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Case study of marine product distribution for small-scale fisheries in Rayong Province, Eastern of Thailand -Focusing on middle person-

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Introduction

The fisheries sectors are very important and need the information in order to management the fisheries system and sustain the fisheries resources. The government and other agencies have been searched and collected on the fisheries data but the statistic data for this sector are very limited especially from the small-scale fisheries. Particularly, the statistics or complete data regarding marine products distribution and market from small-scale fisheries are not available, there are mostly the statistics of commercial fisheries. As well as the existed academic paper is a few. Therefore, the research conducted survey of marine product distribution in Rayong Province, Thailand as a case study, which focused on the fish distribution by collect the data from small-scale fishers and middle persons. Furthermore, the objective of this research is to describe the relationship of middle person and small-scale fishers.

Methodology

This research used two questionnaires, Household survey and Interview schedule for middle persons questionnaire. The target respondents were small-scale fishers and middle persons along the Rayong coastal area. The total number is 297 fishers and 39 middle persons. The 297 of sampling number came from three districts which adjacent to the sea: Klang District (53 samples), Muang District (216 samples) and Baan Chang District (28 samples). Furthermore, the research collected main middle person names and address by asking from the fishers. The research conducted survey by face to face in 2013 and 2014. The location/fisher groups are shown at the *Figure 1*.

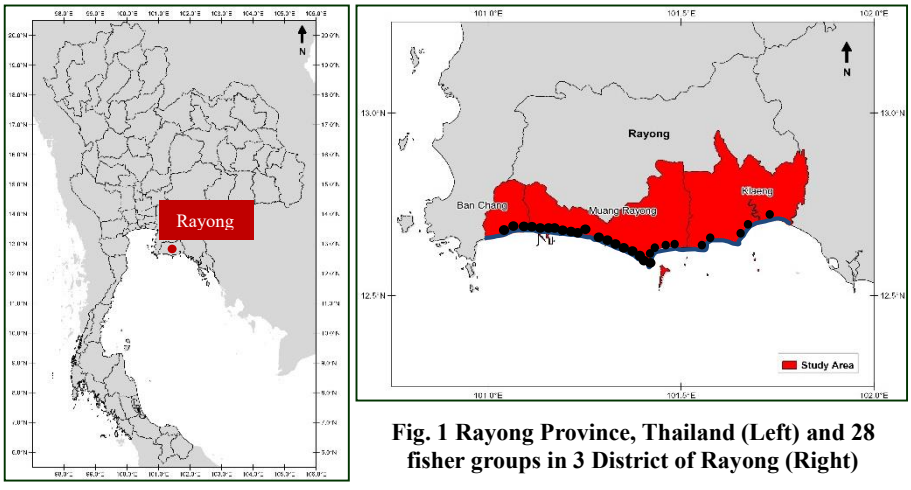

Fig. 1 Rayong Province, Thailand (Left) and 28 fisher groups in 3 District of Rayong (Right)

Results

More than 60.0% of fishers sell their catch to middle person in community, 21.5% sell by themselves at the local market and only 9.6 sell to fish retailer. The fishers sell their product by middle person comes to landing site 54.0% while the fishers bring their products to sell by motorcycle 36.1%.

Most of the middle persons (38.5%) were between 41-50 years old and they are women which they play an important role in selling business while men's role is fishers. 41.0% of the middle person established their own business during 2001-2010. Before started to be a middle person, most of them used to be the fishers/wife's fisher or labor. It means that the middle persons are familiar with the fishery because they were the fishers before. In this case, it is a good opportunity to have a new or additional income for the women who became a middle person. Moreover, the reason why they select this job because they can sell fish easily every day. Furthermore, in the past, in some areas did not have middle person so they decided to be a middle person. As well as the 87.2% of middle persons are women and their husband is a fisher, therefore, middle person (wife) can get fish from fishers easily.

The middle persons (79.5%) can operate their job by themselves, need not to employ a labor, because it is not a big business. They do the business almost every day. For the sailing value/day, the result show that most of them (51.3%) can get 1,000-5,000 Baht/day, and 20.5% can get 5,001-10,000 Baht/day. Furthermore, besides buying aquatic product, the middle persons also sell fuel oil, net, and loan money to the fishers.

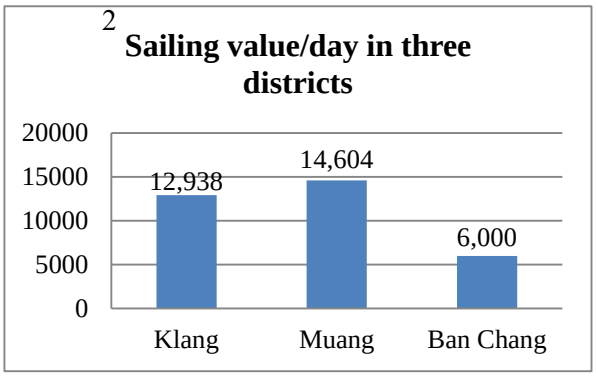

Fig. 2 Selling value/day in three districts

The average sailing value/day of middle person in Muang District has highest value (14,604 Baht/day) while Klang District got average income 12,938 Baht/day and Ban Change got 6,000 Baht/day *(Fig. 2)*. From the result, Muang District is a tourist area or central on Rayong Province. There are many fishing boat landed here, and there are many places for selling fish product such as Municipal market, Wat Lum local market, and Banphe market. In Klang District, due to it is a conservation area, a small number of fishing boat landed here, therefore, it is not much middle person buy aquatic product in this area. For Ban Chang District, it is an industry zone. There is less number of capture fisheries but many of green mussel culture.

Aquatic product purchasing

Blue swimming crab is the most species collected from the middle persons both high season and low season. In high season, the middle persons can get blue swimming crab 2,428 kg/day, squid 1,742 kg/day, and various fish (cannot identify the species) 811 kg/day. In low season, the middle persons buy almost the same species with high season but less quantity. It means that the main species in Rayong Province are blue swimming crab and squid. The middle persons buy the aquatic product from fisher (86.0%), buyer (11.0%), and fish vender (fish collector from their relative or friend around their house) (3%). Most of the middle persons (48.0%) come to buy the aquatic product at the landing site. 45.9% of sellers (such as fishers, middle persons) bring aquatic product to the middle persons' house by using motorcycle with side car, pick up, and by walking.

The number of sellers has from 1 to 28 sellers per one middle person. 20.5%, 15.4, 12.8%, and 10.3% of middle persons buying aquatic product from 3, 2, 4, and 1 sellers, respectively. It indicated that most of middle persons are not a big buyer. Most of them buy the aquatic product from the same sellers/fishers. There are many reasons, for example, 28.2% of the middle persons said that the sellers are old acquaintance/friend, 20.5% answered that the sellers are relative while 7.7% said that it is a good quality and 5.1% of middle persons said that the sellers have large amount of aquatic product.

For the trends of easiness to buy the aquatic product, it was easy to buy at the previous time since year 2009. But there are some species (i.e. Blue swimming crab, Mackerel) that very difficult to buy during the year 2012-2013. As well as some species cannot find and buy during the low season such as Mullet. The middle persons determined the buying price by checking price from other middle persons alongside with the market price too. The price will be high during low season and festival because of less aquatic products and tourists increasing. On the other hand, it will be low price during high season because of many aquatic products. For example, the buying price of big size of blue swimming crab in high season is around 120 Baht/kg while low season is 260 Baht/kg. For the payment system, 84.0% of the middle persons pay the money directly to the seller at the same time as receiving aquatic product while 16.0% pay the money one day after receiving aquatic product.

Aquatic product selling

In order to sell the aquatic product, most of middle persons 50.5% use motorbike with side car for their transportation. The middle persons 17.9% sell the aquatic product at their house and shop so they need not to use any transportation for selling. There are many customers buy the aquatic product from the middle persons such as restaurant, other middle persons, and local people&tourists (at local market). But most middle persons (66.0%) sold the product at local market to local people and tourists while 27.0% sold to restaurant, and 7.0% sold to other middle persons. The middle persons prefer to sell at the local market because it can easily bring and sell the aquatic product to customers. The selling locations are at Muang Rayong and local Market.

The middle persons determined the buying price by themselves (98.9%). Only 1.1% was determined by buyer (restaurant). For the payment system, 85.6% of the middle persons can get the money directly from the buyers at the same time as selling aquatic product while 14.4% get the money after selling aquatic product. The amount of payment day is depended on the agreement between the middle person and buyer. The range is during 2-7 days and it can be extended to 30 days in case of selling to restaurant.

The middle persons (60.0%) provide loan or fishing gear to sellers (fishers) in order to help them for the operation cost. After fishers get aquatic product, they need to sell all product to the middle persons. Although middle persons do not provide any loan/fishing gear to fishers, fishers are willing to sell their product to the same middle persons. Whatever the aquatic product is high or low quality, big or small amount, and high or low price, the middle persons would buy all products from the fishers. The fishers do not sell to other middle persons.

If the fishers sell to other middle persons, the previous middle persons would not buy their product for next time. As well as, if the middle persons do not buy the product from the same fishers, those fishers might sell their products to other middle persons and do not sell to them for next time. This is can be called "Mutual System".

Conclusion and discussion

In this research, the middle persons are the person who collects the aquatic product from the fishers, buyer, and fish vender and then sells to local people (customers), restaurants, and other middle persons. The aquatic product sellers are the fishers who mostly are the fishers' wife. Most of the fishers landed their fish catch at the coastal area which in front of their village or the place that can avoid from the strong wind. The fishers prefer to sell their catch to the middle persons than restaurants and customers because it is convenient and easy for them. It need not to bring their catch to the selling point. Therefore, they can take a rest after back from the sea.

The marine product distribution was show at *Figure 3*.

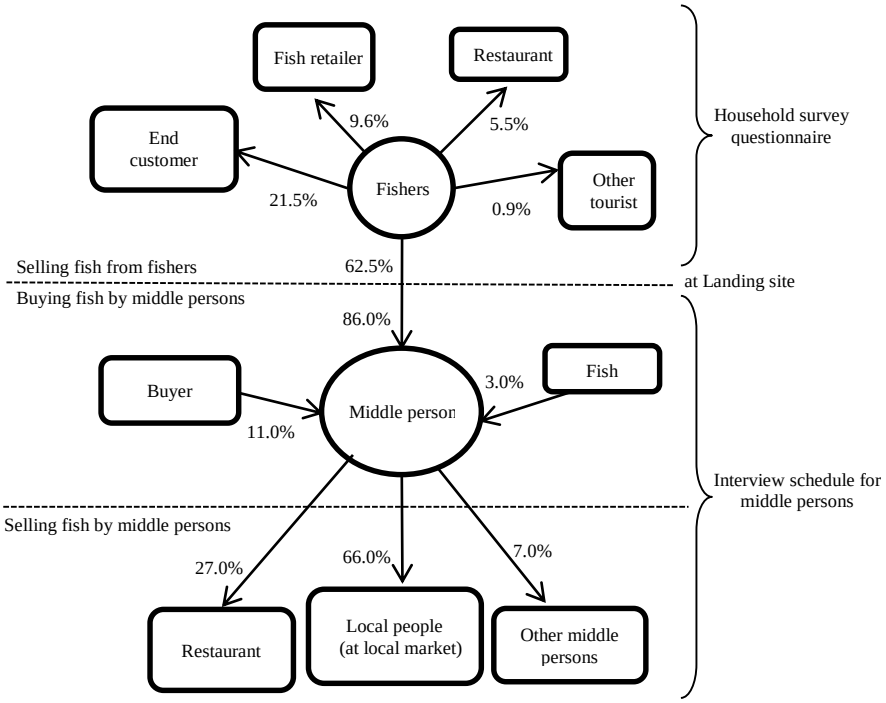

Fig. 3 marine product distribution

The species and quantity of aquatic product for buying/selling would be depended on the fishers. During the southwest monsoon season (May-October), the middle persons got high amount of crab and shrimp. While the northeast monsoon season (October-February), the middle persons got high amount of fish. The middle persons need to prepare the ice bucket for buying aquatic product from the landing site. They would buy the aquatic product from the same fishers and buy all the species and size from the fishers even the aquatic product is low quality. The price is not fixed, it is depended on the market price. The price may increase during weekend or holiday which there are many tourists. In case of the fisher loan money from the middle person, the middle person won't pay lower prices for buying fish but they will deduct the paying money from the fisher. The fishers and the middle persons thought that it is like a "Mutual System" for them. The system is base of distribution in this area. Some officer said that middle persons exploit fishers, but actually they help each other in order to continue their livelihood because it is fair trade and mutual assistance.

The problem in future is to decrease the middle person because of a few successors. Furthermore, the middle persons take a risk for buying-selling payment system because normally, the middle person will pay the buying money to sellers directly but the middle persons might get the selling money late. If the number of middle persons decrease, they might have big buying power and exploit the fishers. Moreover, it also lose significant woman's job.

In the future, it is needed to support the mutual system to create and establish marine product co-management system with fishers, middle persons and local government. As well as the aquatic product data collection by fishers and the middle persons including value added are very important. The co-management system can help them for more effective and benefit in the selling and buying system.

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Fishermen Satisfaction towards Set net fishing at Mae Rumphung beach of Tapong sub-district, Meaung district Rayong province

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I. Introduction

Set net is a kind of big stationary fishing gear that was transferred from Japan to Thailand, it was installed in Mae Rumphung beach of Muang district, Raying province from 2003 to 2014 under experiment projects among Thai, Department of fisheries(DOF), SEAFDEC and fishermen with aimed of installation are tool for fisheries co-management and resource enhancement. After experiment duration have been finished, fishermen in set net group would like to continue this activity but announcement's ministry of Agriculture and cooperative ministry number 4 on 14 September 1978 was promulgated to ban stationary fishing gear anyway Thai fisheries' law have article 12 and 30 to allow fishermen to have permission area for fishing (stationary category). Therefore, this study would like to collect data on fishermen perception on set net through satisfaction and obtain the attitude of fishermen on set net installation to identify which is should be improve of set net for more acceptance from all fishermen.

II. Methodology

For data collection will use standardized interview to gather the data with total sample from 122 person by 13 person from set net fisher and 109 person from other fisher a long Mae Rumphung beach the sample estimate by used Krejcie and Morgan (Krejcie and Morgan, 1970 reference in Teerawut Akekakul, 2000) for estimate sample size which exactly know population size and it is not too much as 135 of fishermen (data from fisheries district office of Muang district) a long Mae Rumphung beach.

The satisfaction assessment will use Likert technique on attitude measure by divided to 5 levels as following; Most satisfy is 5 score, satisfy is 4 score, Fairy satisfy is 3 score, less satisfy is 2 score, Least satisfy is 1 score. Average score of each question will use to analyze satisfaction of fishermen on set net by how much average will express fishermen satisfaction to each question by divided criterion of each average as following; Score 1.00-1.49 mean Least satisfy, score 1.50-2.49 mean Less satisfy, score 2.50-3.49 mean fairy satisfy, score 3.50-4.49 mean satisfy and score 4.50-5.00 mean most satisfy.

Attitude of fishermen on set net installation for analysis, descriptive Statistic on percentage, average, maximum, minimum and other with suitable one will be used to explain attitude of fishermen to set net installation.

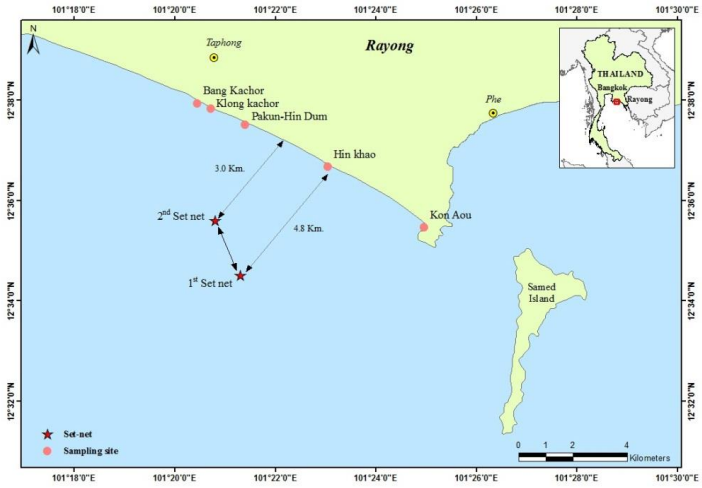

Fig 1: the location of two set net stationary fishing gear and landing site of small scale fishing at Mae Rumphung beach(Ban Kacher, klonkacher, Pakan-Hindum, Hin Khao, and Kon Aou) of Tapong sub-district, Meang district, Rayong

III. Results

Fishermen satisfaction on set net installation at Mae Rumphung beach in Rayong was divided in to three with three components are environmental, resources and socioeconomic the results as in below table.

Table 1 Satisfaction's level of fishermen along Mae Rum Phung beach on set net installation

Issue	**Is it related with set net installation? If it related pleas specific your satisfaction level**		**Satisfaction level**		**No idea**
	Related	**Not related**	**Average**	**STD**	
Environment					
1. Are you satisfy water quality of Mae Rum Phung beach after set net installation	5.7%	91.8%	2.11	0.96	2.5%
2. Are you satisfied sea bottom water condition after set net installation?	2.5%	91.5%	1.86	0.36	2.5%
3. Do you think that set net installation have change water current at Ma Rum Phung beach?	1.6%	95.9%	1.00	0.00	2.5%
Resources					
4. Do you think set net can be fish habitat?	86.1%	10.7%	3.30	1.71	3.3%
5.Did fisheries resources increasing after set net installation?	45.9%	51.6%	3.74	1.58	2.5%
6. Did your catch increasing during set net installation of each year?	28.7%	68.9%	2.77	1.82	2.5%
Socioeconomic					

7.Are you satisfy on set net can protect coastal fisheries from commercial fishing?	54.9%	44.30%	3.59	1.60	0.8%
8. Did your income increase after set net installation?	26.2%	71.3%	2.97	1.82	1.6%
9. Dis you satisfy with income from set net group?	92.3%	-	3.83	1.27	7.7%

99 Fishermen from 122 provide the opinion on set net installation that 54.5% need set net and 45.5% are don't need set net with reason that show in table two.

Table 2: Attitude of fishermen a long Mae Rumphung beach on set net.

Attitude on set net	Frequency	Percent
Set net needed		
Fish habitat and nursery ground	20	37.02
Increase fisheries resources	10	18.51
Increase their fishing ground for squid and fish	9	16.66
Commercial fishing protection	8	14.85
Set net member need to maintain their income	7	12.90
Total	**54**	**100**
Set net no needed		
High catch efficiency	29	64.40
Set net catch small size of fish	6	13.30
Set net provide benefit for set net group	6	13.30
Obstacle for their sailing	4	8.90
Total	**45**	**100**

IV. Conclusion and Discussion

Study on satisfaction for three components on environmental, fisheries resources and socioeconomic can summarize in following;

- Environmental condition: Almost of fishermen said that set net are not disturb environment condition on water quality, sea bottom and water current of Mae Rumphung beach it is relevant with monitoring data on water quality during October 2013 to April 2014 while set net were install show that water around set net are in standard of water quality (Yoshikawa, 2014).
- Resources status : Fishermen are divide in to two group with in similar amount first group is need set net in the area because set net is located for juvenile with fair satisfaction and they said Fish are more abundance after set net installation with satisfaction it is relevant with attitude on set net is fish habitat and nursery ground it can be fishing ground also,

moreover the study on abundance of juvenile around set net shown that set net is the place for spawning and food for juvenile fish(Kamolrat and team, 2005). For fishermen who are not need set net in Mae Rumphung beach said that set net reduce catch of other fishing gear because fish were caught by set net and set net also caught small fish anyway they just want set net change or improve mesh size of net for catch more big size of fish.

- Socioeconomic aspect: also, have two idea from fishermen are advantage and disadvantage of set net for fishermen who are see advantage said that set net can protection coastal are from commercial fishing and increase income for set net fisher group with most satisfaction and when we look at the location of set net it is in border of small scale and commercial area (SEAFDEC, 2008). For disadvantage of set net, it is from fishermen who are catch at night they said they are not clear with set net boundary but anyway they suggest that set net group should put more light to see clear at night they thing set net not relate with their income only set net group are satisfy income from set net.

V. Acknowledgements

I would like to give thank for funding from RIHN project for support data and budget for social survey and fishermen who kindly reply all question.

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Monitoring on the use of Juvenile and Trash Excluder Device (JTED) in Samar Sea, Philippines

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I. Introduction

The Juvenile and Trash Excluder Devices (JTED) is a technical tool reducing by-catch and discard from trawl fisheries. JTED is promoted by the Southeast Asian Fisheries Development Center (SEAFDEC) Training Department under project on the "Reduction of Environmental Impact from Tropical Shrimp Trawling through the Introduction of By-catch Reduction Technologies and Change of Management or REBYC Phrase I", in collaborating with the Food and Agriculture Organizations of the United Nations (FAO). The demonstrations and experiments on the use of JTED have been conducted in most countries in Southeast Asian Region. In 2003, SEAFDEC has worked with the Philippine Bureau of Fisheries and Aquatic Resources (BFAR), Philippines to conduct the training and experiment on the use of JTED in major trawling ground initiated in Manila Bay and similar procedure in other pilot sites namely: Maqueda Bay/Samar Sea, Lingayen Gulf and San Miguel Bay to develop and determine the most appropriate of JTED for the fishery.

The Philippine Government realize on the capture of by-catch that would be cause mortality of juvenile and ecological impact. In order to promote sustainable use of resources and maintain biodiversity, the Philippine Government had declared the Fisheries Administrative Order No.237 Subject: "Regulations Requiring the installment of Juvenile and Trash fish Excluder Device (JTED) in Trawls in Philippine Waters" since 2010. Samar Sea is a small sea situated between the Eastern Visayas and Luzon where is the one pilot sites for the demonstration and experimentation of the use of JTED as well as the site selected to develop Fisheries Management Plan in Philippine. Regarding promoting sustainable fisheries practices by determine a rational approach to reduce by-catch from trawl fisheries considering on the use of JTED. It is interesting to monitor the current situation and study the characteristic of commercial trawl fisheries and the attitude on the use of JTED of trawl fisher in Samar Sea.

II. Methodology

The scope of this study is focusing on commercial trawl fisheries operated in Samar Sea, Philippines, the site selected to collect the data on the use of JTED is Calbayog city, which has the largest area of Samar. The Primary data was collected by using a questionnaire to interview the commercial trawler operator who operate trawl fisheries in Samar Sea, the data also gathered from observation of trawl fishing operations using JTED on bottom trawl. The Total number of fishers interviewed is 16 respondents mainly conducting interview at Calbayog fishing Port. The secondary data was collected from document and report concerning with trawl fisheries with JTED in Philippines. The data were analyzed using descriptive statistic in term of number and percentages.

III. Results

1. Socio-economic condition of Commercial trawl fishers

The result of the survey shows that most fishers are age 41-50 years old and all of them are married. There are 31.3% of respondents educated from Primary school, a few percentage of fisher interviewed do not gain education from school (6.2%). Most fisher household have member in their family 6-10 persons with 56.2% and the average family member per household is 6 persons.

2. Trawl Fisheries

Fishing experience and fishing boat, most fisher have experience on trawl fishing operation about 3-20 years (62.5%) and the average fishing experience of fisher interviewed is 20.6 years. Most fisher use fishing boat with length 16-19 meters (64.3%) and the average length of fishing boat is 18.1 meters and the average width of fishing boat is 2.4 meters.

