

Technical Manual of Set-Net Project/Japanese Trust Fund-IV

**SET-NET FISHING TECHNOLOGY TRANSFER
FOR
SUSTAINABLE COASTAL FISHERIES MANAGEMENT
IN
SOUTHEAST ASIA**

Training Department
Southeast Asian Fisheries Development Center

TD/RES/107

April 2008

FORWARD

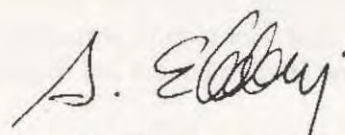
Most coastal fisheries resources of the developing countries including the Southeast Asian countries are overexploited because of the high demand for fishery products and the modernization of fishing technology. Moreover, since most coastal fisheries in the region are small-scale fisheries, coastal fishermen are vulnerable to competition and are often confronted with the conflicts in fishing operations with the decreasing resources. In order to cope with such realities, it has become urgent for fishery management authorities to consider and develop various alternative approaches to the existing fishery activities and management considering such real problems in fisheries.

SEAFDEC/TD implemented a pilot project in Rayong Province which was generally aimed at promoting the set-net as a tool for sustainable coastal fisheries management. Specifically, the project aimed to introduce the set-net fisheries as means of reducing the fishing pressure on coastal fisheries resources; alleviating fishing competition among the various fishing gear types; organizing group cooperation for fishing operations; developing a common policy concept for coastal fisheries management; and enhancing the community's concept on coastal conservation.

SEAFDEC is hopeful that in the near future, fisheries cooperative could be developed in our region. Moreover, SEAFDEC also envisaged that in the long run, the coastal fisheries resources and fishing will be managed by the fishermen themselves following appropriate guideline from respective national governments.

Based on the successful implementation of the Set-Net project in Rayong Province, Thailand, and considering the five years experience together with the compiled data emanating from the project, SEAFDEC will promote the Set-Net as an Eco-Friendly Fishing Gear for Sustainable Coastal Fisheries Management in the ASEAN region. This Technical Manual which includes the rationale and objectives as well as the methods and techniques in implementing set-net fisheries could serve as a good guide for those who intend to start a similar project in their respective countries to manage their coastal fisheries in a responsible manner.

With lesson learned and experience gained from the successful Se-Net project in Rayong Province, SEAFDEC welcomes request for technical assistance in the setting up of a similar set-net project in the countries in the ASEAN region.



Mr. Siri Ekmaharaj, Ph.D.
Secretary-General and
Chief of the Training Department

NOTE FROM TRUST FUND MANAGER

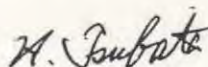
Over the decades, most of coastal fisheries resources in the Southeast Asian region have been over-exploited, which is attributed to an increasing demand for fish products caused by population explosion and rapid economic growth in the region. As a result, fishermen's livelihoods and their communities have been threatened by intensified competition for decreased resources followed by conflicts among them.

Against a negative background of regional fisheries above-mentioned, the ASEAN-SEAFDEC Millennium Conference which was held in Bangkok, Thailand, in 2001 adopted the Resolution and Plan of Action on Sustainable Fisheries for Food Security with a special emphasis on the importance of promotion of responsible/sustainable fisheries management and development in the region. Among SEAFDEC projects implemented in response to the Resolution and Plan of Action of the conference is Set-Net Project under the title of "Introduction of Set-Net Fishing to Develop the Sustainable Coastal Fisheries Management in Southeast Asia" which SEAFDEC Training Department had carried out in Rayong Province, Thailand since 2003.

One of promising methods to address the critical problems faced by the coastal fisheries in the region is considered to be the enhancement of collaborative fishing operations among the local fishermen through set-net fisheries that are a basis for community-based co-management for sustainable fisheries development where fishermen are involved possibly with strong support from governmental agencies. And another aspect to adopt set-net fisheries for this purpose is that a set-net is also considered as an environment friendly and energy saving fishing gear.

After the two-year pilot project in Rayong was terminated in 2005, it was transferred to the Department of Fisheries, Thailand, and TD has continued to render its assistance to the activities in Rayong, considering good results of the pilot project and strong desire of fishermen to further develop set net fishing there. In the course of the implementation of the pilot project, fishermen have come to understand the concept of fisheries management for sustainable fisheries and that it is of great benefit to the betterment of their livelihoods. The project funded by the Trust Fund from the Government of Japan owes its success so much to collaborative efforts among small-scale local fishermen of Rayong Province, the Department of Fisheries, Thailand, SEAFDEC, the Fisheries Agency of Japan and JICA with technical assistance from Himi City, Toyama Prefecture in Japan, and Tokyo University of Marine Science and Technology (TUMSAT).

Lessons learned from the outcomes of the pilot project in Thailand will also be useful for other interested countries in the ASEAN region in carrying out their respective activities with the view of promoting sustainable coastal fisheries management and resources conservation. I really hope that this technical manual of set-net fishing technology transfer will help them introduce and implement set net fisheries appropriately in their respective countries.



Mr. Hideki Tsubata
Deputy Secretary-General of SEAFDEC,
Trust Fund Manager for
Japanese Government Trust Fund Project

NOTE FROM TECHNICAL SUPPORTER



I would like to offer my heartiest congratulations on the successful publication of "The Technical Manual of Set-Net Fishing Technology Transfer" which is being implemented as one of SEAFDEC's projects.

"The Himi Set-Net training project" has been carried out since 2000 in order to contribute to international cooperation and local revitalization.

Himi City is universally recognized as the birthplace of Set-Net fishing gear which is eco-friendly and sustainable fishing gear for coastal fisheries. As a compilation of the project, we held "The International Set-Net Fishing Summit in Himi" in the final year 2002. We had the honor of hosting a delegation of SEAFDEC at the summit. It was the first contact to pave the way for a prosperous future for us.

After the Summit, we made a decision to transfer the Set-Net Fishing Technology to Rayong Province in collaboration with SEAFDEC and Tokyo University of Marine Science and Technology. Moreover, since 2005, we have been gaining grass 'roots support from JICA. We made use of this opportunity by dispatching fishing experts, accepting trainees and providing fishing gear.

When I first visited Rayong in 2006, I felt a great deal of progress was being made. I confirmed that 2 Set-Nets are installed in the sea off of Rayong and are already in operation. The operating techniques of Rayong fishermen have progressed well and their living standard is becoming more and more stable. Noticeable results have appeared as they convert their fishing gear from round haul net to Set-Net and as they implemented the new Set-Net fixing plan in Thailand. As it is now, it seems that Set-Net is gradually winning the understanding of fishermen in Thailand and getting recognition for its characteristic of conservation of the global environment.

I would like to pay my best respects to SEAFDEC, DOF, our counterpart EMDEC and Tokyo University of Marine Science and Technology. Their understanding and endeavors were an indispensable factor to carrying out the project.

Finally, I sincerely hope that SEAFDEC and Himi City maintain cooperative ties with each other and work together, as in the past, to promote "The transmission and distribution of the eco-friendly Set-Net" not only in Thailand but also in other Southeast Asian countries.

堂 故 茂

Shigeru DOUKO
Mayor of Himi City

NOTE FROM TECHNICAL ADVISOR



It is really the great honour for me to express my congratulatory note in this occasion to launch the SEAFDEC Technical Manual of Set-net Fishing Technology Transfer, with my deepest appreciation of my valuable experiences in Rayong Province, through the SEAFDEC Project on *Introduction of set-net fishing to develop the sustainable coastal fisheries management in Southeast Asia*.

The project in Rayong province was started on 2003, initialized by SEAFDEC Training Department, and then fully-supported by Himi City, Toyama Prefecture, Japan, as the JICA Grass-Root Project. Tokyo University of Marine Science and Technology has been also strongly involved for coordinating the academic support through the JSPS-NRCT Core-University Program from the beginning. The technology transfer of Japanese-type set-net was successfully completed by organizing the Rayong fishers for working together, and to install the gear for routine operation works such as the daily net-hauling and marketing, and the periodical gear maintenance works. I would like to express my biggest applause to all the effort by all the stakeholders in this Project.

This project can be the best case study to establish the cooperative system for the small scale fishers, which can give the opportunity for the coastal management at first, and then for the fisheries resource management, through minimizing the fishing pressure by numbers of individual small-scale fishing units in this region. The efforts for the base-line surveys in the first stage and the monitoring activities during the project were also highly evaluated, in order to get the positive willingness from the target fishers group. The number of workshops for evaluating each project step achievement could be also effective for analyzing the supporting/obstacle factors, as well as to distribute the outcomes to the other groups, sectors and regions.

I am confident enough on the future sustainability of the set-net fisheries in Rayong, with the identification of the strong ownership and capability of the target fisher group to operate the set-net gear by themselves. The scientific support from the EMDEC for catch/sale monitoring can be effective enough for analyzing the long-term effect on the socio-economics and environmental aspects. The promotion of the set-net fishing gear to other sites in Thailand and other member countries will be the next super goal for all of us through the further efforts, with the precautionary impact analysis for the transfer of the new fishing techniques in this region. The regulation system for the fishing right or access right to introduce the new fishing gear in the coastal waters, as well as the profit-cost analysis approach should be well established through this pilot model case in Rayong before the further technical promotion to the other sites.

This Technical Manual of Set-net Technology Transfer can be the first challenge to wrap-up the experiences in Thailand with the related information of the status quo of set-net fisheries in Asia. I believe that the manual can be the valuable tool material for the future actions of set-net technology transfer to give the concept and technique wherever and whenever. I know well that the first version of this type of technical manual requires a lot of further elaboration, while I would proudly wish to say that “We can do it better for releasing the complete version in the very near future”.

In the final moment of this congratulatory note, I would like to express my sincere appreciation to all the personnel who devoted the energy for the Rayong Project, and for the publication of this Technical Manual. The strong involvement of Himi city for technical supports can be highly evaluated, especially for completing the JICA project of the grass-roots cooperation for the period from 2005-2007, through the friendly-based partnership with the target fisher group and national/local Institutions. The successful technology transfer of set-net gear in Rayong could be achieved through the strong technical and spiritual leadership by the SEAFDEC Project leader. His encouragement for the younger team member in TD and EMDEC for giving the responsibility in each component task can be also highly evaluated for their performance improvement both for the technical and scientific aspects.

I myself enjoyed a lot for working together with Thai fishers and scientists through all the steps in Rayong Project, and learned a lot through this pilot model case for the technology transfer of set-net to Thailand. I am now moving to Indonesia for the next challenge with SEAFDEC with the new networks and counterparts. I hearty hope that the set-net can work as the best tool for the community empowerment, and for the sustainable coastal resource management, through our further effort in the new Project. I would like to ask all the personnel who concern the set-net technology transfer, for the continuous support towards the larger fruits and big catch in future.

有元 貴文

Takafumi ARIMOTO

Project Technical Advisor,

Professor, Fish Behaviour Section,

Tokyo University of Marine Science and Technology

NOTE FROM PROJECT LEADER



Stationary fishing gears has operate in the coastal waters of Southeast Asia Region for long times, local fishermen employed them on the shallow waters and close to the shore for over 50 years. Traditional fishing gears of the counties in the region show their similarity of those cultures in fisheries, almost of them were made by local material which easily found in the nature such as tree, palm tree, coconut tree, bamboo, rattan, branch of tree, stone, cotton, hemp, rice straw etc. They are fyke net, barrier net, stake trap or fishing stake which they were called in various local languages name and target on coastal fisheries resources. They are considered as the passive fishing gear which could be classified into two groups, first en-trapped by filtering or blocking mechanism from strong current or big tidal range as fyke net, barrier net and second en-trapped by fishes behaviors agent to the function of leader net as stake trap or fishing stake. Presently most of them have given up their fishing; some of them have modified their fishing operation and method by introducing luring light and fine mesh net to their fishing operation to get more catch and damage on the juvenile resources at the same time. They were caused the effect of the fast development of active fishing gear as trawler, push-netter and purse seiner on the coastal waters.

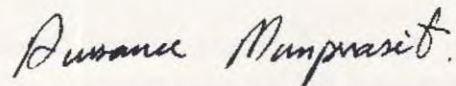
In the last 5 decade, natural fisheries resource had been rich, catch of those traditional stationary fishing gears were not so high, only about 50 percentage of the stock on the area , construction of the gear was also function as their shelter, nursery and spawning ground too. When the active fishing was introduced in the area with no limitation by both legal and illegal operation, under this competition fishing, traditional stationary fishing gear had lost and left the area. Then the active group took every thing from the area for several years until nothing left for the coastal resource could be developed again. So, degradation of the coastal fishing ground was occurred again and again, the over-exploitation area is being increased year by year too. Human food supply from the sea which is big amount and cheaper than others, its become unsaved condition and no security.

In order to recover the coastal resource condition, the coastal fishermen should join their hands and ideas to the cooperative work of their fishing activities and go along with responsible fishing manner for sustainable fisheries in future and together with strong technical support from the government agencies. So stationary fishing gear which had been used in the past was taken into the consideration and modified to be suit with the present fishing situation of the area again. Japanese set-net fishing technology was introduced for the pilot project in Rayong Province, Thailand since 1952 and 1984 but it had not been satisfactory. In 2003, SEAFDEC/TD has carried out the “Introduction of set-net fishing to develop the sustainable coastal fisheries management in Southeast Asia : Case study in Thailand” for 3 years. And followed by the “Follow up survey and Improvement of Set-Net Fishing Technology Transfer for Sustainable Coastal Fisheries Management in Tropical Shallow Waters” for other three more year until 2008. The Rayong Set-Net project has proved a successful in many aspect such as sustainable fisheries, cooperative management of the fishermen, reducing the fishing

pressure on coastal fisheries resources, alleviating the fishing completion among the fishing gear types, developing a common policy concept for coastal fisheries management and enhancing the community's concept on coastal conservation.

On the successful of this set-net project, we would like to thank for the good cooperation and strong support of the staff of EMDEC/DOF, SEAFDEC/TD and local fishermen of Mae Rumpheung Beach fisher group, special acknowledgement to the project technical support and advice from Himi City and Tokyo University of Marine Science and Technology (TUMSAT).

Thank for JICA Grass-root Partnership Program to give the strong technical support to Rayong Set-Net Project from 2005-2007 and conducted all activities in close collaboration with SEAFDEC/TD Project. I believe that this Technical Manual could be a useful guide for the extension fisheries officers, fisheries researchers and instructors of the Department of Fisheries, Universities and fisheries related Institute to develop the Coastal Fisheries Management in Southeast Asia and others part of the world.



Mr. Aussanee Munprasit
SEAFDEC's Set-Net Project Leader,
Assistant Training Department Chief/Technical

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Annex 2. Draft of Administrative Regulations of Mae Rumpheung Set-Net Fisher Group.

INTRODUCTION

Since 2002, Training Department, Southeast Asian Fisheries Development Center had sent a poster presentation on “Set-Net an Eco-Friendly Fishing Gear for Coastal Fisheries Development” with a staff to participated the “International Set-Net Fishing Summit in Himi” held in Himi City, Japan. Staff of SEAFDEC/TD had gained a lot of knowledge and experience from the Summit; also it had stimulated the staff of SEAFDEC/TD to create a pilot project on Set-Net fishing for 2 years period, 2003 – 2005. “Introduction of Set-Net Fishing to Develop the Sustainable Coastal Fisheries Management in Southeast Asian : Case Study in Thailand”, was approved and allocated budget of 20,000 USD under the Japanese Trust Fund I program in the theme of Responsible Fishing Practices.

