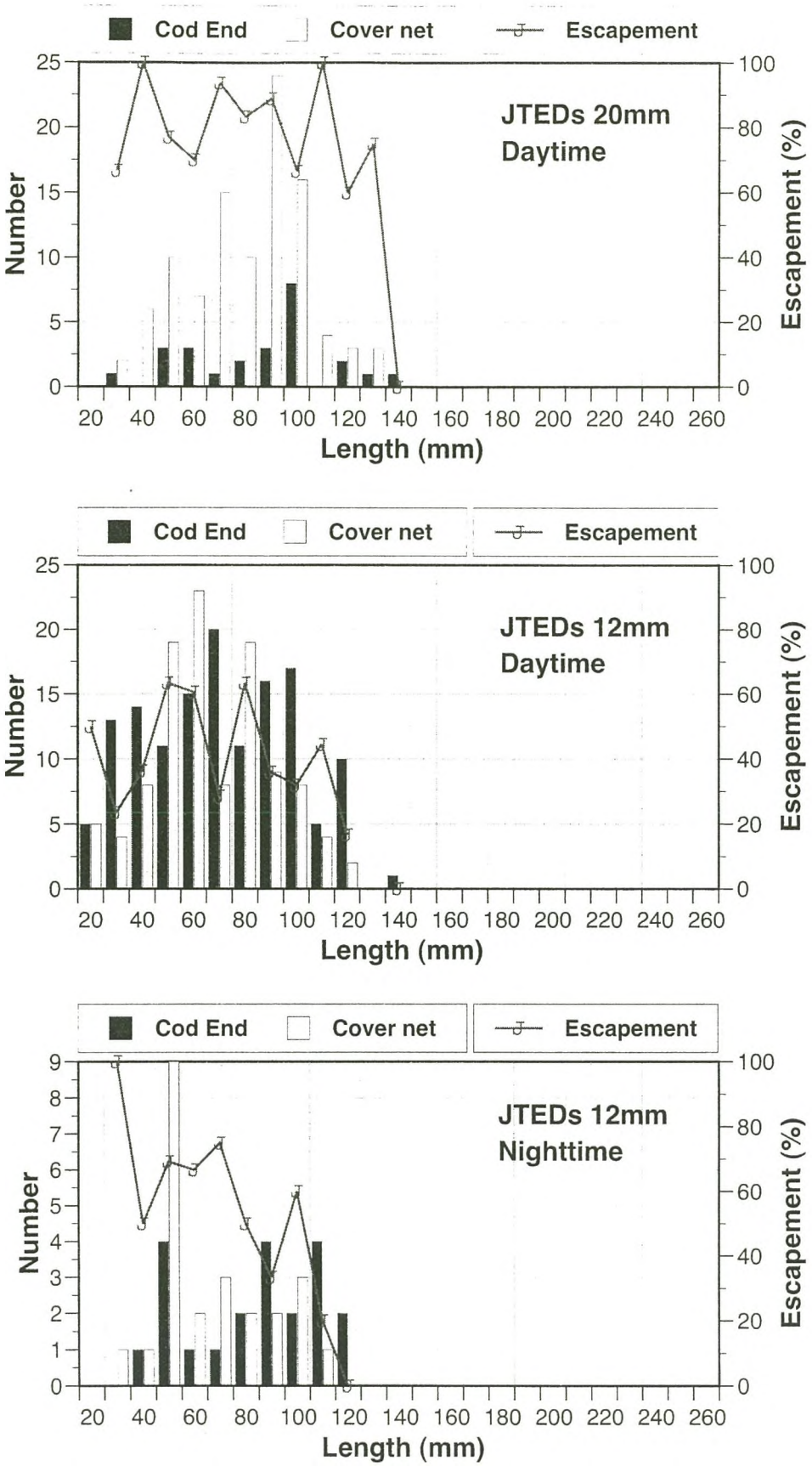


Fig. 15. Relationship between the mantle length and percent of escapement of squid, *Loligo sp.* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

