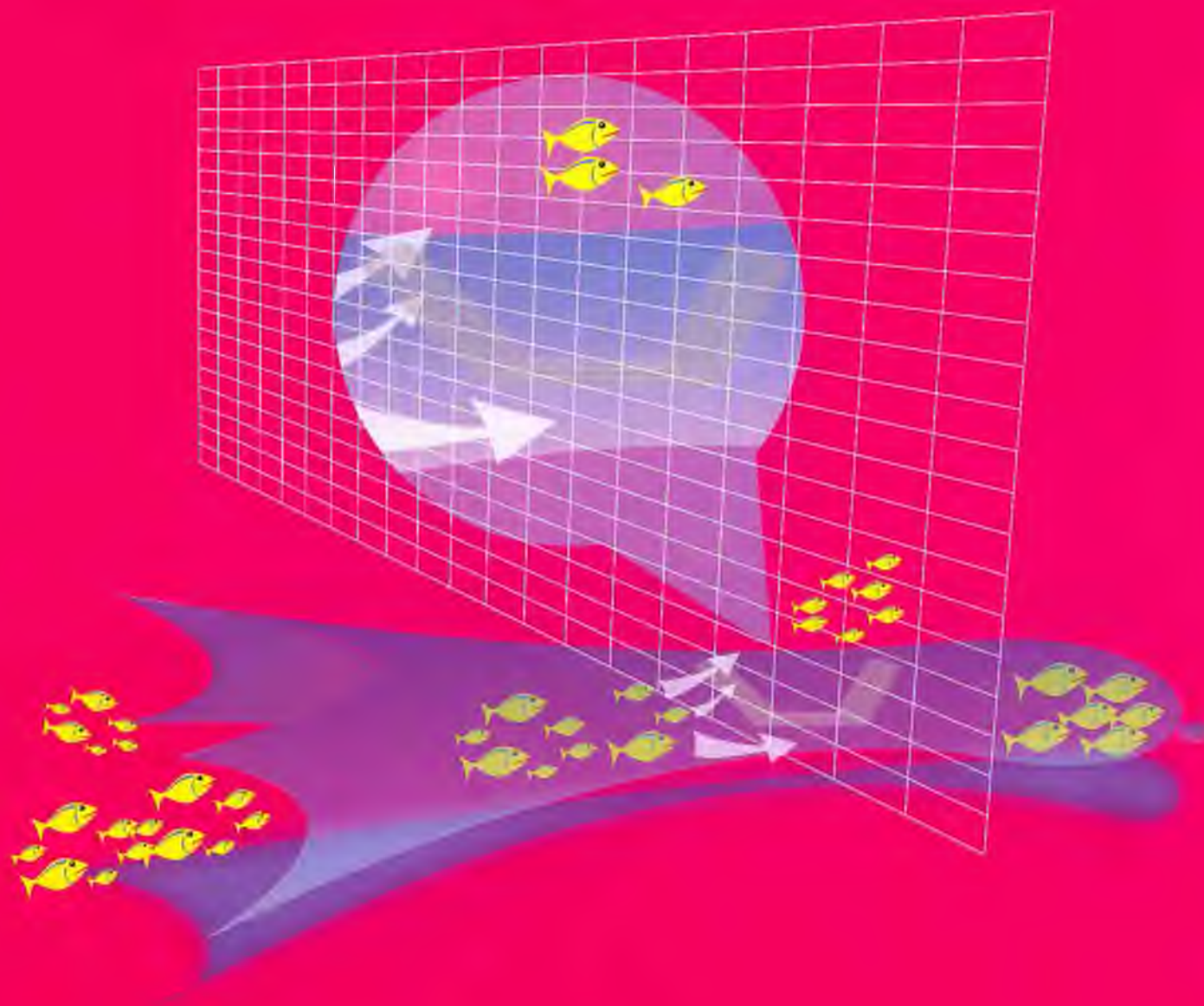# STUDY ON

JTEDs

JUVENILE AND TRASH EXCLUDER DEVICES IN CAMBODIA

SEAFDEC

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
TRAINING DEPARTMENT

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

Bundit Chokesanguan, Suppachai Ananpongsuk
and Raya Pethkam

SEAFDEC Training Department, P.O. Box 97, Phrasamutchedi, Samutprakarn, 10290 Thailand

Southeast Asian Fisheries Development Center
Training Department

TD/RES/101

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

**Bundit Chokesanguan, Suppachai Ananpongsuk
and Raya Pethkam**

SEAFDEC Training Department , P.O. Box 97, Phrasamutchedi, Samutprakarn, 10290 Thailand

ABSTRACT

The experiment was conducted during October 2004 in the Sihanoukvill, Cambodia using the commercial trawler in order to examine the releasing ability of Juvenile and Trash Excluder Devices (JTEDs) in bottom trawl. This experiment was in the serial study of using the JTEDs under the program of selective fishing gear and practice for responsible fishing. Three types of JTEDs, rectangular shaped window, semi-curve with 1 cm bar spacing and rigid sorting grid JTEDs with 1,2 and 3 cm bar spacing were used in this experiment has been shown the best results for releasing the non-target catch and could maintain the maximum catch resulted from the previous experiments.

