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Reduction of Environmental Impact from Tropical Shrimp Trawling, through the introduction of By-catch Reduction Technologies and Change of Management
(EP/GLO/201/GEF)

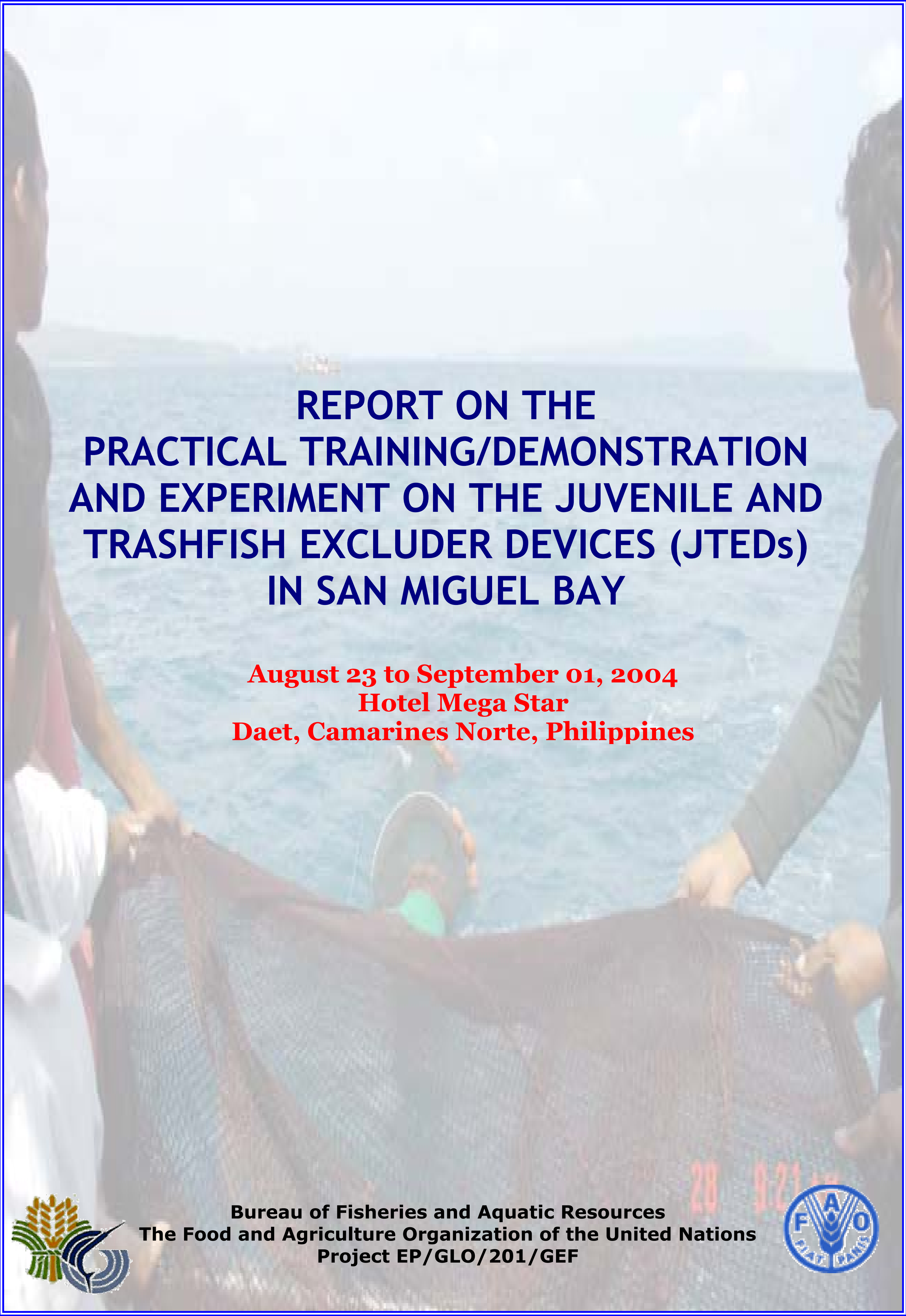
PHILIPPINES

REPORT ON THE PRACTICAL TRAINING/DEMONSTRATION AND EXPERIMENT ON THE JUVENILE AND TRASHFISH EXCLUDER DEVICES (JTEDs) IN SAN MIGUEL BAY

Hotel Mega Star, Daet, Camarines Norte, Philippines

23 August- 01 September 2004

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS



REPORT ON THE PRACTICAL TRAINING/DEMONSTRATION AND EXPERIMENT ON THE JUVENILE AND TRASHFISH EXCLUDER DEVICES (JTEDs) IN SAN MIGUEL BAY

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Bureau of Fisheries and Aquatic Resources
The Food and Agriculture Organization of the United Nations
Project EP/GLO/201/GEF

PRACTICAL DEMONSTRATION AND EXPERIMENT ON THE JUVENILE AND TRASH FISH EXCLUDER DEVICES (JTEDs) IN SAN MIGUEL BAY

INTRODUCTION

1. A collaborative project between FAO/UNEP/GEF and BFAR under Project EP/GLO/201/GEF entitled "Reduction of Environmental Impact from Tropical Shrimp Trawling Through the Introduction of Bycatch Reduction Technologies and Change of Management" was launched in 2002.

2. The project is being undertaken to address issues and concerns related to shrimp fisheries in the tropical regions particularly on bycatch and incidental catches. The Philippines is one of the nine participating countries; and one of the two countries in Asia, Indonesia being the other.

3. The practical demonstration and experiment of JTED is one of the project activities under of the Philippine component and is now on its second year of implementation. The experimentation at San Miguel Bay was a follow- up to the previously conducted trials in Manila Bay, Maqueda Bay/ Samar Sea and Lingayen Gulf.

4. The participants were trawl fishing boat owners/operators, masterfishermen, fishermen and net cutters. Others were LGU top level officers in charge of fisheries (Municipal Agriculture Officers), LGU and BFAR fisheries technicians and extension officers, and fishermen's council/organization representatives.

5. With the participation of the industry and other stakeholders, the demonstration and experiments seek to determine the efficiency and practicability of the technology on JTEDs in reducing the catch of juveniles and thrashfish. They were also intended to educate and enlighten them on related global and regional issues and demonstrate the importance of selectivity devices as a tool in addressing the problems.

6. The 9-days training/demonstration and experiments was conducted through a methodology of seminar/ lectures, workshop and practical construction and rigging of JTEDs, at-sea fishing trials and observations, presentation and discussion on the preliminary results of at-sea trials and building up feedback and recommendation from the participants

7. The lectures and workshop were held at Hotel Mega Star, Daet, Camarines Norte while actual fishing, experiments and demonstration were carried out in the approaches of San Miguel Bay. It was attended by twenty nine (29) participants from Mercedes and Basud, Camarines Norte and Daet, Calabanga, and Tinambac, Camarines Sur and Tabaco, Albay.

The participants and project staff together with Mr. Thaweesak Chanloi of SEAFDEC-TD, Mr. Jonathan O. Dickson, National Coordinator and Mr. Wilfried Thiele of FAO- Rome ((1st, 2nd and 3rd from left respectively).

8. The opening ceremony was held on August 24, 2004 and graced by the local executives of Daet and Mercedes, Camarines Norte, BFAR Regional Director and Assistant Regional Director, the BFAR Coordinator for the San Miguel Bay Fisheries Resource Management Program, a number of officers of non-government organizations; and, the Head of Information and Extension Division of SEAFDEC-TD and Head of the Audio- visual Section of SEAFDEC- TD, Thailand.

