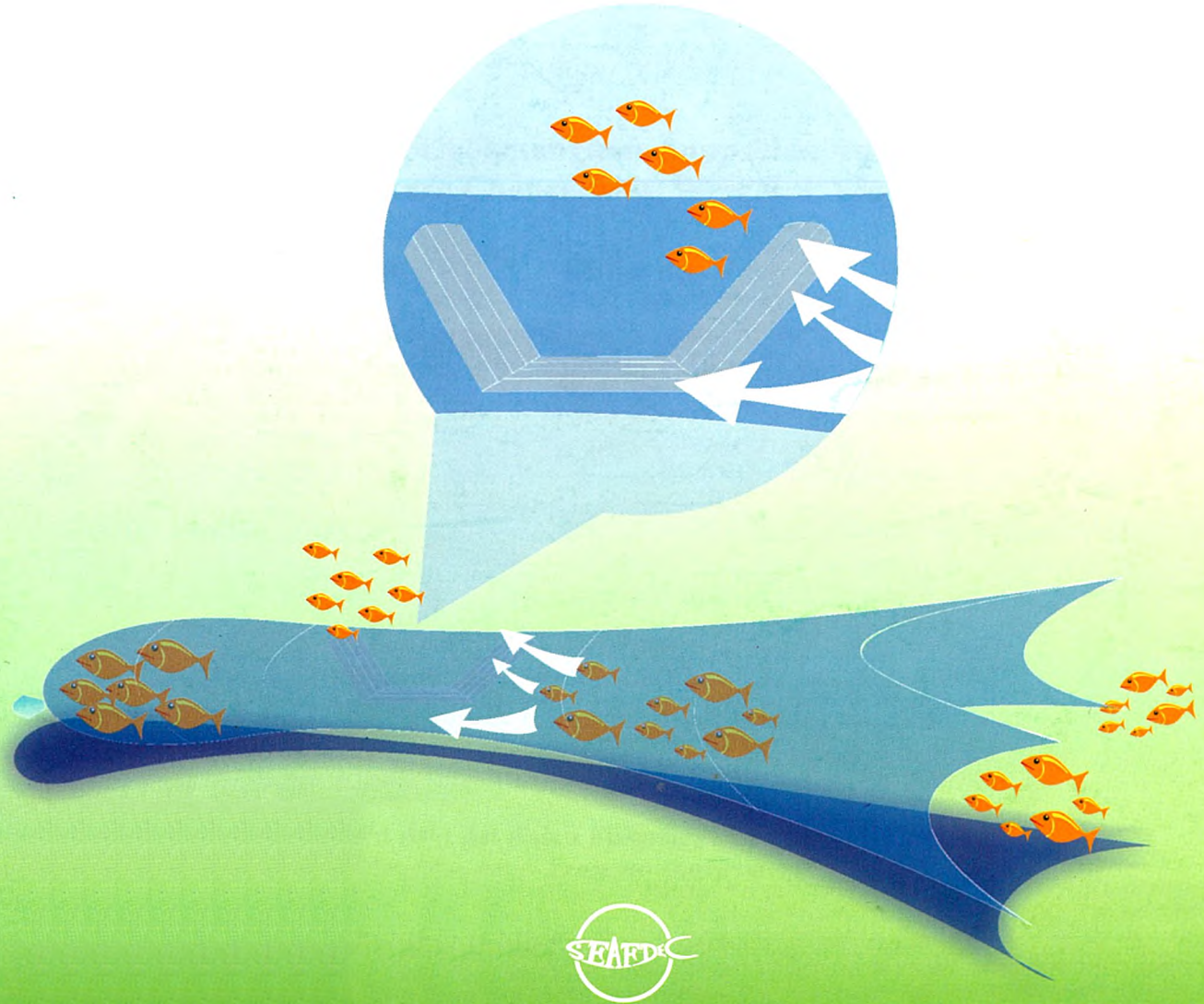
STUDY ON

2nd JTEDs

JUVENILE AND TRASH FISH EXCLUDER DEVICES IN BRUNEI DARUSSALAM



SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
TRAINING DEPARTMENT

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Study on Juvenile and Trash Excluder Devices (JTEDs) in Brunei Darussalam

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ABSTRACT

The SEAFDEC Training Department, in cooperation with the Department of Fisheries, Brunei Darussalam, conducted the second series of experiments on Juvenile and Trash Excluder Devices in Brunei Darussalam. The objective being to study the catching and release efficiency for juvenile and trash fishes using different escape openings of the JTEDs. The rigid sorting grid with a bar space of 1, 2 and 3cm were operated at 6 stations in daytime, 4 stations at night and at 2 special stations for the rigid sorting grid with a bar space 1 cm for sea trials. The rectangular shaped JTEDs and semi-curved d JTEDs were operated at 6 stations at night only. There were a total of 44 operations.

The CPUEs of the fish trawl net, operated in the northern areas of Brunei Darussalam were 283.27 kg/hr, about 54% in daytime and 46% at night. Escape rate percentages, by weight, of the trawl net with the rigid sorting grid JTEDs attached and having a bar space of 1, 2, 3cm, the rectangular shaped JTEDs and semi-curved JTEDs were 30.38, 77.67, 86.29, 40.03 and 12.77%, respectively. However there were some large fishes that could escape from the rigid sorting grid JTEDs with bar spacing of 2 and 3cm of both the rectangular shaped JTEDs and semi-curved d JTEDs. The estimated selectivity curves were shown the sizes of *Leiognathus ssp.*, which escaped from the rigid sorting grid JTEDs with bar spacing of 1, 2, 3cm in both the rectangular shaped JTEDs and semi-curved d JTEDs at L_{50}, were 10.30, 13.29, 14.22, 4.28 and 9.16, respectively. The estimate selectivity curves were shown the sizes of *Gerres ssp.*, which escaped from the rigid sorting grid JTEDs with bar spacing of 1, 2, 3cm of both the rectangular shaped JTEDs and semi-curved d JTEDs at L_{50}, were 11.77, 13.40, 12.90, 11.91 and 10.01, respectively.