The results indicated that the rigid sorting grid JTED 1 cm bar spacing could give the escapement levels of about 21.93% of the total catch when it was about 56.19% and 75.71% were 2 and 3 bar spacing. The escapement level of semi-curved JTEDs and rectangular shaped rectangular shaped window JTEDs are 37.94% and 61.98%, respectively. However, it was observed that semi-curve JTED performed the highest ability to released trash fish as compared with another two type of JTED used in this experiment. It could be suggested that the effectiveness of the modifications for JTEDs used in the region could be further fine-tuned to improve the performance.

Introduction

It has been recognized for sometime that trawling in shallow coastal waters has 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 BRDs/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 JTED. The preliminary results and conclusions from these experiments were reasonably good in terms of catching and releases efficiency of economically important fish species. Comparing nets with and without JTEDs tested the efficiencies of the designs.

During the year 2000, the study continued in other regional countries's water when experiments were conducted in Brunei Darussalam. In these experiments the design of the devices had been refined and the results indicated and 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. The follow-up activities has been carried out in September 2001, JTEDs introduced in Malaysia which collaborated with DOF, Malaysia together with SEAFDEC/MFRDMD. The experiment and demonstrations were carried out in the water off Kedah, the west coast of peninsular Malaysia. In 2002, the activities were carried out in Indonesia. As DOF, Indonesia has also a project on selective fishing gear in the Reduction of Environment Impact from Tropical Shrimp Trawling through the introduction of by-catch reduction technology and change of management. The demonstrations and experiment were carried out in Bintuni Bay, Papua, Indonesia. This activity has been carried out during August to September 2002. The continuous activity was demonstrations and experiments of JTED for the Philippines fisheries officers and fishermen. The experiment and demonstrations site were in Manila Bay during April to May 2003. An additional supporting latest this activities, Brunei Darussalam, has requested SEAFDEC/TD to carry out a second set of demonstrations and experiments in coastal Brunei waters using devices like the (sorting grid JTED, with 1,2,3 cm. grid interval), semi-curve JTED and the rectangular shaped window type JTED. The missions has been carried out during July – August 2003. In April to May 2004, The demonstrations and experiment were carried out in Thandwe, Rakhine state, Myanmar.

To continue these activities, Cambodia was selected as a country where the implementation of such devices can be beneficial. Methodologies in this project will be divided into two parts. The first is demonstration and second is experiment of JTED to Cambodian Fisheries Officers and Fishermen.