Ms. Benjie Camino delivering the speech of Mayor Elmer Panotes

9. The Welcome Remarks of Honorable Mayor Elmer Panotes of Daet, Camarines Norte, was delivered by the Municipal Information Officer, Ms. Benjie F. Camino. He recognized the objectives of the undertaking and expressed his support to accomplish the objectives of the JTEDs training/ demonstration and experiments

Dir. Jaime Dela Vega during his Opening Remarks.

10. In his Opening Remarks, the Regional Director of BFAR RFO V, Director Jaime Dela Vega stressed that using trawl that catches juveniles, immature and trashfish is a waste, hence they must reduce catching them in order to sustain the fisheries particularly in San Miguel Bay. He likewise expressed hope that the fisherfolk participants gain significant information on JTEDs for possible adoption. Moreover, he reiterated the BFAR RFO V support in providing additional information on JTED technology.

Mr. Jonathan O. Dickson presenting the overview of the Project.

11. The National Project Coordinator, Mr. Jonathan O. Dickson, presented the overview of the project; highlighting on its rationale and objectives, the participating countries, agencies as well as institutions, and a chronology of the past and planned activities of the project. He further stressed that the Bureau is not only looking on trawls, but other fisheries as well including the siginificant landings of juvenile/small tunas of purse seiners in General Santos City.

12. Mr. Melchor Ibasco, Administrative Officer and representative of Mayor Pepito P. Lo of Mercedes, Camarines Norte rendered the Mayor's message.. He said that there is still a need to know about JTEDs since it is extremely a new technology. He also stressed his great desire to protect and conserve the fishery resources and informed the group that almost 80% of illegal fishing has been eliminated. He mentioned that there is a notable recovery on the

fishery resources as reflected in the significant increase of fish catch and depleted species are sprouting back to life in good measure including their very own "damus", a rare fish found only at San Miguel Bay. He likewise indicated apprehension on the immediate application of the technology in his municipality, and only permits the use of trawl and the device when the resource has been replenished.

Mr. Melchor Ibasco delivering the message of Mayor Lo.

Mr. Bundit Chokesanguan of SEAFDEC- TD, Thailand.

13. The Head of Information and Extension Division of SEAFDEC- TD, Mr. Bundit Chokesanguan emphasized on the present initiative of SEAFDEC to introduce the JTED in Southeast Asia to conserve the fishery resources by allowing the immature species to grow. He likewise reported on similar activities being done by other ASEAN countries and that the implementation in the Philippines is probably the most significant and successful. He also conveyed the commitment of SEAFDEC-TD in supporting the project implementation in the Philippines particularly on the production of VCD and other important information and education materials.

Assitant Director Delfin of BFAR-RFO 5

14. In her message, Assistant Regional Director Josie Delfin of BFAR RFO 5 was very optimistic that after the activity the participants will learn to appreciate the project and further stressed that the apprehensions of Mayor Lo is not uncommon, noting that JTED potentially upholds the operation of trawls which may deter his current conservation programs.

Ms. Lakindanum advocating the benefits of JTED.

15. Ms. Marisa Lakindanum thanked and commended the BFAR particularly

for their exemplary efforts towards rationalizing management and conservation of fisheries. She recounted her negative reactions and reservations the first time she heard of the technology at the start of training in Lingayen Gulf. She however gradually appreciated and recognized the advantages the devices could offer as the training progressed. She emphasized the potential benefits gained from JTEDs from the point of view of a Boat Operator. In closing, she encouraged the participants to actively involve in the daily activities to appreciate the program.

LECTURE/SEMINAR

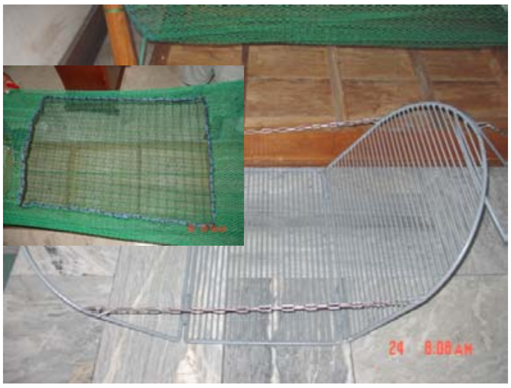
Clockwise: Messrs. Efren Hilario, Rafael Ramiscal, Jess Sanchez, the participants, Mr. Jonathan Dickson and Ms. Noemi Lanzuela during the lectures.

16. The lecture-seminar focused on providing the necessary background for the participant to appreciate the foundation and rationale behind the project. The topics included the Code of Conduct for Responsible Fisheries and Regional Guidelines for Responsible Fishing, Issues related to bycatch and discards (highlighting on juveniles), and the results of selected selectivity studies and JTED designs.

17. Experiences on trawl fisheries in Manila Bay were likewise discussed by the Resource Speaker, Mr. Jesus Sanchez. He gave an overview of the trawl fisheries in Manila Bay in comparison with trawl fisheries of San Miguel Bay.

18. The seminar presented results of selected studies on the reduction of catches on juveniles and other protected species such as square mesh windows, JTEDs, and TEDs. It emphasized on the common and concerted efforts of various countries and international organizations in finding technical solutions to address related issues in order to manage and protect fishery resources and marine ecosystem.

19. The various designs of JTEDs, as well as step-by-step construction and rigging were likewise discussed. This provided the participants better comprehension on the technical aspects in the construction and rigging of the devices. This also tackled the materials and equipments needed in the construction and maintenance of the device.



JTED variations used during the experiments; inset Square Mesh Window and Rigid Sorting Grid Horizontal Bar.

20. In addition, Status of the implementation of Regional Project in SEAFDEC Countries was presented by Mr. Bundit Chokesanguan of SEAFDEC- TD. It provided the participants a wider perspective on the efforts conducted by the international community as part of advocacy on responsible fishing towards the attainment of sustainable fishery resource.

21. Ms. Marisa Lakindanum also presented her experiences as a trawl fishing boat operator in Lingayen Gulf. She further gave testimonies on the benefits of the JTEDs as she herself has been a participant in of the previous training and experiments in Lingayen Gulf.

22. One of the highlight of the training was the promotion of the activities on radio. Messrs. Bundit Chokesanguan, Jonathan O. Dickson, Rafael V. Ramiscal and Ms. Marisa Lakindanum were invited and interviewed live on PRN- DZMD AM Radio Station- Daet, Camarines Norte. The one-hour program provided them with the opportunity to broadcast the

program activities and discuss about the advantages JTEDs and its importance in the promotion of responsible fishing technologies and towards the conservation, protection and rational management of fishery resources..

PRACTICAL WORKSHOP

22. The one and a half- day practical workshop engaged the participants in actual rigging of six pre-fabricated JTED frames under the supervision and coordination of the technical staff.

23. Six codends corresponding to each JTED variation were completed. The JTEDs were as follows: Rigid Sorting Grids 1 and 1.5 cm vertical bar spacing, Rigid Sorting Grids 1 and 1.5 horizontal bar spacing, Square Mesh Window and Rectangular- shaped Window. Furthermore, one Control (codend without JTED) and two Cover nets were constructed by the participants. They were also involved in cutting the pattern of the second frame and subsequently attached at the rear portion of the Rigid Sorting Grid.

AT-SEA TRIALS/EXPERIMENTS

24. The parallel tow using similar trawl net design equipped with different JTEDs was carried out. Participants were entailed to take part in the fishing operation activities and in sampling, sorting, weighing and measurement of samples.