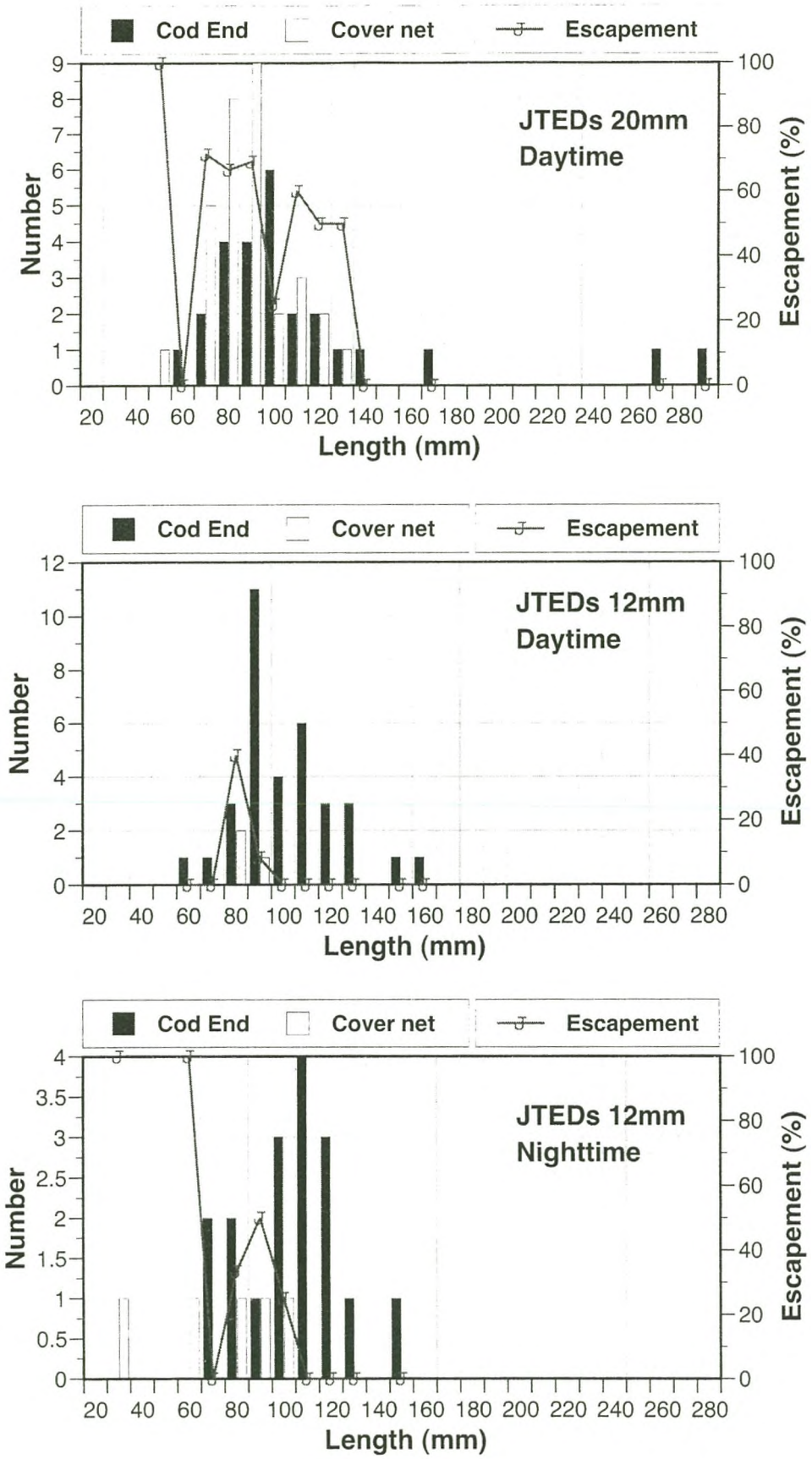


Fig. 16. Relationship between the mantle length and percent of escapement of cuttle fish, *Sepioteuthis sp.* from day and nighttime trawling using 12mm and 20 mmof JTEDs.