4

Material and Methods

An experiment was conducted in October 2004 using bottom otter board trawl on the small-scale fishing boat in the coastal of Sihanoukville, Cambodia from Latitude 90°34′90 N to Latitude 103°14′ 85 N and Longitude 103°24′50.1 E to 103°26′59.7 E (Fig. 1). Twenty-ninths operations were done in fishing ground. The modified JTEDs were designed to release juvenile, small fish and trash fish and still maintain big catches in the cod-end. In this experiment, three modified were constructed which developed by SEAFDEC/TD, namely, rigid sorting grid, semi-curve and rectangular shaped rectangular shaped window JTEDs. All the JTEDs types were operated in the day time only, there were conducted using rigid sorting grid JTED with bar space of 1 cm, 2 cm and 3 cm. And there were operated semi-curve and rectangular shaped rectangular shaped window JTEDs with 1 cm of bar spacing only. Rectangular shape JTEDs was 80x100 cm^2 iron frame, with diameter 10 mm and the escape opening using vertical grid (iron rod with diameter 6 mm). For semi-curve type was the same size of the opening (80x100 cm^2) but the escape opening using vertical soft grid (polyethylene rope Z twist with diameter 6 mm.)(Fig.2). Both types have 20 escapes opening with 40 mm bar spacing. For the rigid sorting grid JTEDs was modified from the NOFITRAOMSA/S Sort-X system, this system was developed in Norway, and it consist of a metal grid fitted into the top side of the trawl ahead of the cod-end. The rigid sorting grid was made of rigid rod steel and consisted of three sections join together Two separate grid with fixed bar space 40 mm. were connected to polyethylene net covered steel frame, the main function of which was guide escaping fish away from the trawl net and to keep the system balanced during operation. This weighed about 15 kg. and neutral buoyancy was achieved with plastic floats. During fishing operation, the sorting grid opened and kept in a steady position by using chains. The angle of attachment was 45 degree in the first part of the sorting grid. The JTEDs frame consist of 65x80 cm^2 two pieces which the top of frame is a semi-curve shape were modified to suitable for the net shape and the 50x80 cm^2 was the middle piece with 40 mm bar spacing (Fig.3.).
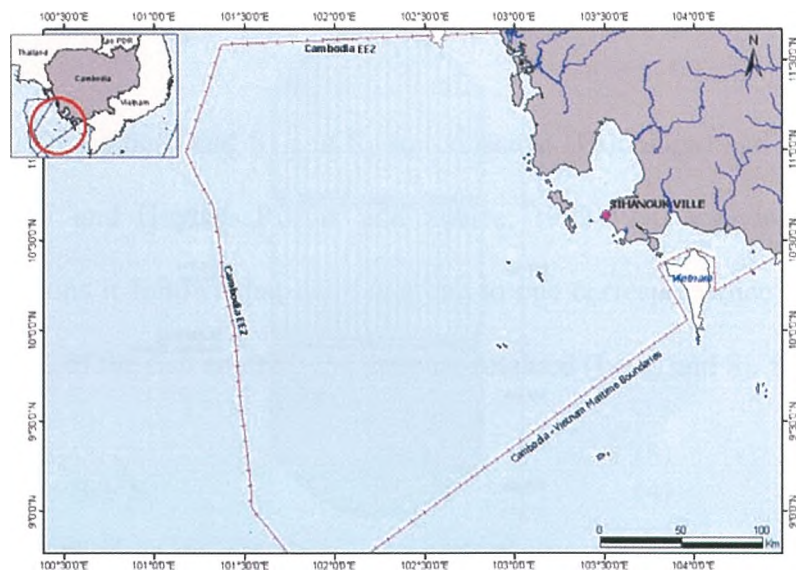

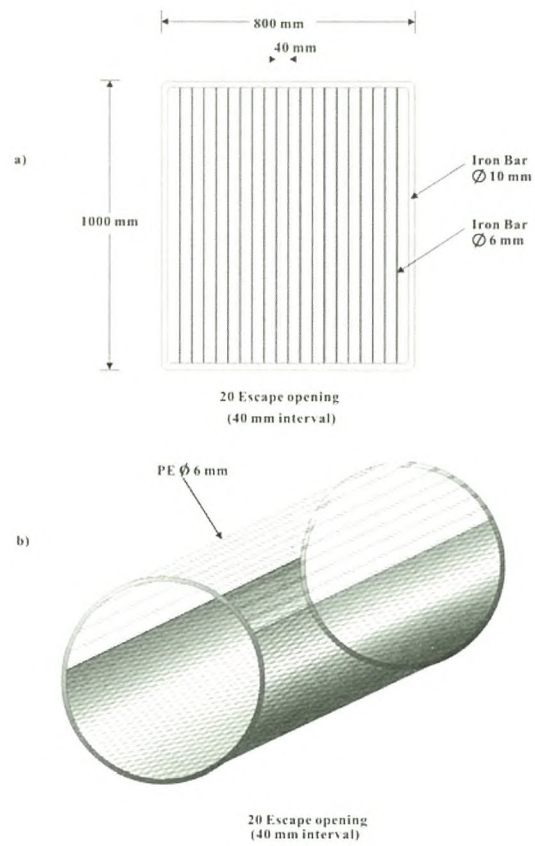**Fig. 1** Experiment area in coastal Sihanoukville, Cambodia

Fig. 2 Diagram of construction of JTEDs
    a)   Rectangular shape window JTEDs
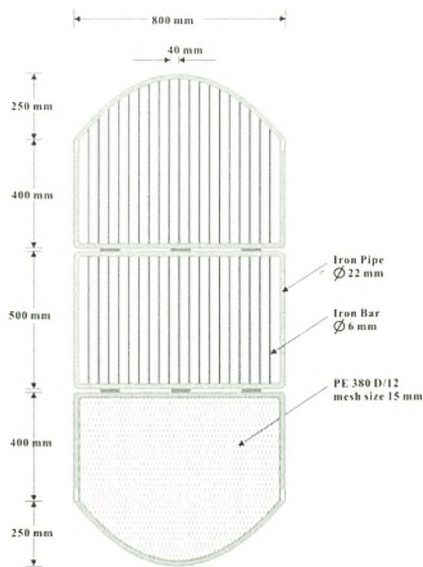   b)   Semi-curve TEDs