The participants preparing to shoot the net.

25. A total of sixteen valid hauls at one hour per haul were completed, yielding a total catch of about 2,582 kgs. or a catch per unit effort of 129 kgs./ hour.

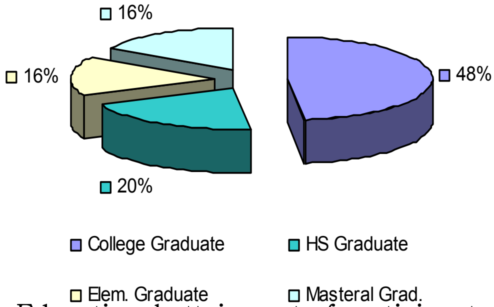
26.The Project Technical Coordinator, Mr. Wilfried Thiele of FAO- Rome joined the 2nd day of trials and observed encouraging performance of some JTED designs.

27.A more comprehensive detail of the experiment is included in a separate technical report.

PARTICIPANTS' PROFILE

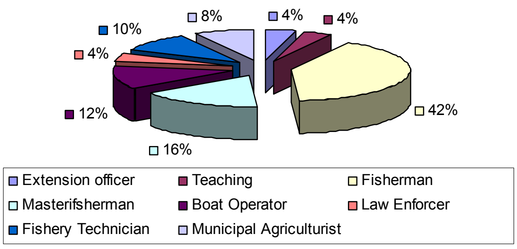
28.There were a total of 29 participants. Average age was 48 years-with the youngest at 32 and oldest at 60. The majority was males (86%) and 89% were married).

29. With regard to the Educational attainment, nearly half (48%) of the participants were college graduates and 20% graduated from high school. Participants who are Masters degree and Elementary Graduates both had 16%.



Educational attainment of participants

30.The majority of the participants were fishermen (42%), followed by Masterfishermen with 16%, Boat Operators with 12%, while 10% and 8% for Fishery Technicians and Municipal Agriculturists respectively. Extension Officers, Law Enforcers and Teachers had 4% each.



Employment

31.Based from fishermen and masterfishermen respondents, they indicated that low catch was already experienced even before they were into trawl fishing. Problems encountered were identified as follows: a) low fish catch due to increasing number of fishing boats b) banning of trawl operation within municipal waters resulted to loss of fishing ground and increased fuel cost e) lack of capital; f) illegal fishing activities such as encroachment of commercial fishing vessels in municipal waters; g) Increasing fuel cost; h) fishermen's lack of information on conservation measures; and i) problems on marketing of catch.

32.Majority of the participants agreed on the importance of using JTEDs in fishing (93%) as evidenced in the exclusion of juveniles and small fish during the trials and recognized its positive effect on the management and conservation of the resources in the area. The remaining 7% were not favor for reasons that all of the catch including juveniles are being sold even lower price, hence, JTEDs may only decrease the already low income of fishermen. Similar number (93%) agrees to use responsible fishing methods while the remaining 7% abstained from answering the question raised. They also acknowledged that similar trainings on the JTED technology are important to reach out the larger part of stakeholders and industry.

33. For the urgent conservation of fishery resources in the area, the immediate use of JTED in trawl emerged as the primary response (93%) while the remaining 7% suggested that it should only be implemented after the conduct of intensive study and consultation/ information dissemination.

34. Overall, 89% of the participants believed that the objectives of the training were attained. Only 7% considered that not all of the objectives were attained since not all areas of the Bay was not covered by the training and experiments. The remaining 4% abstained from responding to the query.

35. The boat operators-participants own at least fifteen (15) trawl fishing boats and a total of twenty six (26) trawl fishing nets.

36. During the post-trial discussions and Closing ceremonies, the salient feedbacks were the following:

a) If JTED is proven effective and practicable, it is important for the LGU's legislative body like Sangguniang Bayan to formulate local legislation to put JTED into use.

b) Some of the participants from the LGUs found JTED conflicting with FAO 201 (Ban on Active Gears in municipal waters) as many of the trawl operation is being conducted within municipal waters. Hence JTEDs must be used for operation outside municipal waters.

c) The use of JTED particularly the Norwegian type will reduce not only juveniles but also on catch of small but already matured species. These fishes are likewise being sold, albeit at lower prices which potentially reduce their income..

d) When the JTED is introduced, there may be a need to evaluate existing minimum mesh size regulation since the gear is already selective by virtue of the JTED.

e) Concerns were also raised with regard to catch spoilage caused by the device especially when catch volume is high. .

f) Participants recognized that JTEDs positively exclude juveniles and small trashfishes as demonstrated during the trials and that similar demonstration should also be conducted in other areas to gain wider endorsement and acceptance.

g) The participants anticipated that the technical group conducting the experiments shall prepare technical papers with technical terms. However, these materials must be translated into extension manuals/materials in layman's term and in local dialect for the fishermen to internalize and understand.

h) Participants expected that they be provided with VCDs for film viewing by the local executives and technicians especially during conduct of meetings of the Sanguguniang Bayan and local fisherfolk.

i) JTED is a new concept and the success of its implementation or acceptance by concerned stakeholders also requires extensive information and education campaign. Posters and other information dissemination materials are essential tools. There is likewise a need for intensive training among trawl fishers and stakeholders. The project implementors were also challenged to persevere and work hard to achieve its objectives given the present issues and concerns associated with the fishery.

j) While JTED certainly excludes the juveniles and small trashfish, the negative effect of trawl fishing as it scrapes the bottom of the fishing ground still remains. A participant reaction noted that there is reduced negative impact when fishing is appropriately zonified and that there is an on-going effort to identify and zonify fishing grounds (spawning, breeding and other vulnerable areas). Hence, fishing like trawl should be strictly prohibited in identified vulnerable areas. Moreover, it was also emphasized that JTED is only an option or tool which could be used only when found practicable to manage existing fisheries..

k) The technology on JTED could be an alternative to eventually reduce the negative impact of trawl particularly on the resources. It was also recommended to formulate a Fishery Administrative Order prescribing the trawl fishing industry to incorporate JTED in its operation.

l) When appropriate, fisherfolk must initiate to modify or apply a JTED type which is most applicable considering the size of their nets and fishing boats.

m) It was likewise recommended that an intensive and massive consultation must be conducted prior to its implementation and formulation of appropriate policies/ laws.

n) Other participants requested similar training in their area (i.e. small boat shrimp trawls). It was likewise expressed that this could also be an initiative of the concerned authorities to demonstrate their concern and not to displace small fisherfolks engaged in the fishery.

o) JTED is a good project and anything which is good does not fail. Therefore, the participants must cooperate for its successful implementation.

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STUDY ON THE JUVENILE AND TRASH FISH EXCLUDER DEVICES (JTEDs) IN SAN MIGUEL BAY

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Abstract

A series of demonstration and experiment using various designs of juvenile and trashfish excluder device (JTED) are being conducted in major trawling grounds in the Philippines with the objective of developing and determining the most appropriate and practicable design/s for the fishery. The project is being undertaken by the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) in collaboration with the Food and Agriculture Organizations of the United Nations (FAO) under Project FAO/EP/GLO/201/GEF. This paper covers at-sea trials conducted in the approaches of San Miguel Bay, Philippines.

A total of 16 valid hauls were completed with a total catch of 2,583 kilograms or a catch-per unit-effort (CPUE) of 129 kgs/hr. Commercial fish comprised the bulk of the catch with 71.5% while non-commercial or trashfish had the lowest percentage of 0.6%. *Jako*, or the low-value species and juveniles had 26% and 1.9% respectively.