Project site selection survey had been started in April 2003 at Mae Rumpheung beach, Rayong Province and Prathew District, Chumporn Province, then Mae Rumpheung beach of Rayong Province was selected. Base line survey, information distribution and gathering the fishermen for the project working group had been taken for 2 months, set-net fishing gear construction took other 2 months. Then first installation has conducted in October 2003, and fishing operation has continued title present.

The first year of the project implementation, the project had started with no technical assistance from Japanese Expert and advisor, so the result of first year of the project was not good. The average catch was about 175 kilogram per operation, operation period just only 5 months due to very poor maintenance and in appropriate construction of the gear. The fisher group decide to retrieve the net before Monsoon season started all fishing gear were retrieved on shore for maintenance and repaired. Re-construction of the net and frame rope were conducted under the technical assistance and advised of Himi set-net experts Mr. Tadashi Hamaya, Mr. Isao Hamano during the monsoon season. Then, after the monsoon season was over, re-installation were start in early of October with close cooperation of Himi set-net experts. Big improvement on fishing techniques of the fisher group operation was clearly observed in the second year, the everaged catch was increased 2 – 3 times of the first year. The fishermen in the project have gained a lot of knowledge and experience from training and advice by experts and project staff. Management of the fisher group has great improved too, financial and account was well done, Deposit money for future operational budget was increased; profit sharing to the member was also increased. So, it was satisfactory for the fishermen in the project, also small-scale fishermen on the area around the project site are happy with safety of their fishing gears and better catches on the set-net project area.

Income of the fisher group has better improved; prize of fish has increased due to high demand on freshness of the catch. So income of the set-net fishing group was improved about 15 – 20% the year average income. In consideration on energy saving in fishing activity, set-net fishing required less fuel consumption because of near shore fishing ground and few hours' operation at sea. Less percent of engine power is required during fishing operation and economical speed of fishing boat for approaching to the fishing ground. Not only engine consumption but also human energy could be saved too. In generally small-scale fishermen will spend about 8 – 10 hours in the sea but it needs only 2 – 3 hours for set-net fishing. So fishermen could have more time for other activities at home.

Five year experience with Rayong Set-Net project, we have observed that fishing ground around the set-net project area has developed so much, stock of coastal resources in the project area were increased such as squid, crab, shell, demersal fish etc. catch of those species were observed increasing from set-net project and other individual fishermen in the area.

Catch from set-net could provided job for the family of the members by taking part time job in family fish processing factory at home with out investment cost for raw material, it will be provided by the set-net fisher group. After selling of the products, family will get their labour charge and profit. With these related activities, social of the local community could be developed too.

In 2007, the similar project as Rayong Set-Net has established in South Sulawesi of Indonesia. The "Technology Transfer of Japanese Type Set-Net" was approved by JICA under JICA project between Japan and Indonesia, the project carry out in collaboration between Tokyo University of Marine Science and Technology, Japan and Hasanuddin University in south Sulawesi, Indonesia. All fishing activities of the project carry out by small-scale fishermen of Palette fishing village in Bone. Fishing operation has started since 3rd March 2008, the project will be continuing until 2010.

Finally as above mention, the set-net fishing could be used as a tool for Sustainable Coastal Fisheries Management in Southeast Asian region. This technical manual will be a useful guide to create the similar project as Rayong of Thailand and Bone of Indonesia for the Sustainable Coastal Fisheries Management in the region.

PART I: Project Implementation

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Set-Net: a tool for Sustainable Coastal Fisheries Management

by Aussanee Munprasit

Introduction of the large-scale stationary fishing gear to develop sustainable coastal fisheries management in the coastal area, Set-Net was selected. It is a large scale fishing gear which consists of many parts of its structure fixed in the sea for long period. Its catching mechanism is just block fishes swimming route and guide them into the ended trap and wait for collecting by the fisherman. Set-Net could not catch all of the fishes in the area and its catch are all alive and could be selected for the wanted and release the unwanted one. So concept of the project is to use set-net fishing for the following purpose:-

1. To organize collective fishing operation of the local fishermen to alleviate fishing competition in the congested fishing ground.
2. To develop common policy concept in fishery management for fishing gear occupying wide fishing ground.
3. To protect the coastal fishing ground from others destructive fishing gear or heavy fishing activities.
4. To enhance coastal resources by providing more substrate and shelter for marine living organism.

Five years implementation of Rayong Set-Net project, it has proved so many things of the project concept's ideas as follows;

Project Outcome

Results of the pilot project proved that the set-net fishing gear is environment-friendly while promoting cooperation among the local small-scale fishermen. The set-net also serves as means of improving the incomes of the fishermen and also performing well as a resource conservation tool. The set-net can be used in coastal fishing grounds with due consideration to the environment and especially in protecting the bio-diversity of the coastal areas and conserving the fisheries resources. From the feedback of the small-scale fishers group participating in the project in Mae Rumpheung beach, there was maximum satisfaction in the adoption of the set-net fisheries by the fishers group during the four years of the project implementation.

Environment-Friendly Fishing Gear

Having no impact on the environment since it does not release wastes into the environment, the set-net is therefore considered an environment-friendly fishing gear. A set-net fishing operation also does not cause any harm on the fisheries resources. While the set-net serves as fishing ground protector from other active fishing gear such as the trawlers and luring light fishing gear, it also enhances the coastal resources around the set-net area making it an environment-friendly fishing gear. From the observations made during the implementation of the pilot project, the bio-diversity around the area where the set-net was installed has been preserved and protected.

Local Fishermen Group Participation and Capacity Building

The operation of set-net fisheries promoted the establishment of a small-scale fishers group, which conducts a form of cooperative fishing since about 10 fishermen are involved in every set-net operation. In the implementation of the project, community participation has been promoted as demonstrated when 40 volunteer fishermen from the project area constructed the set-net fishing gear which they completed in two months.

During the launching ceremony of "Set-Net Experimental Project" in July 2003, about 85 small-scale fishermen and their families from seven fishers groups took part in the ceremonies where the concept of coastal resource management using the set-net was presented and explained in details. As a result, some members of the Administrative and Management Committee of the fishers groups that were set-up by the project agreed to manage the activities of the fishers especially the operation of set-net fishing.

During the implementation of the pilot project, cooperative management system was introduced gradually including the concepts of sustainable coastal fisheries and fisher group establishment and development. Thus, the concept of group cooperation management of the fisheries resources became clear to the fishermen turning the set-net fishing activity as a cooperative venture in fisheries proving that collaborative activities in the set-net area of the coastal fishing grounds could be promoted. Moreover, the operation of the set-net also serves as capacity building for the fishermen raising awareness on environmental issues and the protection of the marine resources. The fishermen became aware of the status of the fisheries resources and on how they could help conserve such resources through the use of responsible fishing practices.

In addition, the managerial skills of the fisher group members through the Administrative and Management Committee have been enhanced as shown in the successful management of their members who showed willingness in accepting the technological innovation which is the introduction of the set-net. The Committee also made efforts to optimize the commitment of the members in the project and boost the solidarity among the fisher group members.

Economic Growth through Increased Income

In the project area, the set-net fishing operation has contributed significantly to the economic growth of the beneficiary fishers group in Mae Rumpheung. Firstly, being an Otoshi-ami type of gear, the set-net is also an energy saving fishing gear since the fishers spend shorter period of working hours at sea (3-4 hours/day). Being stationary, the set-net therefore saves on energy especially during the current high-oil-price crisis.

Secondly, it was noted that during the implementation of the project, the fishers group was able to deposit part of their income in the amount of 216,119 Baht in 2005 which they reserved for their operating funds. Comparing their outputs in 2004 and 2006, it was noted that the average income per day-trip of a fisherman was increased from 5,000 Baht to 6,500 Baht although the average catch per day-trip decreased from 255 kg to 215 kg.

The good quality of their catch led to the better prices coupled by their efforts to increase the catch value through better fish handling techniques and marketing strategies that the fishers learned from the project. The fishers were also able to earn additional income by doing part-time fishing around the set-net area (e.g. about 300-400 Baht/day from squid jigging). Indeed, fishing near the set-net area becomes a year-round activity.

Environment Conservation Tool

The continuing exploitation of the fisheries resources through irresponsible fishing practices by some unconcerned fishermen due to the worsening poverty situation in the coastal areas make it necessary for fisheries administrations to give more focus on fisheries resources management. The set-net fishing gear proved to be a tool for resources conservation as it serves as protector of the fishing grounds because commercial fishing gear such as trawler, purse seine, luring light fishing gear, etc. are kept away from the set-net area. The installation of the set-net makes it impossible for such commercial fishing gear to operate in coastal waters. As a stationary fishing gear, the set-net can also be an enhancement gear because the marine resources can live and survive around the set-net area. Moreover, the set-net area also serves as zone for resources rehabilitation and fish spawning as shown from the result of a survey which indicated the presence of juvenile marine resources around the area.

Project Implementation Process

by Narumol Thapthim

The coastal fisheries in this region have been developed through increasing demand of fishery product and modernization of fishery technology, and now these fisheries face with over exploitation of resources in the coastal area.

Most of coastal fishermen in the region depend on small-scale fisheries and become vulnerable to competition and confliction on fishing operation along with decreasing resources. In order to cope with this kind of tragic condition of the coastal fisheries in the region, it become urgent for fishery management authority in the region to consider and develop various alternative approaches to existing fishery activities and fishery management, taking account of reality problems in fisheries.

It is considered that introduction of set-net with collective operation by fishermen transferred from existing fisheries is one of the alternative approaches to alleviate severe competition in the congested fishing ground and pressure on fishery resources.

Then the project was conducted on the collaborative basic among local fishermen, local fishery extension officers and technical fishery officers. They were formed into the working groups of the project, and then it was carried out under the main activities, together with on site training for the fishermen. The implementation process of the project is show as the following diagram.

Project objectives

1. To reduce fishing pressure on coastal fisheries resources through introduction of set-net as a passive fishing gear.
2. To alleviate fishing competition in the congested fishing ground by organizing collective fishing operation in set-net through the project.
3. To develop common policy concept of fishery management for fishing gear occupying wide fishing ground such as set-net through the pilot project.
4. To enhance the coastal fishery resources by installation of large stationary fishing gear such as Set-net and assess the feasibility and environment impact.

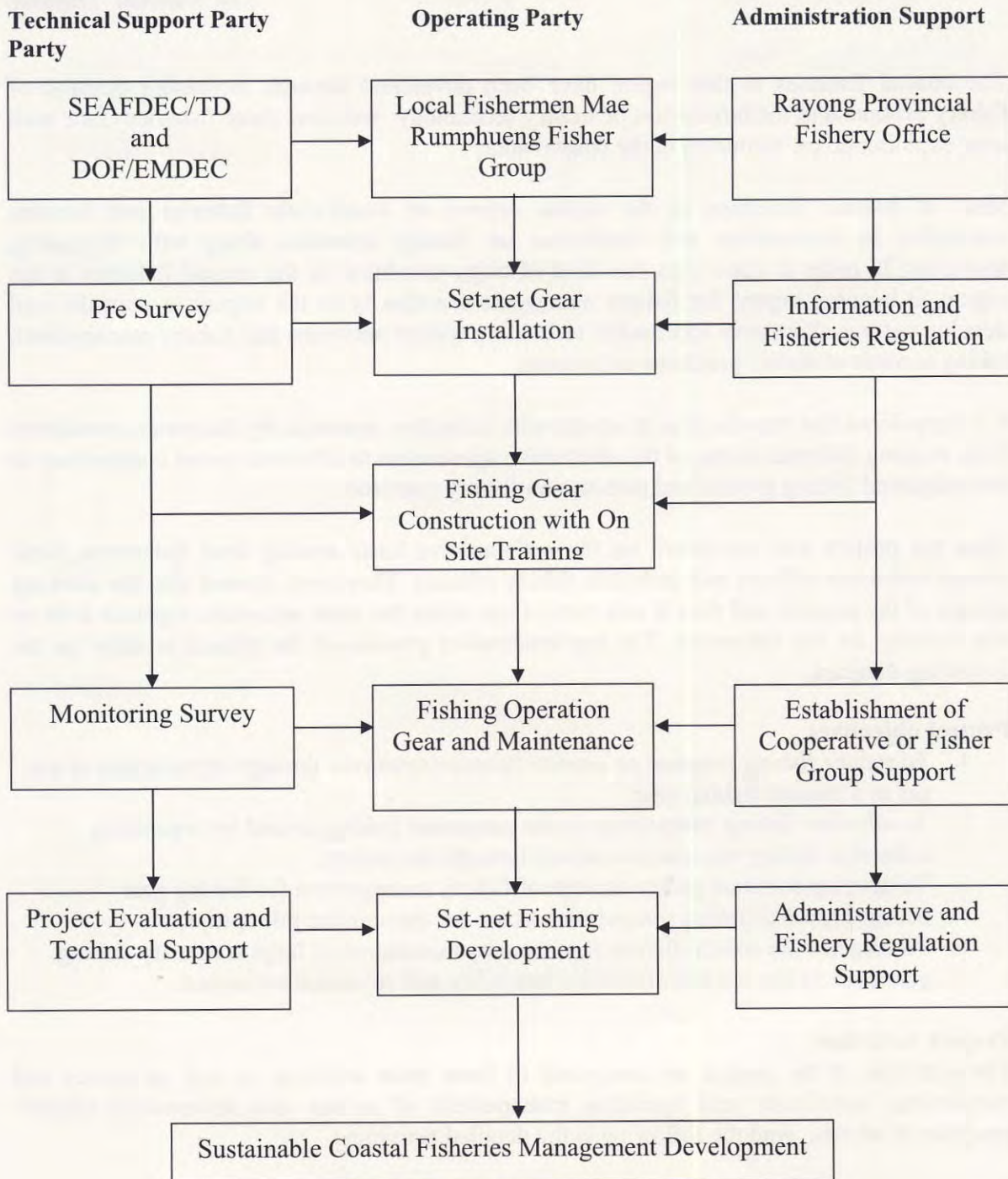
Project Activities

The activities of the project are composed of three main activities as well as survey and monitoring, installation and operation management of set-net and information transfer program of set-net. And the following is the detailed activities:

Survey and Monitoring:

Working groups consisted of 4 sub-teams. There were fishing gear, fisheries biology, fishing ground and fisheries socio-economic. Each team responded for the survey, data collection and compile information related in their field to use for adjusting and designing the project implementation, including, monitoring informative factors, condition of the project implementation and analyze all information and data to evaluate the project.

Implementation Process



Installation and Operation Management of Set-net:

This activity was designed for an appropriate type of set-net gear that suit the fishing ground. Surrounding condition was also taken into consideration. Monitoring on the efficiency of set-net gear design, installation position, harvesting operation and its maintenance was conducted, Fishing gears operated around set-net area were also monitored.

Information Transfer Program of Set-net:

This activity provided the understanding on set-net project implementation, gathering of local fishermen and their leaders to participate in the set-net gear operation, installation and operation. Include providing information to fish product management and incentive allocation through fishing group establishment, restore collected data and result of experiment to local fishers. The activity has arranged a series of technical manual of set-net technical and final report of the project.