Fig. 3 Diagram of construction of rigid sorting grid JTEDs

Experiment and Data collection

Experiment was carried out between 21 October – 28 October 2004 on board coastal commercial bottom trawler based coastal of Sihanoukville. Trawling was carried out during daytime from 0900-1600 hrs. in depths between 12-30 m. The cover net were attached at ahead of the cod-end. Towing speed was approximately 2 to 3 knots. Twenty-ninth operations were done. The entire catch in the cod-end and the cover net were divided into species components and weighed. Escape fish from the trawl net by using JTEDs devices were calculate as:

$$\text{Escape (\%)} = W_{\text{cover net}} \times 100/(W_{\text{cod-end}} + W_{\text{cover net}}) \qquad (1)$$

Where

$W_{\text{cover net}}$ is the catch weight (kg) in the cover net

$W_{\text{cod-end}}$ is the catch weight (kg) in the cod-end

Length frequency of economically important species, and trash fish obtain from both cover net and cod-end were analyzed in relation to the percentage escapement. The parameter of total length of *Thryssa mystax* and *Johnius* sp. were collected during the study in the experimental area.

Estimate of trawl net selectivity

Per Sparre, et.al. (1989) delivered the mathematical expression for the cumulative normal distribution to describe the selection ogive. (As done by Jones, 1963 and 1976). However, from a calculation point of view it is easier to work with the so-called "logistic curve":

$$S_L = \frac{1}{(1 + e^{(S_1 - S_2 * L)})} \qquad (2)$$

where L is the length and S_1 and S_2 are constants (Paloheimo and Cadima, 1964, Kimura, 1977 and Hoydal, Rorvik and Sparre, 1982). By applying a few algebraic manipulations it follows that there is a one to one correspondence between Length at which 50% of the fish entering the gear are retained ($L_{50\%}$) and S_1, S_2:

$$L_{50\%} = S_1 / S_2 \qquad (3)$$
$$L_{75\%} = (\ln 3 + S_1)/ S_2 \qquad (4)$$

A direct method is to set up a gear selectivity experiment. The most commonly used experiment is the "covered cod-end method" (described by among others Pope *et. al.* 1975 and Jones 1976). The relatively large meshed cod-end of the

trawl is covered with a small mesh net, which retains (almost) all fish. By comparing the length compositions of the fish remaining in the cod-end and in the cover net, the probability of escapement through the large mesh net can estimated. The model to estimate the selective ogive is defined by Equation (3) rearranged into

$$\ln (1/S_L - 1) = S_1 - S_2 * L \qquad (5)$$

where L is the length interval midpoint

S_L is the fraction of length group L fish retained in the cod-end

$$S_L = \frac{\text{number of fish in the cod-end}}{\text{number of fish in the cod-end and in the cover}} \qquad (6)$$

It is seen that if S = 0 or S = 1 the expression in Equation (5) is not defined.

The regression analysis by Equation (5) gives the results:

Intercept   (a)   = S_1 and

Slope   (-b)   = S_2

Results

Table 1. Shows the general information from the experiment. fishing operations for three different types of JTEDs were carried out.

Catch composition

Fig. 4 Shows the catch composition by group (by percentage of total weight) in the experiment. Percentage of pelagic fish, demersal fish, shrimp and trash fish were 16%, 10%, 1% and 46% combination respectively.

Commercial species mostly found in this experiment are *Saurida undrosquamis, Nemipterus* sp., *Stolepharus indicus and johnius.*

Table 1 General information of the experimental study on the JTEDs attached to the shrimp trawl net during 21 – 28 October 2004 at Sihanoukville, Cambodia.

Type	Date	Haul	T.Spd.	Shooting		Hauling		Depth (m)	Weight(Kg.)		Total
				Time	Position	Time	Position		Cover	Cod-end	
Sort Grid	21/10/04	1	2.1	1020	1042925N 10328560E	1120	NR NR	12.5	2.59	15.88	18.47
1 cm.	"	2	2.1	1300	1035403N 10327689E	1400	1032947N 10328817E	12.5	4.00	26.50	30.50
	22/10/04	3	2.1	0935	1035410N 10327351E	1035	1033463N 10328179 E	23.0	0.83	9.00	9.83
	"	4	3.1	1150	1033264N 10326825E	1250	1034984N 10324615E	20.0	18.00	19.50	37.50
	"	5	2.8	1325	9034930N 10324501E	1435	1035580N 10326461E	24.0	2.50	28.50	31.00
Sort Grid	23/10/04	1	2.5	0925	1035372N 10327530E	1025	1035405N 10325127E	25.0	5.98	7.50	13.48
2 cm.	"	2	2.7	1010	1036625N 10323812E	1210	1039291N 10324113E	30.0	42.00	20.00	62.00
	"	3	2.2	1240	1039073N 10323960E	1340	1036677N 10324275E	15.0	27.50	25.00	52.50
	"	4	2.1	1420	1036660N 10324360E	1520	1038278N 10325800E	22.0	20.99	17.22	38.21
	24/10/04	5	2.2	0850	1041400N 10328985E	0950	1041290N 10326514E	15.0	23.00	24.50	47.50
	28/10/04	6	2.2	1130	1034745N 10329340E	1230	1033268N 10330277E	18.0	7.97	5.14	13.11