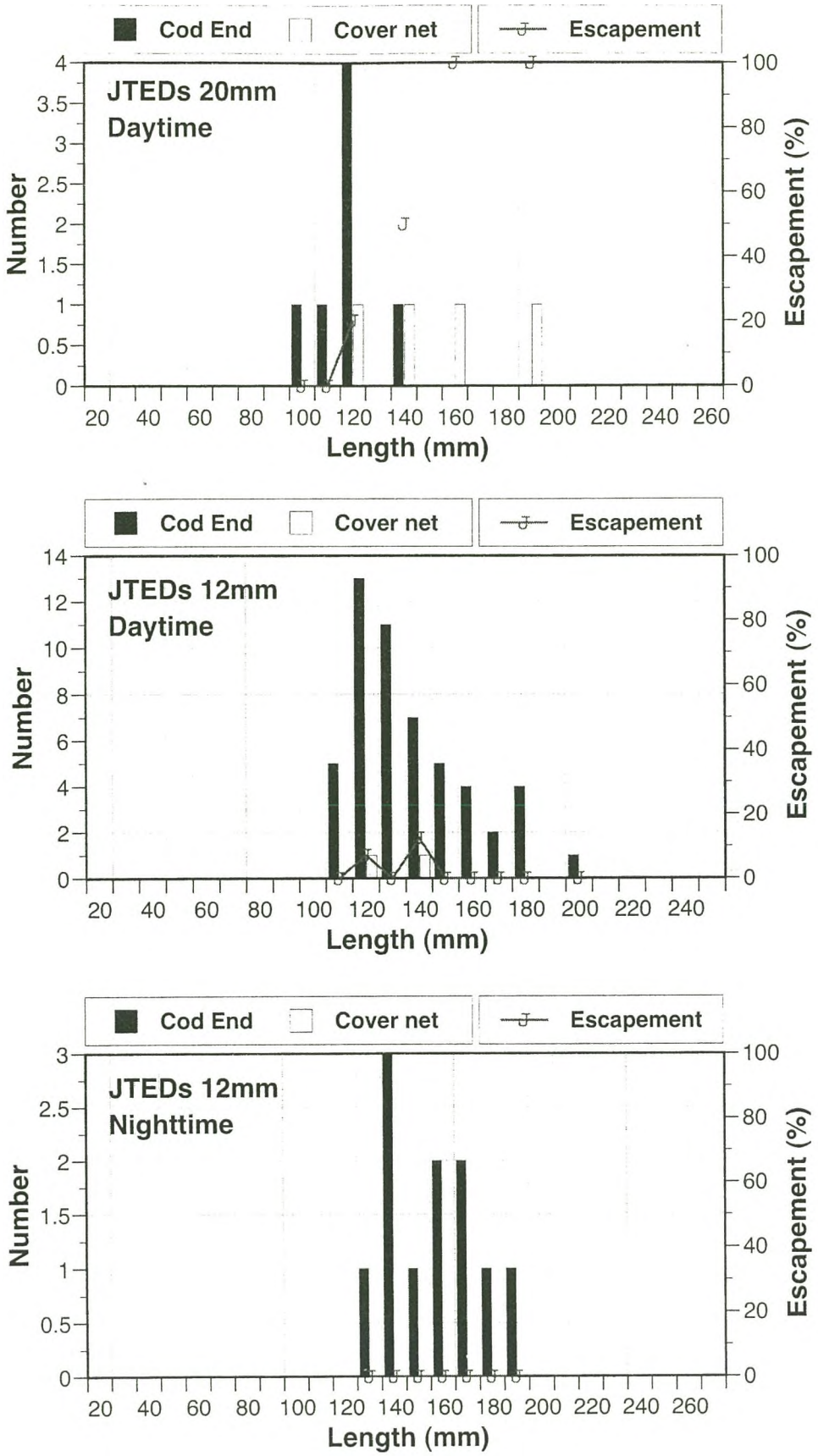


Fig. 17. Relationship between the length and percent of escapement of large shrimp (*Peneus sp.*) from day and nighttime trawling using 12mm and 20 mmof JTEDs.