Moreover, under the three main activities, the project also implemented following activities;

1. Selection of project site through evaluation of seriousness of problems in coastal fisheries and possibility of cooperation with and support from local fishery management authority.
2. Investigation and delimitation of coastal fishing situation in the area of site inclusive of mapping of resources distribution, catch and its distribution and fishing operation by gear.
3. Coordination with existing fishermen operating in the area of site for approval of introduction of set-net.
4. Grouping fishermen in the area of the site for introduction of collection or cooperation fishery management scheme for operation of set-net.
5. Training fishermen on fishing gear design, construction, installation and operations.
6. Monitoring on socio-economic impact on the area of introduction of set-net collectively operated by a group of fishermen, inclusive of impact on other fishery activities in the area of site.
7. Project evaluation of pilot operation of set-net, and to organize technical seminar in order to develop common policy concept for introduction and management of fishing gear such as set-net occupying wide area of fishing ground.

Set-Net Fishing Technology Transfer and Development

by Weerasak Yingyuad and Aussanee Munprasit

Set-Net is a stationary fishing gear which it could function as an effective tool for coastal fisheries management. Its function and catching mechanism is similar to the bamboo stake trap just different by the construction material. The set-net is considered as an appropriate management approach to address the region's declining coastal fisheries resources, e.g. the decreasing fish caught from the Gulf of Thailand and Andaman Sea. The introduction of Set-Net fishing is therefore primarily aimed at promoting responsible coastal fisheries management and conservation of the coastal zone.

An Otoshi-ami type of 30 x 150 x 250 meters in size, the set-net used in the pilot project was installed in the 13 meter deep coastal waters of Mae Rumpheung beach in Rayong Province and operated by a group of fishermen from the small-scale fishers group in the project area. Set-net fishing operation was done during the day-time by 9 – 11 fishermen, using 3 – 4 small-scale wooden boats (6 meter long). The catch comprised mackerel, sardines, trevally, squid and other fishes. The members of fishers group participating in the project were also trained on the basic concept of fisheries cooperative mechanism and concepts on sustainable fisheries management.

Fishing Technology Development

The original design of the project fishing gear was based on the technical guideline for set-net fishing, "International Set-Net Fishing Summit in Himi" compiled by Prof. Dr. Inoue and his team with some additional of local knowledge and experience of the local fishermen. After the first year trial of the project, we have found many weak points of the original design so we developed the present design as attached in the last part of this chapter. This, we believe it will be suited with the open fishing ground of tropical shallow waters in Southeast Asian region. Fixing power by sand bags, two sub-leader net are need at both side of the playground entrance, deep and narrow of the inner chamber entrance (3/4 of the depth of water and 0.7 meter wide of inner entrance) and 6 points bottom panel pulling rope were designed for the open fishing ground of coastal shallow waters area as Mae Rumpheung Beach of Rayong Province, Thailand.

Appropriate Type for the Fishing Ground

According to the lesson learned from set-net project, since the first introduction of Otoshi-ami in 1953, the second introduction of Choko-ami in 1983 and latest on Rayong Set-Net project 2003, we would like to recommend that Otoshi-ami type could be suited with the open fishing ground (wide area and strong current over 0.5 knots). The design for 12 – 15 meter deep of the coastal fishing ground is shown at the last part of the chapter .

For the shallow waters and closed fishing ground, **Choko-ami type** of set-net should be more appropriate and economically for the small-scale fisher group which located in the close fishing ground like in the bay. It is inexpensive in both investment and operation cost. Small number of fishermen are required for fishing operation (2 – 5 fishermen depending on size). Choko-ami designed for 5 – 7 meter deep fishing ground had been experimented at Ko

Samet, Rayong Province and it will be demonstrated at the Mari culture area of Sriracha, Chonburi Province. Its plan is also show as following.

Environmental Concern of Set-Net Fishing Technology

Even through set-net is a passive fishing gear, but in some occasion it could be harmful to the natural resources such as, if it is situated very close to the shore, using of the submersible cod-end type-exist (Masu-ami) for the area where sea turtle and marine mammal like, cetacean, dugong, etc., using of small mesh size at catching chamber in the spawning and nursing season. Then those natural stock resources could be damaged by this gear too. Therefore in order to avoid damaging on those natural resources, under fishing technology responsibility we would like to make strong comment as follows:-

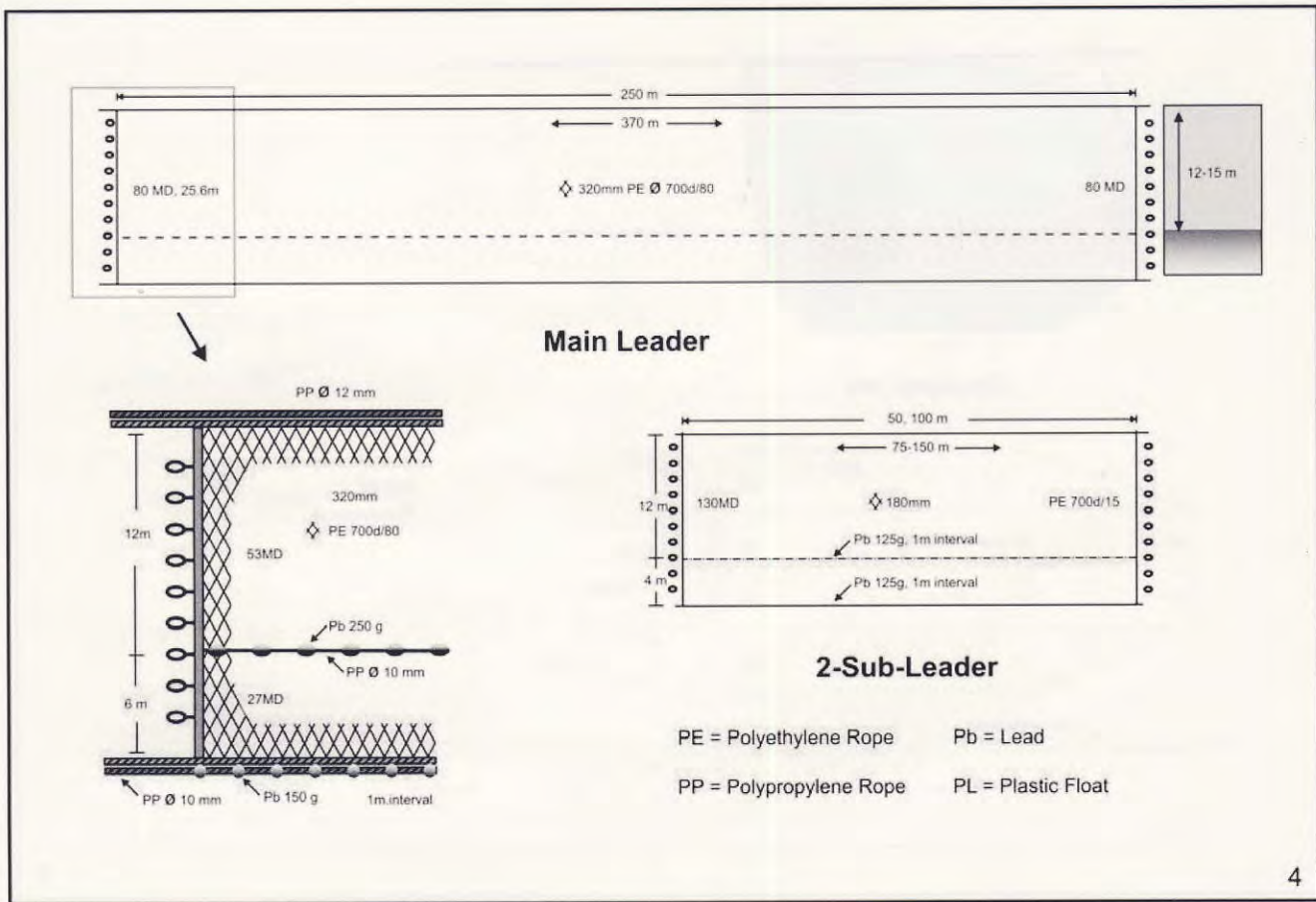
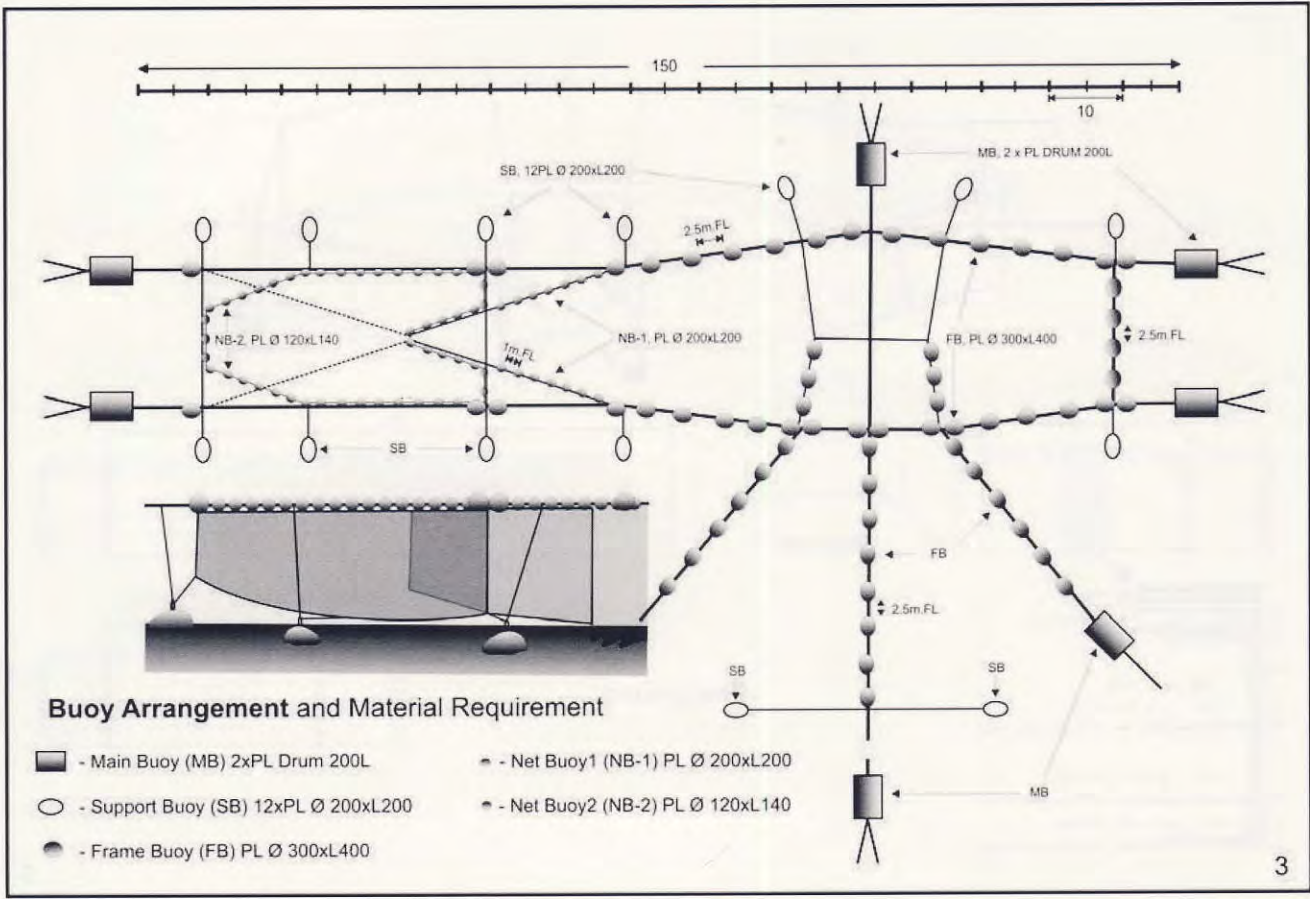
1. Submersible cod-end type set-net (Masu-ami) should not be allowed to use in the coastal waters.
2. Set-Net should not be allowed at very close to the shore (less than 1 kilometer or more than 5 meter deep of the coastal fishing ground).
3. Mesh size at the cod end catching chamber should not smaller than 25 mm.
4. Distance between each set-net should not be less than 1 kilometer away from each other.