KEYWORDS: Bottom trawl, Escape rate, Juvenile and Trash Excluder devices (JTEDs)

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[1] SEAFDEC/TD

[2] DOF, Brunei Darussalam

Introduction

Trawler is a highly efficient gear for catching shrimp and is used in several regions. The Southeast Asian region is in the tropical zone and is a multi species area and the fishermen, who operate shrimp-trawl, do not want to lose any profit. So, they want to catch both fish and shrimp. It has been recognized for sometime that operating shrimp-trawls in shallow costal waters has an adverse effect upon the areas and more directly catches the juveniles of commercially important and immature fish. To avoid the rapid decrease of fish stock, many modifications of BRDs (Bycatch Reduction Devices) have been developed to solve this problem.

After the successful collaborative project with SEAFDEC member countries for responsible fishing on Turtle Excluder Devices (TEDs) in 1997, SEAFDEC/TD (Southeast Asian Fisheries Development Center/Training Department), Thailand, has continued to promote responsible fishing by using selective devices, namely JTEDs (Juvenile and Trash Excluder Devices) in Thailand, Brunei Darussalam, Vietnam, Malaysia and Indonesia. The SEAFDEC/TD has carried out a series of experiments to release the juvenile, small fish and trash fish by conducted experiments using the JTEDs installed in shrimp-trawl nets. The first experiments started in the gulf of Thailand using the rectangular shaped window and semi-curved JTEDs. The second series of experiments were conducted in the waters off the coast of Maura Town, Brunei Darussalam using the more developed JTEDs with a rigid sorting grid. The third experiments were carried out off Cat Ba Island in Hai Phong Province, Vietnam. A fourth series of experiments were conducted in the waters off the coast of Alor Setar, Kedah State of Malaysia. From the four series of experiments it is found that the rigid sorting grid JTEDs has a better separating performance than the rectangular and semi-curved JTEDs. In May 2002, SEAFDEC/TD organized a Regional Practical Workshop on Selective Fishing Devices in association with the FAO/GEF project to promote selective fishing devices under the responsible fishing technology and practices program. This was through training and demonstrations to the participants from member countries. Indonesia was selected as the first country to continue this project at Sorong in August 2002. However this was the fifth series of experiments on JTEDs and was conducted with the cooperation of the Indonesian fisheries department. The experiments were carried out in the coastal waters off Bintuni Bay, Arafura Sea, Papua, Indonesia. The results are similar to other experiments in the past. The sixth experiments were conducted in Manila Bay, the Philippines, with the cooperation of BFAR/Philippines from April 28th to May 8th 2003. The results were quite good. The seventh experiments and demonstrations were conducted in Brunei Darussalam, with the cooperation of the Brunei Darussalam fisheries department. This was the second series of experiments in Brunei Darussalam after the first set in 2000. These experiments were carried out in the northern part of Brunei Darussalam waters.

Materials and methods

The experiments were carried out in the northern part of Brunei Darussalam waters from Latitude 05° 3.3' N to Latitude 05° 10.3' N and Longitude 114° 58.5' E to Longitude 115° 10.0' E using a 110 Horse power Brunei Darussalam trawler, MV. Achoja 1, with an overall beam of 8 m and length of 20 m. The experiment areas are shown in Figure1. The towing speed varied approximately between 2.5 and 3.3 knots. By taking half an hour for each trawling, each type of JTED were operated six times in daytime and four times at night using the rigid sorting grid with a bar spacing of 1 cm, 2cm and 3cm. The semi-curved and rectangular shaped window JTEDs were operated in daytime only, six times each, but two more special half hour operations were conducted using the rigid sorting grid JTED with a bar space of 1cm. The total number of operations were forty-four. The modified JTEDs were designed to release juveniles, small fish and trash fish and still maintain big catches in the codend. There were three types of JTED with five differences used in these experiments; semi-curved, rectangular shaped window and the rigid sorting grid with bar spacing of 1, 2, and 3 cm. The sizes of the iron frame for semi-curved JTED and rectangular shaped window were 80 x 100 cm^2 of 10 mm dia. rod and the escape opening used a vertical soft grid of 6mm diameter polyethylene rope. The rigid sorting grid JTEDs were a modified form of the NOFITRAOMSA/S Sort-X system developed in Norway. The rigid sorting grid JTEDs were made in three sections. The front and central sections are grids, the main frame is iron bar of diameter 10 mm and the grids are also iron diameter of 6 mm, and lastly the rear section is a net cover panel, PE 380d/12 mesh size of 15 mm. The sides of the rigid sorting grid JTEDs use chain connected the front and the rear panel to set the shape and angle of the JTEDs, 45° (clockwise) relative to the horizontal plain and 50° (anti-clockwise) relative to the horizontal plain. In these experiments the cover net, PE 250d/12 mesh size 15 mm, was designed to cover all the escape openings and the codend attached to supporting hoops had a diameter of 1.30 m.

Figure 1. Experimental area in Brunei Darussalam waters.

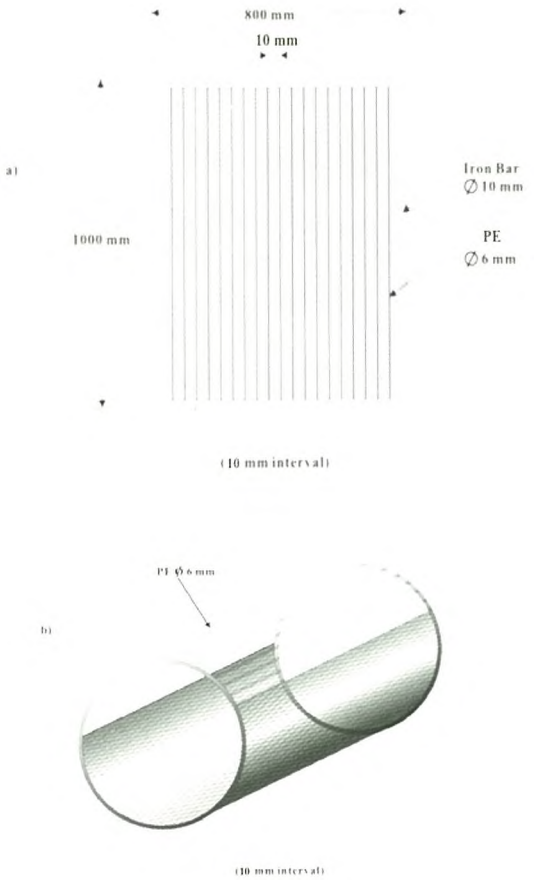

Figure 2. Diagram of JTED construction.
a) Rectangular shaped window JTED
b) Semi-curved JTED