Using six variations of JTEDs on an alternate tow experiments, results indicated better efficiency of rigid sorting grids of different bar spacing and orientation (SGV1, SGH1, SHV1.5, SGH1.5) to exclude juveniles and retain commercial and other useful species. The square mesh window (SMW) with 4 cm bar was observed to be unsuitable as it allowed the escapement of commercial and larger fish. The rectangular shaped window likewise observed to cause undue loss of larger size fish.

1. INTRODUCTION

Due to overfishing problems in many areas, active fishing gears including trawls have been prohibited in municipal fishing grounds or within 15 km from the shoreline. The effectiveness of contemporary measures regulating mesh size and fishing ground restrictions has largely been acknowledged to be impractical and inadequate. The Code of Conduct for Responsible Fisheries (CCRF) enunciates that States should require that fishing methods, gears, methods and practices, to the extent practicable, are sufficiently selective so as to minimize discards and catch of non- target species. Given that trawling is a major fishery and will likely remain an important sector in countries like the Philippines, it is important that methods or devices to make it more selective and consequently reduce its adverse effects in view of the article stated in the Code through reduction on the incidence of juvenile- and trash-fish captured are introduced.

Several efforts have been made to introduce or study methods or devices to exclude or dissociate juveniles and other non-target or unwanted catch from the target of commercially important species thereby reducing the impact to resources and biodiversity. Among these are the square mesh codend and Bycatch Reduction Devices (BRDs), including the Turtle Excluder Device (TED) and Juvenile and Trashfish Excluder Devices (JTEDs). JTEDs are being promoted by the Southeast Asian Fisheries Development Center (SEAFDEC) Training Department under its 5-year ASEAN-SEAFDEC Plan of Responsible Fishing Technologies and Practices. Experiments have been carried out in most countries in Southeast Asian Region (Thailand, Brunei Darussalam, Vietnam, Indonesia and Malaysia) where encouraging results in certain designs have been indicated.

The project implementation started in November 2003, with the first training and experiments in Manila Bay. Similar procedures have been conducted in other key trawl areas including Maqueda Bay, Lingayen Gulf and San Miguel Bay. This paper covers the results of the trials conducted in San Miguel Bay, Philippines.

2. MATERIALS AND METHODS:

The experiment was a part of the Practical Demonstration and Training conducted in San Miguel Bay, which was conducted on August 23 to September 01, 2004. Lecture, workshops and actual fishing/ data collections are methodologies adapted. Workshop where construction of the needed codends and cover nets were accomplished for two days while actual fishing demonstration *cum* experiments were conducted for four-days.

Materials and equipment used in the sampling areas were weighing scales (15, 20, and 1 kilogram graduation) for obtaining the sample as well as the total weight of the catch, measuring devices, wrist watch, portable GPS and SONAR (Echo Sounders). The data collected were taken down in two prepared forms (JTED Forms 1 and 2) for further analysis.

2.1.1. Fishing Boats and Trawl Nets

For the purpose of the demonstration and experiments, two typical trawler boats were used for parallel tow procedures. The boats were traditional outrigerred bancas of about 20 m in length powered by converted land engines (8DC9/B12 Isuzu engines) of about 320-horse power (Figure 1) and 43 Gross Tons.

***Figure 1*. Trawl Fishing Boats, San Miguel Bay, Camarines Norte.**

The net used was Norwegian type, made of nylon material (polyamide, PA). The structural of trawl used in the experiments incorporated with Juveniles and Trashfish Excluder Devices (JTEDs) is shown in Figure 2. Cover nets were provided in the codend to determine the quantity and composition (species and size) escaping species.

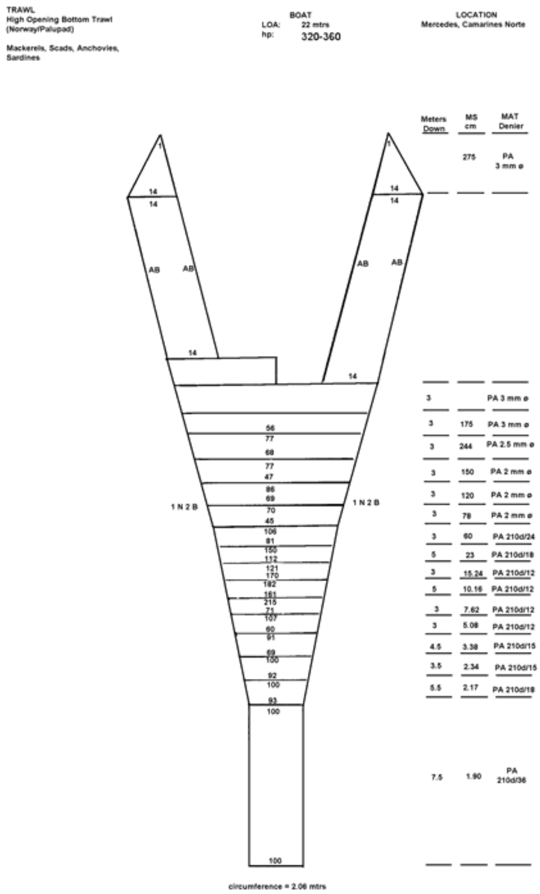


***Figure 2*. Typical Norwegian Type of Trawl used at San Miguel Bay.**

2.1.2. JTED Types

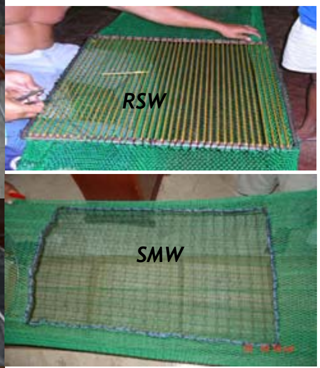


Figure 3. JTED Types used at San Miguel Bay.

The experiments were conducted using 6 variations of JTEDs 1) Sorting Grid 1cm vertical bar (SGV1), 2) Sorting Grid 1cm horizontal bar (SGH1), 3) Sorting Grid 1.5cm vertical bar (SGV1.5), 4) Sorting Grid 1.5 horizontal bar (SGH1.5), 5) Rectangular-Shaped Window (RSW) and, 6) Square-Mesh Window (SMW) (Fig 3). The variations were selected based from the results and experience gained from previous runs in other areas.

2.1.3. Fishing Operations and Data Collection

The trawl fishing gear with JTEDs were alternately deployed in parallel, one hour standard tows at an average speed of 5 knots. Fishing depth was at an average of 42m. Hauls of less than one hour or any operation with unfavorable result such as twisting of the hoops and torn meshes of the codend were considered invalid and were not included in the analysis. In San Miguel Bay, there were 16 valid hauls (Figure 4) completed. Control haul (without JTED) was likewise performed.