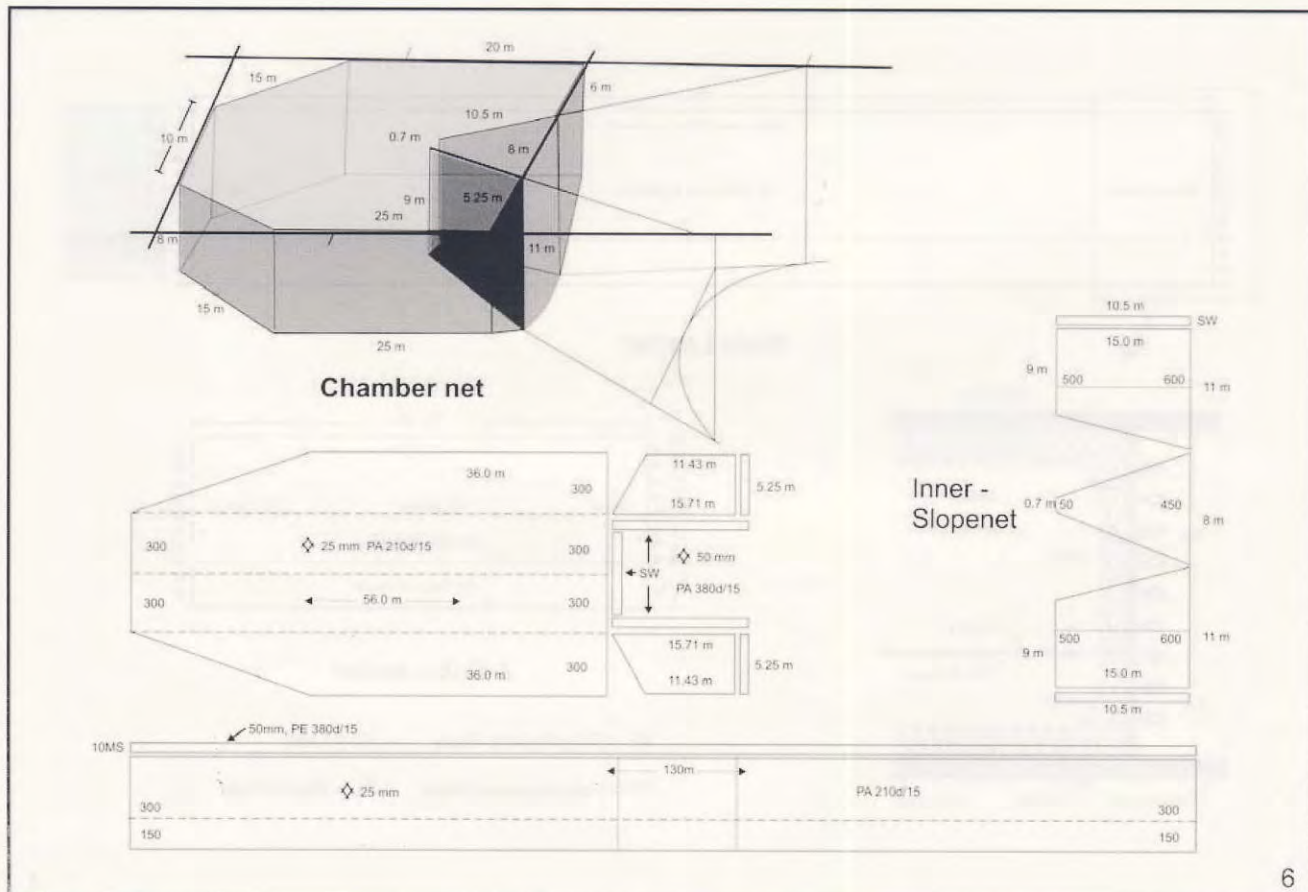
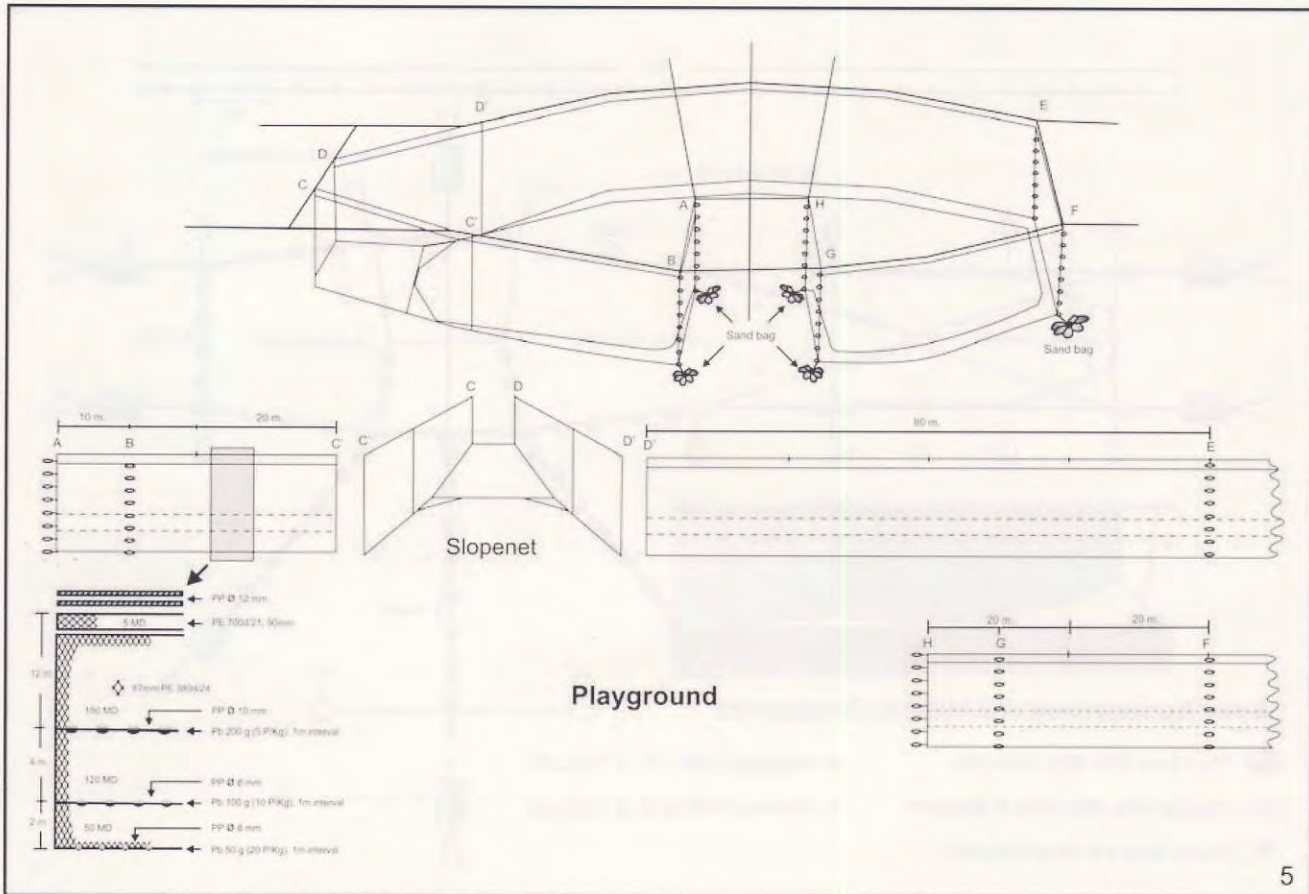
Fishing Operation Technology

Set-Net could be considered as a large scale fishing gear, requiring many man power for operation and maintenance. In a developed country like Japan, various types of auxiliary fishing gear, hauling devices are equipped onboard for saving of labour cost or small the labour problem. But in our region, there are still a lot of unemployed labour and also a lot of fishermen in the local area, which they could be employed by set-net fishing. Moreover, set-net fishing could train them on how the cooperation work can be effective. Hence, finally, they can manage the fisher groups, fishing activities, and the fisheries resources in their coastal area. In some cases, development of auxiliary fishing gear and boat should be considered, in order to make the operation for more convenience and safety aspect, such as the introduction of flat boat and hauling device by Himi- JICA grass-root partnership program to Rayong Set-Net project etc.

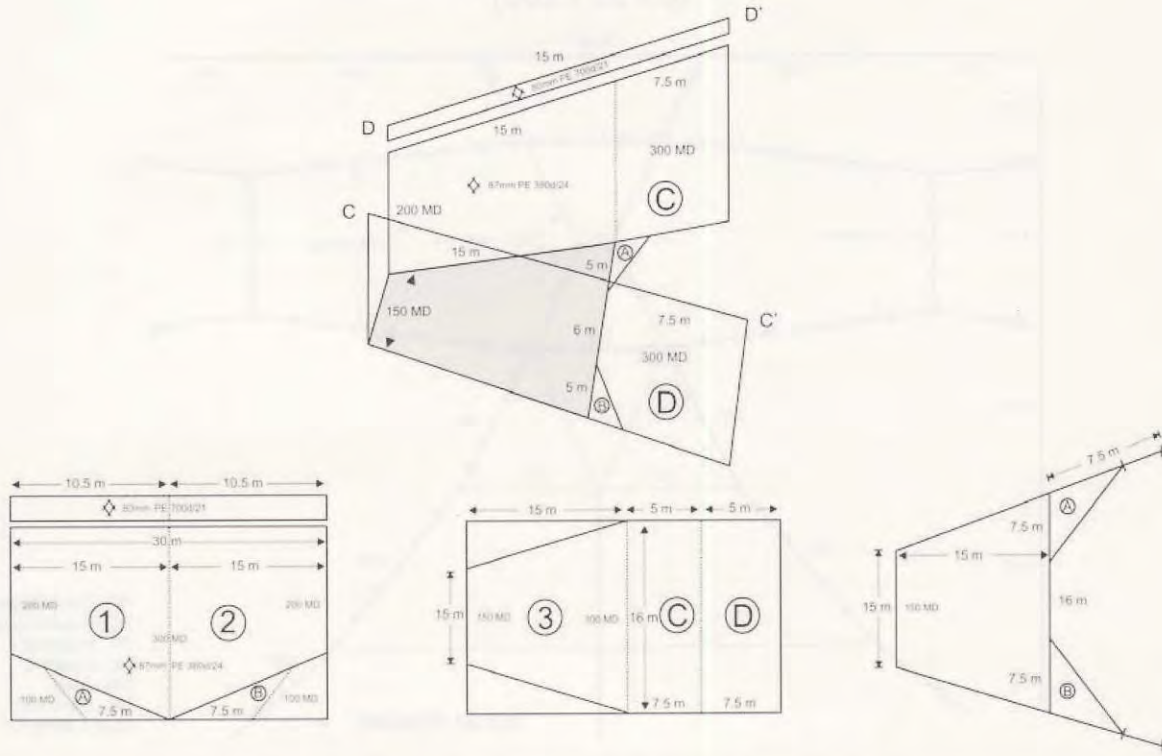
Fish Handling Approach

Surprisingly, catch from set-net can gain the highest price because of the freshness of the catch. Set-net catch is harvested from the chamber which fishes still swim in the chamber like a cage. All of them are still alive. In order to gain the highest price of the set-net catch, fishing handling technology has been introduced to the fisher group, such as keeping in the ice box as fast as possible after scooping them from cod-end chamber. In case of large catch amount, exceeding the demand of local market, the remained catch will be sent to other market which could not be gained the good price. In such case, catch store cages could be introduced or just leave them in the cod end chamber and close its entrance wait for the next day with a good marketing management. By doing this, the fisher group could gain their highest incomes by applied these fishing techniques together with marketing system then Set-Net project will meet the full objective effectively.