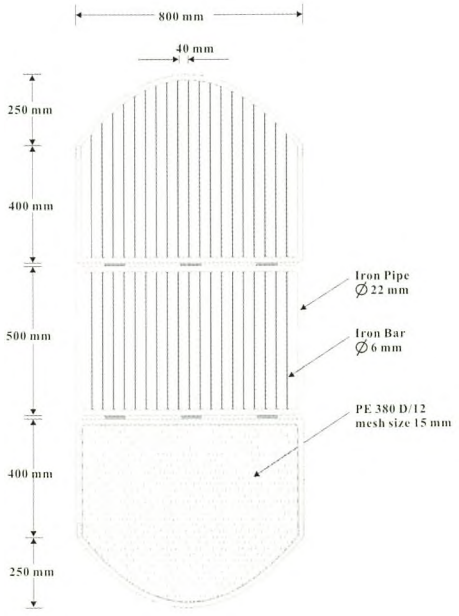

Figure 3. Diagram of rigid sorting grid JTED construction

Data collection and estimate of trawl net selectivity

The entire catch in the codend and the cover net were divided into species components and weighed. Escaped fish from the trawl net using JTED devices were calculated as:

$$\text{Escape (\%)} = \mathbf{W}_{\text{cover net}} \times 100/(\mathbf{W}_{\text{codend}}+\mathbf{W}_{\text{cover net}}) \quad (1)$$

Where, $\mathbf{W}_{\text{cover net}}$ is the catch weight (kg) in the cover net
$\mathbf{W}_{\text{codend}}$ is the catch weight (kg) in the codend

The escape rate from the codend is given by following equation.

$$\boldsymbol{E} = (\boldsymbol{Wv} \times 100) / \boldsymbol{Wt} \quad (1)$$

Where, $\boldsymbol{E}$ is escape rate
$\boldsymbol{Wv}$ is weight of catch in the cover net
$\boldsymbol{Wt}$ is total weight.

The estimate of the trawl net selectivity curve using a linear model (described by Pope *et. al.* 1975 and Jones 1976). This method is the most commonly used by comparing the length compositions of the fish remaining in the codend and in the cover net, the probability of escape through the large mesh net can estimated.

1. Linearized model

Trawl selection curve was approximated by the following equation.

$$\boldsymbol{S} = 1 /\{1 + \exp(\boldsymbol{a} + \boldsymbol{b}*\boldsymbol{l})\} \quad (2)$$

Where, $\boldsymbol{l}$ is the total length of the fish and $\boldsymbol{a}$ and $\boldsymbol{b}$ are constants.
The equation is linearized by taking logarithms.

$$\ln(1/S - 1) = a + b*l \quad (3)$$

In this model, the parameter is estimated by minimizing the following.

$$\sum_{i=1}^{n} [\ln\{(1/S) - 1\} - (a + b*l)]^2 \quad (4)$$

From equation 4, the regression coefficient "b" is obtained as.

$$b = \sum[(l - \bar{l})(y - \bar{y})] / \sum(l - \bar{l})^2 \quad (5)$$

Where $y = \ln[(1/S) - 1]$, and $\bar{y}$ is average. The intercept "a" is calculated by the following equation.

$$a = \bar{y} - b\bar{l} \quad (6)$$

Results

The experiment found that the catch per unit effort (CPUE) of the trawl net in Brunei Darussalam are 283.27 kg/hr/haul, about 54% in daytime and 46% at night (Figure 4). The catch weights from the 44 stations are shown in Fig.5. The escape rates from each type of JTED from the catches in the covernet and codend found that the rigid sorting grid with bar space 1 cm has the least escape rate, 30.38 %, whereas bar spacing of 2 and 3 cm have about 77.67% and 86.29%, respectively. The escape rate of the semi-curved JTEDs and rectangular shaped window JTEDs are 42.03% and 12.77%, respectively. The escape rates from each type of JTEDs are shown in figure 6. The escape rates of the rigid sorting grid JTEDs show that a bar space of 1,2,3 cm can release juveniles and small fish at 30.5%, 81.05%, 85.74% in daytime and 30.14%, 72.59%, 87.12% at night, respectively (Figure 7).

In these experiments *Leiognathus ssp.* and *Gerres ssp.* were two genus that were caught in various sizes. The escape weight of *Leiognathus ssp.* by the 1, 2 and 3 cm bar spacing rigid sorting grid, semi-curved and rectangular shaped window JTEDs are shown in figure 8. The escape rates of *Leiognathus ssp* were 47.17, 93.29, 95.37, 14.89 and 52.48% for the 1, 2 and 3 cm bar spacing rigid sorting grid, semi-curved and rectangular shaped window JTEDs, respectively. The rigid sorting grid with a bar space 3cm released the most. The selectivity ogive of *Leiognathus ssp.* in total length, using a trawl net with 1, 2 and 3 cm bar spacing rigid sorting grid, semi curved and rectangular shaped window JTEDs with codend mesh size 1.5 cm are shown in figures 9 and 10. The results indicate that L_{50} caught by trawl net with rigid sorting grid 1, 2 and 3 cm were 10.3, 13.29 and 14.22 cm, respectively. The selectivity ogive of *Leiognathus ssp.* in total length at L_{50} from the semi-curved and rectangular shaped window JTEDs was 4.28 and 9.16 cm. The selectivity ogive of *Leiognathus ssp.* in body width, using a trawl net with 1, 2 and 3 cm bar spacing rigid sorting grid, semi curved and rectangular shaped window JTEDs with codend mesh size 1.5 cm are shown in figures 11 and 12. The results indicate that L_{50} caught by trawl net with rigid sorting grid 1, 2 and 3 cm were 1.50, 1.75 and 1.92 cm, respectively. The selectivity ogive of *Leiognathus ssp.* in body width at L_{50} from the semi-curved and rectangular shaped window JTEDs was 1.87 and 0.94 cm.