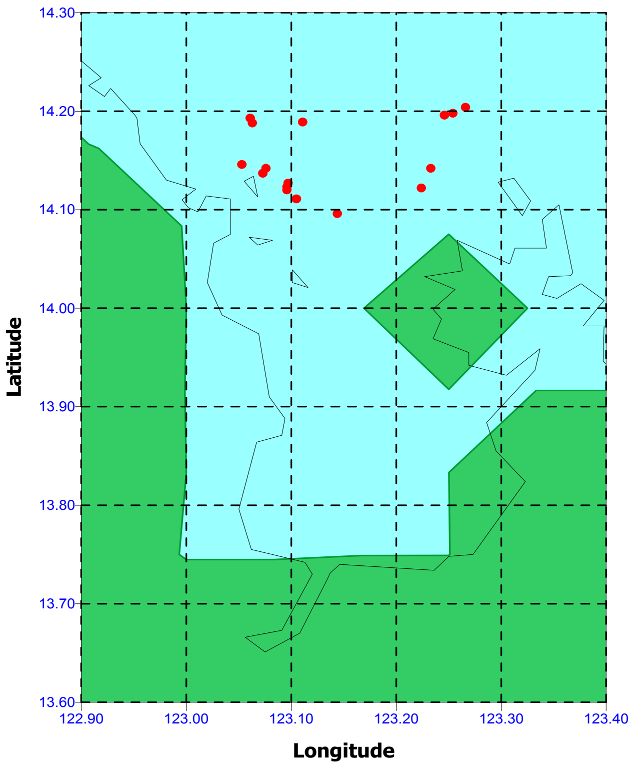


Figure 4. Fishing stations, San Miguel Bay.

2.1.4. Fish catch categorization

The entire catch of each haul was sorted and weighed according to group or at species level, whenever possible. The number of individual fish was also determined by actual counting or raised accordingly when sampling was done. Fish catch was measured individually in total length (TL) in mm. Body width (BW) and Body Depth (BD) in mm were also measured on some occasions to determine the TL-BW- BD relationship.

In consideration of the project objectives of reducing the catch of juveniles and trashfish while also minimizing the loss of valuable commercial species, the catch was arbitrarily categorized according to value and size as follows: commercial, trash fish and other non-commercial (*jako*), juveniles and shrimps (Table 1).

The selection of the most appropriate JTED was based on the rate of escapement according to catch category. Specifically, higher escapement rate for juveniles and trash fish and vis- a- vis with low escapement rate for commercial fish and shrimps are the most important factors to be considered.

2.1.5. Escapement Rate

The rate of escapement attributed to the JTEDs was calculated using the following equation:

$$E = (W_{cn}/(W_{cn}+W_{ce}))*100 \quad (1)$$

Where E = Escapement rate by weight in %
W_{cn} = Catch in cover net (gm)
W_{ce} = Catch in codend (gm)

Also,

$$E = (N_{cn}/(N_{cn} + N_{ce}))*100$$

Where E = Escapement rate by number (%)
N_{ce} = Catch in cover net (number)
N_{ce} = Catch in codend (number)

2.1.6. Selectivity

In covered codend experiment, when the fraction retained is plotted against mid-length of corresponding group, the points following a sigmoid curve called as the "gear selection ogive" resembling a cumulative normal distribution. However, the easiest expression to describe the gear selection ogive is the so-called "logistic curve" defined by the following equation:

$S_L = 1/1+ \exp(S_1\text{-}S_2*L)$ (2)

Where, $S_L = \dfrac{\text{\# of fish of length L in the codend}}{\text{\# of fish of length L in codend and cover net}}$ (3)

L = mid-length interval

S_1&S_2 = constants (Palohaimo and Cadima, 1964; Kimura,1977, and Hoydal et al, 1982)

And can be rewritten as

$Ln(1/ S_L - 1) = S_1 - S_2*L$ (4)

Where, $S_1 = a$

$S_2 = b$

By applying a few algebraic manipulations it follows that there is a one-to-one correspondence between S_1 and S_2 and L25%, L50% and L75%, the length at which respectively 25%, 50% and 75% of the fish are retained in the codend. The length range from L25% to L75% is called "selection range":

L25%	=	$(S_1 - \ln 3)/S_2$	(5)
L50%	=	S_1/S_2	(6)
L75%	=	$(S_1 + \ln 3)/S_2$	(7)

S_1 and S_2 can be derived fro L75% and L50% as follows:

S_1	=	L50%*ln(3)/(L75%-50%)	(8)
S_2	=	ln(3)/(L75%-L50%)=S_1/L50%	(9)

Likewise in a cover net experiment, the probability of escapement can also be determined using the model to estimate selective ogive as defined by the following equation :

$Ln(1\text{-}/S_L\text{-}1) = S_{1\text{-}}\ S_2 * L$

Where,

L = Length interval midpoint

S_L = fraction of length group L fish retained in codend

$S_L = \dfrac{\text{\# of fish in the codend}}{\text{\# of fish in the codend and cover net}}$

3. RESULTS AND DISCUSSION

3.1. Total catch and composition

A total of 16 valid hauls were completed which yielded a total catch of 2, 583 kilograms or a catch-per unit-effort (CPUE) of 129 kgs/hr. Figure 5, shows the overall catch distribution of catch category by weight. Commercial fish comprised the bulk of the catch with 71.5% while trash had the lowest percentage of 0.6%. *Jako*, or the commercialized trashfish catch and juveniles had 26% and 1.9% respectively. It is noted that shrimp catch was insignificant given that the gear used was high opening trawl designed mainly for fish.

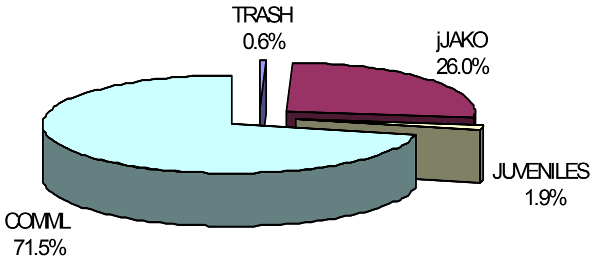


Figure 5. **Relative catch composition, San Miguel Bay.**

The fishing experiments revealed that ponyfish was the most dominant species group with 35.59% of the total catch followed by goatfish with 1.2%. (Table 2). It also showed operations using sorting grid 1.5 cm. horizontal bar (SGH1.5) indicated highest CPUE at 351 kgs/hr while sorting grid 1cm horizontal bar (SGH1) was next at 150.9 kgs./ hr. Sorting grid 1cm vertical bar spacing and sorting grid 1.5cm vertical spacing had 54.8 kgs./ hr. and 107.3 kgs./ hr. CPUE respectively.

Table 2. Percentage catch composition by species group (kgs)

SPECIES	SGV1.0	SGH1.0	SGV1.5	SGH1.5	RSW	SMW	CTRL	TOTAL	%
Nemipterids	0.0	0.0	0.2	0.2	0.0	0.0	0.2	**0.0**	**0.0**
Hairtail	5.5	0.8	4.0	0.0	0.0	2.5	0.0	**0.0**	**0.5**
Anchovy	5.1	1.6	0.6	0.8	0.0	2.5	4.5	**0.0**	**0.9**
Apogon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**
Goatfish	1.0	16.6	3.0	0.0	0.0	5.5	5.2	**0.0**	**1.2**
Ponyfish	32.8	98.2	23.6	693.3	1.5	16.2	53.5	**0.9**	**35.6**
Squid	0.7	1.3	1.9	2.8	0.0	0.5	0.0	**0.0**	**0.3**
Lizardfish	0.0	0.0	0.7	13.3	0.0	0.1	0.1	**0.0**	**0.5**
Others	119.3	334.2	295.8	696.0	26.3	50.0	59.8	**1.6**	**60.9**
TOTAL (in kgs.)	**164.5**	**452.7**	**329.8**	**1406.3**	**27.8**	**77.3**	**123.2**	**2581.5**	**100.0**
No. of Hauls	**3**	**3**	**3**	**4**	**1**	**1**	**1**	**16**	
CPUE (kgs./ hr.)	**54.8**	**150.9**	**109.9**	**351.6**	**27.8**	**77.3**	**123.2**	**127.9**	

Table 3 shows catch composition by category group according to weight. Commercial fishes dominated the catch with 71.8% followed by jako (low-valued species which are usually dried, used for fish paste, fish sauce and even fish meal) 25.7%. Portions of jako, which are low quality due to poor handling, are however usually discarded. Juveniles of commercial fishes including cephalopods (squids) were about 1.9%. Trash fish (those that are not locally utilized and discarded) only comprised 0.6%.