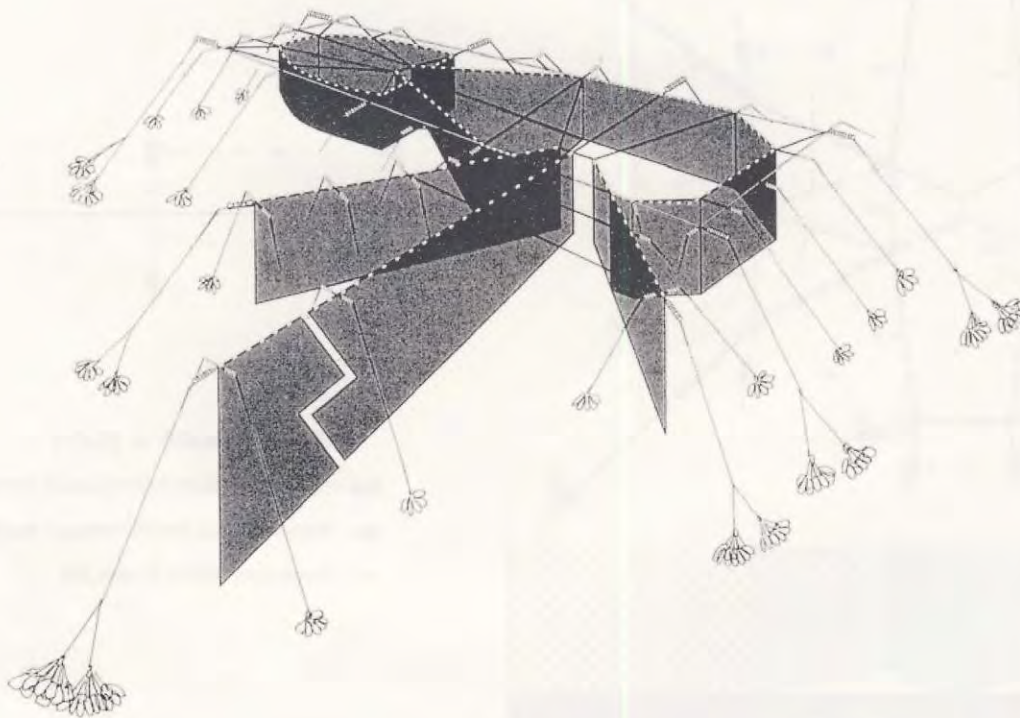


SLOPE NET net panel cutting



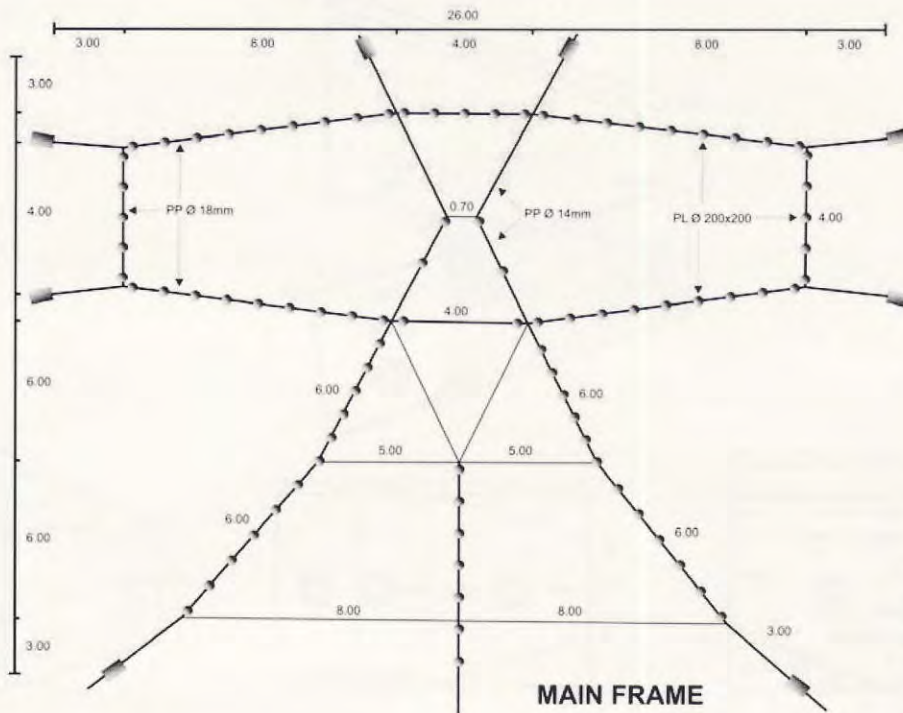
7

SET-NET OTOSHI - AMI TYPE

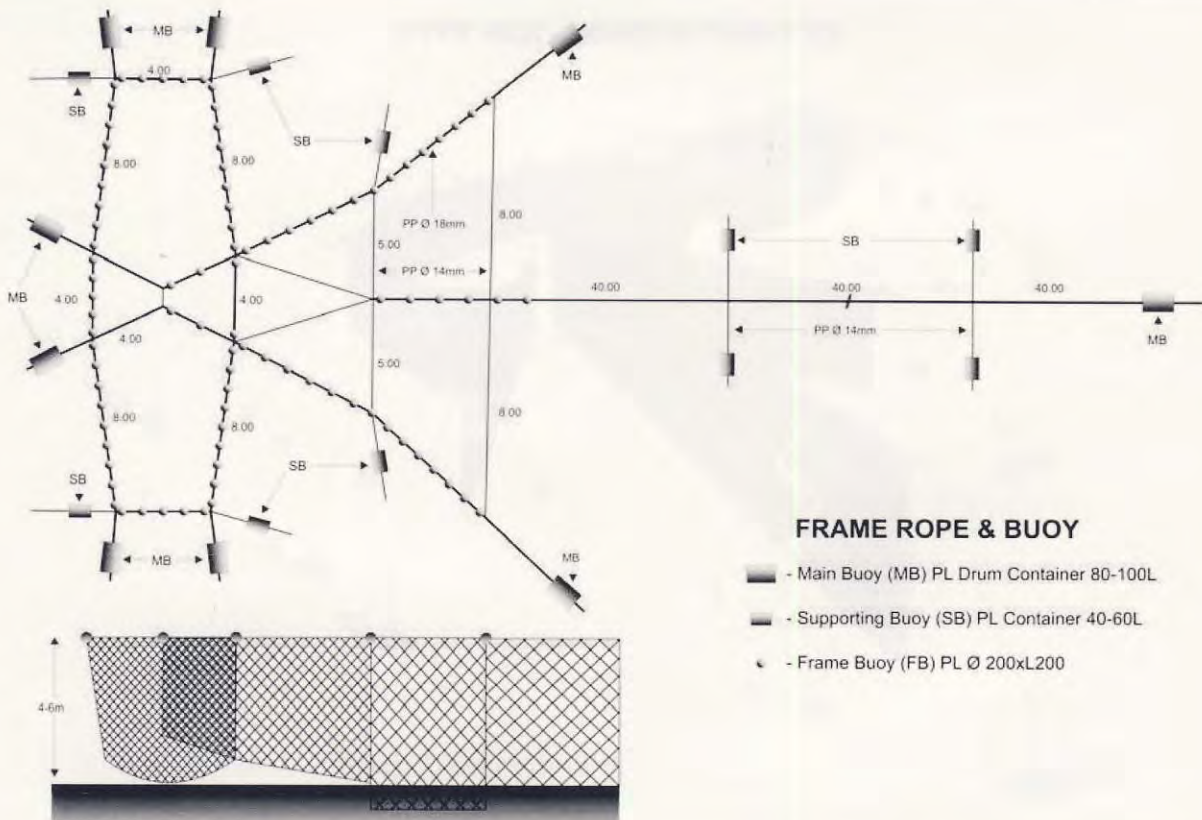


8

**PLAN OF SHALLOW WATER SET-NET(CHOKO-AMI TYPE)
FOR 5 METER DEEP
(6 x 20 x 200)**



1

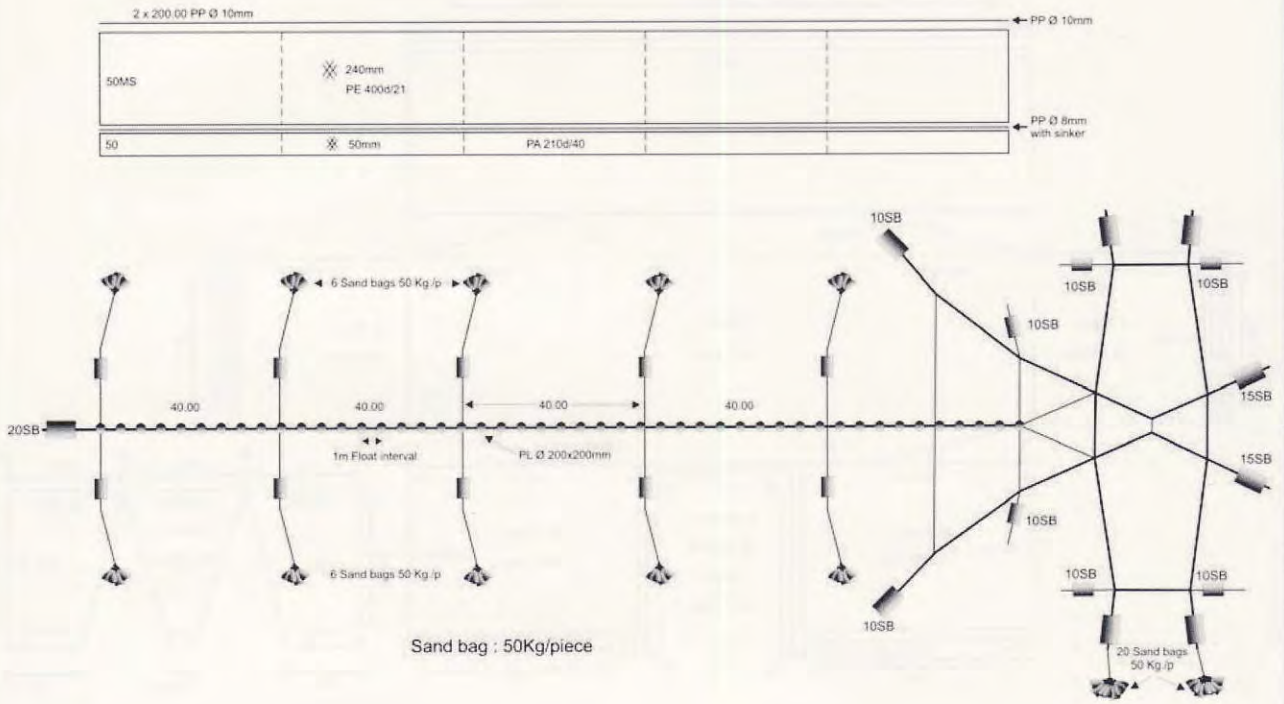


FRAME ROPE & BUOY

- - Main Buoy (MB) PL Drum Container 80-100L
- - Supporting Buoy (SB) PL Container 40-60L
- - Frame Buoy (FB) PL Ø 200xL200

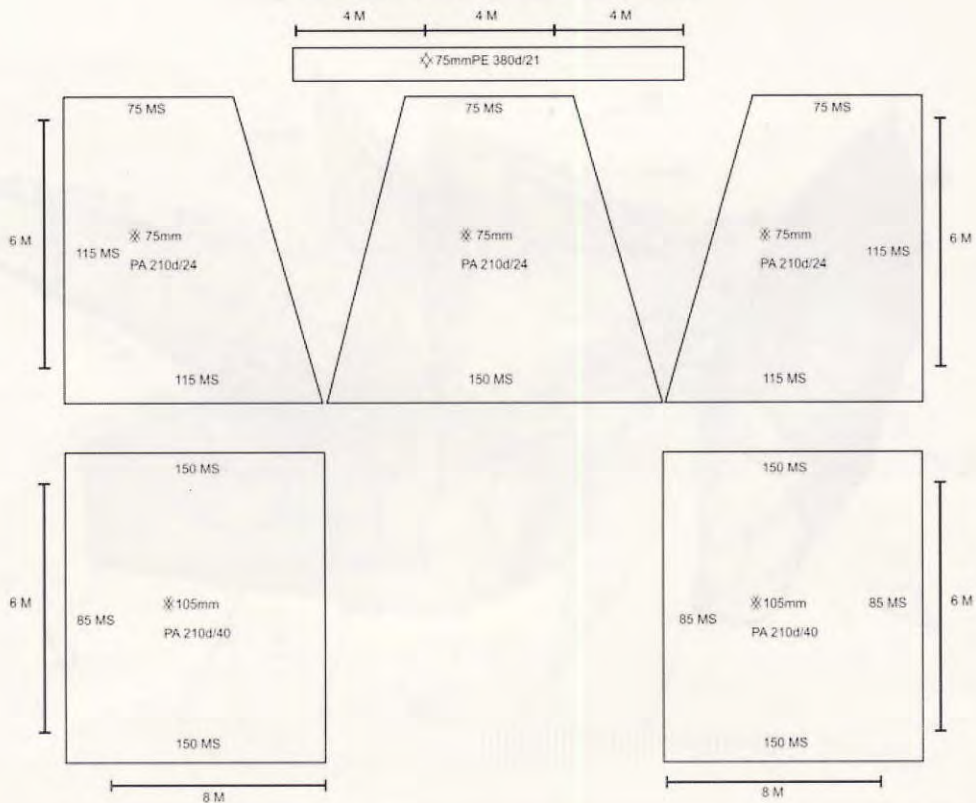
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MAIN LEADER & SAND BAG