| Type	Date	Haul	T.Spd.	Shooting		Hauling		Depth (m)	Weight(Kg.)		Total
				Time	Position	Time	Position		Cover	Cod-end	
Sort Grid	24/10/04	1	2.2	1125	1041435N 10326225E	1225	1041704N 10324067E	15.0	26.00	23.00	49.00
3 cm.	"	2	2	1300	1041630N 10324116E	1400	1042201N 10326131E	20.0	27.50	8.50	36.00
	"	3	2	1420	1042270N 10326140E	1520	1041386N 10328185E	15.0	2.72	3.85	6.57
	"	4	2.1	1600	1041435 N 10328301E	1700	1041435N 10329900E	15.0	10.52	8.87	19.39
	25/10/04	5	2.1	0920	1035645N 10328229E	1020	1035645N 10329212 E	28.0	49.00	4.00	53.00
	"	6	2	1040	1034124N 10329391E	1140	1032038N 10330416E	18.0	47.00	4.00	51.00
Rectangular shaped window	25/10/04	1	2	1385	1032698N 10330098E	1435	1031513N 10329594E	18.0	26.50	12.50	39.00
1 cm.	"	2	2.1	1505	1031825N 10329389E	1605	1034267N 10328980E	18.0	24.00	16.26	40.26
	26/10/04	3	2.1	0900	1035991N 10327926E	1000	1034043N 10328652E	25.0	6.00	4.69	10.69
	"	4	2.2	1020	10B4007N 10328565E	1120	1036007N 10326007E	25.0	9.14	13.50	22.64
	"	5	2	1145	1033812N 10328093E	1245	1031697N 10326771E	18.0	23.00	9.00	32.00
	"	6	2.5	1315	1031485N 10329092E	1415	1033250N 10327342E	28.0	17.23	8.30	25.53
Semi Curve	27/10/04	1	1.8	0915	1036490N 10330550E	1015	1034616N 10329229E	30.0	2.00	18.00	20.00
1 cm.		2	2	1035	1034616N 10329351E	1135	1036860N 10330593E	20.0	0.89	10.87	11.76
		3	2.4	1215	1033219N 10328864E	1315	1031799N 10329369E	15.0	1.17	10.00	11.17
		4	2.1	1340	1031723N 10327929E	1340	1033815N 10328896E	18.0	13.96	13.05	27.01
		5	3.1	1500	1033760N 10329340E	1620	1036074N 10328930E	20.0	14.14	12.10	26.24
	28/10/04	6	1.6	0915	1035928N 10330845E	1015	1035085N 10329704E	28.0	14.00	11.45	25.45
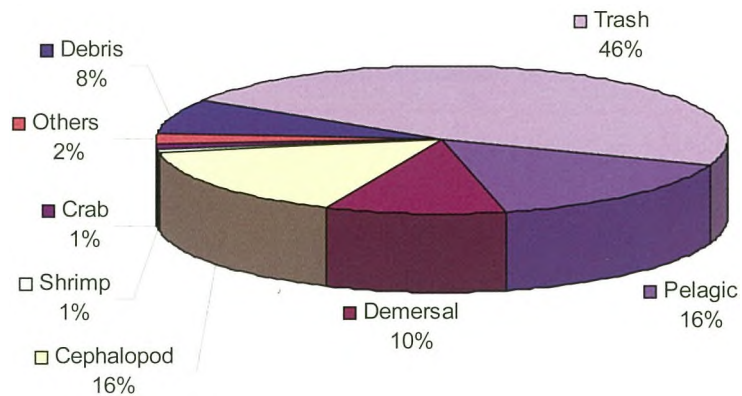
Fig. 4 Total Catch composition by group (by percentage of the total weight)