Table 3. Catch composition by category (kgs)

CATEGORY	SGV1.0	SGH1.0	SGV1.5	SGH1.5	RSW	SWW	CTRL	TOTAL	%
FISH-COMM-LARGE	102.2	436.9	120.7	853.1	27.5	60.3	32.8	**1633.5**	**63.3**
FISH-COMM-LARGE-JU	3.2	5.7	0.1	2.1	0.0	1.1	32.5	**44.7**	**1.7**
FISH-COMM-SMALL	36.5	5.2	188.4	23.5	0.3	15.4	57.8	**327.1**	**12.7**
FICH-COMM-SMALL-JU	0.8	0.0	0.0	0.0	0.0	0.0	0.0	**0.8**	**0.0**
FISH-NONCOMM (TRAS	6.2	1.1	2.0	6.1	0.0	0.0	0.0	**15.4**	**0.6**
FISH-NONCOMM (JAKO	15.0	2.5	16.7	518.6	0.0	0.0	0.1	**552.9**	**21.4**
CEPHALOPHOD	0.5	1.2	1.3	0.4	0.0	0.5	0.0	**3.9**	**0.2**
CEPHALOPHOD-JUVENI	0.2	0.1	0.6	2.5	0.0	0.0	0.0	**3.4**	**0.1**
TOTAL	**164.5**	**452.7**	**329.8**	**1406.3**	**27.8**	**77.3**	**123.2**	**2581.5**	**100.0**
TRASH	6.2	1.1	2.0	6.1	0.0	0.0	0.0	**15.4**	**0.6**
JAKO	51.4	2.5	16.7	518.6	0.3	15.4	57.9	**662.8**	**25.7**
JUVENILES	4.2	5.9	0.7	4.6	0.0	1.1	32.5	**48.8**	**1.9**
COMM'L	102.7	443.3	310.5	877.0	27.5	60.8	32.8	**1854.5**	**71.8**
SH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**
TOTAL	**164.5**	**452.7**	**329.8**	**1406.3**	**27.8**	**77.3**	**123.2**	**2581.5**	**100.0**

3.1.1. Rate of escapement

The mean escapement rates according to JTED variation and catch category/grouping are shown in Table 4.

Table 4. Rate of Escapement according to JTED variation and catch category.

BY WEIGHT

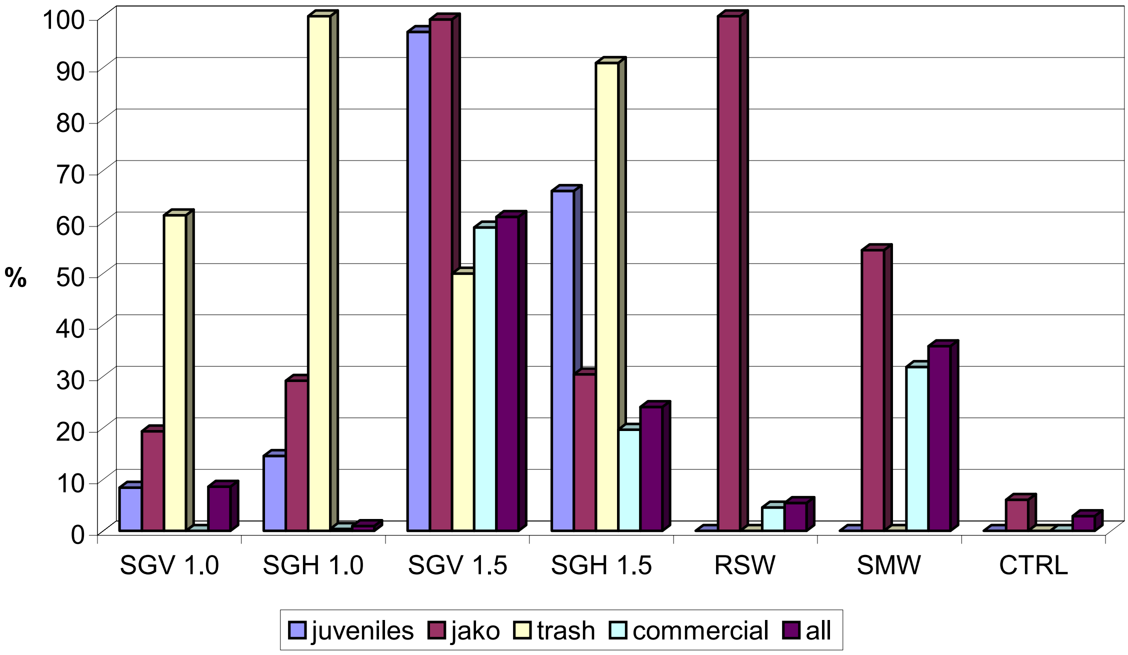
Catch category/JTED variation	SGV 1.0	SGH 1.0	SGV 1.5	SGH 1.5	RSW	SMW	CTRL
TRASH	73.7	80.0	50.0	90.9	#DIV/0!	#DIV/0!	#DIV/0!
JAKO	22.1	24.9	94.2	32.2	100.0	54.5	6.0
JUVENILES	37.7	56.4	98.2	66.0	#DIV/0!	0.0	0.0
COMMERCIAL	0.0	0.0	8.5	18.2	4.5	31.8	0.0
SH	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
TOTAL	**9.8**	**0.8**	**39.1**	**24.1**	**5.4**	**35.9**	**2.8**
Bisugo	#DIV/0!	#DIV/0!	#DIV/0!	0.0	#DIV/0!	#DIV/0!	0.0
Dilis	#DIV/0!	#DIV/0!	#DIV/0!	99.3	#DIV/0!	80.0	77.8
Saramulyete	#DIV/0!	0.3	#DIV/0!	#DIV/0!	#DIV/0!	36.4	0.0
Sapsap	21.9	6.7	83.3	24.3	100.0	33.4	0.0
Pusit	36.4	#DIV/0!	#DIV/0!	85.0	#DIV/0!	0.0	#DIV/0!
Kalaso	#DIV/0!	#DIV/0!	#DIV/0!	0.0	#DIV/0!	0.0	0.0
Others	3.7	0.3	32.2	24.0	0.0	36.7	0.0
TOTAL	**9.8**	**0.8**	**39.1**	**24.1**	**5.4**	**35.9**	**2.8**

In terms of escapement, sorting grids are indicated as the more efficient among the JTEDs and the rate of escapement apparently is in direct correlation with bar spacing, i.e. the bigger space bars (1.5cm) are more efficient (having higher escapement rate) as compared to smaller space bars (1 cm). A more detail comparison of mean rate of escapement between SGV1.5 & SGH1.5 indicate that by weight as much as 98.2% of the juveniles escaped through former while 66% escaped through the latter. However, In terms of the *jako* (which are mainly small-sized ponyfish) categories, catch which are also of value to fishermen and their exclusion should be minized, SGV1.5 had higher escapement rates of 94.2% as compared to the SGH1.5 rate of 32.2%. SGH1.5 however also had a higher escape rate for commercial category at 18.2% as compared to SGV1.5 of 8.5%. (Table 4, Fig 6). It appears that the adjustment of the bar orientation in sorting grid (from vertical to horizontal grid) likely reduced the escapement of small-sized ponyfish and other fish with small body width but larger body depth like hairtails. This is significant considering that even if these species are low value, they generally forms the dominant landing and augment income for trawl in the country.