Fishing operation and number of worker on board, most fishers spend 3 days per trip to go to operate trawl fisheries in Samar Sea and average trip in a month is 7 trips. They take a hauling 3 times per day. Most of trawl owner employed 6-10 workers to operate fishing on board, the average number of labor is 8 workers per boat.

Catch species and catch volume, most fisher has operated bottom trawl fisheries, the main target species are fish, shrimp and squid. The highest catch volume come from fish about 1,008.8 kilograms per trip which compose of species: Threadfin bream, lizard fish, mackerel, slip mount, pony fish, sardine, black Pomfret and the value of fish is 57,348.8 Peso per trip. The average catch volume of shrimp is 11.6 kilograms per trip with value of 2,297 Peso. The fisher had the average catch volume of squid is 47.3 kilogram per trip and value of squid is 5,701.7 Peso. It is observed that the fisher can catch target specie with a few by-catch/trash was caught because they install JTED with trawl fisheries.

3. Attitude on the use of JTEDs

Satisfaction on the use of JTED, most fishers feel satisfied on the characteristic of JTED include material and design of JTED with 75%. They believe that JTED help trawl fisheries reduce juveniles (62.5%). Most fishers think that the fishing cost is not increase while they operate trawl fishing with JTED (81.25%). They feel satisfied on the catch volume (81.25%) even they cannot earn income from by-catch/trash fish because it can catch only big fish after install JTED. However, 68.75% of fisher satisfied to continue operate trawl fisheries with JTED and intend to promote JTED to other people. The fisher had optimistic view that JTED would help to conserve the fisheries resources.

Advantage and Disadvantage on the use of JTEDs, the fishers interviewed express their view that JTED has benefit to reduce the capture of juvenile, it can escape and growth to mature and reproduce the fisheries resources that led to sustainable fisheries. They also noted that trawl fisheries with JTED tend to catch bigger fish and sorting fish catch is cleaner. However, some fisher respondents think that installation of JTED would increase fuel consumption. Sometime, the garbage has obstructed in JTED during trawl operation that it could damage the net. In case of anchovy trawl fishing, the fisher can catch less anchovy that affected to their income generating. Some fisher faced the problem of the use of JTED that make the speed on trawl slow down and high fuel consumption as well as the price of material making JTED is expensive if using stainless steel which is longer use than iron material.

The fishermen suggested to apply JTED to other fishing gear and they understood the benefit on the use of JTED that could conserve fisheries resources reducing juvenile which would

growth to propagate for the future. They asked the financial support for the installation of JTED. However, most fisher respondents showed a willingness to continue to use of JTED.

IV. Conclusion

Most fishers are age between 41-50 years old, graduated from primary school and they have 6 members in their family. The commercial trawl fishers have experience on trawl operation about 21 years, they use fishing boat with length 16-19 meters to operate fishing and catch mostly fish species such as Threadfin bream, lizard fish, mackerel etc. with fish value 57,349 Peso/trip. Most fishers feel satisfied on the characteristic of JTED include material and design of JTED with 75%. They believe that JTED help trawl fisheries reduce juveniles and satisfied to continue operate trawl fisheries with JTED as well as intend to promote JTED to other people. The fisher had optimistic view that JTED would help to conserve the fisheries resources by reduction of juvenile, and reproduce the fisheries resources that led to sustainable fisheries.

V. Acknowledgement

I would like to express my sincere thanks to “The Strategies for Trawl Fisheries Bycatch Management (REBYC-II CTI)” for support in conducting monitoring activity in Calbayog City, Philippines. I most gratefully acknowledge Project Technical Working Group of Philippines, our SEAFDEC team, Mr. Bundit Chokesanguan and Mr. Suppachai Ananpongsuk to kindly advise and support during field survey, I would like to special thanks to my colleague for their help and support.

Outline of Small-scale fishing in Eastern, Center and Southern Gulf of Thailand

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I. Introduction

Thailand has a long coast line about 2,614 kilometers cover 23 provinces located along the coastal so that the fishing activities relate with the fisher folk more than 2,000 communities, the census of the National Statistical Office in year 2013 show the total number of fishery household is about 45,058 household involved in fisheries. In 2013, the fish production value is 104,152 million Baht approximately 10.6 percent to the Gross Domestic Product and 7.6 percent of agriculture sector (NSO, 2013) that show the fisheries sector contributed significantly to country economy, apart from generate income and employment it also supports the various fisheries industries. The small-scale fisheries in Thailand provide many livelihoods to the people living along the coast area. Small-scale fishers operate fishing in inshore water less than 3 miles from shore with no boat or using the fishing boat less than 10 gross ton and using simply fishing gear such as gill net, trap, hook and line for various target species.

Nowadays, the fisheries industry is rapidly developments with the open access fishery that lead to the overfishing and decline of fisheries resources. It would be affect to small-scale fishers who exploit of the fisheries resources for their livelihood. It is an urgent need to restore the fisheries resources and solve the fisheries problem by implementing the systematic fisheries management to the fishing communities. The lack of information on the small-scale fisheries is the one factor that contributed to the difficulties in establishing fisheries management system. This paper describes a case study aimed at documenting the characteristics of small scale fisheries in Thailand, the study will fulfill the information gap on the small-scale fisheries in Thailand and provide the baseline data to develop workable management solution in case of limit resources.

II. Methodology

This study mainly focus on major coastal Gulf of Thailand by dividing into three regions consist of Eastern, Center and Southern region and selected three sites to be the representative of each region namely: Rayong Province, Prachuap Kirikhan and Chumphon Provinces, and Surat Thani Provinces respectively. The data collection was conducted during 2012-2015 by face to face interview using the questionnaire to the fishers in three target area. The sample size of three target area was calculated by extraction, the actual number of sample size are 297, 286 and 316 samples respectively as shown in table 1. The set of data were analyzed using descriptive statistic to delineate the fisheries condition of coastal area of three target area in term of number and percentages. The results would be presented in table or a matrix format for easy understand. In addition, the secondary data were collected from Provincial Fisheries office, District fisheries, the report, research paper concerning on the small-scale fishing in the coastal area.

Table 1 The extraction number and number of sampled size

Target Area	Rayong	Prachuap-Chumphon	Surat thani
No. of fishers	1,458	953	1,795
No. of extraction	302	274	337
Actual No. of sampling	**297**	**286**	**316**

III. Results

1. Type of fishing boat

There are two type of fishing boat categorized by powered of boat; in-board and out-board powered. The out-board powered fishing boat is locally known as "Long-tail boat", most fishing boat made of wooden material. Most fisher interviewed in Rayong and Surat Thani use in-board powered fishing boat employed fisheries with 88.4% and 92.5% respectively while 53% of fisher in Prachuap-Chumphon engage in fisheries by using long-tail fishing boat. Most fisher interviewed of three study area use the fishing boat with length 6-13 meters and equipped with engine5-185 horse power.

2. Main type of fishing gear

Crab gill net is the main type of fishing gear in Rayong, Prachuap-Chumphon and Surat Thani all area with 36.8%, 28.4% and 40.2% respectively. In Rayong, the fisher favor to use fish gill net and shrimp trammel net for fishing (14.0% and 13.6%) and the squid jig is the one fishing gear that fisher favored in this area. For Prachuap-Chumphon, Squid falling net is the second most frequency among the fishers (26.9%), it is observed that the anchovy falling is only favor employed in this area (8.7%). Besides, fish gill net take the second place among the fisher in Surat Thani, the result found that Crab trap and shrimp trap are favored use in this area more than the other (8.8%,5.3%).

3. Fishing season

Base on the fisher experience in fishing operation, the crab gill net and fish gill net can operate throughout a whole year, however the crab gill net has a peak season from June to September in Rayong and October to December in Prachuap-Chumphon as well as Surat Thani is from September to November. The high season of fish gill net in Rayong, Prachuap-Chumphon and Surat Thani are October-December, February-May, and March-August respectively. The fishers will use the shrimp trammel net when they found the abundant of shrimp in the coastal sea. In addition, the small-scale fisher respondent explained that they engage in fisheries with more than one type of fishing gear and they will change fishing gear for the peak season of target species. During low season, some of them repair fishing boat and preparing fishing gear and some fishers earn additional income from agriculture and Aquaculture as well as some fishers employ in labor and trade.

4. Fishing effort

The average fishing trip of all fishing operation is one trip per day due to the small-scale fishers operate fishing in the coastal area (within 3-10 kilometer from shore). The fisher interviewed of Rayong, Prachuap-Chumphon and Surat Thani operate the crab gill net fishing around 21.3, 11.6, and 18 days respectively during high fishing season. The fisher respondent of three study area use fish gill net for fishing around 20.3, 17.7, and 20 days

respectively during peak fishing season as well as they spend 19.8, 13.9, and 15 days respectively in a month to operate shrimp trammel net.

5. Main target species

The blue swimming crab is the main species of crab gill net fishing that the fishers catch about 23.2 and 41 kg. per trip in Rayong, Prachuap-Chumphon respectively, the result show the highest volume of this species in Surat Thani about 75.9 kg. per trip. Most fishers from Rayong and Prachuap-Chumphon catch mackerel using fish gill net with 114.7 and 155.7 kg. /trip respectively, while the fishers in Surat Thani can catch mullet as the main target species from fish gill net with 61.1 kg. per trip. The highest catch of shrimp from shrimp trammel net fishing (29.4 kg. /trip) was operated by Surat Thani fishers.

IV. Conculsion

The characteristic of small scale fisheries is employing fishing in inshore and one day trip operation, the small-scale fishers use in-board and out board powered fishing boat with length 6-13 meters equipped with engine 5-185 horse power. They own more than one type of fishing gear, the fishing gear selective depend on fishing season of target species nevertheless the fishers can catch the variety species. The main type of fishing gear of three study area is crab gill net that can operate throughout a whole year especially the peak season is during monsoon season due to the strong winds bring aquatic animals to coastal line, Blue swimming crab is main target species which the catch volume is highest in Surat Thani Province 75.9 kg. per trip. However, most fishers earn the additional income from agriculture and aquaculture while some fishers repair their fishing gear and fishing boat in low season period.

V. Acknowledgement

I would like to express my sincere thanks to “Research Institute for Humanity and Nature (RIHN)” for financial support in conducting social survey in coastal area under Coastal Area Capability project. I most gratefully acknowledge our team leader, Dr. Tsutom Miyata to kindly advise and give me the valuable knowledge as well as the fishers in the coastal area to provide the information, I would like to special thanks to my colleague for their help and support.

Baseline survey on fishing efforts and landing in the Southwestern Gulf of Thailand

Kongpathai Saraphaivanich, **Yanida Suthipol**, Namfon Imsamrarn

I. Introduction

A baseline survey on fishing efforts and landing in the Southwestern Gulf of Thailand is an activity under the title of "Strengthening Malaysian and Thai Partnership in support of Joint Fisheries Planning and Management in the Western Gulf of Thailand" which was implemented from July 2014 to December 2015. Its aim is to gather preliminary information on fishing efforts (vessels, gear, and people) and landing of catch, which would be used as basis to improve the monitoring and control of fishing activities. In addition, the survey hopes to serve as a medium through local teams can participate, thus strengthening the cooperation between Thailand and Malaysia.

II. Methodology

1) Designed by teams from both countries, the questionnaire on baseline survey covers important information on vessels name, vessels registration number, vessels owner name, specification symbol of vessels, type of vessels, port of registry, size of vessels, engine power, VMS system in the vessels, fishing area, nationality of vessels, history of vessels, nationality of captain/ master, number and nationality of crew through fishing operation and fish landing information such as fishing operation, major target species, landing port, and supply.
2) The targeted area for the survey consists of three provinces in Thailand: Pattani, Songkhla, and Narathiwat; and three states in Malaysia: Kelantan, Terengganu, and Pahang. These areas were selected due to their close proximity to the border, opening the possibility of having a joint venture fishing arrangement between both countries. The actual total number of questionnaire from survey in Thailand and Malaysia is 409 and 459 samples respectively.

III. Results

- *The first level of data analysis*

The first level of data analysis is summary feedbacks from the questionnaires conducted by two countries from April to September 2015. The baseline survey found that most of the fishing vessels in Thailand is purse seiner (51.84%), while in Malaysia is trawler (71.77%). There were only 96.09% of fishing vessels who were officially registered in Thailand. This contrasts the statistics of Malaysia: all fishing vessels were registered in their country. Most of the length of fishing vessels in both countries lies in the interval 18 to 23.99 meters, and engine size in 220 to 499 Hp. Most of fishing vessels in Thailand (98%) and Malaysia (96%) operate in their respective waters. In regards to nationality of captain/master fisherman in Thailand, most of them are Thai, while the nationality of crews is Cambodian, Burmese, Thai, and Lao. In Malaysia, the most common nationality of captain/ master fisherman is Malaysian, while the nationality of crews consists of Thai, Malaysian, Vietnamese, Cambodian, Lao, and Burmese. For fish landing, most of Thai fishing vessels are landing in Thai fishing port (98%) and all of Malaysian fishing vessels are landing in Malaysian fishing port. Supplies, such as ice, fuel, provision, general vessels maintenance, and fishing equipment were bought from their countries. Vessels Monitoring System (VMS) was

installed to Thai and Malaysian fishing vessels about 16.53% and 36.17% respectively. In Malaysia only Zone C2 fishing vessel were installed with VMS. The highest total catches in Thailand are purse seine (72.78%), trawler (12.46%) and fish trap (4.14%). Whereas in Malaysia, highest catch is trawler (54.30%), followed by purse seine (45.37%) and fish trap (0.13%).

- *The second level of data analysis*

The second level of data analysis is an advance examination into illegal fishing vessels. It uses information from the questionnaire, such as: port of survey, number of vessels at specific port, specification of vessels (color of super structure, name and ID number, port register, type of fishing gear), previous name and nationality of flag, area of fishing/ landing, number of crew and nationality, nationality of captain, number of working days at sea/month, fuel consumption, source of provision and supply. Assumption of IUU fishing vessels from baseline survey is 12.41%. Most of illegal fishing vessels are purse seine. Most of illegal fishing vessels length is 18-23.99 meters, with an average of 16.3 meters and weight 30 GT and over.

However, in the same period of baseline survey, Thailand implemented Port in- Port out Control (PIPO) system to combat the IUU fishing vessels. In regards to this system, the fishing vessels weight 30 GT and over have the responsibility of implementing this system. According to this system, the fishing vessels less than 30 GT should be watchdog because it is easy to enter the illegal fishing operation.

IV. Recommendations and suggestions

Recommendations and suggestions to improve the planning, development, and management of fishing effort, and monitoring of landing in Malaysia and Thailand Sub-region are given as follow:

1. Establish a Memorandum of Understanding (MoU) between Malaysia and Thailand through landing information dissemination that covers the area of Songkhla Province, Pattani Province, Narathiwat Province in Thailand and Kelantan, Terengganu and Pahang in Malaysia;
2. Identify and appoint a National Coordinator, who will oversee the exchange of landing information;
3. Promote the improvement of fishing effort management in close cooperation between local authorities nearby boundary;
4. Encourage and emphasize the need for vessels marking inspection, in accordance with national regulation;
5. Consider and develop tools for fishing vessels less than 24 meters in length to reduce illegal fishing activities;
6. Encourage the usage of information from VMS for validation of fishing ground;
7. Expand research: baseline survey activity should not only be considered for commercial fishing vessels, but also for small-scale fishing vessels. The results of baseline survey will be used as information for planning and development of activities to improve management of fishing effort and monitoring landing in Sub-region.

V. Reference

SEAFDEC/TD. 2016. *The report on baseline survey on fishing effort and landing in the Southwestern Gulf of Thailand*. Samut Prakan, Southeast Asian Fisheries Development Center/ Traiing Department. TD/RP/189. 30 pages.

Environmental assessment of the set-net operation in Rayong Province, Thailand

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Environmental assessment of set-net operation in Mae Rumphueng Beach, Rayong Province was evaluated during 2013-2014. Field surveys around the set-net fishing ground were conducted in the beginning (October 2013), middle (January 2014), ending (April 2014) periods of the operation and six months after the operation ending (October 2014). The results of paired t-test showed that acid volatile sulfide (AVS) of the bottom sediments within set-net A, set-net B and the reference area from four periods were not significantly different (p>0.05). Additionally, average amount of AVS including set-net A, set-net B and the reference area in the beginning (0.0011±0.0018 mg/g dry), middle (0.0026±0.0029 mg/g dry) ending (0.0028±0.0028 mg/g dry) and after-ending (0.0053±0.0117) were much lower than the criteria value for critical farm (2.5 mg/g dry proposed by Yokoyama, 2003). The density of benthic macro-fauna during middle and ending periods in set-net area were significantly higher than those in other areas; whereas those during beginning and after-ending periods were not significantly different. These results indicated that set-net operation did not relevant to the polluted substance, AVS, but had an influence in the increasing of benthic macro-fauna density during the operation season, which was recovered to the initial condition after removal of gear construction.

Keywords:
set-net, acid volatile sulfide (AVS), benthic macro- fauna, environmental assessment

I. Introduction

The marine fishing in Thai territorial waters has been operated in the Gulf of Thailand and Andaman sea with coastline of 1,972 km facing to the Gulf of Thailand and 1,037 km facing to Andaman Sea. It is rich in nutrient brought in by many rivers [Wanttayakorn, 2014] and bottom in shallow water is either muddy or sandy suitable for fishing operation. The annual marine production from fishing, which was 150,000 tons in the 1950s, increased sharply to 1,000,000 tons in 1968 and reached to 3,380,300 ton in 2005. During the last decade marine fisheries, however, it was continuously declined which that marine production remained 1,614,500 tons in 2013 [DOF 2016]. The destructive fishing gear and fishing pressure on coastal fisheries resources considered as one of the main causes of resource deterioration. In order to alleviate mentioned problem by organizing group cooperation for Eco-friendly fishing operation, set-net has been experimentally operated in Mae Rumphueng beach, Rayong Province, since 2002. Recently, there were 5 set-net experimental operations in Thailand waters at Rayong, Chonburi and Prachuap Khiri Khan Province

Set-net is a type of stationary fishing gears with a large-scale trap net. It is used in coastal waters to intercept migrating fish schools in the leader net, subsequently entrapping them inside the chamber trap. The set-net has been operated in Thailand waters over decades. Long term of set-net operation probably had the potential to effect the environment around it by functional as sediment trap. However, environmental assessment of set-net operation has not been conducted. Most of researches studied in related with Thailand set-net were fishing techniques [Manpasit 2005], catch profit [Manajit 2011] and management [TD 2008]. Therefore, the Research Institute for Human and Nature (RIHN), Eastern marine Fisheries Research and Delevopment Center, DOF, Thailand (EMDEC) and Southeast Asian Fisheries Development Center (SEAFDEC) conducted collaborative project aiming to conduct environmental condition survey in order to determine environmental assessment of the set-net operation focusing on the water quality, total acid volatile sulfide (AVS) and benthos around set-net fishing ground.

II. Materials and Methods

The study sites were located at Mae Rumphueng beach, Rayong Province, Thailand. There were 22 survey stations including 8 stations around the set-net A (4 stations at the edge of set-net and 4 stations with 100 m far away from edge of set-net), 8 stations around the set-net B (4 stations at the edge of set-net and 4 stations with 100 m far away from edge of set-net) and 6 reference stations (Station number 1, 2, 3, 4, 5 and 6). Location of the survey stations and survey activities are shown in **Figure 1.**

Field surveys were conducted at different period namely beginning (October, 2013), middle (January, 2014) and ending (April, 2014) period of operation and six months after operation ending (October 2014). The field surveys were carried out on board, namely Bangphe 14. Water profile including temperature, salinity, dissolved oxygen (DO) and pH were measured by using multivariate devices (Mantaray Model I). Water sample at surface, middle and bottom were collected by van dron with that chlorophyll-a were measured according to [Michell and Kiefer, 1984]. Sediment samples were collected by Ekman grab with that sediment grain size, total acid volatile sulfides (AVS) and benthic macro-fauna were analyzed as follow;

-The sediment grain size samples were carefully collected in surface layer and kept in plastic bag and put in ice-boxes then was transferred to laboratory for analysis. Five sub-sambles of each station were weighed out approximately 100 g for each sub-sample. Each sample was then dried in drying oven at 100 ^{o}C for 24 hr and dry weight were recorded. Then the sample were dry sieved through series of sieves including 2mm, 1mm, 0.5mm, 0.125 mm and 0.063mm mesh size. The samples were separated and weighed on balance to +/-0.01 g accuracy.

-AVS samples with three replicates in each station were carefully kept in plastic box and put in ice-boxes then was transferred to laboratory for analysis. It was assayed by changing sulfide in various from into hydrogen sulfide (H_2S) using 18N sulfuric acid (H_2SO_4). The amount of H_2S in the sediment was then measured using Hedrotek column (AVS test column).

Samples for benthic macro-fauna were washed and sorted through a 0.5mm mesh sieve and preserve in 5% seawater formalin added Rose Bengal solution. Benthic specimens were identified to class level under stereo-microscope with the aid of published figures and description of Arnold and Birtles (1989); Rouse and Pleijel (2001). The density of benthic

macro-fauna was standardized to number of individuals per square-meter (ind/m^2) in order to compare the differences between sampling period and between sampling site.

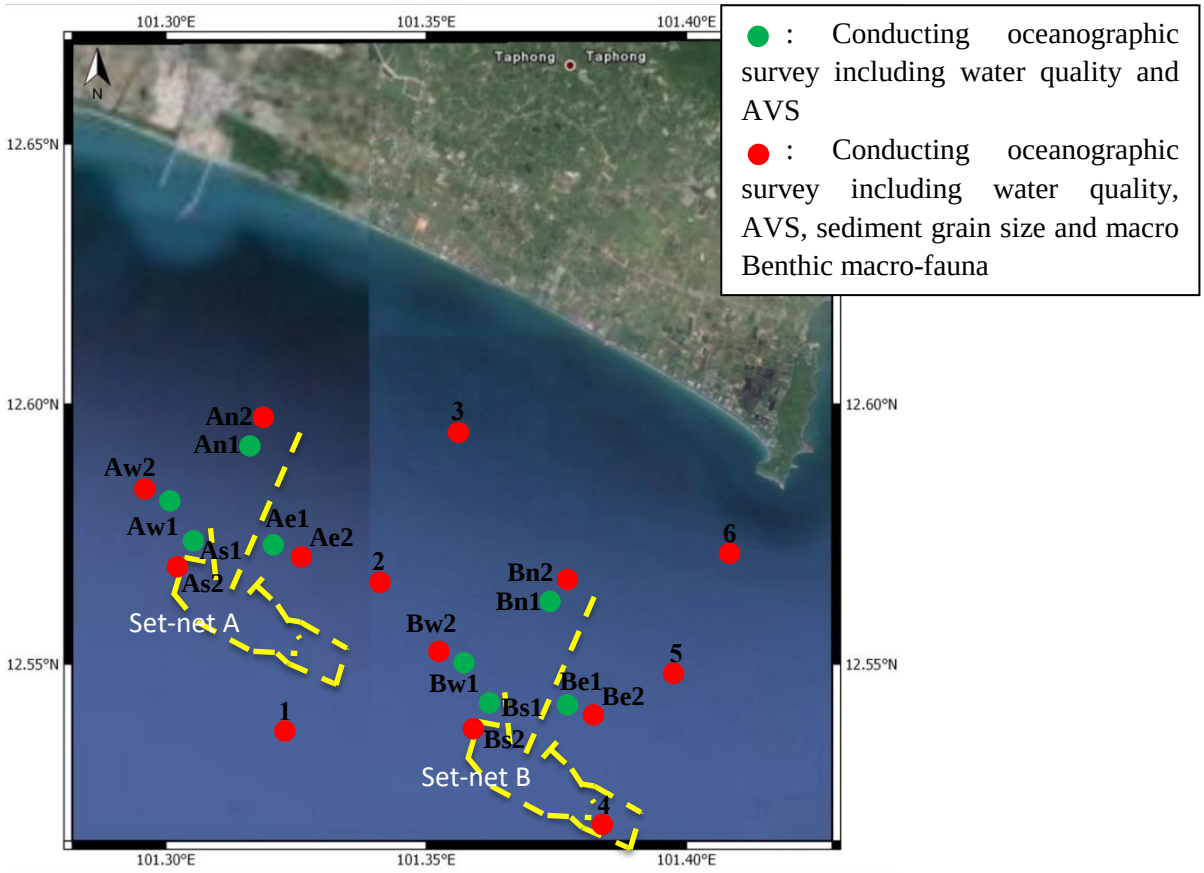

Figure 1. Survey location and activities conducting at Mae Rumphueng beach, Rayong Province, Thailand during October 2013 to October 2014. *Remark: Sediment grain size were only conducted in beginning period*

III. Results and Discussion

Water quality

Set-net was constructed in flat area with average depth of 12.5 meter. Average temperature, salinity, dissolved oxygen, pH and chlorophyll-a at surface, middle and bottom layer in the whole study period were shown as **Table1**. The results showed that fresh water flux input effected to saline in the study area in October which average salinity in 2013 and 2014 were 30.5 and 31.5, respectively. The fresh water flux input lead to the high chlorophyll-a concentration in October due to it normally brought nutrients from terrestrial to water. The Chlorophyll-a concentration were high at the bottom layer through all study period. The study area was located close to the shore. Therefore, it possible strongly effected from wave and tidal current, which lead to high Chlorophyll-a concentration at the bottom by nutrient re-suspension from the bottom sediment. In addition, it was found that water column was well mixed situation except in October 2014 when weakly water stratification was observed which average salinity in surface, middle and bottom were 29.3, 31.7 and 33.7, respectively.