Escapement Level

The escapement levels from each type of JTEDs from the catches in the cover net found that the rigid sorting grid with 1 cm of bar spacing has the least escapement level, 21.93%, whereas 2 and 3 of bar spacing have around 56.19% and 75.71%, respectively. The escapement level of semi-curved JTEDs and rectangular shaped rectangular shaped window JTEDs are 37.94% and 61.98%, respectively.
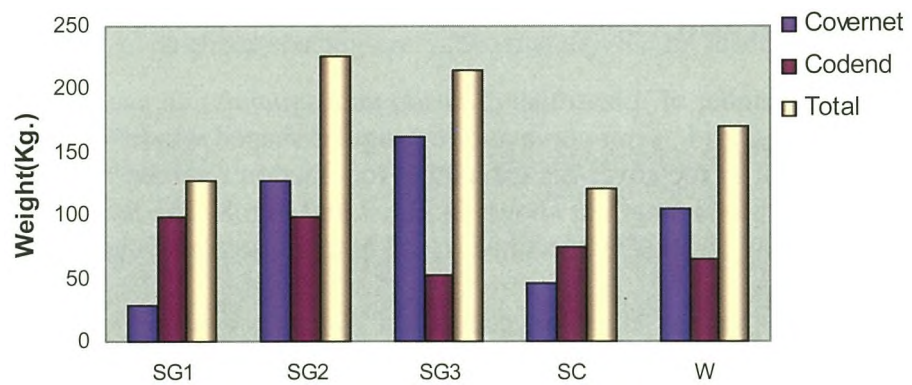

Fig. 5 The escapement levels from trawl net using each type of JTEDs
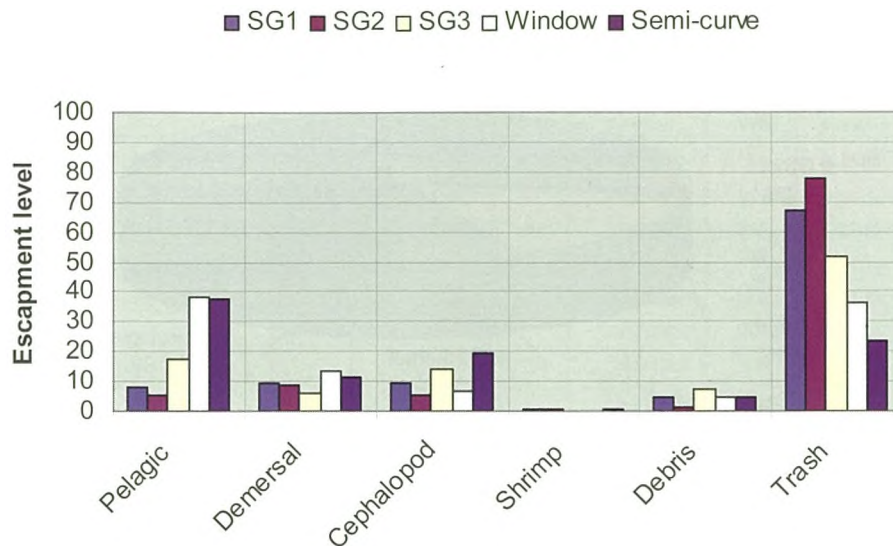
Fig.6 Escapement level of different type of JTEDs

In these experiments Lizardfish (*Saurida undosquamis*) and Threadfin bream (*Nemipterus* sp.) were to species that were caught in various sizes. The size composition of *Sauruda undosquamis* and *Nemipterus* sp. using rigid sorting grid, semi-curve and rectangular shaped window as well as number of fish retained in cover net. The minimum size of *Saurida undosquamis* caught is 5.5 cm. and maximum size is 26.0 cm. The minimum size of *Nemipterus* sp. caught is 1.5 cm. and maximum size is 16.0 cm.

Trawl net selectivity

The number of Lizardfish (*Saurida undosquamis*) in each length class caught by rigid sorting grid , semi-curve and rectangular shaped window JTEDs cod-end and number of fish in the cover net calculated for fraction retained by Equation (6) are plotted against total length as shown in Fig. 7 and Fig. 8. The length at which 50% of the fish entering the gear are retained ($L_{50\%}$) as calculated by Equation (4).

Calculation of fraction retained of *Saurida undosquamis* caught by rigid sorting grid JTEDs with 1, 2 and 3 cm of bar spacing cod-end plotted against total length associated with the estimate logistic curve are shown in Fig. 7a) . The length at which 50% of the fish entering the gear are retained ($L_{50\%}$) for 1,2 and 3 cm bar spacing of rigid sorting grid JTEDs are 9.8 cm, 16.0 cm and 14.7 cm, respectively.