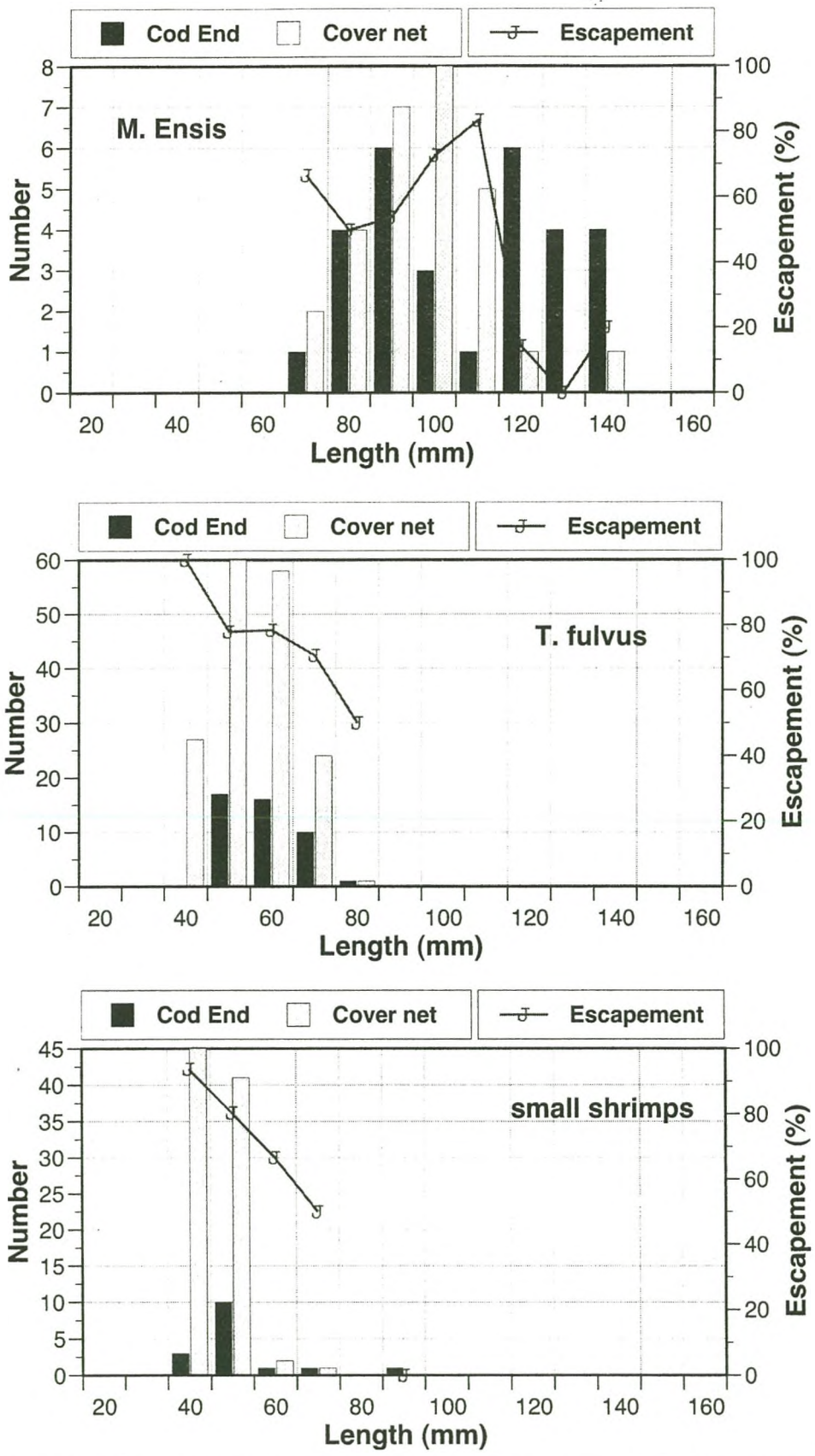


Fig. 18. Relationship between the length and percent of escapement of the *Metapeneus ensis*, *Trachypenaeus fulvus* and others samll shrimps from nighttime trawling using 12mm JTED.