Table 1. Physiochemical properties of sea water in all periods

Parameter (n=24)	Layer	Beginning	Middle	Ending	After-ending
Temperature (^oC)	Surface	29.60±0.23	27.40±0.19	31.49±0.16	30.23±0.32
	Mid	29.16±0.12	27.31±0.10	31.45±0.11	30.32±0.09
	Bottom	29.04±0.08	27.31±0.09	31.43±0.11	30.01±0.13
Salinity (PSU)	Surface	30.16±0.11	34.01±0.05	34.16±0.07	29.32±0.27
	Mid	30.47±0.23	34.00±0.06	34.16±0.09	31.66±1.08
	Bottom	30.75±0.10	34.00±0.08	34.15±0.08	33.74±0.18
Dissolved oxygen (mg L^{-1})	Surface	6.55±0.15	7.27±0.34	6.68±0.15	no data
	Mid	6.44±0.10	6.95±0.10	6.26±0.06	no data
	Bottom	6.30±0.42	6.91±0.11	6.16±0.05	no data
pH	Surface	8.15±0.03	8.04±0.09	8.17±0.05	8.23±0.09
	Mid	8.15±0.03	8.25±0.01	8.20±0.04	8.30±0.05
	Bottom	8.15±0.03	8.26±0.01	8.22±0.04	8.27±0.05
Chlorophyll-a (ug L^{-i})	Surface	0.490±0.162	0.264±0.076	0.351±0.073	0.435±0.113
	Mid	0.474±0.119	0.242±0.084	0.431±0.134	0.756±0.358
	Bottom	0.888±0.268	0.307±0.111	0.465±0.137	0.981±0.169

Sediment grain size

Standard grain size terms of sedimentary particles using in the present study were ; clay and silt (<0.063mm), very fine sand (0.063-0.125mm), fine and medium sand (0.125-0.5mm), coarse sand (0.5-1.0mm), very coarse sand (1.0-2.0mm), gravel (>2.0mm)

The results of analysis of grain-size distribution are shown in **Figure 2.** The grain size deposited in the survey area consisted of 0.1 to 3.2% clay and silt, 0.3-17.5% very fine sand, 25.5-74.3% fine and medium sand, 8.1-30.8% coarse sand, 3.9-23.4% very coarse sand and 0.2-8% gravel. Fine and medium sand fractions were predominant, the component of clay and silt making up a small amount in the study area.

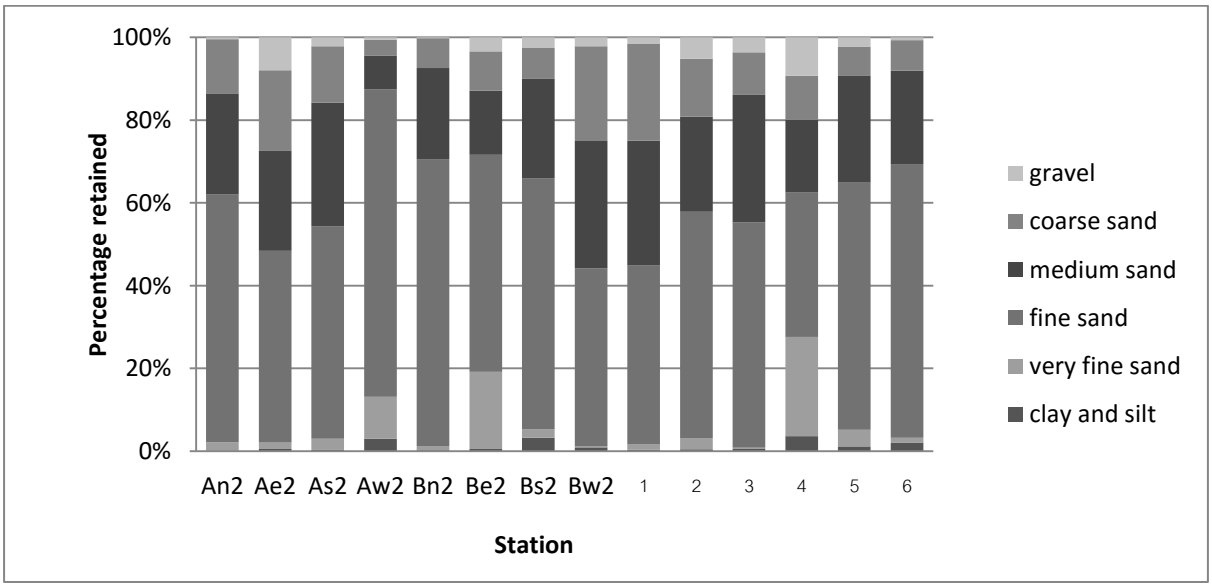

Figure 2. Percentage of grain size composition of surface sediments in each station retained by type of sediment fractions

Total acid volatile sulfides (AVS)

Sulfides have been used as possible indicators of toxicity in sediment. Sulfide in various forms occurred in the sediment had caused by biological and chemical process. AVS is a sediment parameter that is operational defined as sulfide accumulated in the sediment.

The results showed that the average amount of sulfides accumulated in the sediments collected from set-net operation area were 0.0007±0.0008, 0.0016±0.0024, 0.0034±0.0034 and 0.0040±0.0059 mg/g dry (set-net A) and 0.0016±0.0024, 0.0036±0.0031, 0.0022±0.0019 and 0.0028±0.0050 mg/g dry (set-net B) in the beginning, middle ending and after ending period, respectively. While the average amount of sulfides accumulated in the sediments collected from reference area were 0.0014±0.0018, 0.0044±0.0066, 0.0080±0.0140 and 0.0106±0.0130 mg/g dry in the beginning, middle ending and after ending period, respectively (Fig. 3). The average hydrogen sulfide contents in sediment of set-net area A and set-net B were mostly not higher than the reference area through study period. Additionally, It was also found that sulfide in the set-net A area increased with set-net operations but the differences were small amount compared with SD and sulfide in the set-net B area was quite fluctuated in which the maximum did not find during ending period.

The results of paired t-test, within set-net A, set-net B and reference area from four periods showed that they were non significantly different of sulfide in each period (p>0.05) and also with the results from Two Factor ANOVA showed that there were non significantly different of sulfide between set-net area and reference area (p>0.05). Therefore, it could be concluded that there was no relationship between amount of sulfide and set-net operation. In the other words, set-net may not cause the accumulation of sulfide in sediment at Mae Rumphueng beach, Rayong Province, Thailand.

The average amount of AVS in the study area combining set-net A, set-net B and the reference area in the beginning (0.0011±0.0018 mg/g dry), middle (0.0026±0.0029 mg/g dry) ending (0.0028±0.0028 mg/g dry) and after-ending (0.0053±0.0117) periods were lower than the other reports [Salaenoi, 2015] and much lower than the criteria value for critical farm [2.5 mg/g dry proposed by Yokoyama, 2003]. The characteristics of sediment corresponded to the accumulation of hydrogen sulfide which sand had less ability to absorb hydrogen sulfide than clay and silt. The less amount of sulfide content in these study area may be due to the sediment character which was predominant by fine and medium sand.

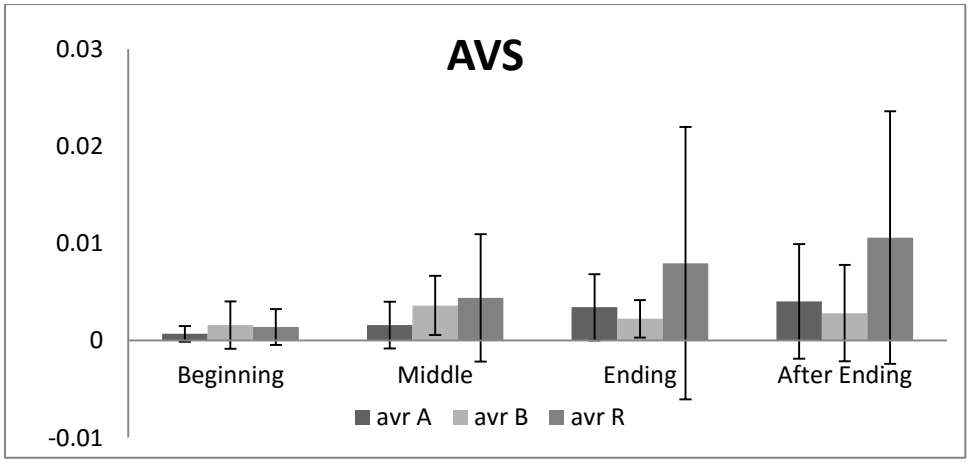

Figure 3. The average concentrations of Total Acid Volatile Sulfide (AVS) with standard deviation from set-net A, set-net B and reference area

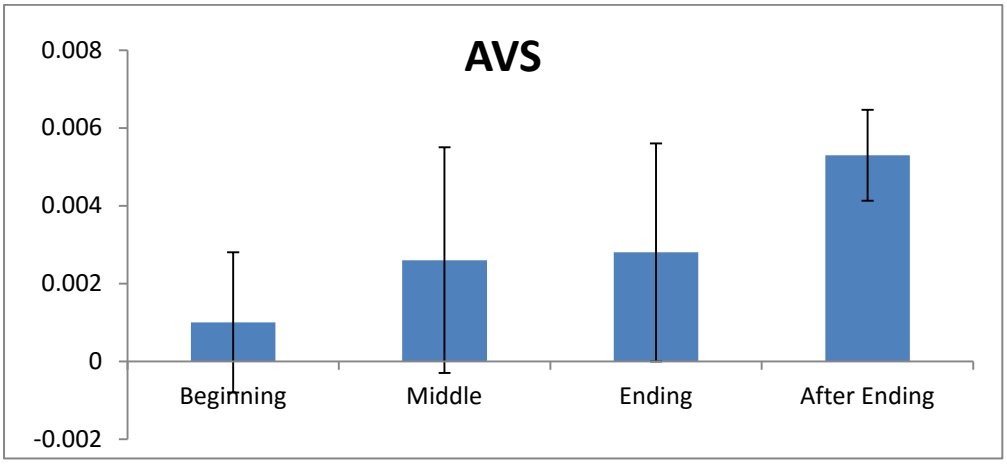

Figure 4. The average amount of Total Acid Volatile Sulfide (AVS) with standard deviation from every station in four periods

Benthic marco-fauna

Two thousand and four specimen belonging to 6 phyla 11 classes from 14 stations were sampled that including Nematoda, Annelida (Polycheta), Mollusca (Gastropoda and Bivalvia), Arthropoda (Ostracoda, Copepoda and Malacostraca), Echinodermata (Ophiuroidea, Echinoidea and Holothuroidea) and Chordata. The major group of benthic macro-fauna was Polychaeta which average percentage composition through study period was 33.36% followed by Malacostraca (23.00%) and Bivalvia (18.23%). Polychaeta and Malacostrace were the most frequent group occurring in all 14 stations, while other groups were found only in some stations (Fig 5).

Benthic macro-fauna density was seasonal with highly in April and low in October. The average density and average density ration of benthic macro-fauna around set-net A, set-net B and reference area are shown in table 2. It was found that range of average density ration of set-net A/reference area and set-net B/reference area was 0.81-1.03 in beginning and after-ending period and higher than 1.37 and 1.39 in middle and ending period, respectively.

The results from pair t-test showed that density of benthic macro-fauna during middle and ending periods in set-net area were significantly higher than those in other areas; whereas those during beginning period and after-ending were not significantly different at 95 confident interval. These results indicated that set-net operation had an influence in the increase of benthic macro-fauna density during the operation season, which was recovered to the initial condition after removal of gear construction.

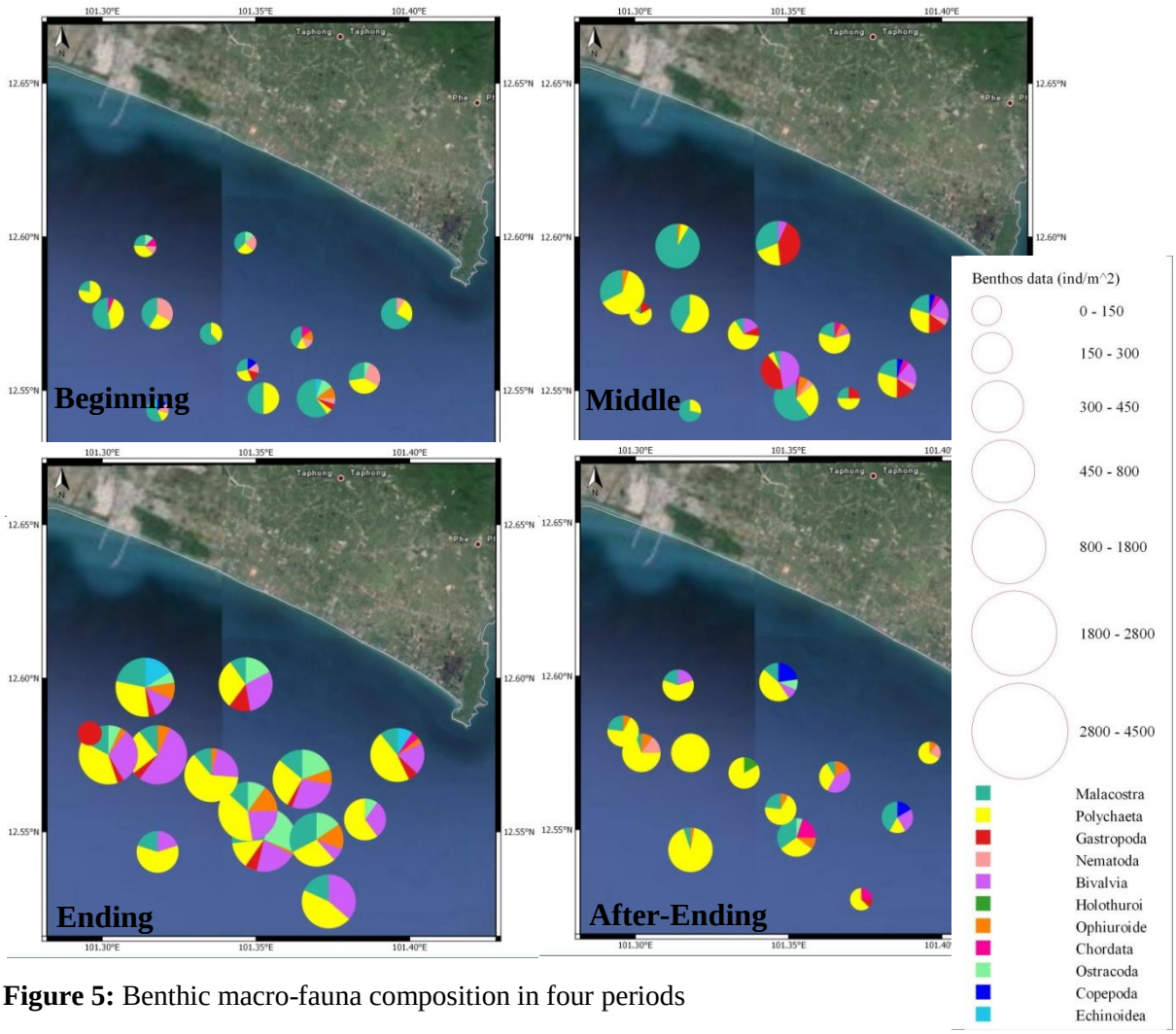

Figure 5: Benthic macro-fauna composition in four periods

Table. Average density and average density ration of benthic macro-fauna of benthic macro-fauna in set-net A, set-net B and the reference area

		Beginning	Middle	Ending	After-ending
Average density (ind/m^2)	Set-net A	192	513	1500	263
	Set-net B	183	354	2442	225
	Reference area	186	258	1083	278
Average density ration	Set-net A/Ref.	1.03	1.99	1.39	0.95
	Set-net B/Ref.	0.98	1.37	2.25	0.81

IV. Conclusion

1) Set-net is one type of friendly fishing gear in term of environmental impact.

2) There is no relationship between amount of sulfide and set-net operation. In the other words, set-net may not cause the accumulation of sulfide in sediment at Mae Rumphueng beach, Rayong Province, Thailand.

3) Set-net operation had an influence in the increasing of benthic macro-fauna abundance during the operation season, which was recovered to the initial condition after removal of gear construction.

V. Acknowledgement

The authors would like to thank Research Institute for Humanity and Nature (RIHN), Kyoto, Japan, Eastern Marine Fisheries Research and Development Center, DOF, Thailand and Southeast Asian Fisheries Development Center for funding anf technical support this study

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Water Characteristics in the Cambodian water in November 2015

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Abstract

Twenty four oceanographic survey stations were carried out by CTD, seabird 911 plus equipped onboard RV Koyo Maru in the Cambodian water during 10 - 21 November 2015 cover 101.989^{o} E to 103.635^{o} E and 9.084^{o} N to 11.236^{o} N. Its results including temperature, salinity, density and Dissolved Oxygen (DO) were used to determine water characteristics and their causes. The results showed that water profile was complex in some station because of water masses intrusion from the North and Northeast of the study area. This water masses occupied at the depth from the surface to 40 m in North and Northeast. Its thickness, however was continuously less when it flowing southward. This water masses characteristic was high temperature, low salinity and low density. Additionally, low oxygen condition (about 2.6 ml/l) in near bottom water was found in some study area when the bottom depth deeper than 40 m. Even though, DO near the bottom in deep area was low but not low enough to harm to organism. The study results show that strong water stratification led to low oxygen in the study area.

Key word: Water characteristics, the Cambodian water

Species Composition, Density and Distribution of Fish Larvae in the Cambodian Water

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Abstract

The species composition of fish larvae in different habitats are very important for fisheries management. In total of 2,606 individual representing 47 families were collected between 10 – 21 November from 22 stations in Cambodian water. Sample was collected using a oring net from the surface layer and an oblique haul each station. Time for haul depended on water depth. The mean density of ichthyoplankton at this area was 658 ind./1000 m^3 .The catches consisted primarily of fish larvae, indicating that the Cambodian water was important as nursery ground for fish. The top major families were Gobiidae (42.55% contribution), Engraulidae (9.98% contribution), Bothidae (9.22% contribution), Bregmacerotidae (42.55% contribution) and Caragidae (9.98% contribution) were dominant in the catch. Station 16 had highest density amongst the stations. The average diversity index was 1.72. The average evenness index was 0.88. The average family richness was 11 families. Amongst 47 families, 10 appeared to be commercially important and they are inhabit inshore as adults fish.

Key words: Species composition, Fish larvae, Oring net, Cambodian water

I. Introduction

Cambodian water is one of large marine ecosystem, which coast of Cambodia is along the Gulf of Thailand from Thai border in the northwest to the Vietnamese border to southeast. The coastal area includes several large bays and extends across the provinces of Kon Kong and Kampot and the municipalities of Sihanoukville and Kep. The offshore marine area contains numerous islands. The coast covers a length of some 435 km along Gulf of Thailand, and the EEZ of approximately 55,600 km^2 (Chamchang,2008) and relatively shallow with an average depth of about 50 meters.

Ichthyoplankton research is a key role in our understanding of the ecology and evolution of fish and their constituent populations. Research into the distribution and abundance of ichthyoplankton is likely to improve our understanding of the interrelationships between fish species during their early life stages, estimate the size of a spawning stock from habitat. In this present work, the study of ichthyoplankton is a part of the biological oceanographic survey aimed for fishery management (Rezagholinejad,2016). The understanding of abundance and distribution of fish larvae inconjunction with ecological conditions could fill up the gap in the study of fish life history.

Nowadays, little information is available about the ichthyoplankton of the Cambodian water. Hence, the study aimed to investigate the species composition, density and distribution of fish larvae in Cambodian water.

II. Materials and Methods

2.1 Study site

Ichthyoplankton samples were collected at 22 station in Cambodian water (9°12′-11°24′ N and 101°98′ – 103°62′ E) during November 10 – 21, 2016 using the vessel Koyo Maru.

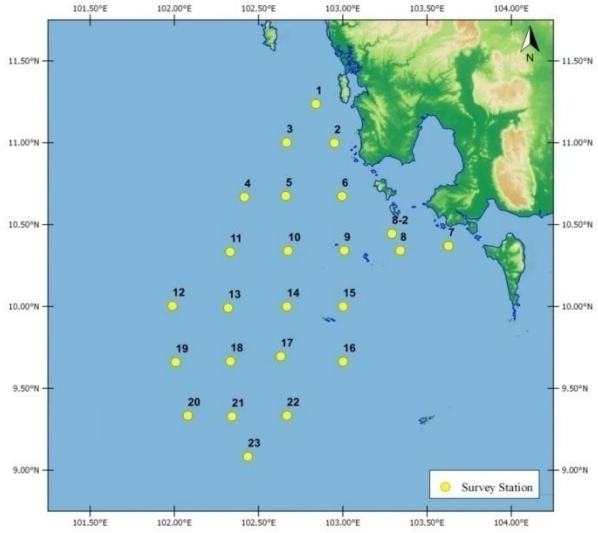

Figure1. Position of Oring net operation

2.2 Sampling Procedures

All fish larvae were collected by Oring net 130 cm. in diameter (mesh size of upper part2 mm. and lower part 335µm.).A flow meter was attached to the mouth of net to determine the volume of sea water filtered during each tow. The sampling period depended on water depth from the surface layer and an oblique haul each station at ship speed of 2 knots. Collected specimens were preserved in 10 % formalin sea water buffered and then analyzed identified in the laboratory, after which they were changed to 70 % ethyl alcohol solution.