The escape weight of *Gerres ssp.* by the 1, 2 and 3 cm bar spacing rigid sorting grid, semi-curved and rectangular shaped window JTEDs are shown in figure 13. The escape rates of *Gerres ssp* were 9.23, 74.32, 57.10, 14.27 and 36.63%, respectively. The selectivity ogive of *Gerres ssp.* in total length, using a trawl net with 1, 2 and 3 cm bar spacing rigid sorting grid, semi-curved and rectangular shaped window JTEDs with codend mesh size 1.5 cm are shown in figures 14 and 15. The size selectivity of *Gerres ssp.* in total length indicate that L_{50} caught by the trawl net with the rigid sorting grid of 1, 2 and 3 cm was 11.77, 13.40and 12.90 cm, respectively. The selectivity ogive of *Gerres ssp.* in total length at L_{50} from the semi-curved and rectangular shaped window JTEDs was 11.91 and 10.01cm. The selectivity ogive of *Gerres ssp.* in body width, using a trawl net with 1, 2 and 3 cm bar spacing rigid sorting grid, semi curved and rectangular shaped window JTEDs with codend mesh size 1.5 cm are shown in figures 16 and 17. The results indicate

that L_{50} caught by trawl net with rigid sorting grid 1, 2 and 3 cm were 1.23, 1.76 and 1.62 cm, respectively. The selectivity ogive of *Gerres ssp.* in body width at L_{50} from the semi-curved and rectangular shaped window JTEDs was 1.57 and 1.38 cm.

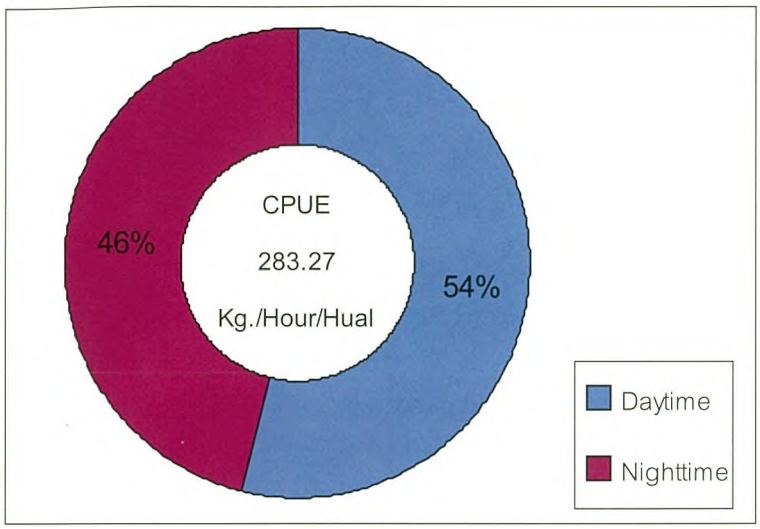

Figure 4. The CPUE of trawl net in Brunei Darussalam water

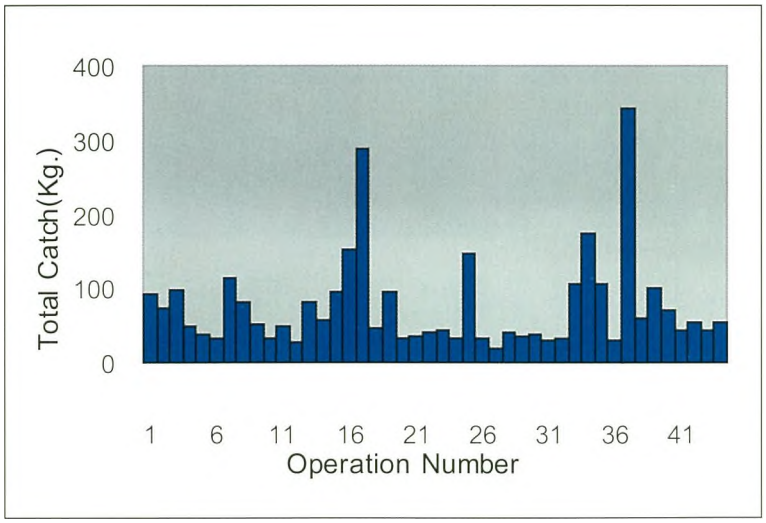

Figure 5. Total catch of the Trawl net from 44 stations.

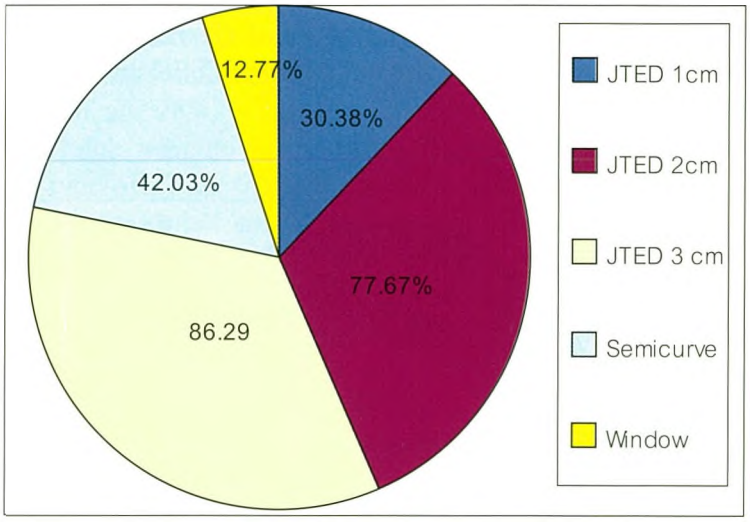

Figure 6. The Escape rate from the trawl net using each type of JTED.