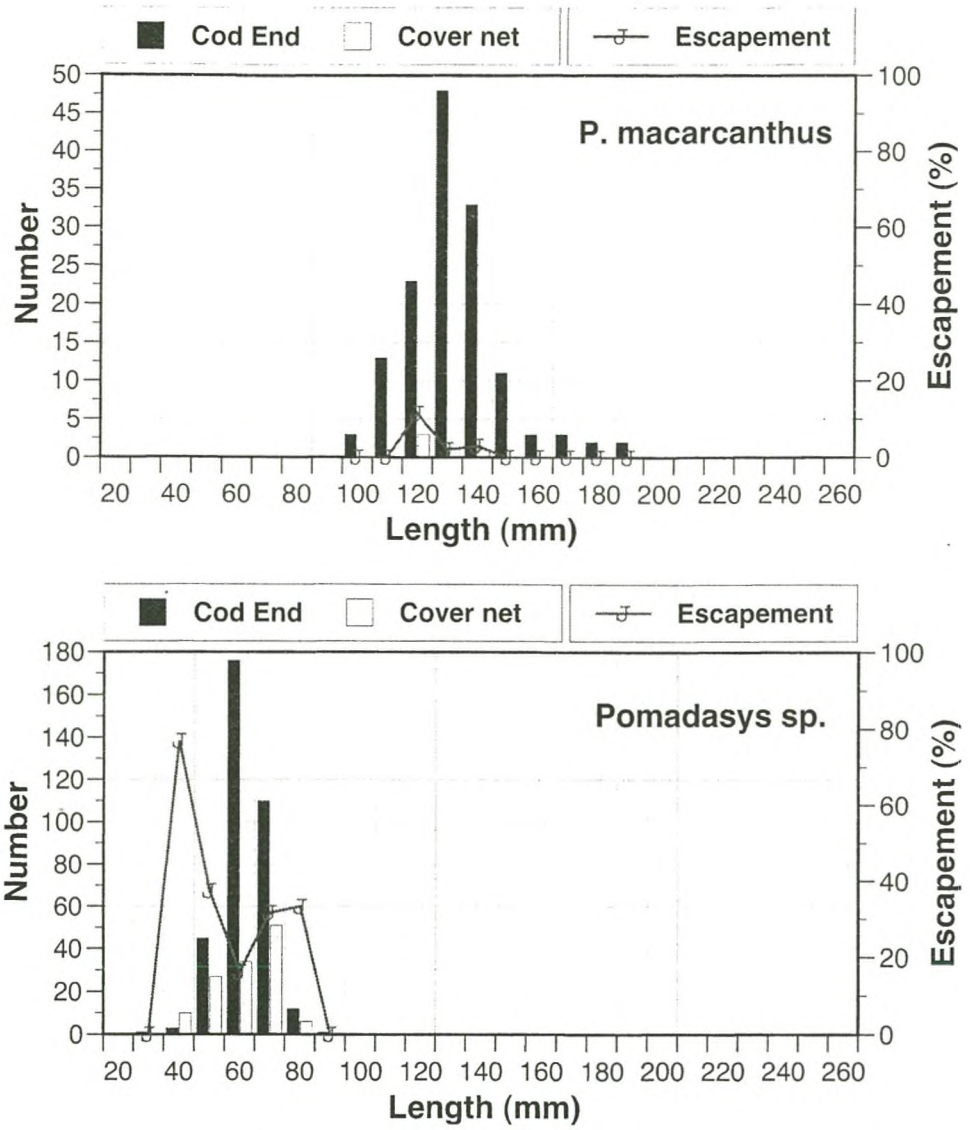


Fig. 19. Relationship between the length and percent of escapement of the *Priacanthus macracanthus* and *Pomadasys sp.* from nighttime trawling using 12mm JTED.

4. General Remarks and Conclusion

Implementation and introduction of selective device are very urgent need for the Southeast Asia Countries due to the over fishing of the marine resources of both demersal and pelagic fishes. JTED is one of the size selective device can be use in order to release small size of fishes and catch only big size ones. In principal of using this device, the target species or large size of fish or shrimp or squid/cuttle fishes should keep them in the codend and release only small/juvenile ones. From the experiments in this study, the 12mm bar spacing JTED may be suitable device to save the juvenile and small fishes including trash fishes for sustainable fishing because of high selective

device. The 12mm bar spacing JTED may not suit to the country where the fishing ground is still abundance of fishes. Experiment for suitable JTED may need to conduct before implementation.

Another parameters such as ease installation and operation for fishermen are also need to consider. Design and improvement of device in order to answer this question.

Acknowledgement

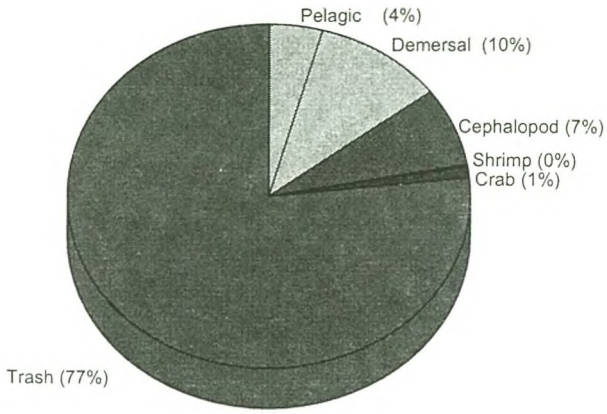
We would like to express sincere thanks to the Japanese Trust Fund for funding and make this study possible.

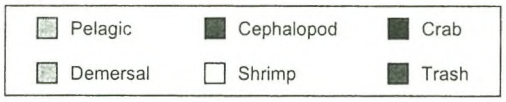
References

SEAFDEC, 2000. Study on Juvenile and Trash Excluder Devices (JTEds) in Thailand. Training Department, SEAFDEC. TD/RES/47.

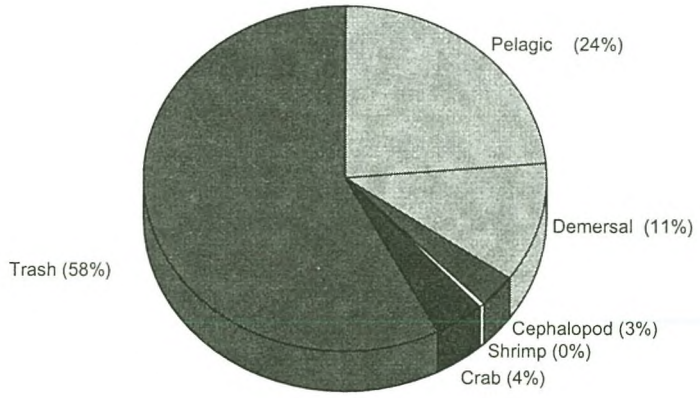
Appendices

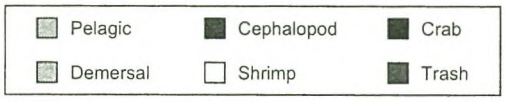
Appendix 1 Catch composition by group (by percentate of total weight.