2.3 Laboratory Method

Fish larvae were identified mainly to family level base upon description given in number of reference for larval fishes (Leis and Carson-Ewart, 1983; Russell, 1976; Okiyama, 1988;).Unidentified larvae were placed in unknown category due to the samples were too small to identify and damaged larvae were placed in incomplete category

2.4 Data Analysis

The fish larvae were identified through keys provided by, Nelson (2006). The number of total fish larvae and the top five most abundant families which were standardized to number caught per 1000 m^3, at the different sampling stations to compare the distribution of fish larvae, their abundance and diversity. In order to calculate diversity of fish larvae assemblage Diversity index ($H^{'}$). Family richness index (Margalef, 1958) and **evenness index** (Pielou, 1996)**.**

III. Results

Total fish larvae

In total of 2,606 fish larvae (the average of total larvae 95 ind./1000 m^3),the fish larvae assemblage comprised 48 families. The density of ichthyoplankton at this study site was 0 to 658 individual/1000 m^3. Five dominant families, Gobiidae (42.55%) was the family which had the highest abundance that is followed by Engraulidae (9.98%), Bothidae (9.22%) Bregmacenrotidae (7.96%) and Carangidae (7.28%) (Table 1) were observed consistently throughout the station in the investigated area. The highest density was observed at station 16 and the lowest at station 20. Base on the constancy of occurrence, 5 families of Gobiidae, Engraulidae, Bothidae, Bregmacerotidae and Carangidae were consider as constant families of which Engraulidae, Bothidae, Carangidae were the commercial important family.

Referring to the category adult's habitat, 3 families were neritic fish, 26 families were inshore-reef fish, 11 families were shallow to oceanic fish and 2 families (Ophidiidae, Exocoetidae) were oceanic fish

Table.1 Density of fish larvae at Cambodia water between 10 – 21 November 2015.

Family	Ind./1000 m^3	% of total fish larvae	Family	Ind./1000 m^3	% of total fish larvae
Gobiidae	30	42.55	Tetraodontidae	1	0.34
Engraulidae*	7	9.98	Priacanthidae*	1	0.27
Bothidae*	7	9.22	Scorpaeridae	1	0.26
Bregmacenrotidae	6	7.96	Lethrinidae*	1	0.24
Carangidae*	6	7.28	Sphyraenidae*	1	0.24
Nemipteridae*	3	4.30	Serranidae*	1	0.16
Clupeidae*	2	2.67	Sillaginidae*	1	0.14
Callionymidae	2	2.57	Citharidae	1	0.11
Leptocephalus	1	1.59	Siganidae	1	0.11
Lutjanidae*	1	1.50	Antennariidae	1	0.08
Leiognathidae	1	1.24	Polynemidae	1	0.08
Scombridae	1	1.08	Carapidae	1	0.07
Cynoglossidae*	1	0.99	Ophidiidae	1	0.05
Mullidae*	1	0.70	Exocoetidae	1	0.04
Sciaenidae	1	0.63	Centriscidae	1	0.04
Apogonidae	1	0.55	Paralichthyidae	1	0.04
Platycephalidae	1	0.54	Syngnathidae	1	0.04
Synodontidae*	1	0.54	Holocentridae	1	0.04
Champsodontidae*	1	0.52	Opistognathidae	1	0.04
Labridae*	1	0.43	Terapontidae*	1	0.04
Monacanthidae	1	0.35	Gerreidae*	1	0.03
Cepolidae	1	0.34			

* Commercial fish

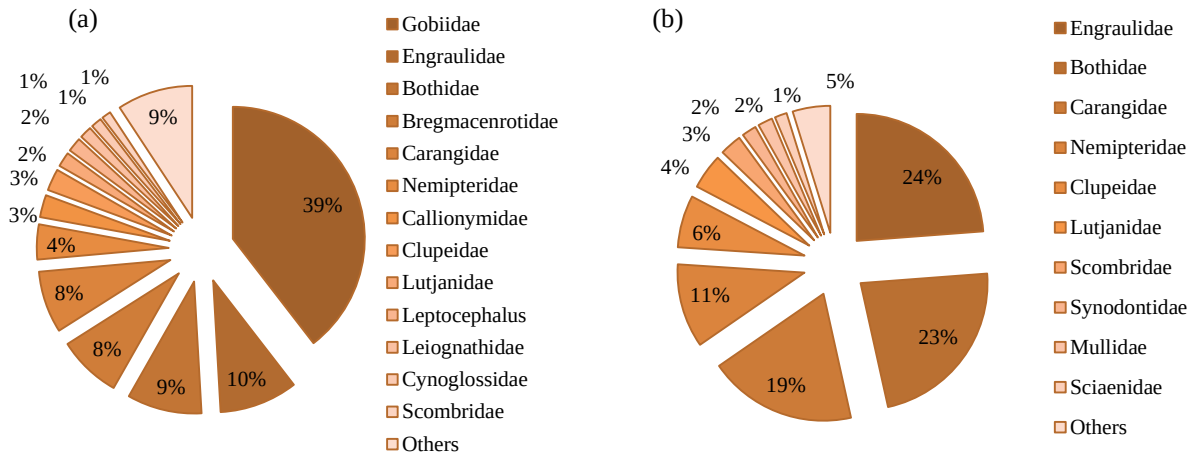

Figure.2 Total of fish larvae a) Percent of total fish larvae b) Percent of total commercial fish

Distribution of the top five commercial fish larvae

For fish larvae were found 42 families, 10 families all of them (Fig.2b) (more than 44% of total fish larvae) were important commercial species. Five commercial fish were the most density family comprising Engraulidae, Bothidae, Carangidae, Nemipteridae and Clupeidae

Engraulidae

Engraulids larvae were observed at 11 out of 22 sampling station, most of them situated in station 16, follow by station14 and station 10. In summary, almost engraulids larvae were distributed in near shore. (Fig.3a)

Bothidae

Bothids larvae were observed at 18 out of 22 sampling station, They were the second most **abundant** family of commercial fish in this study. They were largely distributed but more abundant near shore. (Fig.3b)

Carangidae

Carangids larvae were ranked the third density of the total commercial fish (Fig.4b). They were commercially important fish have constituted 8 % of the total fish larvae (Fig.4a). Almost found in all station, they were largely distributed. (Fig.3c)

Nemiteridae

Nemiterids larvae were observed at 11 out of 22 sampling station, They were important in both commercial and artisanal fisheries, which were ranked the fifth density of the total commercial fish. Mostly they were distributed in near shore. (Fig.3d)

Clupeidae

Clupeids larvae were ranked the fifth of total commercial fish, observed at 9 out of 22 sampling station. They were distributed in mid-southern part on Cambodian water. (Fig.3e)

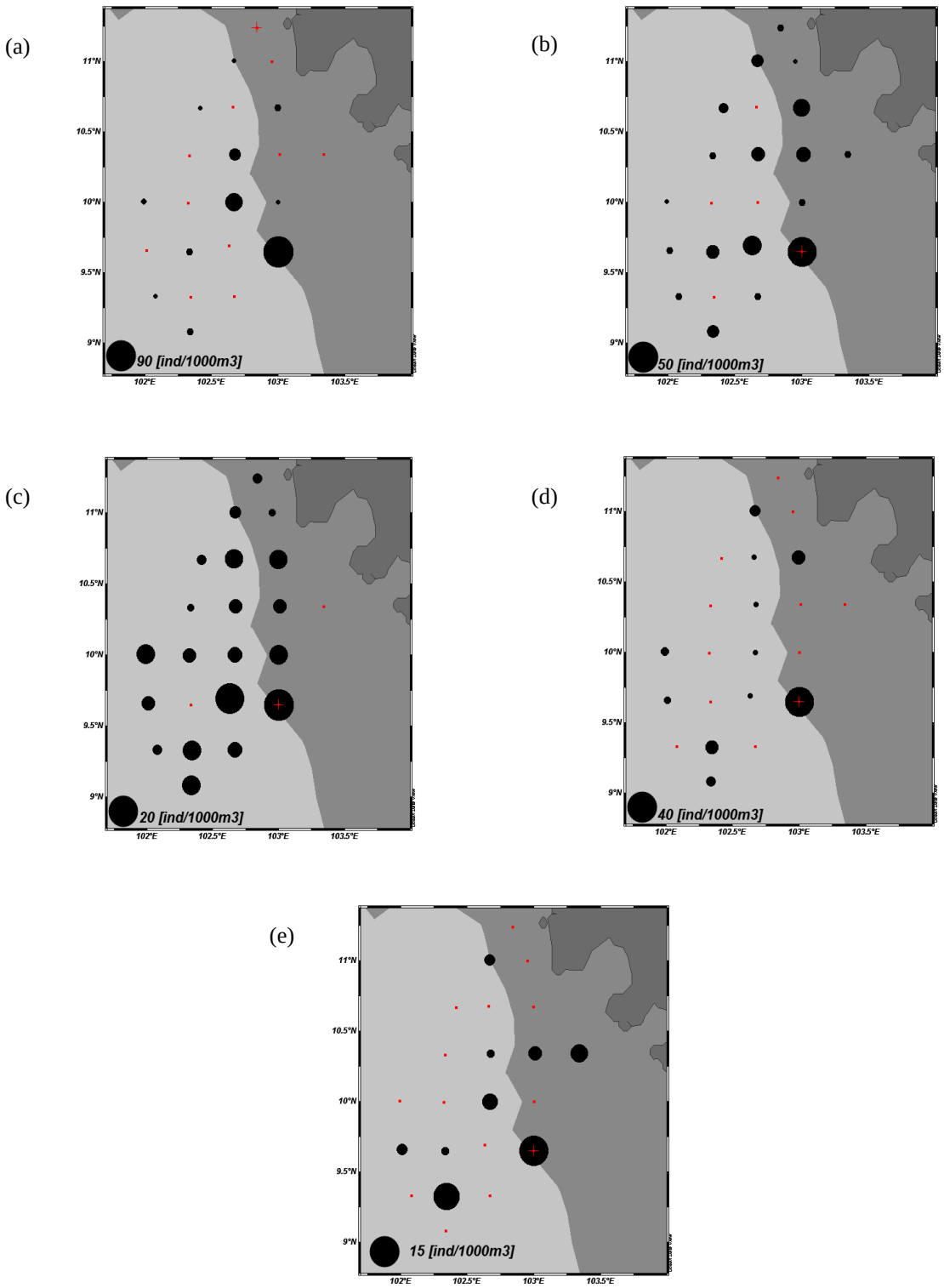

Figure.3 Distribution of top five commercial fish larvae a) Engraulidae b) Bothdae c) Carangidae d) Nemipteridae e) Clupeidae

Ecological indices

The average diversity index was 1.72 in the investigate area. (Table 2)The highest value of diversity index (H′) was at station 19 (2.44) , follow by station 16 (2.37) and station 12 (2.10) with the lowest at station 8 (0.87). The average evenness index was 0.80 in the investigate area. The highest value of evenness index was at station 22 (0.99) and the lowest at station 14 (0.39). Average family richness showed 11 families in the investigate area. The

highest value of family richness was at station 21 (24 families), while was found with lowest value at station 3 and 13 (3 families)

Table.2 Ecological index of fish larvae

Station	Diversity index	Evenness index	Family richness
ST.01	1.52	0.95	5
ST.02	1.75	0.98	6
ST.03	2.05	0.76	15
ST.04	1.87	0.90	8
ST.05	1.88	0.82	10
ST.06	2.37	0.82	18
ST.08	0.87	0.79	3
ST.09	1.43	0.74	7
ST.10	2.07	0.73	17
ST.11	1.67	0.93	6
ST.12	2.10	0.80	14
ST.13	0.96	0.87	3
ST.14	1.21	0.39	22
ST.15	1.79	0.86	8
ST.16	1.68	0.55	21
ST.17	1.73	0.66	14
ST.18	1.74	0.84	8
ST.19	2.44	0.84	18
ST.20	1.37	0.99	4
ST.21	1.89	0.60	24
ST.22	1.47	0.92	5
ST.23	1.95	0.81	11
Average	1.72	0.80	11

IV. Discussion

This study was the total fish larvae belonging to 43 families observed in Cambodian water. In addition, a comparative analysis of our data with the results of ichthyoplakton surveys carried out in November 20-23, 2005 (Chamchang, 2008) was made. These authors identified 32 families (the density of fish larvae was 0-783 ind./1000m^3), including Gobiidae, Engraulidae and Bothidae was dominant, in the sample collected in Cambodian water. A comparison of ichthyoplankton collected in Chang Island, Trat province; Thailand (Songchisawat, 1989) surveys carried out in January-December 1987,which nearby area Cambodian water showed that Gobiidae, Engraulidae and Bregmacerotidae was dominant. Similar with the study by Termvidchakorn (2016), who surveys in Ao Trat and Chong Chang between March 2014 and January 2015, found that Gobiidae was the dominant family. Gobiidae are distributed widely in the coastal areas regardless of climate and factors such as temperature and biological variables (Ara et al.,2012; Kwak and Klumpp, 2003; Blaber et al.,1997)

This study first report for analysis diversity index and evenness index in Cambodian water. A comparison studies by Termvidchakorn (2016), that nearby area Cambodian water found that the average diversity index was 2.07 (this study was 1.72) and the average evenness index was 0.80 (this study 0.80). Factor that can contributes difference of diversity index and

evenness index are food and availability, predator abundance, larval behavior and physical condition (Leis, 1991). The spatial distribution in species composition and density appear to be considerable for fish larvae communities utilizing Cambodian water, where was coastal area.

Light Fishing Boat Detection by VIIRS Low Light Imaging Data in the Inner Gulf of Thailand from October 2015 to September 2016.

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Abstract

This study aimed to compare the number of light fishing boat, trend of number of light fishing boat and relationship between Radiance of pixel in VIIRS DNB and DNB Spike Median filter Index (DNB SMI) by using VIIRS low light imaging data in the Inner Gulf of Thailand from 1 October 2015 to 30 September 2016 (12 months). The data used were VIIRS Boat Detection (VBD) Data from The Earth Observation Group and NOAA National Geophysical Data Center, Visible Infrared Imaging Radiometer Suite (VIIRS) Data from NOAA Comprehensive Large Array-data Stewardship System (CLASS) and location of light fishing boat (observe fieldwork) from SEAFDEC for analysis. The results showed that accumulate number of light fishing boat in the Inner Gulf of Thailand during study period (12 months) were 16,714 vessels and accumulate average were 1,393 vessels/month. In the closed area of the Inner Gulf of Thailand, during the close season (June to July) the accumulate number of light fishing boat were less than during the open season (August to May). From those results, the dense area of light fishing boat were assumed as the main fishing ground of the Inner Gulf of Thailand. In the main fishing ground, the accumulate number of light fishing boats were 12,126 vessels and accumulate averaged were 1,011 vessels/month. The high density period of light fishing boat were during 16 October till 15 February (Northeast monsoon) and the low density period were during 16 May to 15 October (Southwest monsoon). The trend analysis results of the number of light fishing boat in the two area: 1) inside-outside the closed area of the Inner Gulf of Thailand and 2) inside-outside the main fishing ground area of the Inner Gulf of Thailand showed that both area had high trend in Northeast monsoon period and low trend in Southwest monsoon period. The relationship between Radiance of pixel in VIIRS DNB and DNB Spike Median filter Index (DNB SMI) indicate that Radiance of pixel in VIIRS DNB has a high relationship to DNB SMI which had a positive relationship ($r = 0.73$). But the calculated SMI values of light fishing boat from observe fieldwork from the relationship's equation had all minus values, this may because of the position from observe fieldwork were located in the cloudy area as seen from the VIIRS DNB image. There had the case study which recommend that if SMI value were less than a threshold 0.035 that were identified to be not fishing boat therefore if there were cloudy area in the Inner Gulf of Thailand, there will be possible that the number of light fishing boat were more than 16,714 vessels in this study period.

Keywords: Detection / Light Fishing Boat / Visible Infrared Imaging Radiometer Suite / Closed of the Inner Gulf of Thailand

The Using of Harvest Control Rule, ABC calculation Rule 2, the case study of Swordfish (*Xiphias gladius* Linnaeus, 1758) Catch Data

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Abstract

The Catch data of swordfish from Indian Ocean was provided during the scientific working group on neritic tuna stock assessment in Southeast Asian, SEAFDEC/MFRDMD, Malaysia in 2016, in order to be used as the practice for participants. The result was first analyzed by ASPIC program to calculate the MSY level of swordfish, which given the MSY level was 32,100 MT. The using of Allowable Biological Catch (ABC) Rule 2 concept was given the range of catch quota based on the recently data (3 years data). The result from rule 2 – 1 (the CPUE based analysis) was giving the catch quota range as 23,126.7 MT and 18,501.4 MT as the higher and lower range respectively and current CPUE was about 0.4773 kg/1000 hooks which ABC range of CPUE was between 0.4942 and 0.3952 MT, respectively while the result from rule 2 – 2 (the catch based analysis) was giving the catch quota range as 31,132.3 MT and 24,905.9 MT as the higher and lower range respectively.

Keywords: Swordfish, Harvest Control Rule, ABC Rule 2, Catch Data

I. Introduction

Catch data of Swordfish (*Xiphias gladius*) from longline fishing of Indian Ocean. Provided by Dr. Tsutomu Nishida, National Research Institute of Far Sea Fisheries, Japan. During the scientific working group on neritic tuna stock assessment in Southeast Asian, SEAFDEC/MFRDMD, Malaysia in 2016. This data set was analyzed by ASPIC software and summarized the result by Kobe Plot. Both two programs were using the Maximum Sustainable Yield (MSY) as a reference point which was approved that the results were reliable. However, to handle with the poor data condition of many SEAFDEC member countries. We needed to find the protocol that requiring not so many data as a not so long time series data (data less than 10 years was acceptable) to calculating the fishing quota quantity as a base data before we can be getting enough data and can be do the assessment using MSY as a reference point in many years later.

The rule 2 of Allowable Biological Catch (ABC) was about the data poor condition which can be separated into two types as

1. Rule 2-1) Only CPUE available and
2. Rule 2-2) Only catch available.

However, for both 2-1 and 2-2, their equations having the same based and character which driven by the important parameters as α, γ, δ and CPUE of Catch as these followings (using CPUE).

This study was aimed to simulate the situations that using the result from ABC rule 2 – 1 and 2 – 2 by together with the MSY based method as ASPIC and Kobe plot for a reference point. The result will be help the fishery researchers, DoF staff and other related persons to understand the concept of ABC. Including the possibility to adapt this method for Thai fishery management.

II. Methodology

The former calculation and analysis using ASPIC (Prager, 2004) and ASPIC grid software together with the summary graph from Kobe plot (Nishida *et al*., 2015).

The ABC calculation using the stock abundance index as the reference point. The concept of harvest control rule was raised in 1980 by Tanaka (Tanaka, 1980), the ABC rule 2 have been tested by Hiramatsu (2004) before modified and proposed by Oshimo and Naya (2014) and Ichinokawa *et al.* (2015), respectively, as these followings

<u>Rule 2-1</u>: For CPUE available data

$$ABC_{limit} = \delta \times C_t \times \gamma_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 1)$$

When	δ	=	The limit of ABC $\begin{cases} high = 1 \\ medium = 1 \\ low = 0.8 \end{cases}$
	C_t	=	Catch at last year
	γ_1	=	The constant parameters from equation 1.1

$$\gamma_1 = 1 + \mathrm{k}\left(\frac{b_1}{I_1}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 1.1)$$

When	k	=	Index of sensitivity, Constant, always = 1
	b_1	=	Slope of <u>CPUE</u> data in last 3 years
	I_1	=	Average data of <u>CPUE</u> in last 3 years

<u>Rule 2-2</u>: For Catch available data

$$ABC_{limit} = \delta \times C_t \times \gamma_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 2)$$

When	δ	=	The limit of ABC $\begin{cases} high = 1 \\ medium = 1 \\ low = 0.8 \end{cases}$
	C_t	=	Catch at last year
	γ_2	=	The constant parameters from equation 2.1

$$\gamma_2 = 1 + \mathrm{k}\left(\frac{b_2}{I_2}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 2.1)$$

When	k	=	Index of sensitivity, Constant, always = 1
	b_2	=	Slope of <u>Catch</u> data in last 3 years
	I_2	=	Average data of <u>Catch</u> in last 3 years

III. Results

The result from ASPIC Kobe plot

First of all, the input data were comprised with year, catch, CPUE and effort. Using the ASPIC and ASPIC grid program calculation. We can get the biological parameters of swordfish as shown including MSY, Carrying Capacity of ecosystem (K), Biomass, Fishing Mortality, Catchability Coefficient (q) and intrinsic rate of increasing (r) as shown in table 1

Parameter	Value
MSY	32,100 t
K	158,000 t
Bmsy	58,300 t
B/Bmsy	1.35
Fmsy	0.55
F/Fmsy	0.55
q	5.0E-6
r	0.55

Table 1: Biological parameters of swordfish

The result from Kobe plot have shown that the status of *X. gladius* still in the safe zone in 2008. However, the trend of catch in form of total biomass/ total biomass at MSY stage and Fishing mortality/ Fishing mortality at MSY stage showing the risky trend in 2004. Even though the catch now moving downward from the overfishing zone (orange zone) but there still close to the border zone. So, this case still needed to be observed carefully. Result shown as this following figure

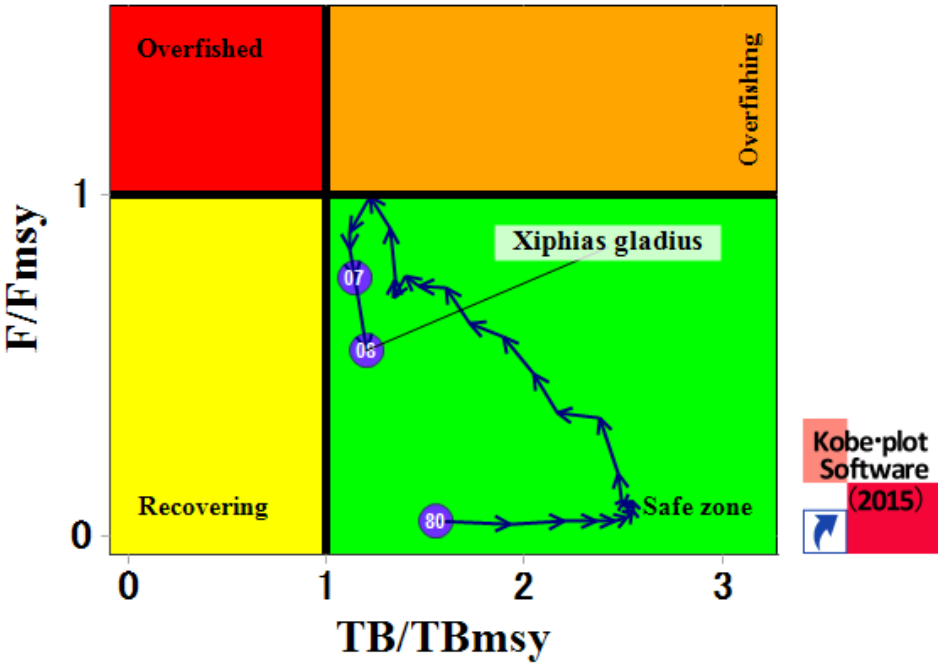

Figure 1: Kobe plot result of Swordfish (*Xiphias gladius*) assessment

For the calculation of ASPIC, the summary graph of catch and MSY level as this following when the blue line is the annual catch (MT) and the orange line is the MSY level which was about 32,100 MT. Comparing with the figure 1, in year 2004 is the peak of this following graph, the catch trends show the over MSY level (37,320 MT) and trend was declining till year 2005. Which the catch in 2005 was nearly to MSY level (32,068 MT) and getting declined. The latest catch in year 2008 was the lowest catch the decade 2010s which catch was about 22,335 MT, nearly to the catch during 1993 – 1994.