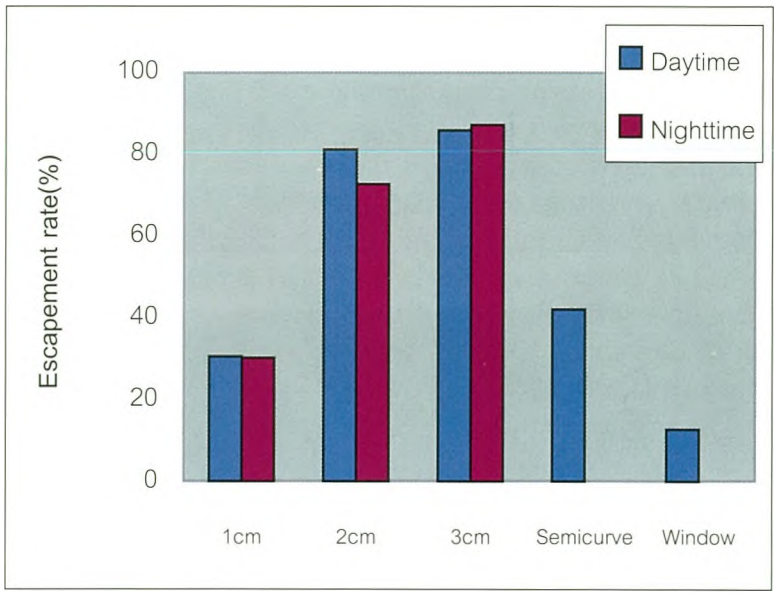

Figure 7. The Escape rate from trawl net using each type of JTED in daytime and at night.

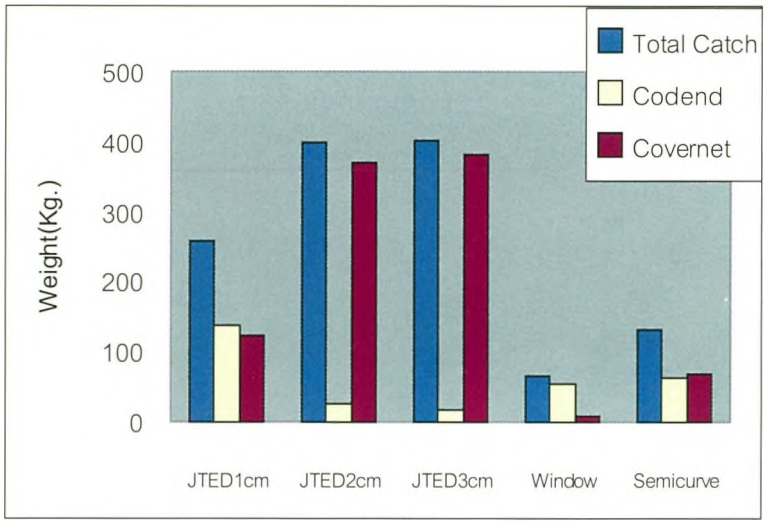

Figure 8. The escape rate of *Leiognathus ssp.* from the trawl net using each type of JTED in daytime and at night

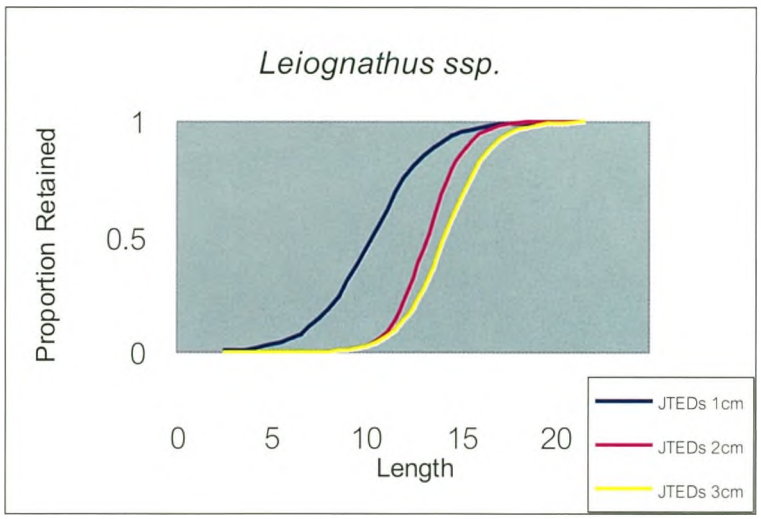

Figure 9. The selectivity ogive of *Leiognathus ssp.* from the trawl net using 1, 2 and 3 cm bar spacing rigid sorting grid JTEDs.

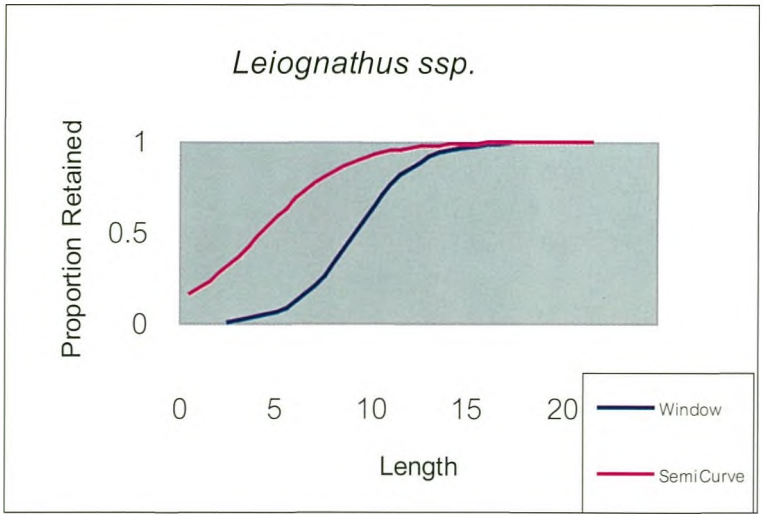

Figure 10. The selectivity ogive of *Leiognathus ssp.* from the trawl net using the semi-curved JTEDs and the rectangular shaped window JTEDs.