Calculation of fraction retained of *Saurida undosquamis* caught by semi-curve and rectangular shaped window JTEDs cod-end ploted against total length associated with the estimate logistic curve are shown in Fig. 7b) . The length at which 50% of the fish entering the gear are retained ($L_{50\%}$) for semi-curve and rectangular shaped window JTEDs with 1 cm of bar spacing are 13.05 cm and 11.80 cm, respectively.
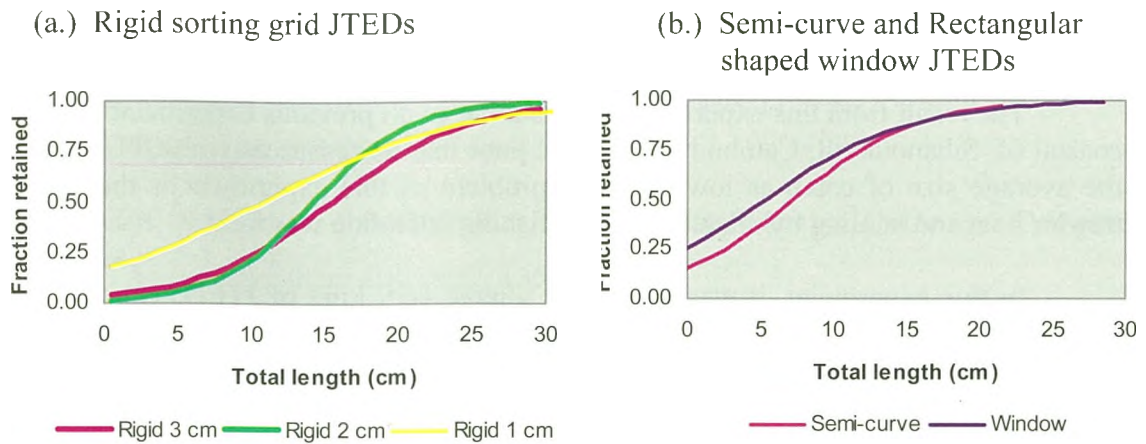
12

(a.) Rigid sorting grid JTEDs

(b.) Semi-curve and Rectangular shaped window JTEDs

Fig. 7 Gear selection ogive for *Saurida undosquamis* caught by 1,2 and 3 cm bar spacing from rigid sorting grid (a.) 1 cm bar spacing of semi-curve and rectangular shaped window JTEDs (b.).

Calculation of fraction retained of *Nemipterus* sp. caught by rigid sorting grid JTEDs with 1, 2 and 3 cm of bar spacing cod-end plotted against total length associated with the estimate logistic curve are shown in Fig. 8a) . The length at which 50% of the fish entering the gear are retained ($L_{50\%}$) for 1,2 and 3 cm bar spacing of rigid sorting grid JTEDs are 10.83 cm, 15.43 cm and 14.26 cm, respectively.

Calculation of fraction retained of *Nemipterus* sp. caught by semi-curve and rectangular shaped window JTEDs cod-end plotted against total length associated with the estimate logistic curve are shown in Fig. 8b) . The length at which 50% of the fish entering the gear are retained ($L_{50\%}$) for semi-curve and rectangular shaped window JTEDs with 1 cm of bar spacing are 7.29 cm and 5.40 cm, respectively.
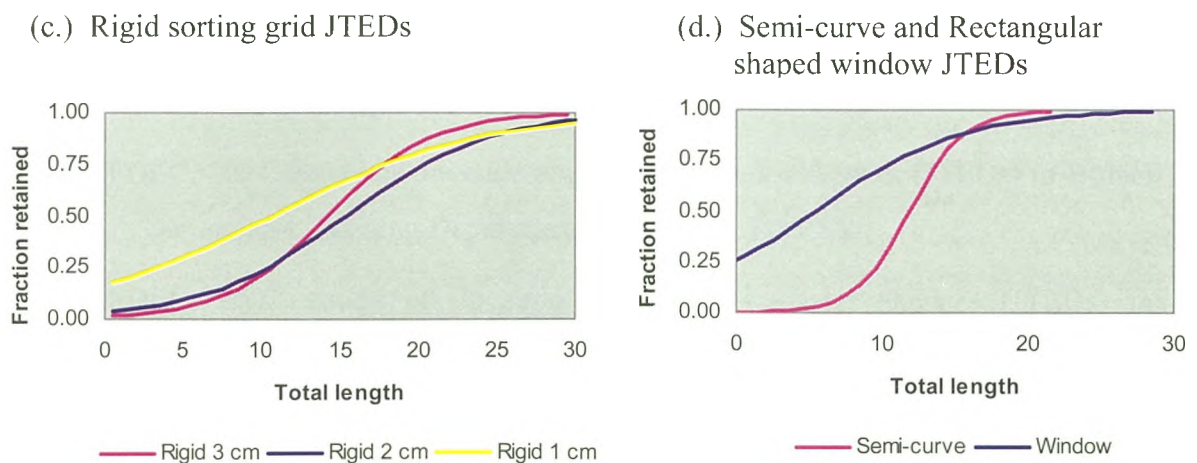
(c.) Rigid sorting grid JTEDs

(d.) Semi-curve and Rectangular shaped window JTEDs

Fig. 8 Gear selection ogive for *Nemipterus* sp. caught by 1, 2 and 3 cm bar spacing from rigid sorting grid (c.) 1 cm bar spacing of semi-curve and rectangular shaped window JTEDs (d.).