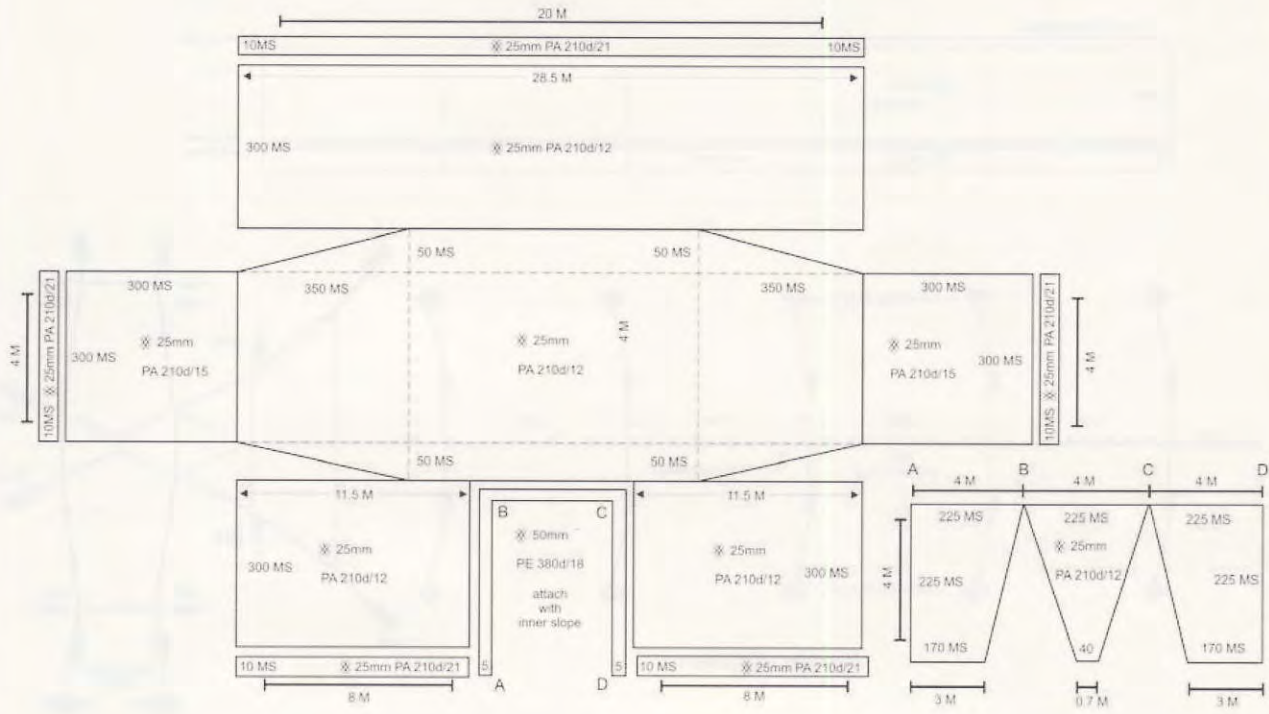
3

OUTER SLOPE & SUB-LEADER



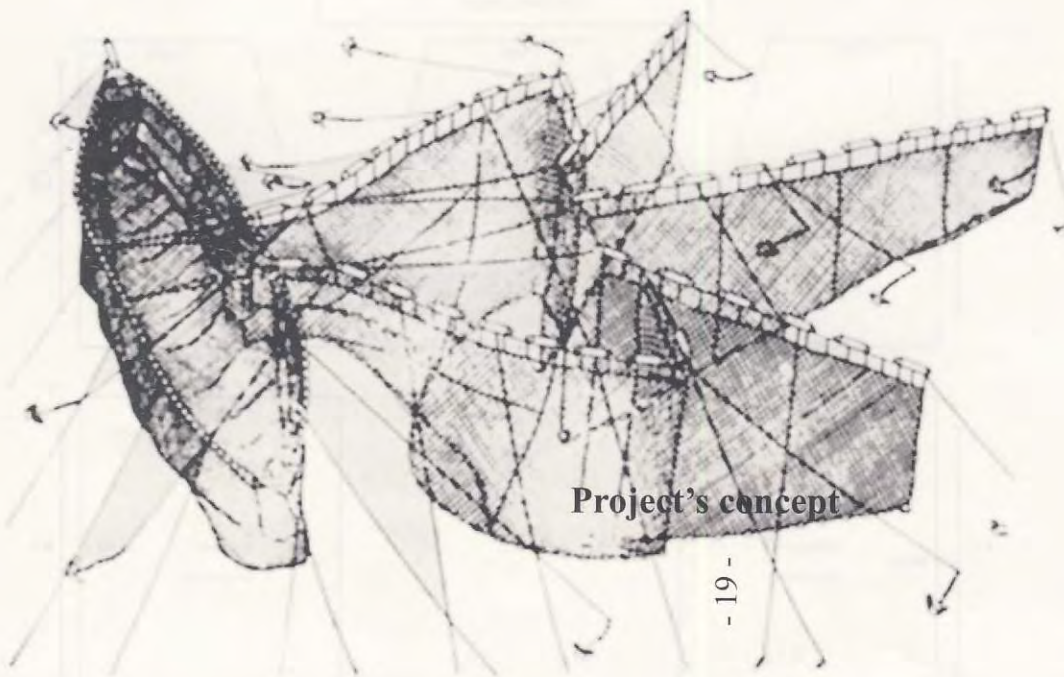
4

CHAMBER NET & INNER SLOPE



5

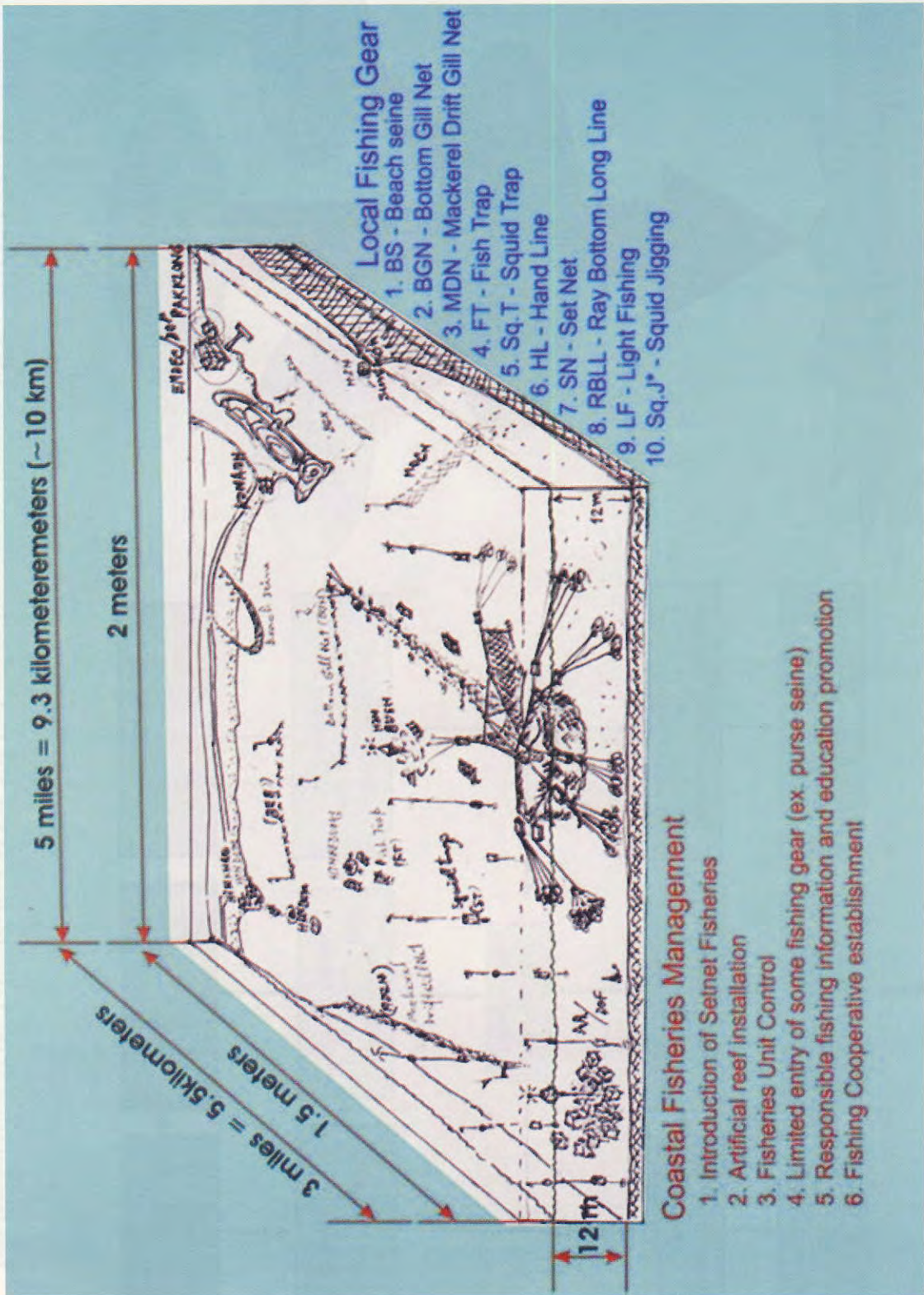
SET-NET CHOKO-AMI TYPE



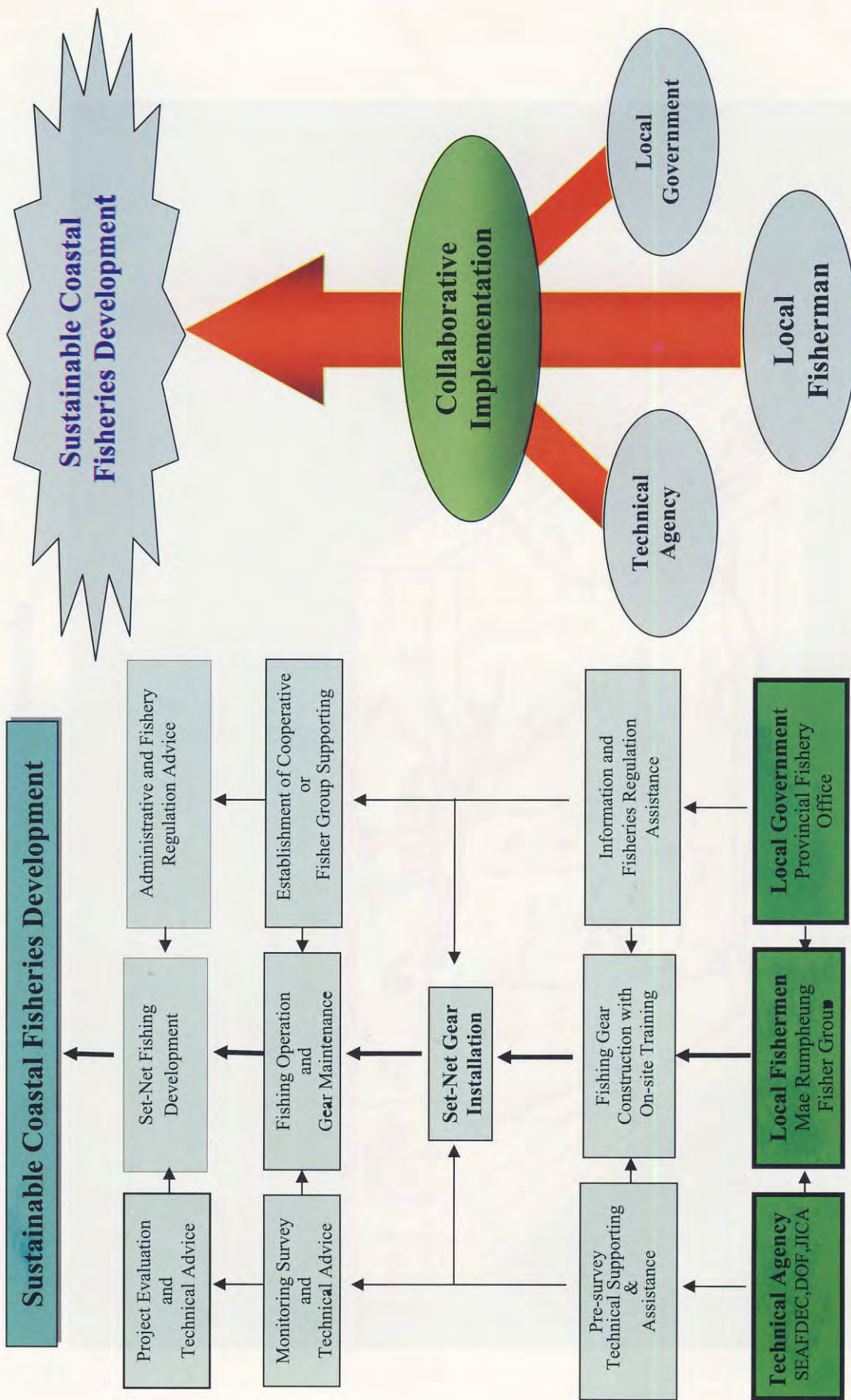
Project's concept

- 19 -

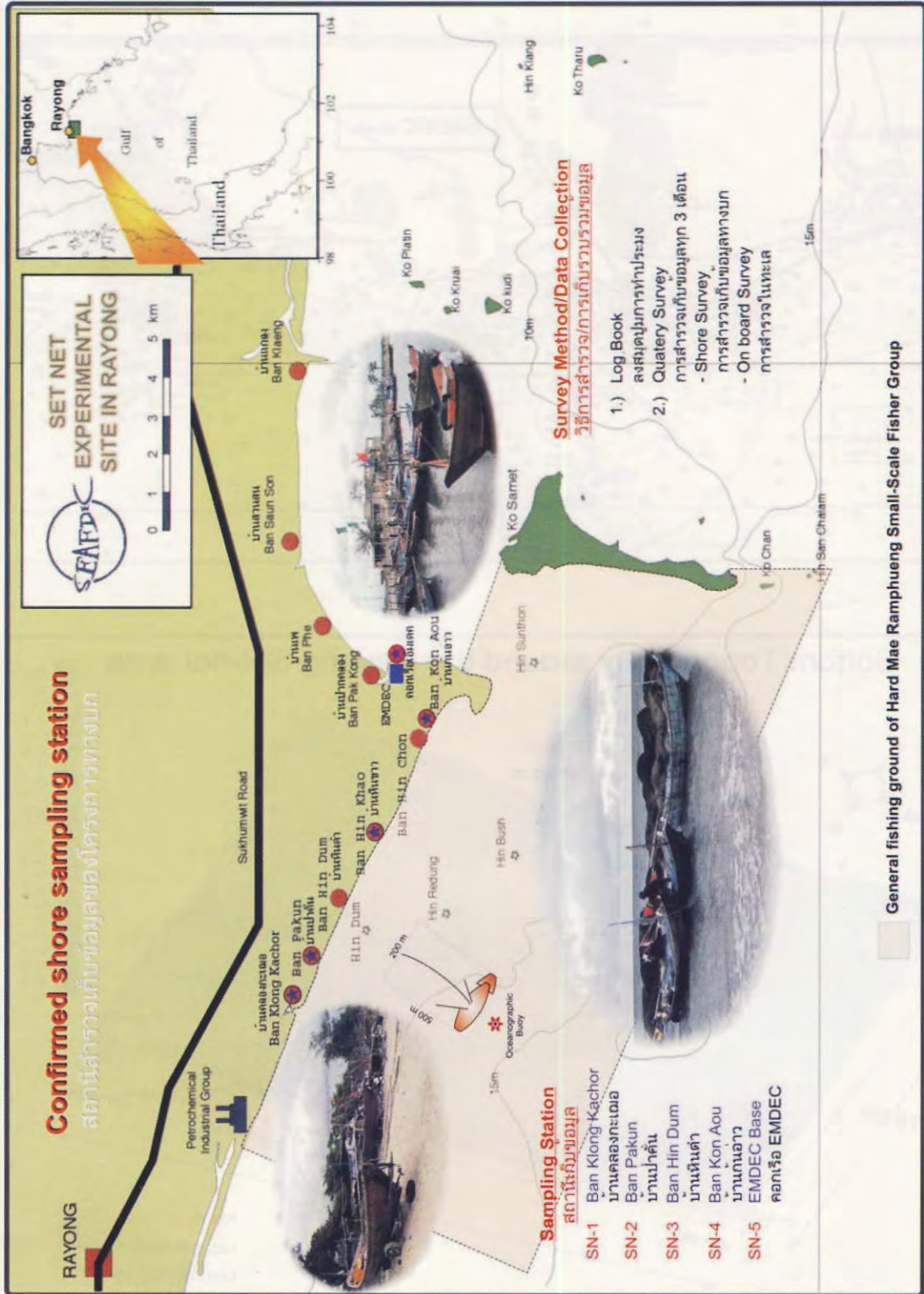
6



Project's concept



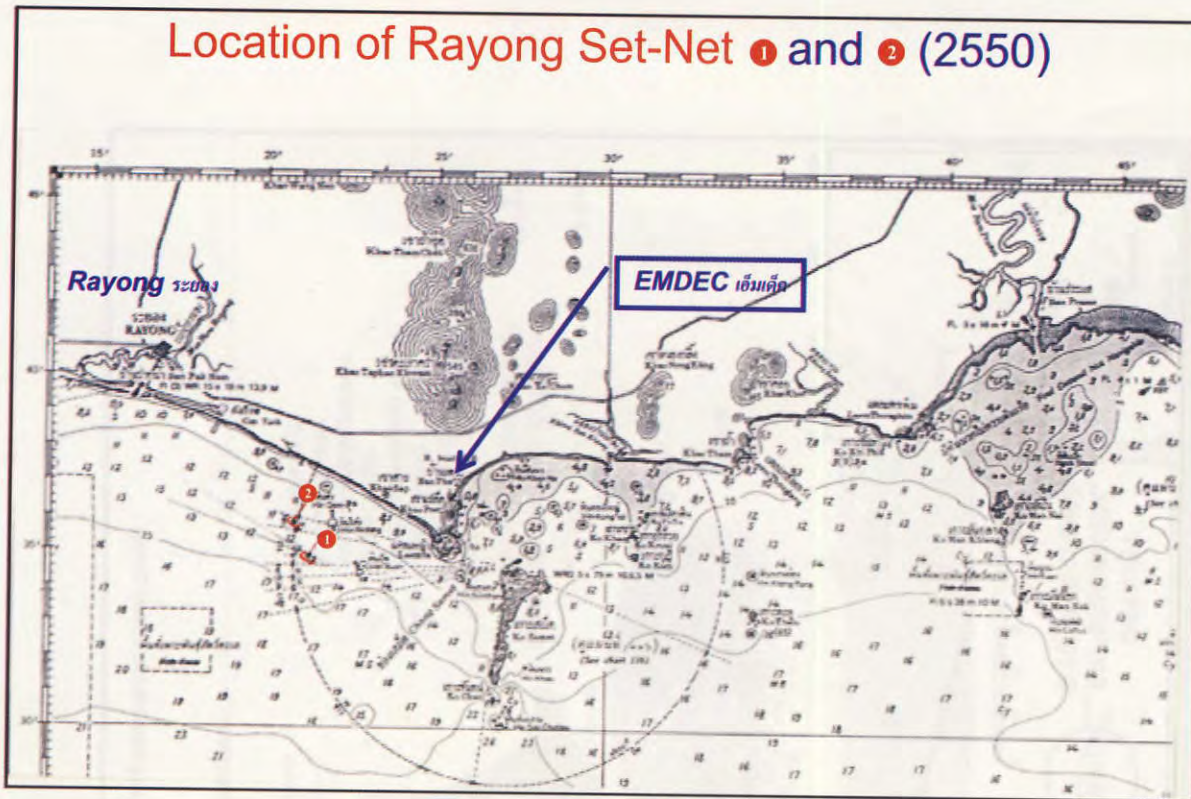
Implementation of the Introduction of Set-Net Fishery to Develop the Sustainable Coastal Fisheries Management



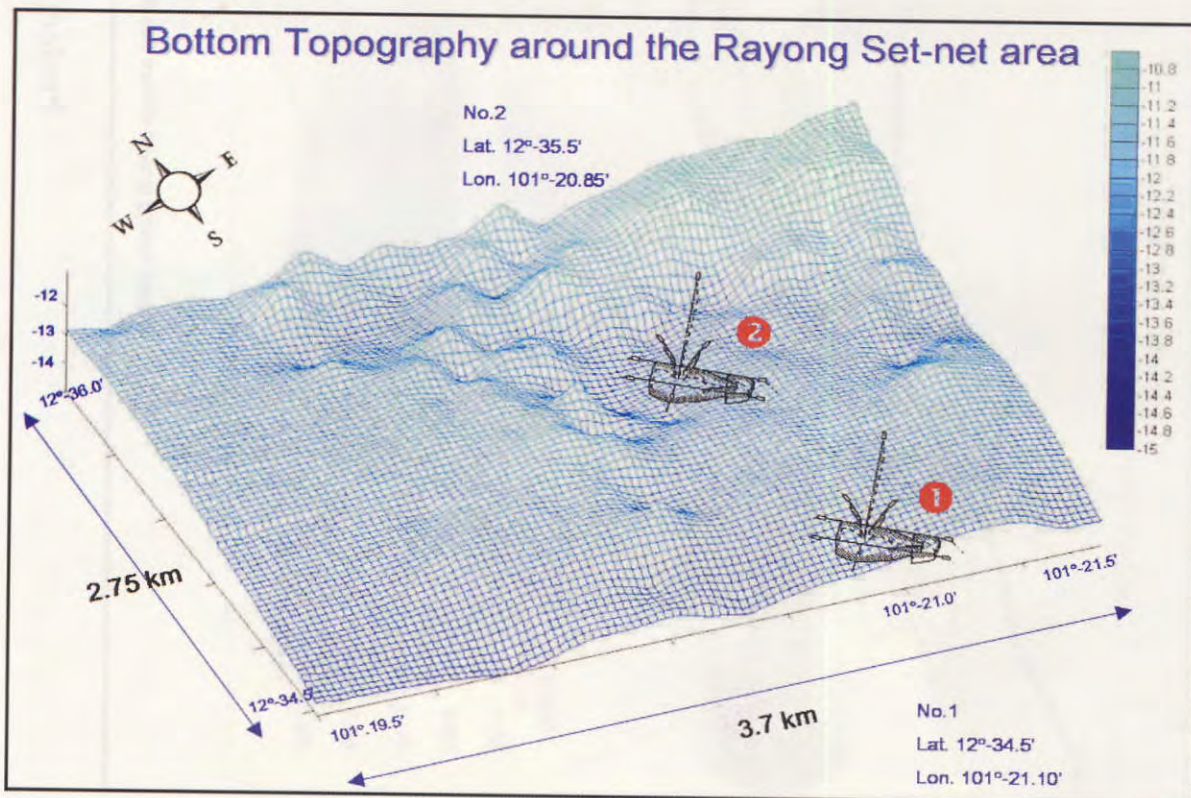
Project site

Set-net location

Location of Rayong Set-Net ① and ② (2550)