It appears that it terms of juveniles, sorting grid with 1 cm bar space (SGV1 and SGH1) showed escapement rate of 37.7% and 56.4% with good retention of jako and commercial species while 1.5cm bar space (SGV1.5 and SGH1.5) had relatively higher juvenile escapement of 98.2% and 66% respectively however with relatively higher escapement rates for jako and commercial species.

In the control net where no JTED was in use, escapement was only observed on small anchovies (*Stolephorus commersonii*), which is around 6% of the *jako* catch. Escapement of juveniles and trashfish in the control net was not observed. The difference between the

Fig 6. Rate of scapement according to JTEDs and catch category (by weight)



escapement rates between net with and without JTED can be attributed to efficiency of the device to allow escapement.

3.1.2. Multi-factor analysis

Running the mean escapement rate in a multi-variate analysis indicated only significant difference on the mean escapement rate across JTED types in the jako and commercial catch component. (Table 5).

Table 5 . Summary of effects on JTED types using percentage escapement, San Miguel Bay			
Main Effect	**Catch component**	**p-level**	**Remarks**
JTED Type	Trashfish	0.315658	Not significant
	Jako	0.014900	Significant
	Juvenile	0.863669	Not Significant
	Commercial	0.000034	Significant
	Shrimp	1.000000	Not Significant
	Total	0.185425	Not Significant

Table 6. LSD test (Probabilities for Post-Hoc Test) for *jako* species as variable							
	{1}	{2}	{3}	{4}	{5}	{6}	{7}
JTED Type	100.00	54.50	6.00	22.13	24.90	94.23	37.72
RSW {1}		.17783	.01448	**.01349**	**.01609**	.82557	**.03220**
SMW {2}	.17783		.15364	.23475	.27411	.15241	.51260
CTL {3}	**.01448**	.15364		.54137	.47606	**.00703**	.22948
SGV1 {4}	**.01349**	.23475	.54137		.88104	**.00305**	.37788
SGH1 {5}	**.01609**	.27411	.47606	.88104		**.00385**	.46505
SGV1.5 {6}	.82557	.15241	**.00703**	**.00305**	**.00385**		**.00837**
SGH1.5 {7}	**.03220**	.51260	.22948	.37788	.46505	**.00837**	

For the jako (low-valued species) category, the escapement rate for SGV1.5 is significantly higher than SGH1.5, SGH1, SGV1 and CTL (Table 6). Similarly, the escapement rate for commercial species for RSW is significantly higher compared to SGV1 SGH1 and SGH1.5. This denotes that among the JTEDs, SGV1.5 and RSW can cause larger loss of *joya* species and can be considered as inappropriate since they may contribute to a higher loss of income to fishermen.

In the same manner, the square mesh window (SMS) with 4 cm bar was indicated significantly higher escapement rate in terms of commercial species. SGV1.5 and SGH1.5 also point to a higher escapement rate as compared to the rest of the JTED variation. In addition, SGH1.5 appears to have higher escapement rate as compared to SGV1.5 (Table 7).

Table 7. LSD test (Probabilities for Post-Hoc Test) for commercial species as variable							
	{1}	{2}	{3}	{4}	{5}	{6}	{7}
JTED Type	**4.50**	31.80	0.00	0.00	0.03	8.73	15.32
RSW {1}		**.00007**	.28818	.20017	.20322	.22573	**.00745**
SMW {2}	**.00007**		.00002	**.00000**	**.00000**	**.00005**	**.00054**
CTL {3}	.28818	**.00002**		1.0000	.99205	**.02508**	**.00089**
SGV1 {4}	.20017	**.00000**	1.0000		.98876	**.00425**	**.00005**
SGH1 {5}	.20322	**.00000**	.99205	.98876		**.00435**	**.00005**
SGV1.5 {6}	.22573	**.00005**	**.02508**	**.00425**	**.00435**		**.01353**
SGH1.5 {7}	**.00745**	**.00054**	**.00089**	**.00005**	**.00005**	**.01353**	

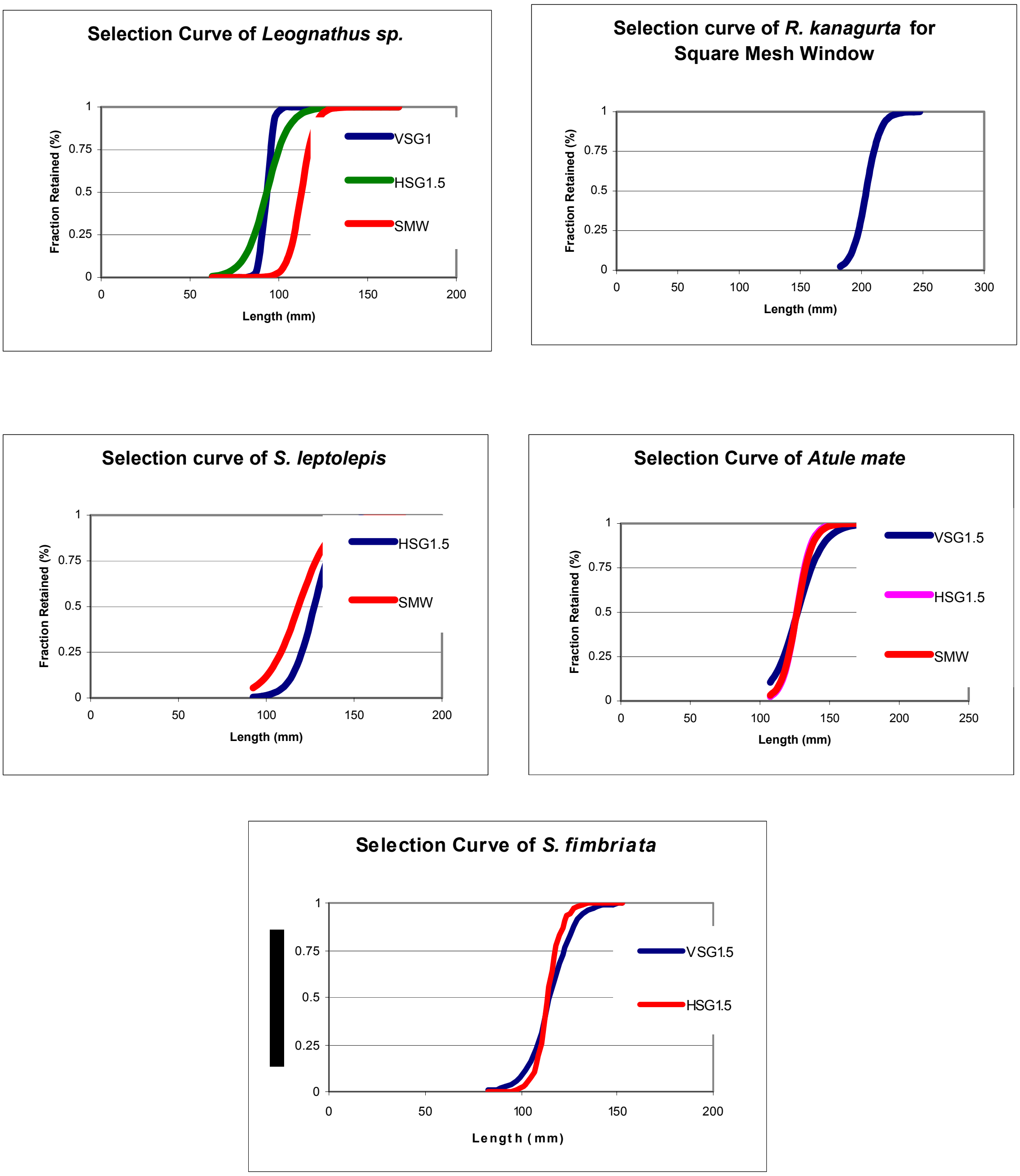
3.1.3. Selectivity by JTED type

The retention and releasing efficiency of the various types of JTEDs experiment and demonstration using Norwegian type of trawl outside San Miguel Bay is hereunder depicted.