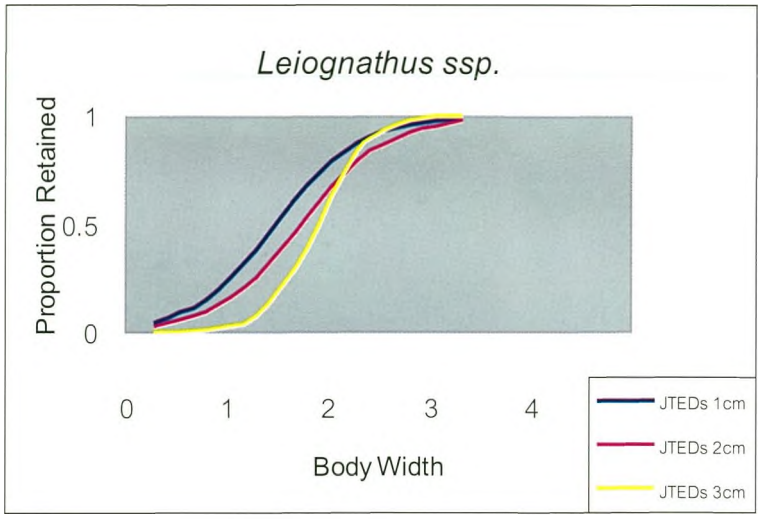

Figure 11. The selectivity ogive of *Leiognathus ssp.* from the trawl net using 1, 2 and 3 cm bar spacing rigid sorting grid JTEDs.

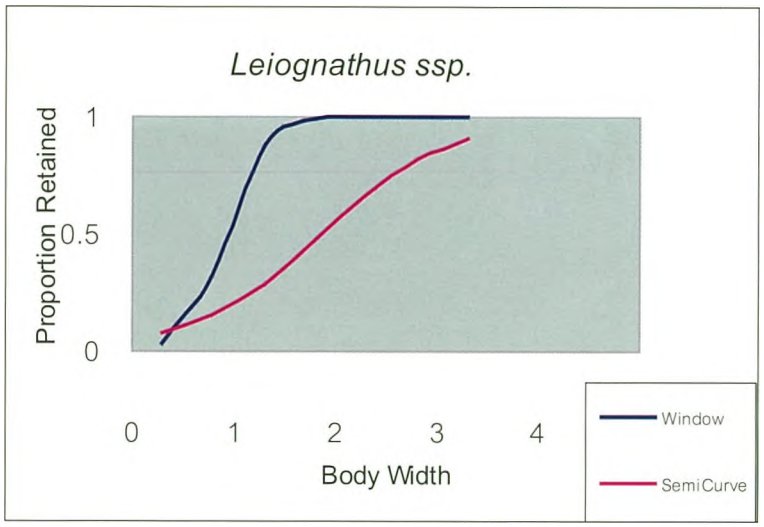

Figure 12. The selectivity ogive of *Leiognathus ssp.* from the trawl net using the semi-curved JTEDs and the rectangular shaped window JTEDs.

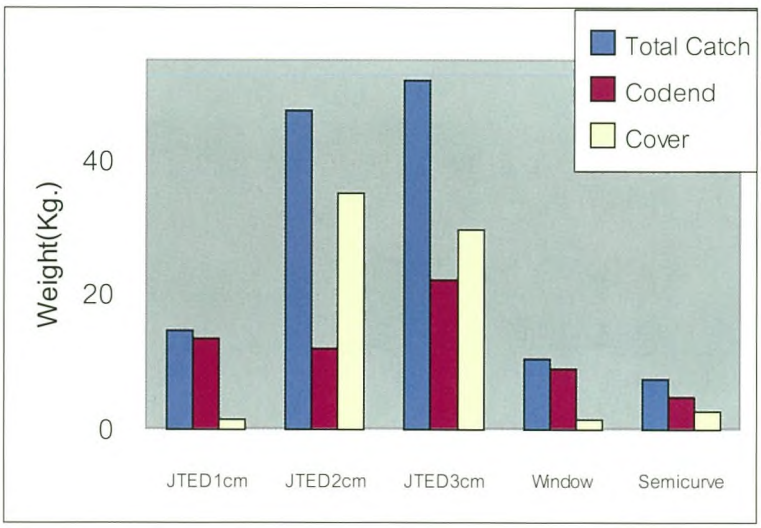

Figure 13. The escape rate of *Gerres ssp.* from the trawl net using each type of JTED in daytime and at night

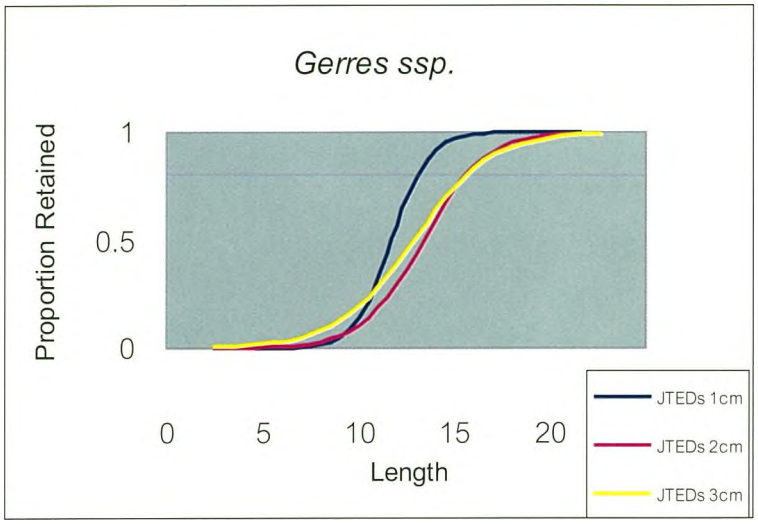

Figure 14. The selectivity ogive of *Gerres ssp.* from the trawl net using 1, 2 and 3 cm bar spacing rigid sorting grid JTEDs.

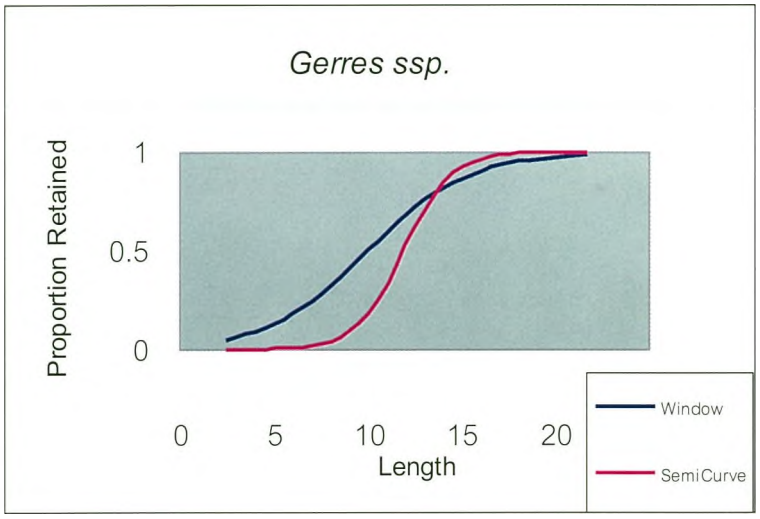

Figure 15. The selectivity ogive of *Gerress ssp.* from the trawl net using the semi-curved and rectangular shaped window JTEDs.