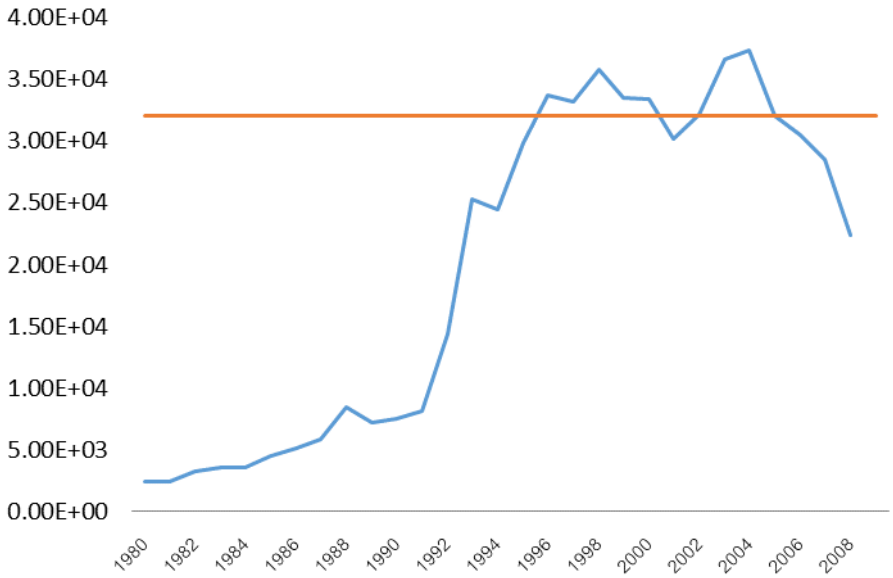

Figure 2: Graph result from ASPIC showing annual catch and MSY level

The result from ABC rule 2 calculation

Meanwhile, the result from ABC calculation, using the same data input as ASPIC and Kobe plot, also showing the interesting result from the same data set. A graph showing the blue line is the annual catch (MT), the orange line is the upper limit (MT) and the grey line is the lower limit (MT). The result was reported in range for easier to managing the catch quota, the result as these followings

- The Rule 2-1

Rule 2-1 is the calculation based on CPUE and latest year catch data which the result will be provided depends on presented fishing situation as shown in figure 3 and 4

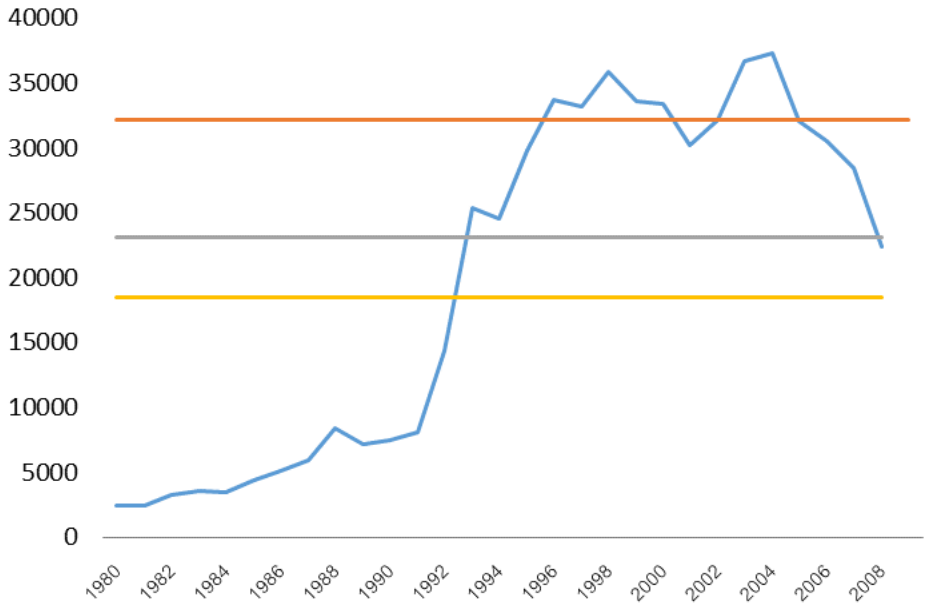

Figure 3: ABC limitation based on CPUE; catch limited, orange line is MSY level, grey line is upper limit of ABC and yellow line is lower limit, respectively.

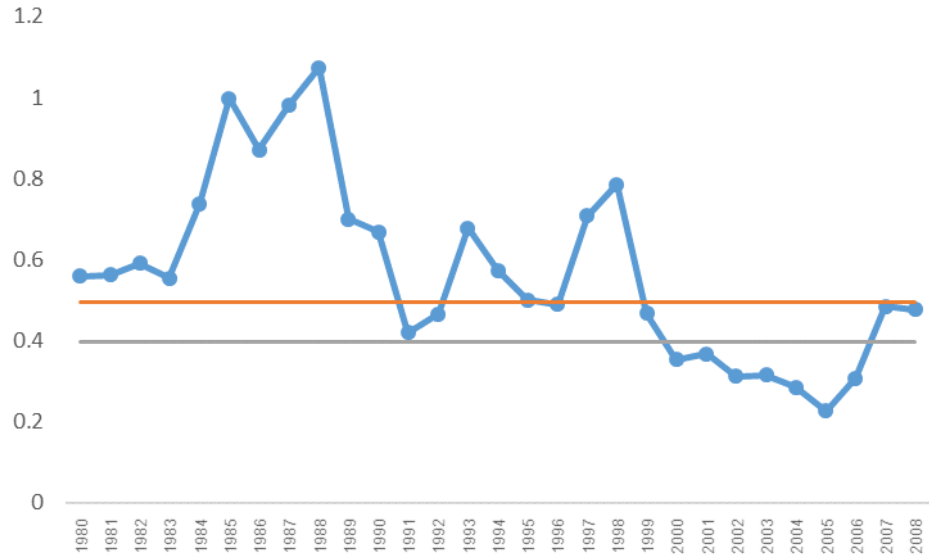

Figure 4: ABC limitation based on CPUE, CPUE limited, orange line is upper limit of and grey line is lower limit, respectively.

The result show that the upper limit of catch was about 23,126.7 MT (orange line) and lower limit (grey line) was about 18,501.4 MT. The goal of 2009 assessment is to control the catch to be not lower than 18,000 MT and not over than 23,130 MT and current CPUE was about 0.4773 kg/1000 hooks which ABC range of CPUE was between 0.4942 and 0.3952, respectively.

- <u>The Rule 2-2</u>

Rule 2-2 is the calculation based on catch in case that CPUE data not available. From the result there are some different characteristic compared with rule 2-1, the result is provided as this figure 5

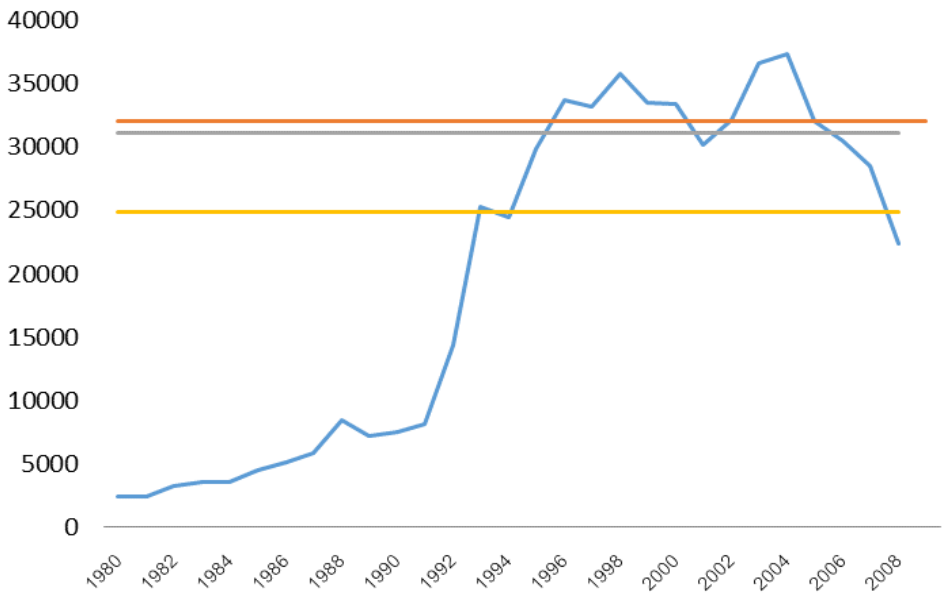

Figure 5: ABC limitation based on catch, orange line is MSY level, grey line is upper limit of ABC and yellow line is lower limit, respectively.

The upper limit of catch (orange line) was about 31,132.3 MT and the lower limit (grey line) was about 24,905.9 MT. So, the goal of year 2009 according to catch based analysis is to control the output (catch) not less than 24,910 MT and not over than 31,130 MT. The summary as shown in table 2.

Reference point	**ASPIC**	**Allowable Biological Catch**	
		Rule 2-1	**Rule 2-2**
Upper limit	32,100 MT	23,126.7 MT	31,132.3 MT
Lower limit	-	18,501.4 MT	24,905.9 MT

Table 2: Summary; the comparison of reference points between each method

ASPIC result show that the ecosystem has enough capacity for 158,000 MT of swordfish. However, the biomass of swordfish now was just about 78,705 MT, which was about 49.8% of full capacity. Considering to the report from Wang and Nishida (2014) the status of swordfish in Indian Ocean, from nine scenarios, now lower than MSY level as well as the spawning biomass also higher than MSY level. But the fishing intensity for current situations may higher than MSY level when lower productivity was assumed for swordfish. This result was in the same way as IUCN red list report (Collete *et al*., 2016) that the current status of swordfish still needed to be carefully managed, even though the status of swordfish fishery in Indian Ocean still not over MSY level yet.

IV. Discussion

From the result of all 3 methods, ASPIC which the input data set was the over 10 years catch and CPUE data. The MSY level from ASPIC having the high amount of catch. Based on the assumption, the highest peak of catch and its ±20% will be used as reference point for long term assessment. Mean while, the both result of ABC rule 2 were based on current catch and its previous 3 years data of both CPUE and Catch based analysis. Which make the result quite specific to the current timeline, means that the ABC range can be changed regarding to the current fishing situations (catch and CPUE). The important point for ABC calculation

were the weight coefficient or index of sensitivity, k. The study of Ohshimo and Naya (2014) indicated that each fish stock in each region will having their own optimum value of k, which the optimum value of k for Japanese stock was 1 and the higher number of k will be led to higher probability of management failure.

From the graphs, even though the ABC based on catch seems to be close to MSY level more than ABC based on CPUE. But, the most important characteristic of ABC is the short-term calculation. Therefore, it can be effected and corresponded to the short time data trends. For this the different trend between CPUE and catch, which those will affecting to the equation in the form of γ from equation 1.1 and 2.1. We can conclude that the limitation of rule 2-1 can be changed in year by year depending on the current 3 years data which will showing the more narrower range than rule 2 – 2. However, regarding to the study of Hiramatsu (2004) show that the rule 2 – 2 have too much uncertainties, the ABC rule 2 – 1 was the better choice.

The further work for the ABC calculation in SEA region is to analyzing and searching for the optimum k and δ value which fit to the regional fish stock, which will be led to the more efficiency TAC management in the future.

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Efficeincy Comparison of Circle Hook versus J-Hook in Pelagic Longline Fishery, Andaman Sea

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Introduction

The FAO Guidelines specified that longline fishery must develop and implement combinations of hook design, type of bait, depth, gear specification, and fishing practices that minimize sea turtle bycatch, incidental catch, and mortality (FAO, 2005). Hook modifications in particular are expected to be one of the most effected tolls in reducing incidental sea turtle mortality.

Take into account on the geo-topographic features in the Southeast Asia waters, about 60% of the sea water areas identify as deep sea where the sea is deeper than 200 m, for examples, in the Andaman Sea, South China Sea, Sulu Sea, Celebes Sea, Eastern Indian Ocean, Banda Sea, Sulawesi Sea., highly migratory species such as tunas, tuna like species, billfishes and others are classified as highly migratory species. It is expected that those large pelagic species existed in the region are still resources. SEAFDEC therefore proposed to conduct the fishing experiment base information collection in many sea areas namely Andaman Sea, the South China Sea and Sulu Sea of member countries' EEZ. A series of field surveys has been carried out accordingly in collaboration with the SEAFDEC member countries using SEAFDEC Research vessel M.V.SEAFDEC and M.V.SEAFDEC2

Materials and Methods

The data is taken from fishing logbook that had been recorded during the cruise surveyed. The survey area was located at Andaman Sea within EEZ of Thai Waters and Myanmar Waters with a depth was varied between 300 and 2700 m (**Fig. 1**). Thirty nine (39) pelagic longline fishing operations were conducted, which were 34 operations from M.V. SEAFDEC 2 (2006-2008) and 5 operations by M.V. SEAFDEC (2010-2011).

The Pelagic longline fishing gear was composed of a nylon monofilament mainline (4.0 mm diameter) and stored in a 2.0 meter winch mainline reel by hydraulic power. Branch lines (2.0 mm nylon monofilament) with a length of 12 m attached to the mainline by stainless steel snap clip. One tuna hook was attached to the branch line by aluminum sleeve at the end. One 40 g lead sinker was attached at 1.5 m above the hook. The distance between each branch line was maintained at 40 m. A PVC float line (300 mm diameter) was attached to a 25 m long nylon rope (5 mm diameter) was further attached to the mainline gear after every 15-20 hooks (which is called one basket). Two types of tuna hook were used **(Fig. 2)**, the stainless steel circle hooks size 14/0 and sun stainless steel tuna hook (J-hook) size 2.8 were set alternated along the longline in order to investigate and compare the efficiency of both types. The number of hooks range from 300 to 620 hooks per operation were deployed. Three species difference of frozen fishes; Round scad (*Decapterus* sp.), Saury fish (*Cololabis* sp.) and Indo-Pacific mackerel (*Rastrelliger brachysoma*) were used for baited. The shooting operation normally was done during the evening hours whereas the hauling was carried out in the next day morning. The emersion time was range for 8.00 to 14.00 hours.

To determine the efficiency of circle hook and J-hook with respect to catch composition and hooking position. At the time of retrieval, the species caught, hook type, and hooking position of all target fishes, as well as by-catch fishes were recorded. The hooking positions were categorized as Upper jaw, lower jaw, and jaw angle were considers as "Mouth". The hooking position inside the moth such as esophageal sphincter, and gill arch were considered as "Internal". All other positions excluding foregoing explanation were considered "Other".

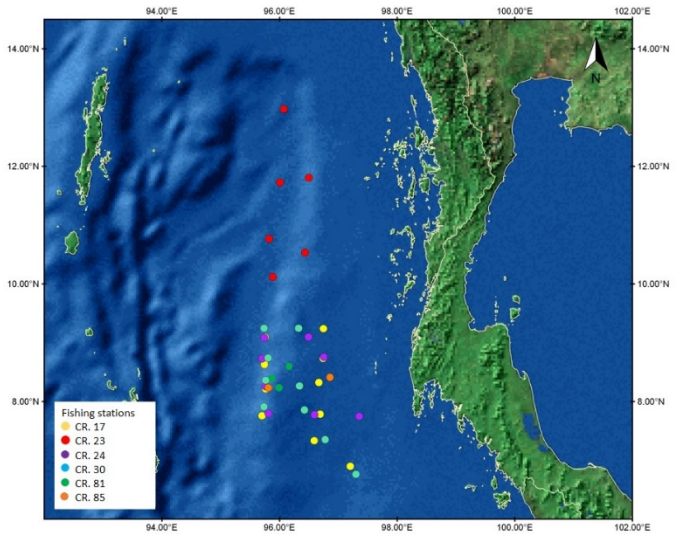

Fig. 1 Study area showing the survey stations of pelagic longline in Andaman Sea

Fig. 2 Photographs of circle and J-hook

Results and Discussion

M.V. SEAFDEC and M.V. SEAFDEC 2 were conducted 39 pelagic longline fishing operations and 20,842 hooks deployed. Hook trails caught 334 fishes representing 30 species, of those, the circle hook caught 205 fishes (28 species) and 129 fishes (14 species) were caught from J-hook. When comparing the target catches between hook types, circle hook were caught 62 (30.24%) whereas for 29 (22.48%) fishes in J-hook. Among the target group, Swordfish (*Xiphias gladius*) were the dominant species caught which high number in circle hook (n=36) than J-hook (n=15) **(Table 1)**. Few significant differences in catch rates of target or by catch species between circle hooks and J-hooks (Kersteter and Graves, 2006). However, the non-target species were caught much higher than target species, which 143 (69.76%) and 100 (77.52%) fishes for circle and J-hooks

respectively. Within this group, Bigeye thresher shark, Pelagic stingray and Snack mackerel were the dominant caught. The results similar to Yokota et al. (2006) and Curran and Bigelow (2011) reported the catchability on large circle hooks (18/0) was maintained target species catches. However, excluding ray species, our result contrary with their reported that large circle hooks reduced for incidental and other by-catch species compared to J-hooks (Curran and Bigelow, 2011).

Table 1 Total number of each species caught in circle hook (C) compared with J-hooks (J), (*) = Target species catches

	Scientific name	**Common name**	**No. caught**	
			C	**J**
Tunas and Billfish	*Thunnus albacares*	Yellowfin tuna*	6	5
	Tetrapturus audux	Striped marlin*	1	0
	Makaira indica	Black marlin*	3	0
	Istiophorus platypterus	Sailfish*	9	7
	Xiphias gladius	Swordfish *	36	15
Shark	*Carcharhinus amblyrhynchos*	Grey reef shark	1	0
	Alopias superciliosus	Bigeye thresher shark	42	20
	Carcharhinus limbatus	Blacktip shark	1	0
	Centrophorus moluccensis	Smallfin gulper shark	6	0
	Carcharhinus sp.	Deep Sea Shark	1	0
	Carcharhinus obscurus	Dusky shark	0	2
	Centrophorus granulosus	Gulper shark	1	0
	Heptranchias perlo	Sharpnose sevengill	4	0
	Carcharhinus longimanus	Oceanic whitetip	1	0
	Alopias pelagicus	Pelagic thresher shark	7	3
	Isurus oxyrinchus	Shortfin mako shark	2	0
	Sphyrna mokarran	Hammerhead shark	1	0
	Galeocerdo cuvier	Tiger shark	1	0
Ray	*Mobula* spp.	Devil ray	0	3
	Dasyatis sp.	Pelagic stingray	9	44
Others	*Sphyraena barracuda*	Great barracuda*	6	2
	Acanthcybium solandri	Wahoo*	1	0
	Alepisaurus ferox	Lancetfish	3	2
	Coryphaenoides sp.	Rattail	5	0
	Gempylus serpen	Snack mackerel	25	20
	Lepidocybium flavobrunneum	Escolar	1	0
	Mola mola	Sunfish	1	0
	Ruvettus pretiosus	Oilfish	1	1
	Lepturacanthus savala	Savalai hairtail	28	5
	Taractichthys steindachneri	Sickle pomfret	2	0
Total			205	129

From total fishes hooked, it was result that 65.66% of fishes caught were hooked in mouth, following 17.77% were found in internal and 16.57% were at other. In comparison, when used the circle hook, 64.22% of fishes caught were hooked in the mouth and only 17.65% were found in the internal. Using J-hook, the majority of hooked were also in the mouth 67.97% and following by 17.19% of internal **(Fig. 3)**.

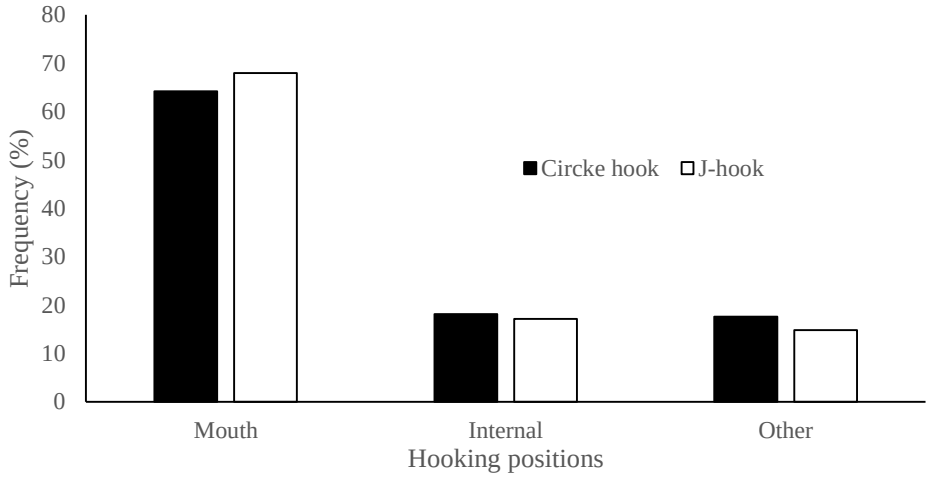

Fig. 3 Frequency histograms of the hooking position for total caught.

Regarding to hooking locations, the used of circle hook shown reduce the number of deep hooked (internal) and increase mouth hooking in some pelagic fish **(Fig. 4)**. For example, Yellowfin tuna were predominant (100%) hooks in the mouth with both hook types. Related to Kersteter and Graves (2006), found that 88% of Yellowfin tuna were hooked in the jaw by circle hooks. The specie of Snake mackerel were hooked at the mouth using circle hooks (80%), as compared with J-hooks (40%). In contrast, this species shown more hooked in the internal with J-hooks (60%), while only 12% were hooked in this location in the circle hooks. Similar to the result of Prince et al. (2002) which clearly indicated that the circle hook can minimize deep hooking for Sailfish in the recreational fishing. The circle hooks are more likely to hook animals external rather than internal (Kersteter and Graves, 2006). However, the result from Ward et al. (2009) indicated that both circle hook and J-hook, mostly, hooked at the mouth position (lip and jaw), with higher frequency than other positions. The large circle hook (size 16/0) may increase the probability of hooks exiting through the eye socket and they suggest that the use of circle hooks will result in lower mortality rate at haulback of target and non-target species (Kersteter and Graves, 2006).