Figure 7 shows the selectivity curve at 50% retention length of various JTED types using SGH1, SGV1, SGH1.5, SGV1.5, SMW, RSW including the control net. The L50% selection curve of Leiognathus sp. were 92.5, 92.5 and 112.5 mm (SGH1.5, SGV1 and SMW); S. leptolepis were 117.5 and 127.5 mm (SMW and SGH1.5); S. fimbriata were both 117.5 mm (SGH1.5 and SGV1.5), A. mate measured all at 127.5 mm (HSG1.5, VSG1.5 and SMW) and for the R. kanagurta were 207.5 mm at SMW. The results of SGH1.5 and SGV1.5 device used had no significant difference at 50% length retention of S. fimbriata and A. mate with a size of 117.5 and 127.5 mm respectively

During the three days demonstration of SGH1.5, SGV1.5 and SMW result can release and retain commercial species with a minimum total body length of 117.5 mm of the following species like; S. leptolepis, A. mate, S. fimbriata and R. kanagurta. The Rastrelliger sp. positively cannot escape or released using 1.5 cm grid but can escape using four (4) cm square mesh window. The commercial size species using sorting grid horizontal and vertical one (1) cm (SGH1 and SGV1) definitely cannot pass thru the small sizes of grid. Hence, small sizes with a minimum of 92.5 mm of ponyfish/ slipmouth can only be released on one (1) cm interval of grid.

Figure 7. Selection curve of selected commercial species caught in San Miguel Bay.



4. Observations and Recommendations

The trials demonstrated the better efficiency of rigid sorting grids of different bar spacing and orientation (SGV1, SGH1, SHV1.5, SGH1.5) to exclude juveniles and retain commercial and other useful species. The result however is not very certain which among the variation of sorting grids as best type considering the desired level of escapement on the catch categories or grouping. It is however apparent that horizontal positioning of the grid can reduce the exclusion of thin-deep bodied species like ponyfish and hairtails that should be minimized when using the device and of significant importance since these species form a significant landings from the fishery. Further trial should now be focused on these variations including the use of square mesh in rigid sorting grids.

The square mesh window (SMW) with 4 cm mesh bar and rectangular-shaped window were observed to be unsuitable due to observed undue loss of large-size commercial fish.

As requested during the training/experiments, supplementary training and trials at the local levels to further promote awareness and acceptance among target users and other stakeholders.

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Table 1. Catch categorization

GROUP/CATEGORY	Common	Family/Scientific
COMMERCIAL	Cuttlefish	*Sepia sp.*
	Octopus	*Octopus*
	Squid	*Loligo sp.*
	Squid	*Sepioteuthis lessoniana*
	Sand crab	*Potunus sanguinolentus*
	Long-eyed swimming crab	*Podopthalmus vigil*
	swimming crab	*Portunus pelagicus*
	Coral/Christian crab	*Charybdis feriata*
	Mantis shrimp	*Squilla sp.*
	Mullet	*Mugilidae*
	Whiting	*Sillaginidae*
	Terapon	*Terapon sp.*
	Largescaled terapon	*Terapon theraps*
	Fourlined terapon	*P. quadrilineatus*
	Threadfin bream	*Nemipterus sp.*
	Monocle bream	*Scolopsis sp*
	Emperor fish	*Lethrinus sp.*
	Yellow stripe scad	*S. leptolepis*
	Hairtail	*Trichiuridae*
	Indian spiny turbot	*Psettodidae*
	Short-bodied mackerel	*R. brachysoma*
	Lizardfish	*Saurida sp.*
	Grouper	*Epinephelus spp.*
	Threadfin	*Polynemidae*
	Batfish	*Platax sp.*
	Pomfret	*Parastromateus niger*
	Splendid ponyfish	*Leiognathus splendens*
	Common ponyfish	*Leiognathus equulus*
	Whipfin ponyfish	*L. leuciscus*
	Ponyfish	*Leiognathus spp.*
	Goldband goatfish	*Upeneus moluccensis*
	Sulphur goatfish	*U. sulphureus*
	Goatfish	*Upeneus luzonius*
	Striped goatfish	*Upeneus vittatus*
	Spotted golden goatfish	*Parupeneus sp*
	Grunt	*Pomadasys sp.*
	Spadefish	*Ephippidae*
	Unicornfish	*Acanthuridae*
	Jack/Trevally	*Caranx xp.*
	Sardinella	*Sardinella spp.*
	Barracuda	*Sphyraena sp.*
	Wrasse	*Labridae*
	Terapon	*Terapon sp.*
	Mojarra	*Gerres sp.*

GROUP/CATEGORY	Common	Family/Scientific
SHRIMP	White/Indian white shrimp	*Penaeus indicus*
	Green tiger prawn	*P. semisulcatus*
	Giant tiger prawn	*P. monodon*
	Western king prawn	*P. latisculatus*
	White/banana shrimp	*P. merguiensis*
	Witch prawn	*P. canaliculatus*
	Greasyback shrimp	*Metapenaeus ensis*
	Endeavour shrimp	*M. endeavouri*
	Snapping shrimp	*Alpheus sp.*
	Rough shrimp	*Trachypenaeus sp.*
JUVENILE	Squid	*Loligo sp.*
	Threadfin bream	*Nemipterus sp.*
	Goatfish	*Upenaeus sp.*
	Monocle bream	*Scolopsis sp*
	Whipfin ponyfish	*L. leuciscus*
	Jack/Trevally	*Caranx xp.*
	Indian mackerel	*Rastrelliger kanagurta*
	Terapon	*Terapon sp.*
	Anchovy	*Stolephorus sp.*
	Short-bodied mackerel	*Rastrelliger brachysoma*
	Lizardfish	*Saurida sp.*
	Yellow stripe scad	*S. leptolepis*
	Sardinella	*Sardinella spp.*
	Spinefoot	*Siganus sp.*
TRASHFISH/ NON-COMMERCIAL SPECIES	Crablet	*Charybdis sp.*
	Bluntnose lizardfish	*Trachinocephalus myops*
	Cardinalfish	*Apogon spp.*
	Toadfish/Pufferfish	*Tetraodontidae*
	Tonguesole	*Cynoglossidae*
	Flounder	*Paralychtidae*
	Pugnose ponyfish	*Secutor spp.*
	Ponyfish	*Leiognathus spp.*
	Flathead	*Platycepahlus spp*
	Goby	*Gobiidae*
	Mojarra	*Gerridae*
	Jelly fish	
	Others	
	Triggerfish	*Balistidae*
	Eel	
	Sea snake	
	File fish	
	Zebrafish	
	Stonefish/stargazer	
	Sea cucumber	
	Shells	
	Starfish	