Bottom Topography around the Rayong Set-net area



Public Information and Gathering Local Fishermen



Pre-survey On shore



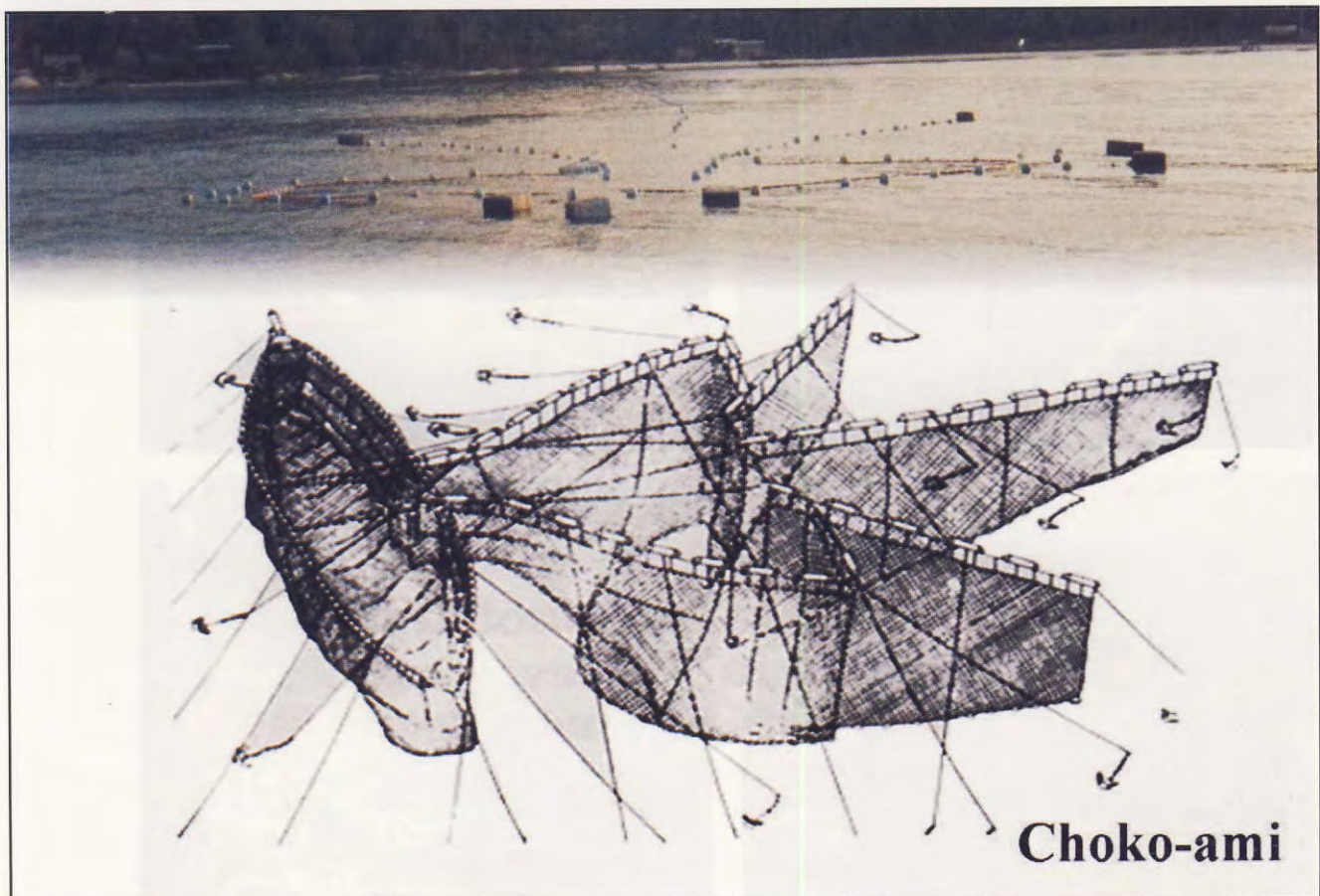
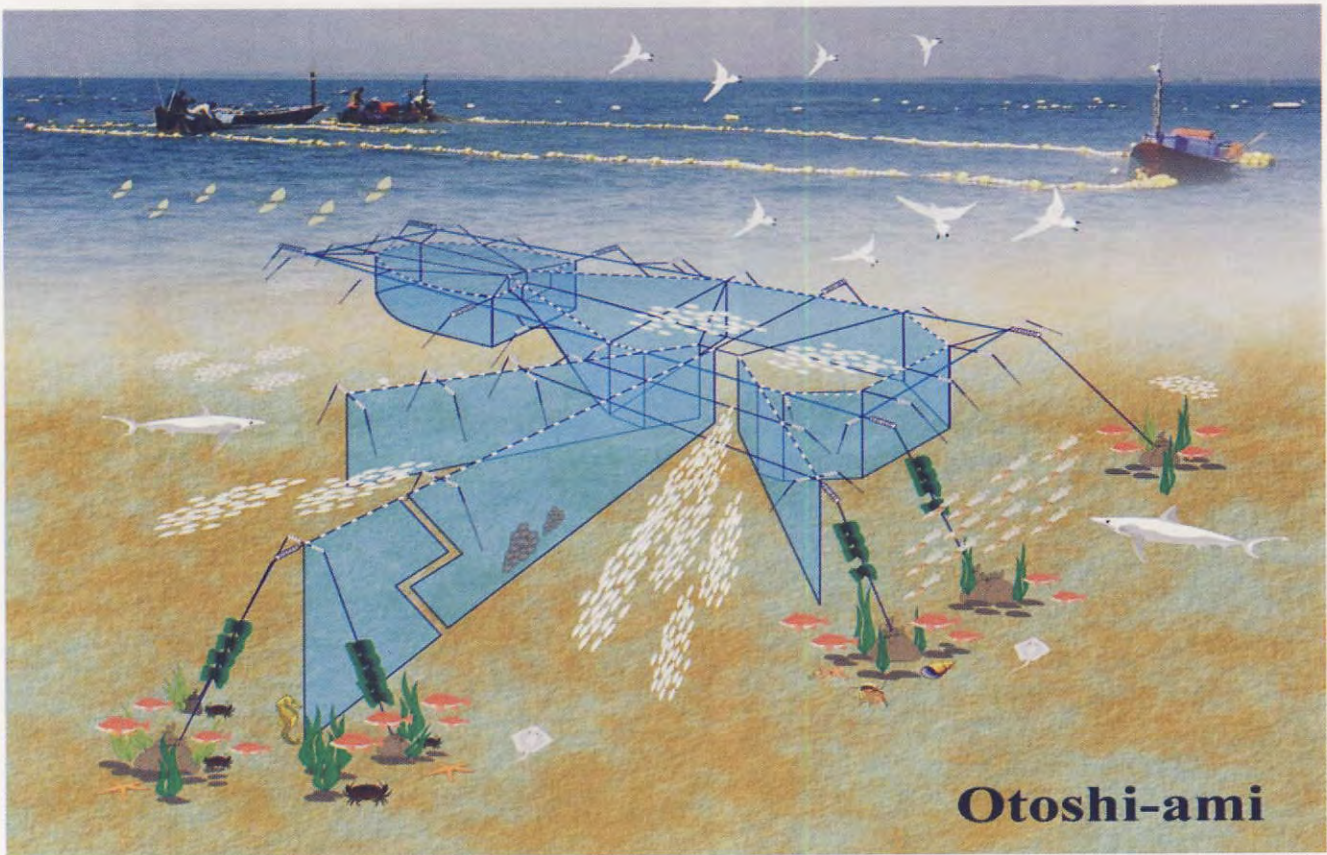
Pre-survey on board



Pre-project establishment meeting



Type of Set-Net



Gear construction and fishing operation



Technology improvement



Developed plan of Otishi-ami



Chamber adaptation

Project Responsibility Transfer From Original owner to the Fisher Group



Project transferring

PART II : Project Outcome

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• Environmental Impact	36-41
• Socio-Economic Impact	42-44
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Sustainable Fisheries Impact

Set-Net : An Environment Friendly Fishing Gear for Sustainable Coastal Fisheries Management
From SEAFDEC Newsletter Vol. 30 No. 3 Jul. – Sept. 2007

Most coastal fisheries resources of the developing countries including the Southeast Asian countries are overexploited because of the high demand for fishery products and the modernization of fishing technology. Moreover, since most coastal fisheries in the region are small scale fisheries, coastal fishermen are vulnerable to competition and are often confronted with the conflicts in fishing operations with the decreasing resources. In order to cope with such realities, it has become urgent for fishery management authorities to consider and develop various alternative approaches to the existing fishery activities and management considering such real problems in fisheries.

One approach promoted by SEAFDEC to address the critical problems faced by the region's coastal fisheries is the adoption of set-net fisheries. In 2003, SEAFDEC/TD promoted the use of set-net as an environment-friendly and energy saving fishing gear through a pilot project implemented in Rayong Province, Thailand. The project, which received funding from the Government of Japan Trust Fund Program, was a collaborative effort among the small-scale local fishermen of Rayong Province, SEAFDEC and the Fishery Agency of Japan with technical assistance from the Himi City Fishery Agency and Tokyo University of Marine Science and Technology (TUMSAT). Lessons learned from the outcome of the pilot project could be useful for the other countries in the ASEAN region in carrying out their respective activities related to sustainable fisheries management and resources conservation.

Project Objectives

The SEAFDEC/TD pilot project in Rayong Province was generally aimed at promoting the set-net as a tool for sustainable coastal fisheries management. Specifically, the project aimed to introduce the set-net fisheries as means of reducing the fishing pressure on coastal fisheries resources; alleviating the fishing competition among the fishing gear types; organizing group cooperation for fishing operations; developing a common policy concept for coastal fisheries management; and enhancing the community's concept on coastal conservation.

The Set-Net

Set-Net is a stationary fishing gear which could function as an effective tool for coastal fisheries management. Its function and catching mechanism is similar to the bamboo stake trap but differs from it in the construction. The set-net has been considered an appropriate management approach to address the region's declining coastal fisheries resources, e.g. the decreasing fish catch from the Gulf of Thailand and the Andaman Sea. The introduction of Set-Net fishing is therefore primarily aimed at promoting responsible coastal fisheries management and conservation of the coastal fisheries resources and the fishing grounds.

An Otoshi-ami type of net which is 30 x 150 x 250 meters in size, the set-net used in the pilot project was installed in the 13-meter deep coastal waters of Mae Rumpheung beach in Rayong Province and operated by a group of fishermen from the small-scale fishers group in the project area. Set-net fishing operation is done during the day-time by 9-11 fishermen using 3-4 small-scale fishing boats (6 m long). Their catch comprises mackerel, sardines, travelly, squid and other fishes. The members of the fishers group participating in the project were also trained on the basic concept of fisheries cooperative mechanism and concepts on sustainable fisheries management.

Project Outcome

Results of the pilot project proved that the set-net fishing gear is environment-friendly while promoting cooperation among the local small-scale fishermen. The set-net also serves as means of improving the incomes of the fishermen and also performing well as a resource conservation tool. The set-net can be used in coastal fishing grounds with due consideration to the environment and especially in protecting the bio-diversity of the coastal areas and conserving the fisheries resources. From the feedback of the small-scale fishers group participating in the project in Mae Rumpheung beach, there was maximum satisfaction in the adoption of the set-net fisheries by the fishers group during the four years of the project implementation.

Environment-Friendly Fishing Gear

Having no impact on the environment since it does not release wastes into the environment, the set-net is therefore considered an environment-friendly fishing gear. A set-net fishing operation also does not cause any harm on the fisheries resources. While the set-net serves as fishing ground protector from other active fishing gear such as the trawlers and luring light fishing gear, it also enhances the coastal resources around the set-net area making it an environment-friendly fishing gear. From the observations made during the implementation of the pilot project, the bio-diversity around the area where the set-net was installed has been preserved and protected.

Local Fishermen Group Participation and Capacity Building

The operation of set-net fisheries promoted the establishment of a small-scale fishers group, which conducts a form of cooperative fishing since about 10 fishermen are involved in every set-net operation. In the implementation of the project, community participation has been promoted as demonstrated when 40 volunteer fishermen from the project area constructed the set-net fishing gear which they completed in two months.

During the launching ceremony of "Set-Net Experimental Project" in July 2003, about 85 small-scale fishermen and their families from seven fishers groups took part in the ceremonies where the concept of coastal resource management using the set-net was presented and explained in details. As a result, some members of the Administrative and Management Committee of the fishers groups that were set-up by the project agreed to manage the activities of the fishers especially the operation of set-net fishing.

During the implementation of the pilot project, cooperative management system was introduced gradually including the concepts of sustainable coastal fisheries and fisher group establishment and development. Thus, the concept of group cooperation management of the fisheries resources became clear to the fishermen turning the set-net fishing activity as a cooperative venture in fisheries proving that collaborative activities in the set-net area of the coastal fishing grounds could be promoted. Moreover, the operation of the set-net also serves as capacity building for the fishermen raising awareness on environmental issues and the protection of the marine resources. The fishermen became aware of the status of the fisheries resources and on how they could help conserve such resources through the use of responsible fishing practices.

In addition, the managerial skills of the fisher group members through the Administrative and Management Committee have been enhanced as shown in the successful management of their members who showed willingness in accepting the technological innovation which is the introduction of the set-net. The Committee also made efforts to optimize the commitment of the members in the project and boost the solidarity among the fisher group members.

Economic Growth through Increased Income

In the project area, the set-net fishing operation has contributed significantly to the economic growth of the beneficiary fishers group in Mae Rumpheung. Firstly, being an Otoshi-ami type of gear, the set-net is also an energy saving fishing gear since the fishers spend shorter period of working hours at sea (3-4 hours/day). Being stationary, the set-net therefore saves on energy especially during the current high-oil-price crisis.

Secondly, it was noted that during the implementation of the project, the fishers group was able to deposit part of their income in the amount of 216,119 Baht in 2005 which they reserved for their operating funds. Comparing their outputs in 2004 and 2006, it was noted that the average income per day-trip of a fisherman was increased from 5,000 Baht to 6,500 Baht although the average catch per day-trip decreased from 255 kg to 215 kg.

The good quality of their catch led to the better prices coupled by their efforts to increase the catch value through better fish handling techniques and marketing strategies that the fishers learned from the project. The fishers were also able to earn additional income by doing part-time fishing around the set-net area (e.g. about 300-400 Baht/day from squid jigging). Indeed, fishing near the set-net area becomes a year-round activity.

Environment Conservation Tool

The continuing exploitation of the fisheries resources through irresponsible fishing practices by some unconcerned fishermen due to the worsening poverty situation in the coastal areas make it necessary for fisheries administrations to give more focus on fisheries resources management. The set-net fishing gear proved to be a tool for resources conservation as it serves as protector of the fishing grounds because commercial fishing gear such as trawler, purse seine, luring light fishing gear, etc. are kept away from the set-net area. The installation of the set-net makes it impossible for such commercial fishing gear to operate in coastal waters. As a stationary fishing gear, the set-net can also be an enhancement gear because the marine resources can live and survive around the set-net area. Moreover, the set-net area also serves as zone for resources rehabilitation and fish spawning as shown from the result of a survey which indicated the presence of juvenile marine resources around the area.

Picture description



Otoshi-ami type of set net and Local fishermen's participation in set net preparation



Set net operation and fish products from set net



Marine resource rehabilitation around set net area

Environmental Impact

by Taweekiet Amornpiyakrit

Environment friendly fishing Gear

Set-net is considered as an environment friendly fishing gear due to its passive capture mechanism, waiting for migratory pelagic species to enter and captured in the final chamber. It does not also release any wastes into the environment in the capture process. With comparison to the Thai traditional bamboo stake-trap, Japanese type set-net construction is composed of synthetic fibers and materials, while the bamboo stake trap's structure is based on the natural materials as bamboos and timbers. Set-net can greatly reduces the use of those materials which are now diminishing. To help protect the forests and mangrove trees, using the synthetic materials in some parts of the bamboo stake-trap or fully replaced, can be an alternative, yet easy handling and replacement. In case of mesh size of netting panels used in the set-net, its proven showed that during the implementation of the project, there was no incidental catch of dolphins, or other marine mammals in any parts of the set-net. However, sea turtles may have a chance to enter through the final chamber, but there is no possibility to be entangled due to the fined mesh (1 inch) and opened surface of the chambers. Using mesh size less than 1 inch is not allowed in this experimental project and probably set up as a regulation for the future use in Thailand. In the final stage of capture process, fishermen can release unwanted-catch without any loss.