Conclusion and Discussion

The result from this experiment were similar to all previous experiment but the coastal of Sihanoukvill, Cambodia has quite poor marine resources with CPUEs and the average size of catch as low value. A problem of this experiment is the small trawler boat and hauling by manual so some fishing operation was fault.

In this experiment, it was found that almost very kind of JTEDs can release the juvenile and small fishes and retained the larger sizes of fish in the cod-end. The 1 cm bar spacing of rigid sorting grid JTEDs has the least escape rate, and is the most suitable compared to an other JTEDs. However the spacing of rigid sorting grid JTEDs must be adjusted to suit the average size of that country and needs the agreement of local fishermen. Certainly, the local fishermen did not want to use the high escape rate JTEDs with their trawl net.

This experiment, selectivity ogives were calculated from total length of released fish. Selectivity ogives showed escaped fishes were of a size comparable with the bar spacing of the rigid sorting grid JTEDs.

Acknowledgements

REFERENCES

Evans, S.M. and R.I. Wahju. 1996. The shrimp fishery of the Arafura Sea (Easter Indonesia). Fish. Res. 26 : 365-371.

Gheissari, N., and A. Bab-Hadiashar. 2003. Model Selection Criteria in Computer Vision: Are there different?. 185-194

Hoydal, K., C.J. Rorvik and P. Sparre, 1982. Estimation of effective mesh size and their utilization in assessment. Dana, 2:69-95.

Jones, R., 1976. Mesh regulation in the demersal fisheries of the South China Sea area. Manila, South China Sea Fisheries Development and Coordinating Program. SCS/76/WP/34: 75 p.

Kimura, D.K., 1977. Logistic model for estimating selection ogives from catches of cod-ends whose ogives overlap. J. Cons. CIEM, 38(1):116-9.

Pope, J.A., et al. 1975. Manual of methods for fish stock assessment. Pt3. Selectivity of fishing gear. FAO Fish. Tech. Pap., (41) Rev. 1:65p.

Mastawee, P. and Y. Theparoonrat. 2002. Trawl Net Mesh Selectivity for Lizardfish (*Saurida elongata*) and Blackspotted Trevelly (*Caranx leptolepis*) Using Square and Diamond Mesh Cod-end. Thai Fisheries Gazette. Vol. 55. P. 457-465.

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

SEAFDEC, 2001. Study on Juvenile and Trash Excluder Devices (JTEDs) in Brunei Darussalam. Training Department, SEAFDEC.TD/RES/.

SEAFDEC, 2002. Study on Juvenile and Trash Excluder Devices (JTEDs) in Vietnam. Training Department, SEAFDEC.TD/RES/.

SEAFDEC, 2002. Study on Juvenile and Trash Excluder Devices (JTEDs) in Malaysia. Training Department, SEAFDEC.TD/RES/.

SEAFDEC, 2002. Study on Juvenile and Trash Excluder Devices (JTEDs) in Indonesia. Training Department, SEAFDEC.TD/RES/.

SEAFDEC, 2003. Study on Juvenile and Trash Excluder Devices (JTEDs) in Philippines. Training Department, SEAFDEC.TD/RES/.

Sparre, P., E. Ursin, and S.C. Venema. 1989. Introduction to tropical fish stock assessment; Part 1- Manual. FAO Fish. Tech. Pap. 306/1, 337 p.

Tokai, T. 1997. Methodology of evaluating selectivity performance:- Two selective processes of trawl sorting device: Fish encountering and being sieved. Proceeding Southeast Asian Fisheries Development Center. P. 242-247.

Tokai, T. and Y. Fujimori. 1999. Estimation of gillnet selectivity curve by Kitahara's method with Solver on MS –Excel. The 3rd JSPS International Seminar, Sustainable Fishing Technology in Asia towards the 21th Century. 93-97 p.

Tokai, T., S. Omoto, R. Sato and K. Matuda. 1996. A method of determining selectivity curve of separator grid. Fish. Res., 27 : 51-60.