Haul No. 1 Daytime 20mm Grid





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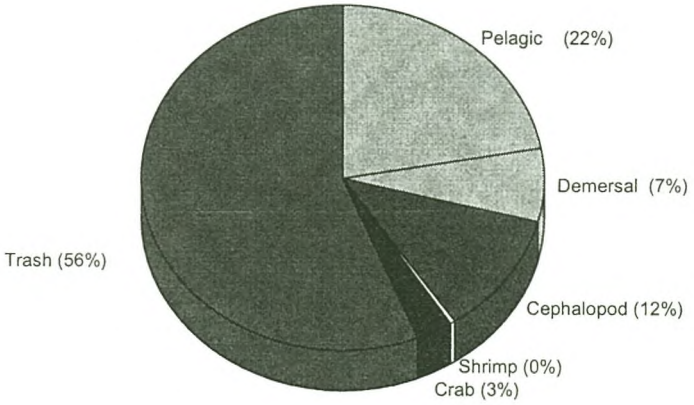

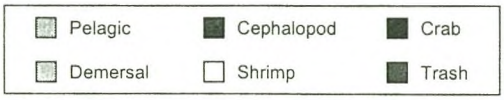

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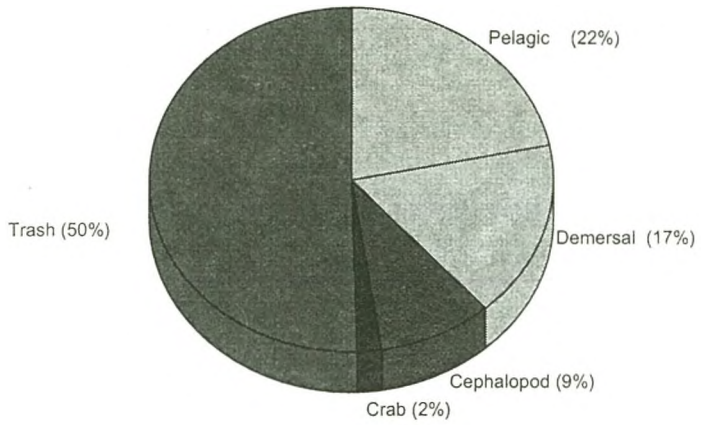

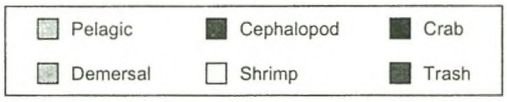

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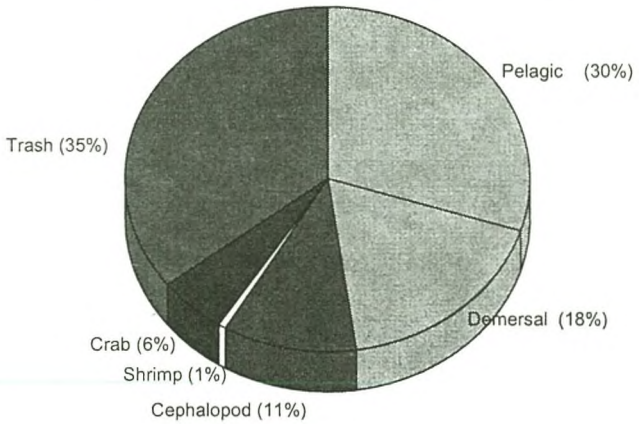

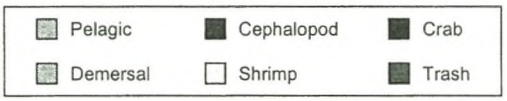

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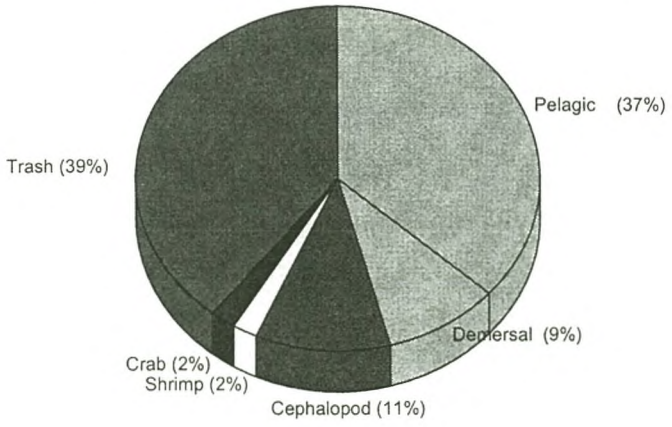