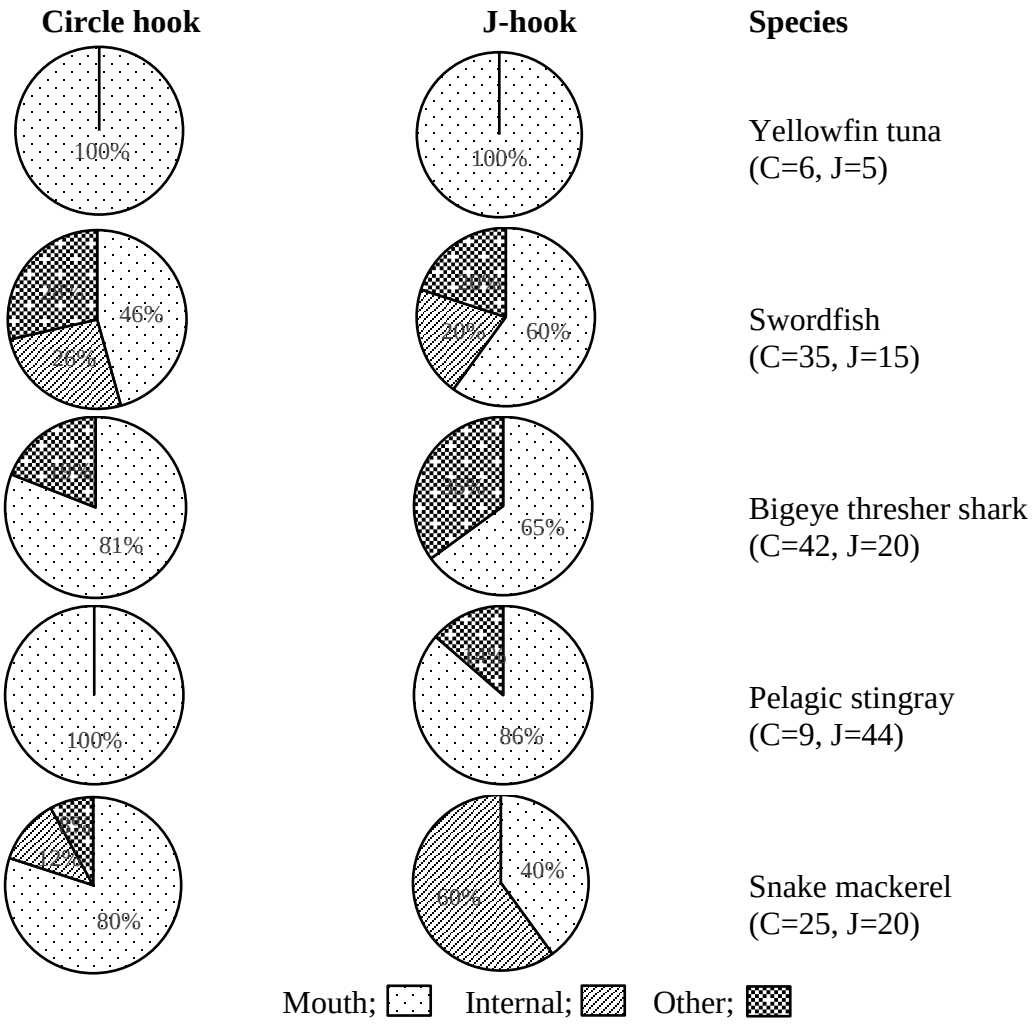

Fig. 4 The percentage of hooking position by species and hook types. The number of observed is indicated for circle hooks ("C") and J-hooks ("J").

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“Research and study on fish passage for improvement of fish migration at cross-river barrier in Thai basin”

Thaweesak Thimkrap

Abstract

Inland fisheries resources in the Southeast Asian Region especially in THAI Basin is important source to deliver food security and income for rural households and also to serve as valuable source of protein. However, inland fisheries are becoming increasingly threatened by riverine development projects. Construction of cross-river obstacles such as dams, weirs, roads, etc. as means as rapid development in response to increasing population and demand for agriculture products, changes in migration of fish. Appropriate mitigation measures to alleviate possible impacts from barrier for migration of fish are therefore necessary.

Fish migrations are undertaken major reasons including spawning, feed and seeking refuge. These migrations are also essential to ensure the dispersal of species and maintain genetic fitness within fish communities. Fish Passages, also as known as fish ladders or fish passage, are structures placed on or around constructed barriers (such as dams or weirs) to give fishes the opportunity to migrate.

Fish passages have been constructed worldwide and have proved to help migration many fishes globally. Nevertheless, in order to assure the effectiveness of the fish passage, it is important that fish passage design criteria are established for local species and conditions of the specific region, and should not adapted from studies to conduct elsewhere.

Each weir or dam on a river that is targeted for Fish Passage construction represents a unique situation. There are many aspects that need to be considered within the design of a Fish Passage, the species diversity and size of the migrating fish community varies from site to site. Fish Passages are designed to cater for the physical characteristics and swimming abilities of the prevailing fish community. Typically, the smaller species of fish are weaker

swimmers and are unable to negotiate the faster flows in a Fish Passage that larger fish can. The hydraulic conditions within a Fish Passage need to provide both enough depth for large fish whilst ensuring the velocity is suitable for smaller fish.

Considerations were raised on specific requirements of different species and stages of fish that should be taken into consideration in designing, construction and operation of fish passage. On the several types and designs both of Close to nature type fish passes and Technical fish passes these types could have advantages and disadvantages over different circumstances, it was noted that particular attention should be given on position of the entrance; while the design of Fish Passage needs to also take into consideration both biological and hydrological aspects in order to provide free passage of fish up- and down-stream. In addition, the specificity of habitats and typical cross-river obstacles in the region, having big differences between upstream and downstream water levels, as well as between rainy and dry seasons, should be carefully considered in designing of fish passage.

Thaweesak T.

Fishery Engineering Section

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IMPROVEMENT OF ENERGY AUDIT DATA AQUISITION FOR REAL-TIME EFFICIENT FUEL MONITORING OF TRAWL FISHING VESSELS

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Abstract

Energy audit was proved as necessary activity to provide for fuel cost saving and decline environmental impact from carbon dioxide released from fishing vessels. Fuel consumption metering system is one important improvement for real-time monitoring on fishing vesseles. Fuel consumption data logger, CKPT-31, support all required parameters to operate fishing vessels at optimum conditions. And also to save fuel by reducing ship speed, this logger can show real-time accurate values of fuel consumption and GPS of fishing vessel that operator can use for making recent proper decision. The other than real-time fuel consumption data logger, water-in-fuel emulsion should be one of solution to decrease fuel cost and air pollution from diesel exhaust gas.

Keywords: Real-time energy audit for Thai trawl fishing vessels, Thai energy audit on trawl fishing vessels

Introduction

Two phases of energy audit project were performed by SEAFDEC/TD between 2013 to 2015 fund by FAO purposed for promoting green house gas emission reduction from Thai bottom trawl fishing vessels distributed in both Gulf of Thailand and Andaman Sea by extracting impact parameters of fuel consumption and finding suitable practical way to reach the purpose.

According to data results collected, in term of economic concerns, even expenditures of trawl fishing vessels composing fuel, labor, provision, ice, maintenance, etc. however fuel is almost main cost of all fishing trips. With this reason, all fishers and owners have to address and manage to get high incomes with less expenditures generated during doing fishing activities at sea.

Due to two different requirements among FAO and fishers/owners of trawlers, fishery engineering of SEAFDEC/TD attempts to find suitable way to implement on green house gas and fuel cost reduction through energy auditing project. This auditing need to extract fuel consumption profile of six representative bottom trawl fishing vessels by applying monitoring system including analog diesel fuel flow meter to measure fuel consumption via time and GPS navigator to track fishing path and ship speed during fishing operation. All measured parameters are displayed on screen of indicating devices and recorded manually onto log sheet that required some time for filling and calculation. These manual data collection and monitoring, it made fishers/owners inconvenience to use and understand real-time fuel consumption state. Not only fishers/owners made difficulty but also reporter need long time in extracting and processing raw data for analysis.

Energy audit development using a new energy monitoring system onboard fishing vessels for fuel consumption data logger should be a suitable solution to contribute user-friendly application and real-time fuel consumption monitoring for fishing vessel operator.

One of fuel consumption data logging system is called "CKPT-31" which support measuring and recording both analog and digital signals of sensors including pulse fuel flow sensor, GPS, analog fuel level sensor, and pulse engine revolution sensor. These signals sent to CKPT-31 logger were calculated and displayed on the screen. Fuel consumption analysis, these data in the logger will be load to PC. With display screen, fishers/owners are able to see

real-time fuel consumption rate of fishing vessel which they can monitor their suitable speed of fishing operation at optimum status.

Even though fishers/owners do not accept to invest on new real-time energy audit equipment but fishery engineering team recommend to use it and expect to save fuel about 10-15 % of their operational cost which breakeven should be not over one years.

MATERIALS AND METHODOLOGIES

Fuel performance indicators

In order to access energy performance of fishing vessels, simple indicator was defined and calculated. Fuel consumption rate for vessel speed in steaming and trawling phase were measured and calculated for evaluating and ranking the energy performance of fishing vessels. These measurements is useful for research purpose and to highlight possible suggestions to further investigate vessels.

Improvement of fuel auditing system

Manual data recording of fuel auditing system applied in the first and second phase of the project. All data values displayed on screen of fuel meter, engine revolution meter, gps navigator, and weather meter were recorded by CCTV system. All values recorded by CCTV were replayed to extract data and write onto log sheet that required for some time. Operators of fishing vessels were unable to understand recent fuel consumption condition because of uncalculated values on display of auditing devices.

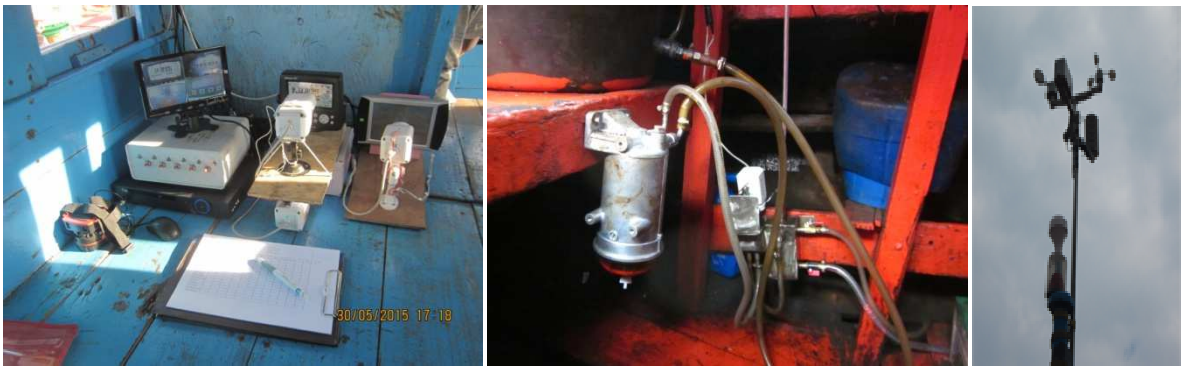


Figure 1 Manual fuel metering system

Fuel data logger receives several signals from GPS antenna for ship position, engine tachometer sensor for engine revolution, fuel flow sensor for fuel consumption of fishing vessel, and these measured values are acquired automatically and displayed real-time values on the screen and recorded into internal memory of CKPT31 shown in Fig. 2. At the end of recording test, these recorded data in CKPT 31 logger was loaded to personal computer through USB cable port for calculation by CKPT manager software that can record and evaluate fuel consumption rate, total fuel consumption, engine revolution, and ship position.

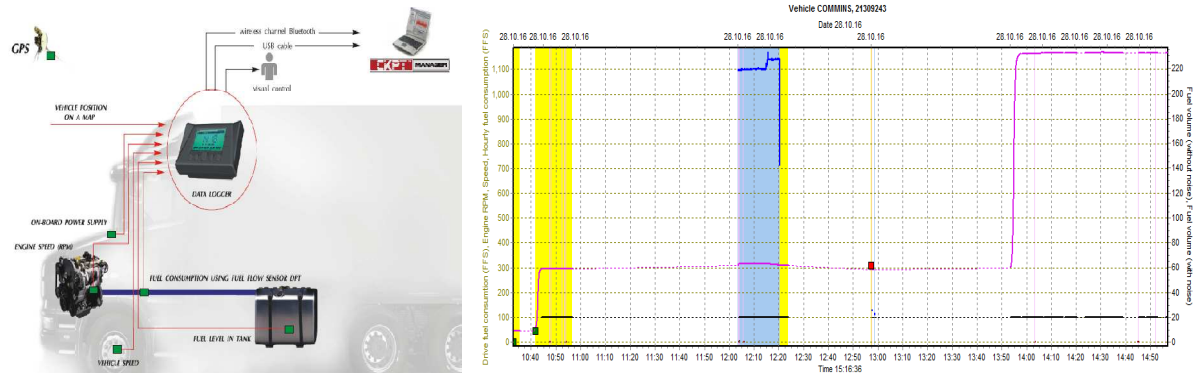
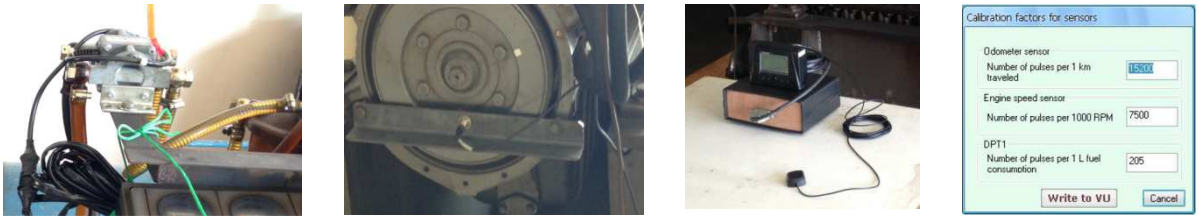


Fig. 2 Diagram of CKPT 31 connected with several sensors including GPS antenna, tachometer sensor, fuel flow DPT sensor. Values table and chart of recorded results were shown and suitable for characterization.

In order to check accuracy of software and hardware, calibration and accuracy of sensors are a process that all measurement devices must be done both before and after attaching different fuel flow and rpm sensors onto engine in Fig. 3, calibration is by varying constant values on CKPT software.



(a) (b) (c) (d)

Fig. 3 (a) different fuel flow sensor, (b) rpm sensor, (c) CKPT monitor with satellite antenna, and (d) calibration constant of sensors

New system of fuel consumption data logger uses different fuel flow sensor which will measure differential fuel consumption among inlet line before entering fuel pump and return line after diesel injector. This difference fuel flow sensor will accurately calculate fuel consumed during combustion. The other parameters that required to measure performance of fishing vessels is shaft rotational speed measured with an optical proximity sensor attached in front of diesel engine Fig. 3 (b). CKPT-31 logger with screen Fig. 3 (c) receives sensor signals and calculate with internal electronic module and show these measured values such total fuel consumption, fuel consumption per hour, GPS position and engine rpm. Operator is easy to observe real-time operation of ship and engine.

RESULTS

Discussion on new fuel data logger

From result measured in the previous phase, the below data extracted from GPS navigator one trip of Wor yingcharoen (Fig. 4), however, other data as fuel consumption, distance were recorded manually at some time. All most fuel consumption data are presented in term of total fuel consumption which is not continuous values, however, total fuel consumption was calculated and brought to estimated fuel consumption of each trawler (Fig. 5).

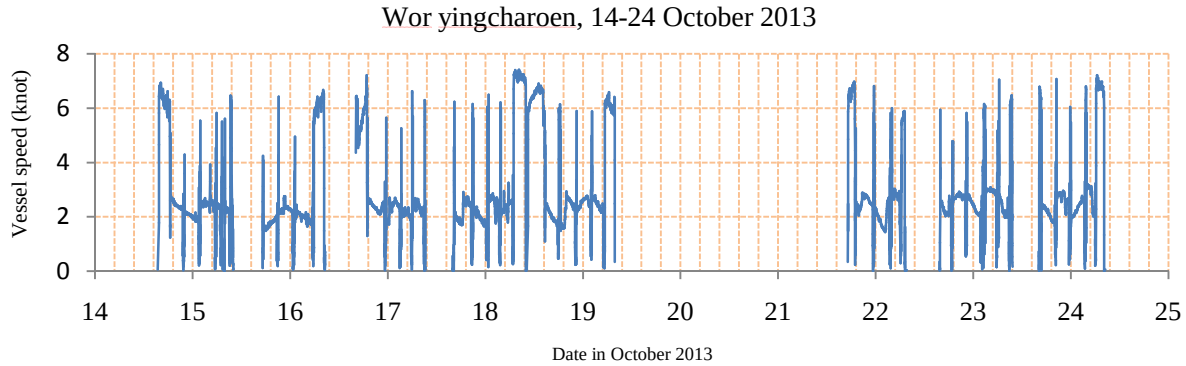


Fig. 4 Shipspeed profiel of Wor yingcharoen having fishing ground in Chaonburi

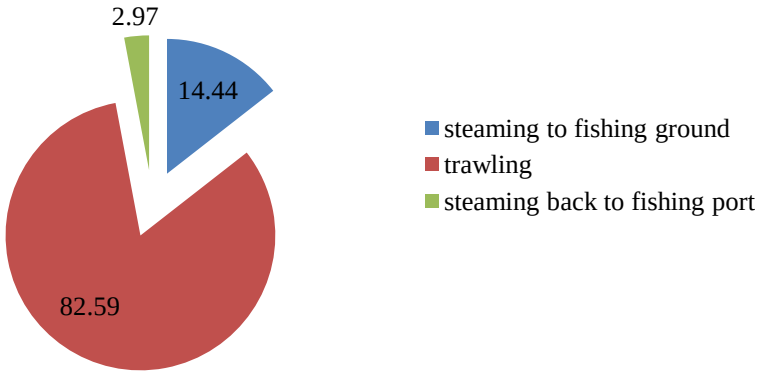


Fig. 5 One trip total fuel consumption percentage of Chokpanthawee small bottom trawl fishing vessel

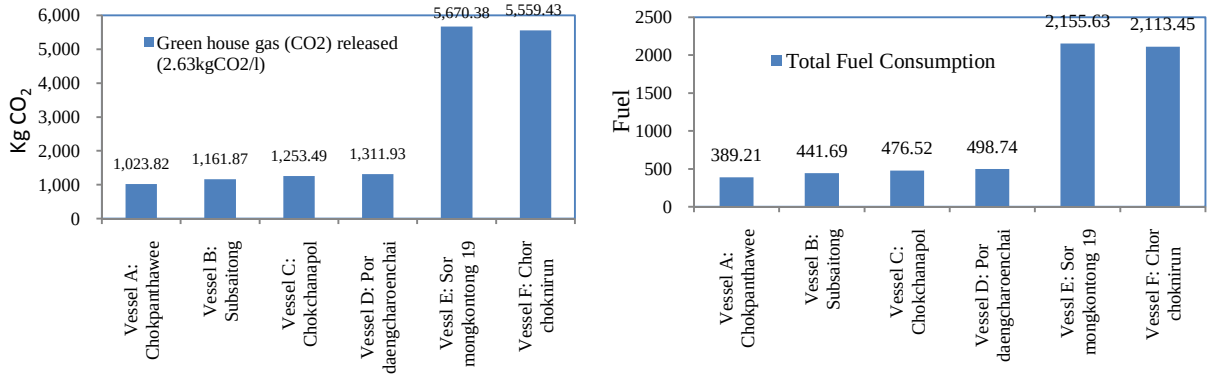
Practical test on engine test base at fishery engineering workshop, the electronic recording system can measure and collect values of fuel consumption rate, total fuel consumption, GPS position and speed, and these results will be displayed on CKPT-31 monitor. These recorded value data can be downloaded from the data logger and transferred to pc through USB cable. With supporting function of CKPT-31, fishers can see real-time fuel consumption condition and ship speed of fishing vessel at recent operation. This function of real-time measurement is possible to contribute fisher/skipper to manipulate optimum speed of fishing vessel at proper condition following specific fuel consumption profile of each fishing vessel which is achieved under standard sea trail test. It is one technique to minimize fuel cost of doing business of the owner and to reduce carbon dioxide emission from combusting diesel fuel.

Discussion on impact parameters to fuel consumption of trawlers [1]

According to auditing fuel consumption of Thai bottom trawler in the first and second phase, each Thai bottom trawl has their specific fuel consumption due to distinguish of ship and engine characteristics, and location of fishing grounds. Almost fuel consumption of Thai bottom trawlers is in trawling period because water resistance and drag force resistance occurring on trawl net are main impact parameters during trawling period. One case study of Wor yingcharoen, high fuel consumption observed from reducing of ship speed on speed-time chart (Fig. 4). But the average trawling speed of Wor yingcharoen is about 2.3 knots. Sometime ship speed in trawling period is surged up. It is possible because of obstruction of trawl net with an object on sea surface. Sea surface property is one of impact parameter to fuel consumption that should be considered as well.

Discussion on evaluation of carbon emission from previous energy audit results:

Carbon dioxide emission from these trawlers was calculated from fuel consumption through complete combustion of diesel fuel. A constant of 2.63 kg CO_2 per liter of diesel oil is for converting diesel oil consumption to kilogram carbon dioxide released. Total fuel consumptions of fishing vessels are varied depending on engine house power, efficiency of engine, service displacement, fishing operation trip, sea condition, fishing ground, and etc. It is impossible to compare among a group of fishing vessel because of distinguish of ship and equipment characteristics even doing the same fishing condition.

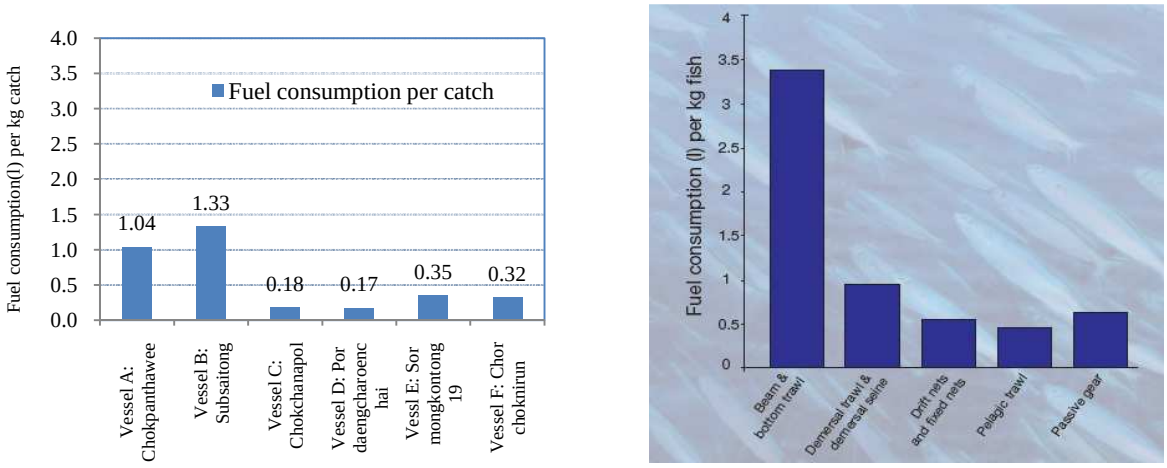


(a) kg CO_2 emission (b) total fuel consumption, liter

Fig. 6 Kilogram CO_2 emission calculated through complete burning of fossil fuel

Discussion on average fuel consumption per kilo catch for difference fishing vessels

One indicator to present current situation of carbon dioxide emission of Thai trawl fishing vessels is average fuel consumption per kilogram of catch. One report from North sea foundation presented in Fig. 7 (b), Beam and bottom trawl in EU produce about 3.4 liter fuel per kg fish which is about nearly three time of Chokpanthawee that generate 1.04 liter diesel per kg catch.



(a) (b) Source: North sea foundation

Fig. 7 Average fuel consumption per kilo catch for difference fishing vessels (a) in Thailand (b) in EU

From previous discussion of carbon dioxide emission, a fishing vessel has more fuel consumption more carbon dioxide released. Thus, based on this criteria, Thai bottom trawl emit less carbon emission than EU bottom trawl.