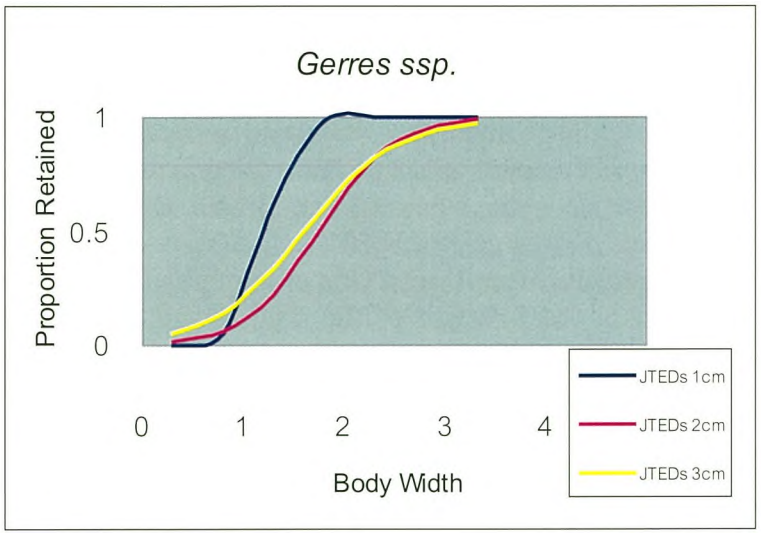

Figure 16. The selectivity ogive of *Gerres ssp.* in body width from the trawl net using 1, 2 and 3 cm bar spacing rigid sorting grid JTEDs.

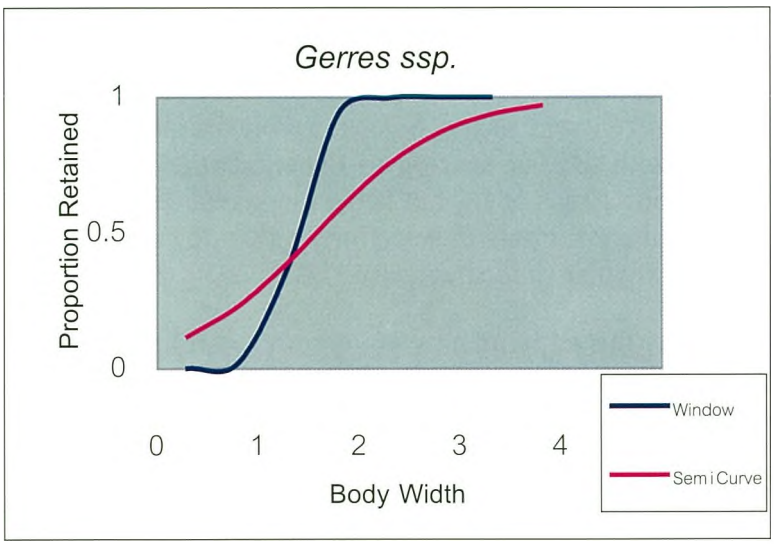

Figure 17. The selectivity ogive of *Gerress ssp.* from the trawl net using the semi-curved and rectangular shaped window JTEDs.

Conclusion and Discussion

Brunei Darussalam has very rich marine resources with CPUEs and the average sizes of catch as higher than other countries in previous experiments. The previous experiments in other countries used a trawling time of an hour but could not be conducted in the same time frame as in Brunei Darussalam because the covernet could not receive very much escaped catch. The results from this experiment were similar to all previous experiments. One other problem encountered was that very big string ray stuck in the first part of the rigid sorting grid JTED, which affected the escape rate.

In this experiment it was found that almost every kind of JTED can release the juveniles and small fishes and retain the larger sizes of fish in the codend. However, there are some large fishes that can escape from the rigid sorting grid JTEDs with a bar spacing of 2, 3 cm, semi-curved JTEDs and rectangular shaped window JTED Escape rates of each type JTEDs were not different between daytime and nighttime. The 1cm rigid sorting grid JTEDs has the least escape rate, and is the most suitable compared to other JTEDs. However the spacing of the 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 nets.

In this experiment, selectivity ogives were calculated from the total length and body width of released fishes. Selectivity ogives show escaped fishes were of a size comparable with the bar spacing of the rigid sorting grid JTEDs. Certainly, JTEDs can release long fishes at L_{50} but some elongated shaped fish at L_{50} are juvenile fish. There was some error data in selectivity ogive of *Leiognathus ssp.* from the trawl net using the rectangular shaped window JTEDs.

However this experiment was very successful because of the helpful cooperation of the Department of fisheries Brunei Darussarlam and local fishermen.

Acknowledgements

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Appendix. 1. General information of the experiment