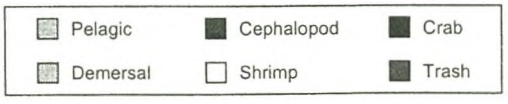

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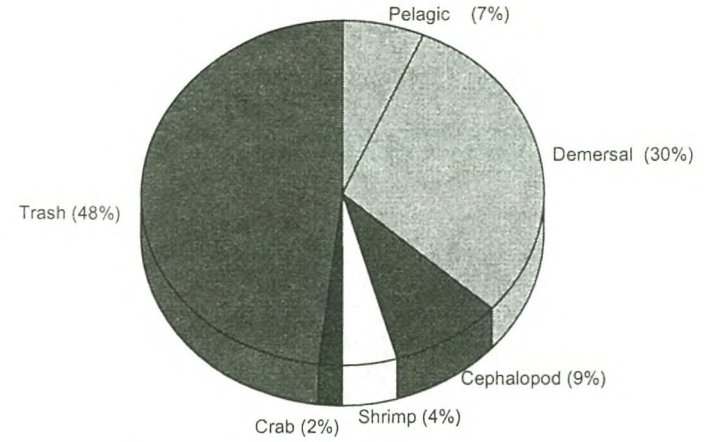

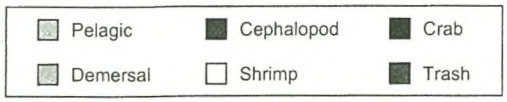

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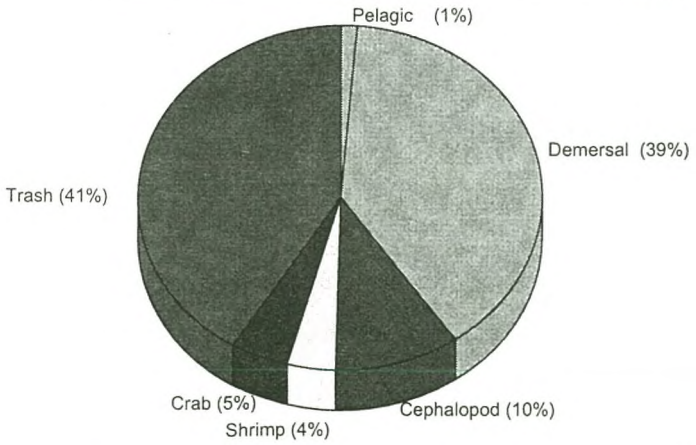

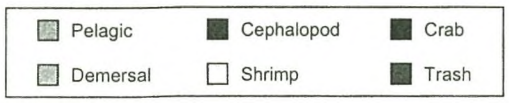

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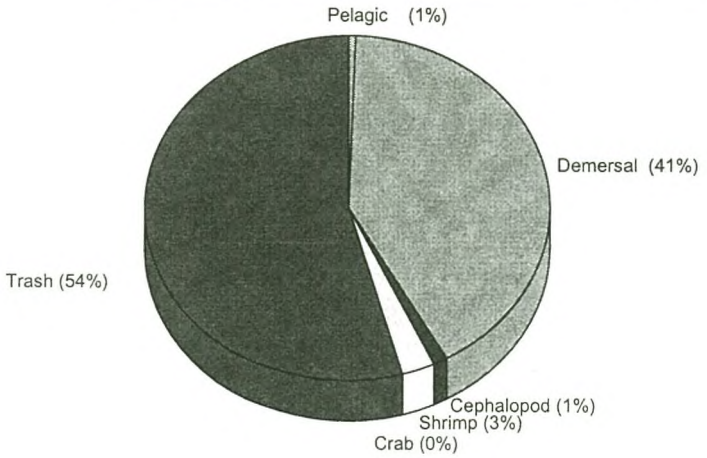

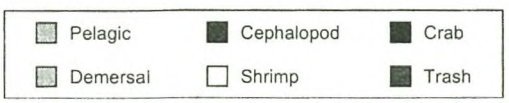

Haul No. 3 Nighttime 12mm Grid

Appendix 2 Catch composition by group (by weight) from both codends and the escapment levels for each target group for different bar spacing of JTEDs.