Discussion on fuel saving by reducing ship speed [2]

Several modifications and readjustments should be considered for fuel optimization. Ship speed reduction is a simple way that various fuel saving document introduce to do because of without any investment cost. After sea trial test to identify fuel consumption profile of investigated trawlers, blow two charts present (Fig. 8) the results of Chokpanthawee and Chokchanapol trawlers. During trawling with trawl net in water, reducing one ship speed one knot contribute to drop fuel consumption 44 % and 55 % or Chokpanthawee and Chokchanpol, respectively.

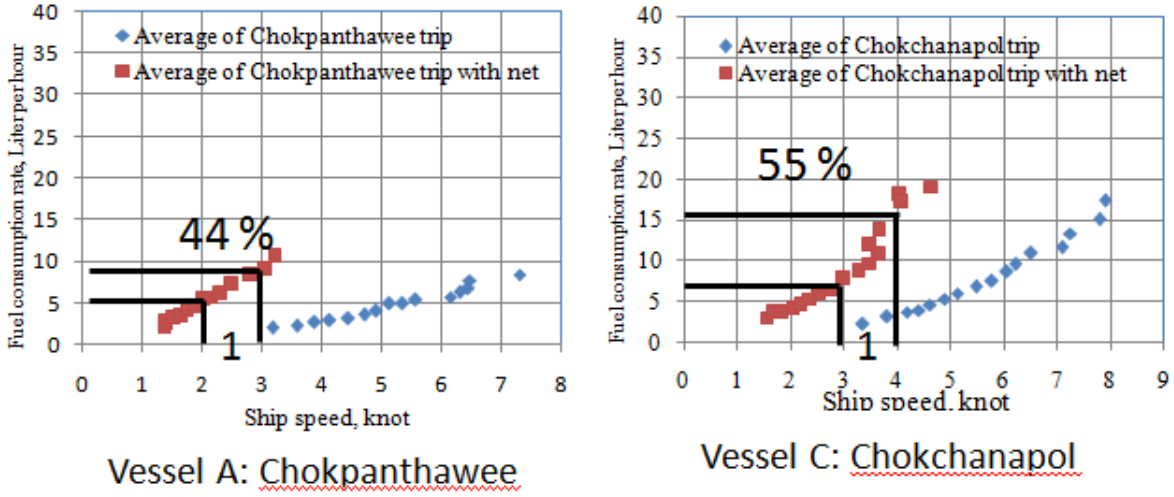


Fig. 8 fuel consumption via ship speed of two trawlers

However, ship speed reduction should be under operator consideration based on practical condition of fishing gear such as forming shape and floating of trawl net. During trawling net, fuel consumption rate of both trawler is sharp raise up because of water resistance force increase power two of net speed. In order to minimize net resistance force, suitable net speed should be tested. Using optimum net speed can drop high rate of fuel consumption rate.

Discussion on using diesel-water micro emulsion to drop both fuel consumption and carbon emission from diesel engine

A new technology of water-in-fuel emulsion, some work call green emulsion fuel [3] or Sosei Water Fuel [4], purpose for saving fuel cost by 40 % and reducing CO_2 and NO_x emission by 50-80% released from diesel engine . This technology can be found in marine cargo industry which should be suitable adapted system for Southeast Asian fishing fleet industry. One practical application on Malaysian fishing vessel in Khuantan, Pahan was done by running SWF for ten day without any engine troublesome and decreased 40 % diesel fuel consumption [4]. The other several works reported that they can mix water 5 to 30 % with fuel with maintaining diesel engine efficiency and drop pollutant of emission.

CONCLUSION

Development of energy audit for Thai bottom trawls for fuel saving and carbon emission reduction must be introduced to local fishers to understand. New improvement of fuel data logger has main purpose for user-friendly and real-time monitoring by fishers/skippers to enhance optimum fuel use of trawl fishing vessels. Utilizing real-time ship and engine monitoring system with energy audit process will save fuel consumption which drop carbon dioxide as well. Not only fuel consumption data logger is interested in, but also water-in-fuel emulsion is one technology to enhance engine efficiency, reduce both fuel cost

and carbon dioxide emission. Some document address this emulsion help to drop 40% fuel cost and 50-80 % of CO_2 and NO_x. This emulsion should be a parallel application technology in energy audit topic for trawl fishing vessel to raise up awareness of fishers to their life and environment.

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Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia

Kongpathai Saraphaivanich, Yanida Suthipol, Namfon Imsamrarn

I. Introduction

Refers to the adopted the International Plan of Action to prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU) in 2001, in which the requirement for port State measure are included. FAO has worked on the PSM to combat Illegal, Unreported and Unregulated Fishing including identified the need for human resources development to implement port State measures while developed as minimum standards - a "FAO Voluntary Model Scheme on Port State Measures" to combat Illegal, Unreported and Unregulated Fishing in 2004. Later, the FAO Conference adopted resolution 12/2009 approving the FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, as a legally binding instrument in 2009. The Objective of the PSM Agreement is to "prevent illegally caught fish from entering international markets through ports". Port State needs to take the actions on restriction of entry into port, use of port, access to port services, in addition the inspection and other enforcement activities are also mentioned in the agreement. Taking into account the important of seafood products from Southeast Asian to around the world market, trade in and out are ones of the important activities. To avoid any impact on trade as well as preventing the entry of IUU fish and fishery products either from international or intra-regional trade, the implementation of port State measures are therefore needed taking into accounts other existing regional management tools developed under the ASEAN-SEAFDEC Collaborative Framework such as ASEAN Catch Documentations, RFVR-24m, ASEAN Guidelines to prevent the entry of IUU products into the supply chain, and etc.

II. Activities

According to above mention, the SEAFDEC Training Department has been implemented PSM activities under the project of "Promotion of countermeasures to reduce IUU fishing" with supported by JTF in collaboration with the SEAFDEC Secretariat. The activities are as follows;

- *The Experts Group Meeting on Port State Measures in Southeast Asia*

The Experts Group Meeting on Port State Measures (PSM) in Southeast Asia was organized from 12 to 14 November 2012 in Bangkok, Thailand. The outputs of the meeting are regional common issues/ constraints and recommendations for implement PSM activities in the region as follows; implementing the PSM Agreement, existing legislations and legal framework, ratification and accession, working model for ports using PSM, multiple jurisdictions by multiple agencies involved in PSM, Catch Documents Scheme (CDS) and Catch Certification and etc.

- *The Experts Meeting on Regional Cooperation to Support the Implementation of Port State Measures in Southeast Asian Region*

The Experts Meeting on Regional Cooperation to Support the Implementation of Port State Measures in Southeast Asian Region was organized from 2 to 4 February 2016 in Bangkok, Thailand. The Meeting came up with 1) Identified issues for harmonization to support the

implementation of PSM in the region 2) Module of capacity building to support PSM implementation in the region, and 3) Concept proposal on regional cooperation to support the implementation of Port State Measures to be addressed at the Council and high-level under the ASEAN mechanism.

At the 48th Meeting of SEAFDEC Council in April 2016, the Concept Proposal on Regional Cooperation for Supporting the Implementation of Port State Measures in ASEAN Region as well as its work plan was addressed for consideration, comments and support. The council suggested to harmonize and integrate with the RFVR Database. The council identified four main aspects that should be considered during the implementation of PSM, these include: 1) denying entry of IUU vessels into AMS's ports based on an integrated vessel database; 2) identification of designated ports; 3) prior notification of vessels entering into the countries' ports; and 4) capacity building for inspectors. In addition, the council also requested SEAFDEC to raise the profile of PSM and its implementation, especially to the higher authorities of the ASEAN and to push toward the process of PSMA ratification and implementation.

- *The Workshop on Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia*

Response to the 48th Meeting of SEAFDEC Council, SEAFDEC in collaboration with Department of Fisheries/ Thailand with the supported by Japanese Trust Fund, Sweden Government, FAO, USAID/RDMA, and Marino-Forum21 organized the Workshop on Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia on 7-10 November 2016. The Workshop came up with: 1) updating of understanding on the implications to the region of the entry into force of the Port State Measures Agreement (PSMA); 2) updating of identification of issues in the PSMA for the region; 3) updating of status, constraints, problem on PSM implementation in the region; 4) list of capacity building needs to support PSM implementation in the region; and 5) SEAFDEC work plan on steps ahead to facilitate implementation of PSM in the region.

III. Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia

Refers to the PSMA		**Recommendations of Regional Cooperation on PSM implementation**	
PART	**Article No.**		**Actions and Needs**
Entry Into Port	Article 7: Designated port	❖ Encourage AMS to identify designated ports for foreign fishing vessel and encourage not to allow foreign fishing vessel to unload fish and fishery products in non-designated ports.	1. AMS to share the Information on ports to be shared with FAO, SEAFDEC 2. For those without designate port, need to know criteria, identification and analysis for designate port 3. Guidance for port designation include procedure, dissemination information and *etc*.
		❖ The list of designed ports should include information of the name of the port,	❖ SEAFDEC shall publicize the information of AMS's designated ports.

Refers to the PSMA		Recommendations of Regional Cooperation on PSM implementation	
PART	**Article No.**		**Actions and Needs**
		address of location, contact person and his/her designation as well as official website in English version.	
	Article 8: Advance request for port entry	❖ AMS shall require, as a minimum standard, the information requested in **Annex A**[1] or relevant document to be adopted by AMS[2] to be provided before granting entry to a vessel to its port.	❖ The Member Countries should provide information on RFVR to SEAFDEC as a tool to support the implementation of PSM in 24 meters and over and also below 24 meters as plan in the future ❖ Expansion of existing RFVR to support the Annex A1 includes history of compliance. ❖ The RFVR should include the vessel less than 24 meters, especially those that use foreign port, but not artisanal vessels: (considering the near-real time updating of the existing RFVR)
	Article 9: Port entry, authorization or denial	❖ Information exchange on the country laws and regulations shall be shared among the AMS taking into accounts that some AMSs (*e.g.* Malaysia and Indonesia) do not allow its fishing vessel excluding carriers to unload catch at other country ports.	❖ Regional workshop to share and discuss laws and regulation ❖ Develop the regional database/website system to share legal /regulations of all AMS (in English) ❖ Encourage to use the existing Port lex (FAO database), SEAFDEC website and RPOA-IUU website for sharing law and regulations ❖ Translate National Law and Regulation into English for wide audience, the resources and support can request to FAO
		❖ To encourage AMS to require foreign fishing vessels and carriers to submit pre-arrival information (such as approval to land catch, origin of catch or certificate of catch) so that port State can decide whether to authorize or deny the entry of this vessel into their port.	❖ Regional Training on PSM implementation for BN, CM, VN to understand the process of PSM ❖ Develop Minimum Standard of Pre-Arrival information (e.g. ACDS) ❖ In case of transmitted or deny the vessels, the communicating the results of port entry should be shared among coastal states

1 Refers to ANNEX 1 of the 2009 Agreement of the port State measures

2 SEAFDEC to provide a simplified document for small fishing vessel for adoption by AMS

Refers to the PSMA		Recommendations of Regional Cooperation on PSM implementation	
PART	**Article No.**		**Actions and Needs**
		Decision to deny shall be communicated to the flag state	and flag states and regional organizations such as FAO, SEAFDEC and RPOA-IUU ❖ Discussion on black list
		❖ To provide the awareness building to relevant stakeholders (e.g. fishing boat owner, importer, port authority, etc.) at national level to enhance the better understanding the country laws and regulations, and other procedure on Inspections.	❖ Develop Training of Trainers Workshops (train to how to, target stakeholders, etc) multi-media (posters, IEC) and apply to local contexts. ❖ Create Communication Strategy and roadmap such as development of PSM webpage contains country profile, law and regulation, FAO Materials and lessons) ❖ Training on PSM implementation for general audience, fishery manger, fishery policy, and inspector
Inspections and Follow-Up Action	Article 12: Levels and priorities for inspection	❖ Adopt the Standard Operating Procedures (SOP) on the risk assessment and inspection of vessels through the harmonization/ consultation workshop.	❖ Regional workshop on development SOP for risk assessment and inspection of vessel in collaboration with relevant Partners: (focus the target group from port managers, operational level, inspectors, technical level) ❖ Prior the development of SOP, Countries should prepare vessel information for the development of SOP on Risk Assessment
		❖ AMS may consider minimum levels for inspection of vessels through, as appropriate, agreement among all AMSs. ❖ To support inspection of the vessels, the historical data/information of vessel are required in the database module of vessels.	❖ Promote the Use RFVR, e-ACDS ❖ Create Application of RFVR-database system for field work.
	Article 15: Transmittal of inspection results	❖ AMS shall transmit the results of each inspection to the flag State of the inspected vessel ❖ AMS shall submit SEAFDEC the total	❖ In case of transmit ion or deny the vessel, the communicating the results of port entry should be shared among coastal states and flag states, FAO,SEAFDEC and RPOA-IUU

Refers to the PSMA		Recommendations of Regional Cooperation on PSM implementation	
PART	**Article No.**		**Actions and Needs**
		number of inspection annually. ❖ When AMS flagged vessel has been denied entry, denied the use of port or denied the landing of fish, the port State needs to share the summary report of inspection to SEAFDEC.	❖ SEAFDEC to facilitate regional center for sharing of the data for ASEAN region.
	Article 16: Electronic exchange of information	❖ To facilitate implementation of this Regional Cooperation, each AMS, where possible, establish a communication mechanism that allows for direct electronic exchange of information, with due regard to appropriate confidentiality requirements. In addition, AMS should cooperate to establish an information-sharing mechanism by SEAFDEC to facilitate the exchange of information with existing database for this cooperation.	❖ Development of the PSM website /database system to support the Regional center for sharing of the data for all ASEAN Member States. ❖ Development two-ways and effective communication ❖ Create the networks on PSMA across different levels (high level and working level) through Email group, Social media, Whatapp, etc.
	Article 17: Training of inspectors	❖ Request FAO, RFMOs, ASEAN, SEAFDEC and relevant agencies on training of trainer for port inspections including legal and operational aspects with an emphasis on practical hands-on component ❖ Develop a network/team among AMSs on training of trainer for port inspections ❖ Consider an existing training module developed by RPOA-IUU in collaboration with the Australian Maritime on port inspections to support the TOT programs.	❖ TOT for inspector to support PSM implementation and development of network ❖ SEAFDEC, FAO and partner should facilitate and support model port as a training site ❖ Establishment on network of inspectors ❖ Making a main standard for inspectors in the region ❖ Regional guideline for port inspection

Refers to the PSMA		Recommendations of Regional Cooperation on PSM implementation	
PART	**Article No.**		**Actions and Needs**
	Article 18: Port State actions following inspection		❖ Sharing information to relevant organization ❖ Develop Guidelines and Inspection Manual (how to do, what to do after inspection retained it) with the support from FAO.

IV. SEAFDEC/TD activities plan to support PSM implementation in the region

Activity	Year/period
Technical workshop for the SOP on vessel inspection at port and information sharing for database system	2017 (February)
The Regional Training on PSM implementation in Southeast Asia for ***fishery manager***	2017 (May)
On-site Training on PSM implementation in Member Countries for ***inspector*** *(3 countries)*	2018
On-site Training on PSM implementation in Member Countries for ***inspector*** *(2 countries)*	2019

Electronic ASEAN Catch Documentation Scheme (e-ACDS) as a Tool to Prevent the Entry of IUU Fish and Fishery Products into the Supply Chains

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Executive Summary

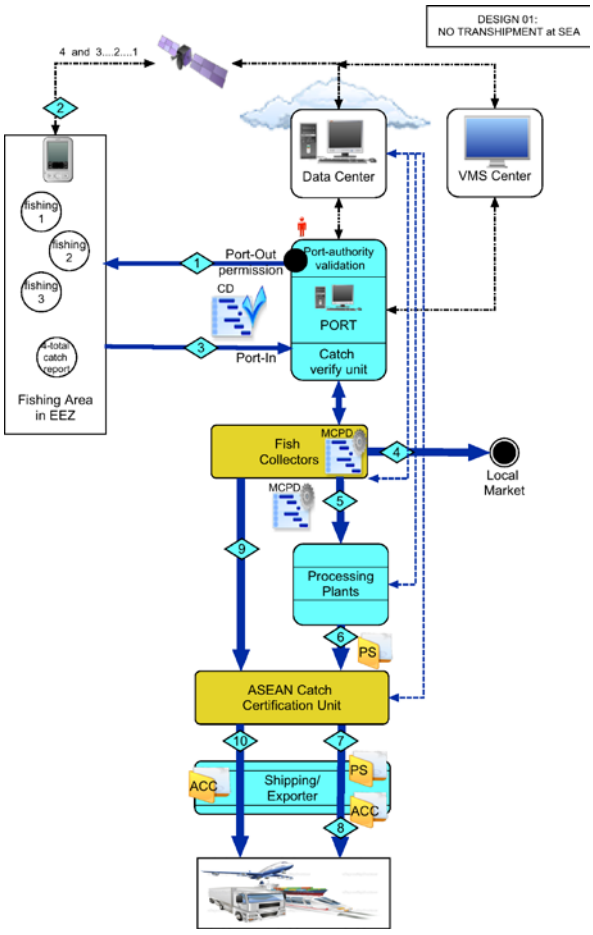
Market driven measures on trading of fish and fishery products has impacted not only to the exporting but also to the importing countries particularly on how to ensure that fishes and fishery products are not come from the IUU fishing activities. Accordingly, many Regional Fisheries Management Organizations have worked toward the introduction of Catch Documentation Schemes (CDS) since the past decade. In addition, EU proposed the implementation of the European Commission Regulation 1005/2008 by countries that exporting their products to the EU but also to some countries that do not export their fish directly to the EU since 2010 which aims to improve the traceability system for capture fisheries and combating IUU fishing. Taking the opportunity from its impacts on ASEAN sustainable fisheries as well as enhancing the intra-regional and international trade of fish and fishery products in long-term, SEAFDEC Member Countries, therefore expressed their support on improvement of the traceability for capture fisheries toward the development of common regional catch documentation scheme/system herein after called "ASEAN Catch Documentation System/Scheme (ACDS) for Marine Capture Fisheries to ensure the sustainability of fisheries for food security toward 2020 within the ASEAN Region.

A concept of the ACDS was discussed and drafted by small group of experts from some SEAFDEC Member Countries on 14-16 October 2014, before consulting with all SEAFDEC Member Countries in December of 2014, and May 2015. The final draft of ACDS concept including the Info-graphic on usages of ACDS in various scenarios catch flows of fish and fishery products into the ASEAN Region are therefore developed for consideration at 48th Meeting of the Council (48CM) in April 2016 and for pilot testing in AMS. The main objectives of ACDS are: 1) provide unified framework that will enhance traceability of fish and fishery products for effective management, 2) enhance the credibility of fish and fishery products for intra-regional and international trade, and 3) prevent entry of fish and fishery products from IUU fishing activities into the supply chains. Moreover, many stakeholders also appealed their concerns at the SEAFDEC Stakeholders Consultation in March 2016 on requirement of the electronic system for ASEAN Catch Documentation Scheme (e-ACDS) which would support the implementation of ACDS and enhance acceptability of ACDS by major importing markets.

The electronic system for ASEAN Catch Documentation Scheme (e-ACDS) has being developed by SEAFDEC in collaboration with the Fish Marketing Organization (FMO) of Thailand who have experiences on development of the electronic system for Movement Catch Purchasing Document (MPCD). Taking into consideration the suggestions made by 48CM on the format, standard and information requirements should be aligned with the importing countries requirements, but maybe simplified for small-scale fisheries in the ASEAN region that enhance its applicability to access the intra-regional and international market. The e-ACDS is integrated the lessons learnt on existing CDSs from the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), Swedish Agency for Marine and Water Management (SwAM/Sweden), the Ministry of Marine Affairs and Fisheries (MAFF/Indonesia) and Department of Fisheries (DOF/Thailand). The e-CDS

consists of 3 main documents namely Catch Declaration (CD), Movement Catch Purchasing Document (MCPD), ASEAN Catch Certification (ACC). Figure 1 shows the flow-chart of the e-ACDS. The system is a Web-based application, run on any computer system and tablet for those fishing vessels that could access to internet via any mode of communication system at sea or land. For those vessels that do not access internet, the initiated Catch Declaration document will be provided before departure to the sea.

The e-ACDS is designed not to link directly with the Vessel Monitoring System (VMS) in case of some country have VMS in place. However, the inspector at field or at the landing site could able to check or monitor the fishing vessel via the existing VMS. But in case the country do not have VMS, validation of vessel location could be cross-checked from Logbook at the landing site. Port-in and port-out validation by port authority are one of the important steps for implementation of the e-ACDS. Meaning that all fishing vessel is required approval from port Authority before going out for fishing. At Sea, fishing master must report their catch amount and species via internet application every time after fishing operation. All catch report will be recorded in the data center, where authorized inspector could access and monitor any time together with VMS tracking information. But in case, fishing vessel do not access internet application, the fishing master must report using the Catch Declaration (CD) form received from port authority before leaving for fishing.



At the port, the CD form particularly fish in quantity by species will be verified and approved. For auction or selling, the MCPD will be created but always refers to the CD unique number. The country need to set up the competent authority to provide the Catch Certification, for fish and /or fishery products for exporting to international market or within ASEAN region. With the purpose of increase effectiveness of e-ACDS, the system requires database of basic information such as list of fishing vessels, fishing master/owners, processing plants, importers/exporters, etc.

The e-ACDS is one of the effective management tools to support the government officer/inspector by preventing the entry of fish and fishery products from IUU fishing activities into the supply chains. The e-ACDS could also enhance the intra-regional and international trade taking into consideration the high demand of non-IUU fish and fishery product by consumers, and importing countries. The e-ACDS is designed to match the requirement of all ASEAN Member States, the system is not created unnecessary burden, cost or lengthy process for importers/exporters. In addition, the AMS can implement via their own server or cloud without any security risk.

Training as a Tool for Human Resource Development (HRD)

Krit Phusirimongkol

I. Introduction

Training is a process that applies different methods to strengthen employees' knowledge and skill needed to perform their job effectively. It means that organizations whether private sector or public sector are generally agree that training and development is very critical to the growth and development of the core activities in which the organizations engages in. However, the organizations are unwilling to invest in training program that has not been sufficiently evaluated in terms of its potential contribution to the organizational strategic goals and mission, and its effectiveness and uses on job to achieve the desired objectives. The solution is the evaluation of training effectiveness that is the measurement of improvement in the employee's knowledge, skill and behavioral pattern within the organization as a result of training program. This measurement help to match the cost incurred in the design and implementation of training with the associated benefits. Thus, it indicates whether the program has been able to deliver its intended goals and objectives. The purpose of this paper is to review the model of training effectiveness for the adoption by the human resources development executives in their planning, designing and implementation training program.

II. Literature Review

There are several model and format developed for measuring HRD and training effectiveness, the most accepted model is that developed by Kirkpatrick. He suggested that there are four areas that required measurement, when analyzing the effectiveness of training program-that is emotional reaction, achievement of objectives, behavioral changes and organizational impact.

Emotional reaction refers to the attitudes of participants at the end of training. An employee who has considerably gained skill and knowledge from the training will be willing to apply it on job, thus bring positive reaction. This could be a barometer for measuring employee's general attitude, expectations and motivation. The measurement is useful in fostering management supports for the training program.

Achieving learning objectives is the second area of measurement, achieving learning objectives is a type of post training evaluation of knowledge and skill gained through the training intervention and which will ultimately translate to improving job performance. A positive emotional reaction and increase practical skill and knowledge of functional concept are indication of successful training and a requirement for meaningful HRD program.