Station	Date	Duration	Latitude	Longitude	Depth (Meter)	Course	Speed (Knot)	Type	Catch(Kg.)			Escape(%)
									Codend	Cover	Total Catch	
1	24/7/46	9:08	05°- 06.9 N	114°- 56.2 E	22.0	294°	3.0	JTED1cm.	60.00	32.00	92.00	34.78
2	24/7/46	13:41	05°- 10.3 N	114°- 55.9 E	37.0	277°	2.8	JTED1cm.	60.00	13.00	73.00	17.81
3	24/7/46	14:58	05°- 10.4 N	114°- 54.8 E	35.0	126°	3.0	JTED1cm.	78.00	19.00	97.00	19.59
4	24/7/46	17:08	05°- 10.1N	114°- 56.1E	36.2	296°	2.8	JTED1cm.	37.00	13.00	50.00	26.00
5	24/7/46	18:17	05°- 10.3 N	114°- 54.9E	35.4	140°	3.0	JTED1cm.	27.00	12.00	39.00	30.77
6	25/7/46	9:00	05°- 05.0N	115°- 07.2E	32.2	063°	2.3	JTED1cm.	18.00	15.00	33.00	45.45
7	25/7/46	10:51	05°- 05.1N	115°- 00.2E	17.5	150°	2.5	JTED1cm.	83.00	32.00	115.00	27.83
8	25/7/46	12:31	05°- 03.3N	114°- 55.5E	12.7	-	2.5	JTED1cm.	47.00	35.00	82.00	42.68
9	25/7/46	14:01	05°- 03.3N	114°- 54.9E	12	-	2.5	JTED1cm.	39.00	14.00	53.00	26.42
10	25/7/46	16:00	05°- 03.3N	114°- 55.9E	11.9	-	2.5	JTED1cm.	24.00	10.00	34.00	29.41
11	25/7/46	18:05	05°- 05.2N	115°- 06.5E	32.2	-	2.5	JTED1cm.	34.00	14.00	48.00	29.17
12	25/7/46	18:58	05°- 03.8N	115°- 08.1E	14.6	-	2.5	JTED1cm.	17.00	9.00	26.00	34.62
13	26/7/46	9:52	05°- 05.1N	114°- 59.5E	17.3	110°	2.6	JTED2cm.	25.00	56.00	81.00	69.14
14	26/7/46	11:02	05°- 05.2N	114°- 58.8E	15.8	110°	2.8	JTED2cm.	12.00	45.00	57.00	78.95
15	26/7/46	12:19	05°- 04.6N	114°- 56.8E	15.2	-	3.0	JTED2cm.	13.00	82.00	95.00	86.32
16	26/7/46	14:30	05°- 03.9N	114°- 54.4E	13.0	099°	2.5	JTED2cm.	22.00	130.00	152.00	85.53
17	26/7/46	15:27	05°- 03.4N	114°- 55.7E	12.2	-	2.8	JTED2cm.	27.00	261.00	288.00	90.63
18	26/7/46	17:07	05°- 04.7N	114°- 59.5E	14.3	-	3	JTED2cm.	5.00	40.00	45.00	88.89
19	26/7/46	18:00	05°- 05.0N	115°- 00.7E	16.1	-	2.8	JTED2cm.	15.00	81.00	96.00	84.38
20	27/7/46	11:41	05°- 05.4N	114°- 59.9E	19	-	2.8	Semicurve	18.00	14.00	32.00	43.75
21	27/7/46	12:37	05°- 04.5N	115°- 00.2E	14.5	-	2.8	Semicurve	22.00	14.00	36.00	38.89
22	27/7/46	14:00	05°- 05.3N	115°- 01.4E	18.2	-	2.8	Semicurve	29.00	13.00	42.00	30.95
23	27/7/46	14:55	05°- 04.3N	115°- 02.6E	12.2	-	2.8	Semicurve	24.00	20.00	44.00	45.45
24	28/7/46	9:53	05°- 05.5N	115°- 07.9E	39.9	-	2.8	Semicurve	19.00	14.00	33.00	42.42
25	28/7/46	10:46	05°- 06.2N	115°- 09.0E	39.3	235°	3	Semicurve	72.00	74.00	146.00	50.68
26	28/7/46	15:02	05°- 04.2N	115°- 07.3E	21.5	110°	2.8	JTED2cm.	8.00	25.00	33.00	75.76
27	28/7/46	17:53	05°- 04.7N	115°- 08.3E	23.5	163°	3	JTED2cm.	11.00	8.00	19.00	42.11
28	28/7/46	18:42	05°- 04.2N	115°- 10.0E	12.2	064°	3.3	JTED2cm.	10.00	30.00	40.00	75.00
29	29/7/46	13:40	05°- 04.8N	115°- 00.6E	15.7	-	2.8	JTED3cm.	6.00	30.00	36.00	83.33
30	29/7/46	14:37	05°- 04.6N	115°- 01.2E	13.2	-	2.8	JTED3cm.	7.00	32.00	39.00	82.05
31	29/7/46	15:36	05°- 05.0N	115°- 01.3E	15.3	-	2.3	JTED3cm.	3.00	27.00	30.00	90.00
32	29/7/46	16:34	05°- 04.4N	115°- 00.5E	12.7	-	2.8	JTED3cm.	1.50	32.00	33.50	95.52
33	29/7/46	17:00	05°- 04.2N	115°- 01.6E	10.4	-	2.8	JTED3cm.	4.00	102.00	106.00	96.23
34	29/7/46	18:10	05°- 04.6N	115°- 00.4E	13.9	-	2.8	JTED3cm.	7.00	167.00	174.00	95.98
35	29/7/46	19:00	05°- 04.0N	115°- 02.4E	11.3	-	2.8	JTED3cm.	42.00	65.00	107.00	60.75
36	30/7/46	9:58	05°- 05.6N	115°- 08.6E	36.3	300°	3.0	JTED3cm.	4.40	26.00	30.40	85.53
37	30/7/46	12:37	05°- 04.8N	115°- 01.7E	14.5	132°	2.8	JTED3cm.	69.00	273.00	342.00	79.82
38	30/7/46	13:48	05°- 04.3N	115°- 01.7E	11.8	288°	3.0	JTED3cm.	5.00	54.00	59.00	91.53
39	30/7/46	15:48	05°- 03.9N	114°- 58.5E	13.2	113°	3.0	Window	92.00	10.00	102.00	9.80
40	30/7/46	16:38	05°- 03.7N	115°- 00.1E	11.2	-	3.0	Window	51.00	19.00	70.00	27.14
41	31/7/46	9:55	05°- 04.4N	115°- 02.1E	12.3	-	-	Window	40.00	3.50	43.50	8.05
42	31/7/46	10:48	05°- 04.6N	115°- 00.1E	15.7	195°	-	Window	49.00	6.00	55.00	10.91
43	31/7/46	11:43	05°- 03.8N	114°- 58.6E	14.3	091°	-	Window	38.00	5.00	43.00	11.63
44	31/7/46	12:48	05°- 04.5N	114°- 59.8E	15.4	131°	-	Window	50.00	5.00	55.00	9.09

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