JTEDs Type 01 (20mm) (Day-time Operation)

	Operation 1				Operation 2				Operation 3							
Group	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape
Pelagic	0.31	1.745	2.055	84.91	1.14	5.31	6.45	82.33	5.585	5.05	10.635	47.48	7.035	12.105	19.14	63.24
Demersal	3.73	1.285	5.015	25.62	2.05	1.003	3.053	32.85	1.665	1.64	3.305	49.62	7.445	3.928	11.373	34.54
Cephalopod	2.425	1.1	3.525	31.21	0.45	0.4	0.85	47.06	2.37	3.19	5.56	57.37	5.245	4.69	9.935	47.21
Shrimp	0.06	0.025	0.085	29.41	0	0.11	0.11	100.00	0.15	0.03	0.18	16.67	0.21	0.165	0.375	44.00
Crab	0.5	0	0.5	0.00	1.1	0	1.1	0.00	1.4	0	1.4	0.00	3	0	3	0.00
Other	0	0	0	#DIV/0!	0.06	0.13	0.19	68.42	0.6	0.25	0.85	29.41	0.66	0.38	1.04	36.54
Trash	3.7	33.1	36.8	89.95	1.155	14.63	15.785	92.68	5.3	21.7	27	80.37	10.155	69.43	79.585	87.24
*TOTAL	10.725	37.255	47.98	77.65	5.955	21.583	27.538	78.38	17.07	31.86	48.93	65.11	33.75	90.698	124.45	72.88

JTEDs Type 01 (12mm) (Day-time Operation)

	Operation 4				Operation 5				Operation 6							
Group	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape
Pelagic	5.66	0.995	6.655	14.95	8.55	0.67	9.22	7.27	12.23	0.415	12.645	3.28	26.44	2.08	28.52	7.29
Demersal	4.035	1.065	5.1	20.88	5.39	0.13	5.52	2.36	2.58	0.61	3.19	19.12	12.005	1.805	13.81	13.07
Cephalopod	2.42	0.387	2.807	13.79	2.596	0.72	3.316	21.71	2.45	1.305	3.755	34.75	7.466	2.412	9.878	24.42
Shrimp	0	0	0	#DIV/0!	0.185	0	0.185	0.00	0.643	0.04	0.683	5.86	0.828	0.04	0.868	4.61
Crab	0.6	0	0.6	0.00	1.7	0	1.7	0.00	0.7	0	0.7	0.00	3	0	3	0.00
Other	0.2	0	0.2	0.00	0.7	0	0.7	0.00	0.6	0	0.6	0.00	1.5	0	1.5	0.00
Trash	2.605	12.83	15.435	83.12	4.935	6	10.935	54.87	4.075	9.5	13.575	69.98	11.615	28.33	39.945	70.92
*TOTAL	15.52	15.277	30.797	49.61	24.056	7.52	31.576	23.82	23.278	11.87	35.148	33.77	62.854	34.667	97.521	35.55

JTEDs Type 01 (12mm) (Night-time Operation)

	Operation 7				Operation 8				Operation 9							
Group	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape	Cod End	Cover Net	Total	% Escape
Pelagic	2.275	0.055	2.33	2.36	0.415	0.01	0.425	2.35	0.16	0.02	0.18	11.11	2.85	0.085	2.935	2.90
Demersal	9.63	1.02	10.65	9.58	10.845	1.806	12.651	14.28	12.125	0.955	13.08	7.30	32.6	3.781	36.381	10.39
Cephalopod	2.68	0.467	3.147	14.84	2.855	0.42	3.275	12.82	0.19	0.175	0.365	47.95	5.725	1.062	6.787	15.65
Shrimp	1.385	0.179	1.564	11.45	0.425	0.83	1.255	66.14	0.316	0.524	0.84	62.38	2.126	1.533	3.659	41.90
Crab	0.67	0	0.67	0.00	1.5	0	1.5	0.00	0	0	0	#DIV/0!	2.17	0	2.17	0.00
Other	1.69	0.03	1.72	1.74	1.63	0.01	1.64	0.61	1.17	0	1.17	0.00	4.49	0.04	4.53	0.88
Trash	5.615	9.418	15.033	62.65	4.36	7.34	11.7	62.74	5.07	10.983	16.053	68.42	15.045	27.741	42.786	64.84
*TOTAL	23.945	11.169	35.114	31.81	22.03	10.416	32.446	32.10	19.031	12.657	31.688	39.94	65.006	34.242	99.248	34.50

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