Behavioral Changes is the third approach to measuring the effectiveness of training focused on the training behavioral changes. The third level of evaluation is about work – related behavioral changes which reflects in performance. This entails studying the changes in employees work related behaviors as a result of training While emotional reaction and knowledge gain can be easily accomplished immediately after training sessions, measuring behavioral changes requires some time lag foe employee to fully implement the newly acquired skill and knowledge.

Impact on Organization is the fourth approach area in Kirkpatrick model revolves around the impact of training and development on the organization. The measurement is

based on the notion that training and human resources development must reflect the organizational culture and strategy. A training program is judge successful only if the training outcome aligned closely with the organization's goals.

III. Conclusion

HRD is one of the most essential part of the organization its one effective function is training as we already know and do a lot of training. We realize that the training process is, and the most important process is the evaluation which presenting the model of Kirkpatrick. So that Training and Extension section under SEAFDEC Training Department try to develop the activities or process of the training for example using the pre-post assessment, daily monitoring, mood meter, energizer and etc. making the training effective and also update the technic and information to make it better as much as we can.

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Training to Do in Preparing Training Courses

Kanokwan Thobphuk, SEAFDEC/TD

I. Introduction

Human resource development is essential and necessary to other agencies and organizations as well. The organization will successful if there are personnel who are qualified and available to perform this task. It is essential that the agency will need to focus on human resource development or knowledge management. It is necessary to be developed in order to development organization and steps to excellence.

II. Activities

The good and effective training / seminar require the implementation plan to know which tasks need to be performed before or after. To perform the job done well, those responsible must have clear understood the procedure to conduct training / seminars. This step in the process of organizing workshops / seminars can be divided into three phases follow as

- Pre-course preparation

- During-course preparation

- After-course preparation

Pre-course preparation

The success of the training is depends on good preparation. In the process of preparation of the activities to be carried out as follows

Planning and logistics

As soon as course dates have been agreed and a venue has been arranged, course organizers need to designate a small support team which assists with the planning, organizing and actual day-to-day logistics of the course. Such an administrative team is of vital importance to a successful training course. Not only can they be responsible for arranging the training room, transport, refreshments, accommodation and entertainment, they can also help to type up participant outputs and sort out any practical problems that may arise so as to allow the trainers to focus solely on delivering a good quality course.

Venue

The venue for training needs to be comfortable and of a suitable size to accommodate and conduct both whole-group and small-group learning. A service-based setting is not always the most appropriate if work demands interfere with the learning. Aim for an environment that provides opportunities for learning without distraction. The location should be readily accessible to participants. Specific consideration should be paid to the needs of participants with disabilities or special needs. You may need to give specific instructions relating to travel, parking and public transport.

Workshop logistics

Ensure that toilets and any necessary catering facilities are available. Always check that the equipment you need is available and working and that you have the materials listed at the beginning of each training or workshop.

During-course preparation

During course preparation is very important the organizer must manage activities continued, prepare for equipment, welcomed the opening speech, registration for the training, assessment training and the closing ceremony of the training.

During-course preparation consists of.

Participants

Define the size and composition of the group in order to determine how the course can be made most suitable for the participants' training needs, how many will be trained, their experience, their professions/occupations and their potential role in promoting and implementing effective and care.

Pre-course assessment

After registration on the first day of the course, participants need to individually complete a pre-course assessment. The end of course assessment completed on the last day has a similar format so that trainers can assess level of learning and improvement.

Daily monitoring / groups monitoring

The main point is that trainers need to get feedback at the end of the training day to know what participants are thinking, and feeling, and this feedback needs to be anonymous.

At the end of each day all the groups discuss for five minutes and complete the 4x4 daily monitoring matrix pictured below on a sheet of A4 paper. These representatives feed back to the trainers the comments from their group. This allows for all concerns to be voiced, but the person who feeds them back is not necessarily the original voice. Trainers note down all feedback and collate it daily. They must respond to feedback and address as appropriate. Monitoring groups stay the same for each day; ensure a different representative stays behind to feed back each day.

Keep it	Change it:
Add it:	What I will remember:

Mood meter

The mood meter can be used after morning or afternoon sessions, or at the end of a day. Put up a flipchart sheet with five smiley faces from very happy to very unhappy on horizontal axis, and along the vertical axis put the days. Give each participant a sticky dot which they place next to the face that most represents how they feel at that point in the course. It is best if the trainer shows how to do this, but then does not look at who is putting which dot where (so as to keep anonymity). Give dots a score of 5 to 1 from very happy to very unhappy and add up the scores for all dots to get the daily score. If you get dots in the middle, or towards the unhappy face this is a signal to trainers that things are not going well and trainers need to pay extra attention to comments/feedback to ensure the majority of the group is kept happy. The downside of using a mood meter is that people tend to place dots where others have placed them; this can have a negative visual effect if they lean towards unhappy.

Daily review

There is a 10 minute review of the contents/issues of the previous day. If the trainer does the review, ensure that you elicit the main points from the previous day from participants using different techniques. If the review is to be led by participants, explain the task at the end of day, every day a different group will do the review. Get some participants to volunteer for each day (random groups), write this list down and keep it visible so groups know when it is their turn. The trainer must ensure that the review covers main issues, by commenting or addition.

Energizers

Use energizers when you feel concentration is dwindling; when you see participants dropping off; after you come back in from lunch break, etc. Energizers are quick (5 to 10 minute) fun activities that help to re-energize participants, enable them to physically move about, laugh and think of something totally unrelated to the training course. All trainers should be comfortable with trying out a few routine as well as new energizers. .

Quiz

At the end of the training, participants are asked to complete an Quiz/Test. This tests the participants' knowledge and shows current understanding in the training course.

End of course evaluation

At the end of training you will need to get participants to quietly and anonymously complete evaluation forms. End of course evaluation will be 2 parts. Part 1 asks participants whether they feel the course objectives have been achieved and asks them to rate the usefulness of the course as a whole as well as the importance they give to different course components. Part 2 is structured in the same way as the pre-course assessment so that questions can be taken from each and compared 'before' and 'after' opinions. When analyzing the forms, trainers can compare in the pre and end-course assessment. The completed forms need to be collated and the results included in the trainer course report. Trainers and course organizers need to analyze evaluation results, share lessons and make recommendations for future training. Feedback on trainer delivery and behavior also needs to be taken into account as self-analysis and self-development are important trainer skills.

After-course preparation

After-course preparation is the last stage is not many activity but important, because is cover to the summary report, finance clearance and the way to develop the training in the future. Including reports and sent a letter to thank the speakers and those involved.

III. Conclusion and discussion

We should consider the culture, gender, race, ability and age of participants. Gender is particularly important, since there may be cultural restrictions on matters that can be talked about by one gender in front of the other. Be sensitive to these issues within small group discussions where same-gender groups may ensure that participants are not made uncomfortable by discussions and exercises. Be aware of religious needs and consider how you might cater for prayers and observances and holidays and ensure that support is given to those with literacy problems.

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Installing the TSUNAMI Warning System by M.V. SEAFDEC

Anuphap Lorpai

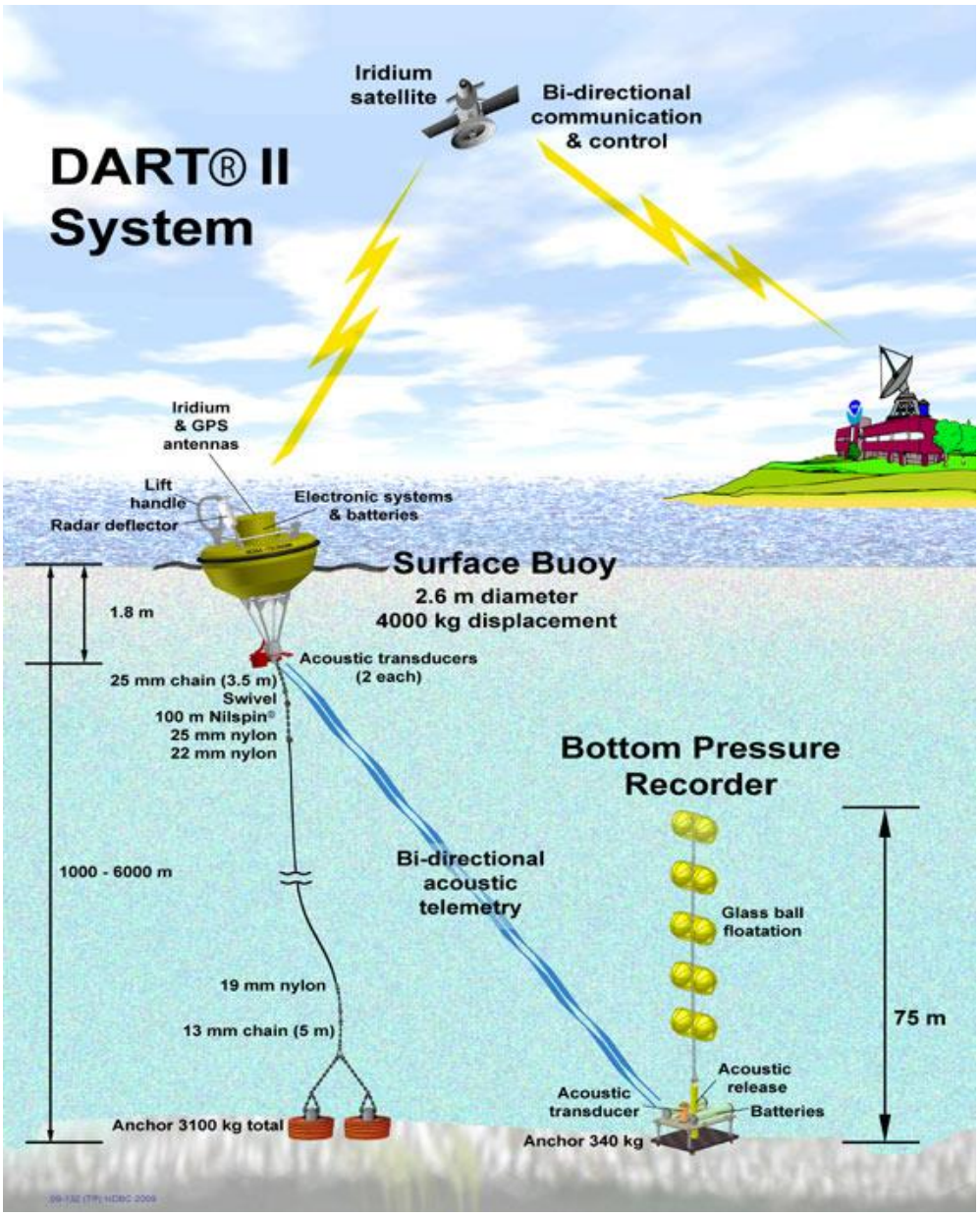
I. Introduction

The disaster in Thailand on 26 December 2004 was impact Thailand's southwestern coast along the Andaman Sea by tsunami. Thai people have never thought before. It happen in the country had lost their entire life. Public property, natural resources, economy Marine ecosystems and landscape an enormous number and difficult recover back to the original. The National Disaster Warning Center Thailand has cooperated to the United States of America's Government, through United States Agency for International Development (USAID) and SEAFDEC/TD to deploy a tsunami warning system in Indian Ocean. Installing alarm systems such action was completed 6 Cruise on Nov, 2006 Dec, 2009 Dec, 2010 May, 2011 Nov, 2012 and Jan, 2014 by M.V.SEAFDEC a vessel of the Southeast Asian Fisheries Development Center to install the system at Latitude 8.5 degrees North, Longitude 88.3 degrees East. Above the west side of Nicobar Island distance 600 nautical miles from Phuket, in the depth 3,515 meters.

II. Methodology

Tsunami warning system in Thailand use of the system (DART II System) The equipment consists of devices used in tsunami warning systems. The base consists of storage and marine buoys, signaling the sea surface called Deep Ocean Assessment and Reporting of Tsunami System (DART). The system detects the occurrence of a tsunami after an earthquake in the Indian Ocean. The process of DART II system. The Real-time tsunami buoy system is comprised of two parts: the bottom pressure recorder (BPR) and the surface buoy with related electronics. The BPR monitors water pressure with a resolution of approximately 1 mm. sea water with 15 second averaged samples. Data is transmitted from the buoy via an acoustic modem, and data is transmitted from the buoy via the GOES Data Collection System. Under normal conditions (no tsunami) the BPR sends data hourly that is comprised of 4 data in 15 minute which are single 15 second averages. The data is reformatted and sent via the GOES self-timed channel and displayed to show open ocean tides. This gives an hourly indication of the health and condition of the entire system. If data are not received from the bottom, the surface buoy uses the GPS derived buoy position for the self-timed message.

An algorithm running in the BPR generates predicted water height values and compares all new samples with predicted values. A complete description of this algorithm can be found here. If 2 data in 15 second water level values exceed the predicted values the system will go into the Tsunami Response Mode. Data will be transmitted on the Random channel (132) for a minimum of 3 hours, giving high frequency data on short intervals with 100% repeated data for redundancy for the first hour. Every GOES transmission will include the time of T=0, which is the time the second out-of-bound value was detected. Every Tsunami Response Model message also includes an ID that identifies the type of data and the time of the data in the message as minutes after T=0. When the time of the hourly self-timed transmission occurs during a Tsunami Response Mode, the BPR will send one-minute data, comprised of the average of 4 data in 15 second, for the preceding 2 hours (120 values). If the ocean is still perturbed after the nominal 3 hours of the Tsunami Response Mode, the hourly self-timed transmission of 120 in one minute averaged values will continue. The system will return to normal mode only after 3 hours of undisturbed water heights.



Installation system DART II is composed of two parts.

1. Deployed Bottom Pressure Recorder (BPR). This machine is located on the current. Pressure of the water changed suddenly. When the tsunami and the transmission of data to the second part of the surface. The installation will be exploring the current and water at different levels. The area will be installed prior to the installation of the system is appropriate. The unit is located within the surface area that can receive signals from the detectors tsunami on the sea floor.
   1. Sensor, CPU and battery
   2. Anchor
   3. Acoustic Release Trigger
   4. Glass buoy
2. Deployed surface buoy for receiving signals from the seas. The buoy has been Data contained within the floating fixture must be tied to a buoy anchored at one end of the cable attached to the anchor at the sea floor. Therefore, it is necessary to explore the depth and nature of the sea floor. The nature of the sea floor must be smooth and not inclined or less inclined.

A survey of the sea floor to note the position of the sea floor and surveyed by GPS. Anchor buoy lines will not be longer than the water depth readings from deep water, but a length equal to 0.985 times the water depth readings from Echo sounder low frequency. Due to the specificity of the motion of the sea sounds. Anchor buoy line is composed of four parts.

1. Chain 1 inch diameter with length about 3.5 m.

2. Wire rope sling 3/4 inch diameter with length about 200 m.

3. Nylon rope 19 mm. diameter with length by formula of
   0.985 x depth of sea.
4. The chain 13 mm. diameter two lines with a length 1.5 m. and 2.5 m. to connection between chain and anchor.

III. Result

After installing the systems have explored the current at different levels. The area will be installed prior to the installation of the system is appropriate. The unit is located within the surface area that can receive signals from the detectors tsunami on the current. Since the installation of such a system is beneficial to Thailand and Indian Ocean, particularly because it can detect the occurrence of a tsunami in the Indian Ocean immediately caused such Tsunami.

Reverse Osmosis Desalination System on board M.V. SEAFDEC

Huttachai Choypanit

I. Introduction

Quantity of water in human body is the factor of body fluid balancing. Our body is compose of about 60% of water. There is about 75% in our brain, Makes up 83% of our blood, 22% in our bones, Makes up 75% of our muscles, Helps to carry nutrients and oxygen to our cells, Moistens oxygen for breathing, Helps to convert food to energy, Removes waste from body etc.

Water on the Earth.

There is water in everywhere on the Earth, Total volume of water is available: The total volume of water on Earth is about 97.5% is sea water and 2.5% is freshwater. 70% of the planet's fresh water is frozen in the icecaps of Antarctica and Greenland; 30% is mostly found underground. Freshwater which is used by some sectors: Irrigation - 70%; Industry - 22%; Domestic use and 8%. Human water needs: The daily drinking water is required for each person is between 2 and 4 liters; it takes 2000 to 5000 liters of water to produce one person's food. Conserving water resources is 2% of freshwater will be produced via desalination by 2015.

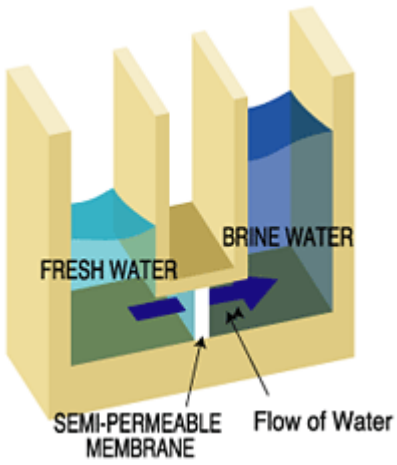
Human cannot live without water at anywhere on Earth, also on board M.V. SEAFDEC. She had plan to storage and generate of water on board for crew living. Storage capacity fresh water tanks on board, capacity of drinking water tank is 46 tons, general fresh water tank about 93 tons. There are two system of fresh water maker on board.

1. Low pressure system,

2. Reverse osmosis desalination system (RO).

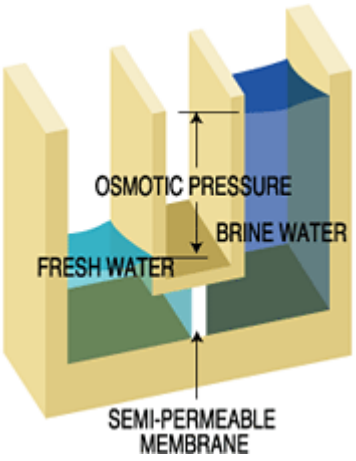
And now please let me to present you on Reverse osmosis desalination system.

II. Osmosis Metthod



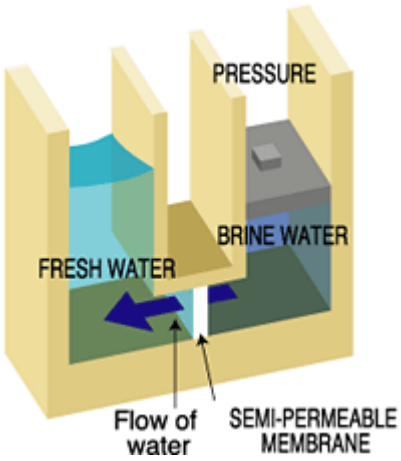
Osmosis is a natural phenomenon, the spontaneous passage of water through a semi-permeable membrane. When two fluids, fresh water and brine water, are separated by a semi-permeable membrane that is permeable to fresh water but not to salt, brine water will become more diluted by absorbing fresh water through the membrane or fresh water. It will start flowing through the membrane to the brine side. This process is named osmosis.

Osmotic Equilibrium



Osmotic pressure varies according to temperature and concentration of the brine water; however, as fresh water passes through the membrane, the levels of the two solutions become unequal. The resulting difference in pressure eventually brings the migration to a stop.

This pressure difference is called osmotic pressure of the brine water.

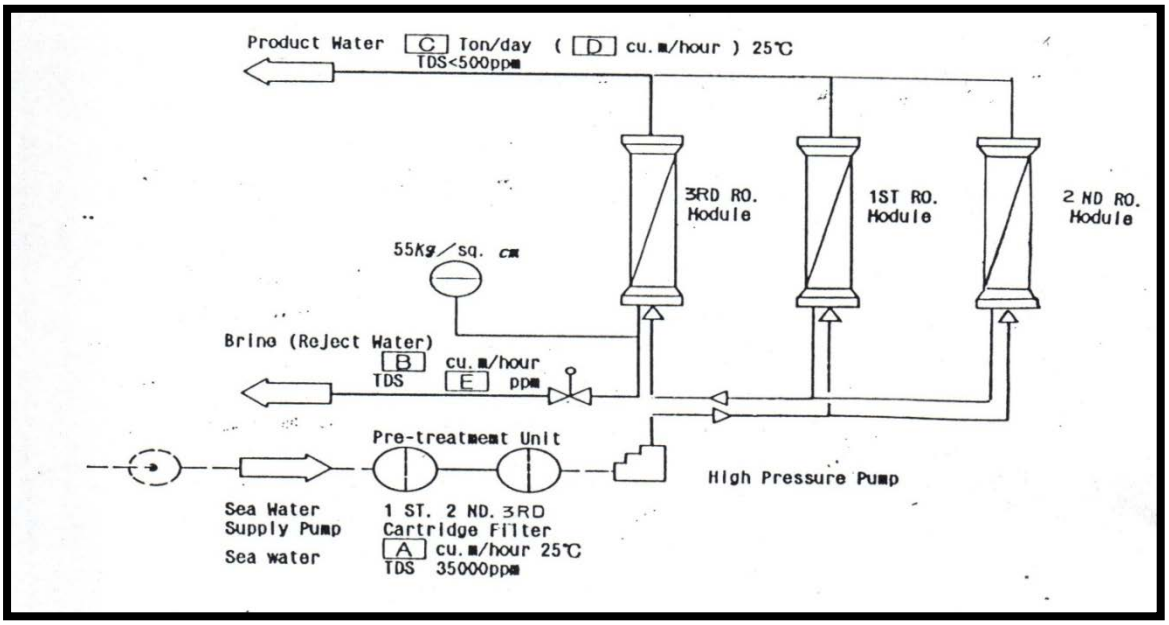


Reverse Osmosis

Reverse osmosis is the process of forcing the water from the salt waterside through a membrane to the fresh waterside by applying excess pressure.

This process is used in treating sea water to get fresh water.

RO WATER GENERATOR SYSTEM DIAGRAM ON BOARD M.V.SEAFDEC



RO Generator System Expenditure on board

M.V.SEAFDEC total working 42 days (1008 hours) desalination water 474,497 liters

Membrane cost is 0.10 baht/liter

Filter whole size of 1 micron and 50 micron for 1 set is cost 0.02 baht/liter

Electrical cost is 0.15 baht/liter

Distillation cost 1 liter is 0.27 baht / liters or 1 ton is 270 baht/m^3

III. Results

Advantages

1. RO is the best solution for treating hard water.
2. RO is able to removes toxin such as lead, mercury, Fluoride, Arsenic, Chlorine which cause human body to be ill. Lead metal is able to make brain damage and anemia.
3. RO water filter is great for removing commonly found Cryptosporidium in lake, river and public supply water.
4. RO water can produce fresh water to make a cruise more longer than only storage capacity.

Disadvantages

1. Water wastage: substances which come out from the process will be disposed out of the vessel as waste water.
2. Expensive: RO water purifier is more costly when it is compared to UV water purifiers and RO water purifier consumes much more electricity.
3. Removes essential minerals: While RO water purifier removes dissolved impurities it removes natural mineral such as iron, magnesium, calcium and sodium which are essential to the human body and cause mineral deficiency to body.
4. Not kills bacteria, viruses: RO water purifier does not kill waterborne disease-causing bacteria and viruses. There is high probability that microorganisms can pass through RO membrane. (It is advisable to pass RO water through the UV water purifier to treat microorganisms)

IV. References

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Wang et al. (1996). Am J Clin Nut 69: 833-841

Mitchell et al. The Journal of Biological Chemistry, 1945: 625-637.

M.V. SEAFDEC Reverse Osmosis Recording Log book.

Sasakura's manual on board M.V. SEAFDEC.