Environment Conservation Tool

The continuing exploitation of the fisheries resources through irresponsible fishing practices by some unconcerned fishermen due to the worsening poverty situation in the coastal areas makes it necessary for fisheries administrations to give more focus on fisheries resources management. An introduction of Japanese type set-net has been proved to be an alternative tool for coastal resources conservation as it serves as protector of the fishing grounds. The installation of the set-net can be a resources enhancement gear because the marine resources can live and survive around the set-net area. Moreover, the set-net area also serves as a zone for resources rehabilitation and fish spawning as shown from the results of the surveys which indicated the presence of juvenile marine resources around the area.

Fishing ground protection

The active commercial fishing gear such as bottom trawlers, purse seiners and fishing boats with luring lights are kept out of the set-net area or at least the realize the existence of set-net in the certain area. Disturbance or encroachment from them was rarely found during the experimental period up to the present. Small-scale fishermen can utilize and harvest the resources in the set-net area by having fishing activities such as squid jigging, fish angling for an alternative income.

Resources enhancement

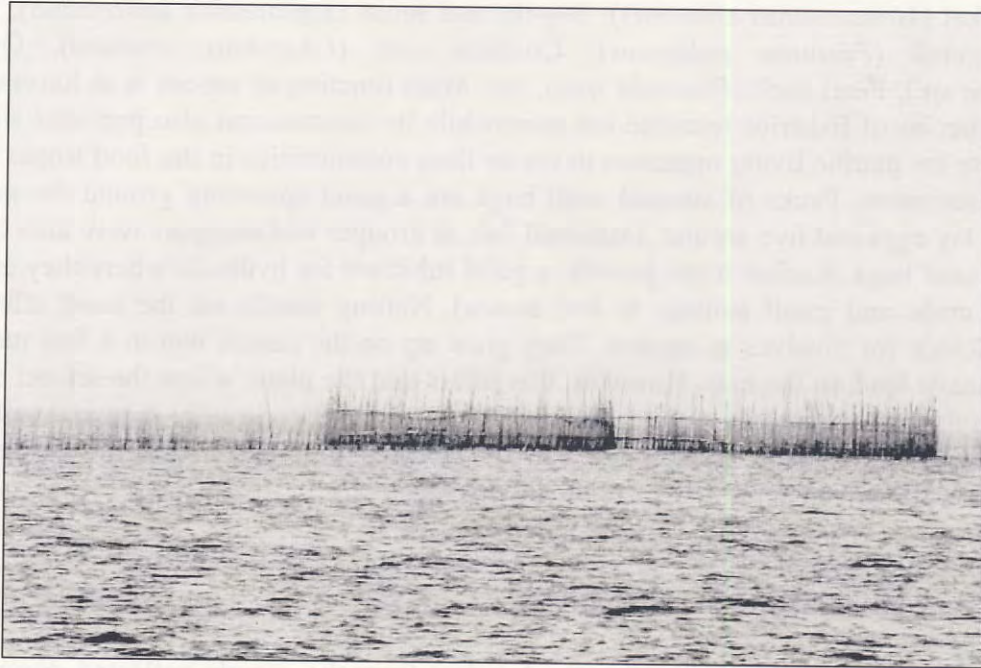
Varieties of catches were found in the hauling of set-net and hi bio-diversity of living organisms was also seen on and around set-net construction by underwater observation. The survey study showed that during the existence of set-net many fisheries resources have been

created on and around the set-net construction such as Yellow-striped trevally (*Selaroides leptolepis*), Siganid (*Siganus spp.*), Gar fish (*Ablennes hians* and *Tylosurus acusmelanotus*), Leather jacket (*Monacanthus chinensis*), Big-fin reef squid (*Sepioteuthis lessoneana*), Blue swimming crab (*Portunus pelagicus*), Cruciata crab (*Charybdis cruciata*), Oyster (*Crassostrea sp.*), Pearl shell (*Pinctada spp.*), etc. Main function of set-net is to harvest the migratory species of fisheries resource but meanwhile its construction also provides shelter and substrate for marine living organism to create their communities in the food tropic level of nature ecosystem. Packs of stacked sand bags are a good spawning ground for squids where they lay eggs and live around. Demersal fish as grouper and snappers were also found around the sand bags. Anchor ropes provide a good substrate for hydroids where they attract small fish, crabs and small animals to live around. Netting panels are the most effective attracting device for bivalves as oysters. They grow up on the panels within a few months causing a heavy load on the nets. However, this infers that the place where the set-net exists is rather productive. Great varieties of marine organisms can be virtually seen and utilized. An alternative on the clam aquaculture can be created simultaneously with the set-net operation as well with an appropriate design and management.

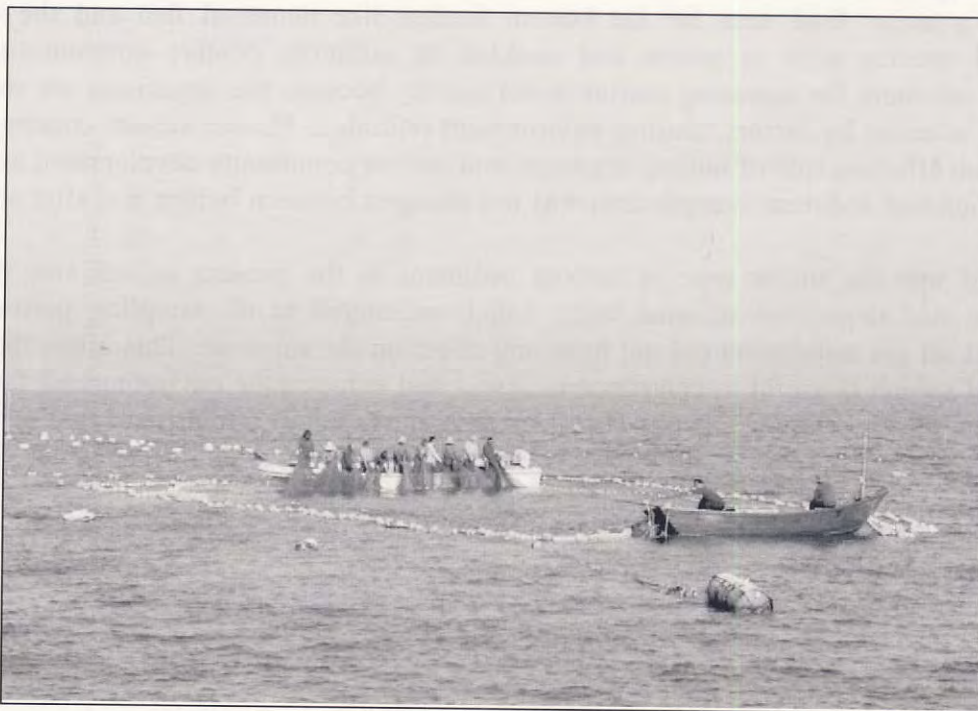
Fouling organisms and bottom community development

Benthic organisms were found very abundant from the sample collected during the set-net in operation period and showed a decline tendency after retrieval of set-net (in monsoon season). This shows that set-net has positive effects to the benthic animal as they increased both by species and numbers. Polychaetes and crustaceans were dominant benthic species during set-net installation while other periods were less. Benthic organisms are considered a major food item for the bottom feeders like demersal fish and the other commercial species such as prawn and cockles. In addition, benthic communities as biological indicators for assessing marine water quality because the organisms are mostly sessile and affected by factors causing environment pollution. Hence, set-net construction could play an effective role of fouling organism and bottom community development as well. Sedimentation and sediment composition was not changed between before and after set-net installation.

Sand was the major type of bottom sediment in the present set-net site. Type, composition and deposition of sand were found unchanged in all sampling periods. It showed that set net installation did not have any effect on the substrate. This infers that the existence of set-net is useful to contribute to assess and enhance the environmental factors. Study on the physical factors change such as temperature, salinity, transparency and water current proved that there was no difference between before and after setting of the net.



A traditional bamboo stake trap installed at a depth of approximately 10 m for capturing pelagic species operated in Chonburi Province).



Newly introduced Japanese type set-net operated in Rayong Province (13-15 m water depth), applying a combination of synthetic fibers and materials which last longer and friendly to the environment (Right). Set-net can greatly reduces the use of timbers, mangrove forests and bamboos compared to the traditional stake traps used in Thailand.



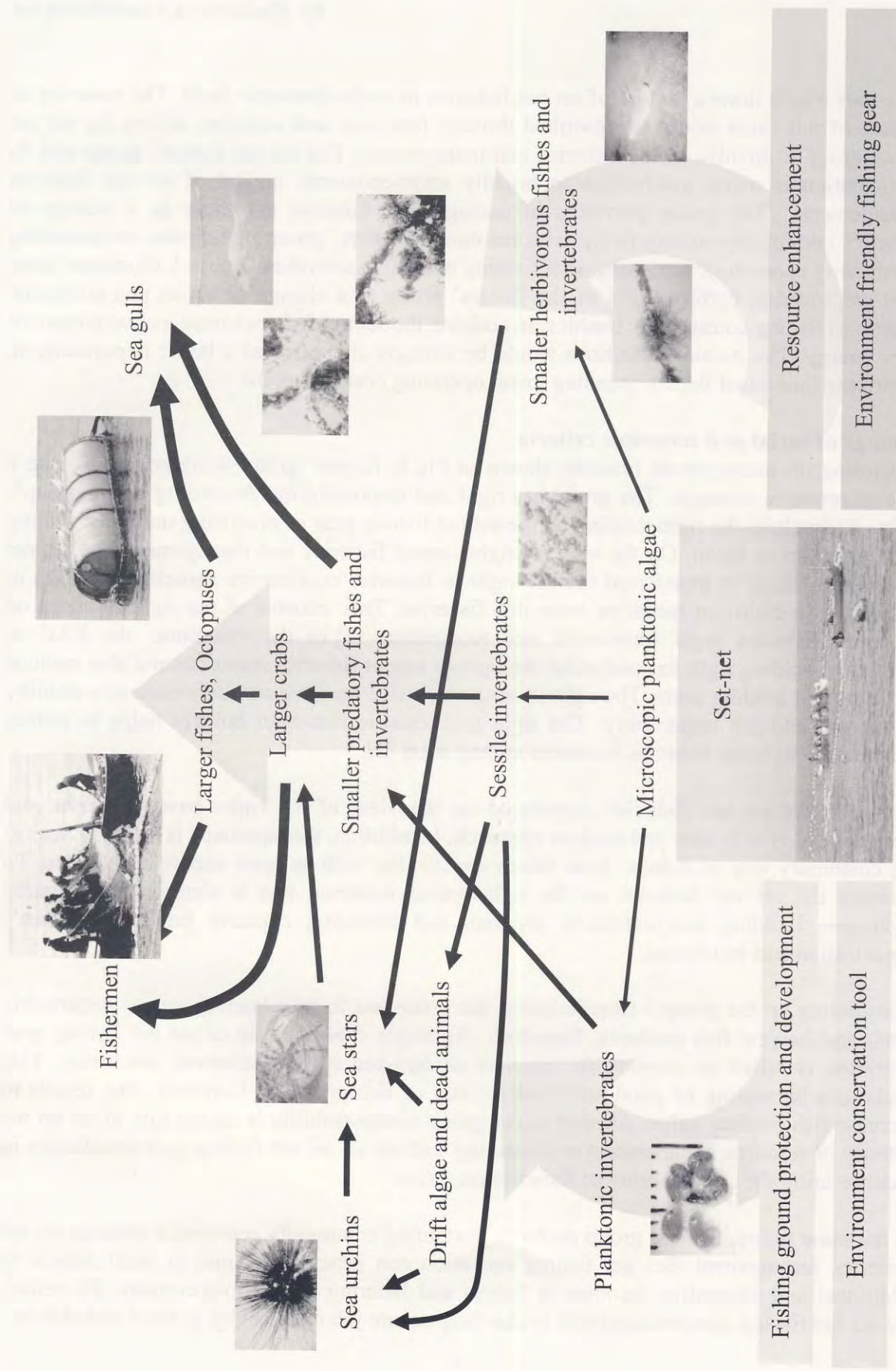
Stacked sand bags and rigged anchor ropes provide nursery and feeding grounds for juveniles and demersal species, meanwhile keep them away from commercial fishing boats like trawlers and purse seiners.



Fouling organisms (such as oysters, hydroids) are commonly found growing up on the netting panels of set-net and can be a good feeding place for fishes and crabs.



Selective manner can be performed during hauling process to avoid capturing unwanted species or size specific in Set-net fishing operation.



A diagram of a food web in the set-net in tropical area.

Socio-economic Impact

by Phattareeya Suanrattanachai

This part would draw a picture of set net fisheries in socio-economic facet. The meaning of impact of this facet would be described through functions and activities driven the set net fisher group to involve in the fisheries and management. The set net fishers' group and its participation is major mechanism to broadly socio-economic impact of set net fisheries management. The group performs in management function assuming as a change of fisheries community society to fisheries resources. Fishers' group participates in sustaining community economics supposing as activating economic activities. Figure 1 illustrates basic dual empowering performances of the fishers' group to a change of social and economic criteria in fishing community. Besides, In addition the set net fisheries have a clear picture of save energy. The picture reflections would be strongly supported as a better opportunity to contribute individual fishers spending lower operating cost of fuel oil.

Change of social and economic criteria

Regarding on management function shown in Fig.1, fishers' group is supposing to take a role as resource manager. The group has right and responsibility. According to the group's right, it can claim the right holding on the set net fishing gear as practicing under the fishing right program in Japan. On the view of rights-based fisheries and management, the set net fisheries in Japan is transferred the use right to fisheries cooperative association (FCA) or individual to claim an incentive from this fisheries. This transfer of the right is based on Japanese fisheries legal framework and recognition [1]. In the meantime, the FAC or individual holding right has particular the right to access fisheries resources and also exclude the non-right holding users. The right to access fisheries resource certainly ensures a stability of income and job opportunity. The right to exclusion non-right holders helps to reduce competition in using fisheries resources among users [2].

However, the set net fisheries considered on the view of the rights-based fisheries and management is very new and modern approach. In addition, this approach is strongly against the customary way of fishers' lives which are familiar with an open access in fisheries. To promote the set net fisheries on the rights-based fisheries, this is significantly required awareness building and extension program and including capacity building of user's organization and institution.

Considering on the group's responsibility, the group has to take leading role to responsibly catch and harvest fish products. Therefore, the major characteristic of set net fishing gear operation is relied on responsible fisheries on targeted species selective sensitivity. This leads to a harvesting of good and fresh quality of fish products. Certainly, this results to increase fish product value. Another is the group's responsibility is taking role to set up the activity of resource enhancement with making full use of set net fishing gear installation in order to bring the sustainability of fisheries resources.

In the same figure, fishers' group performs sustaining community economics towards set net fisheries management. Set net fishing operation can generate income to local fishers as additional and alternative incomes to fishers and laboring fishers, respectively. Therefore, the set net fishing gear management is also help secure job opportunity to local stakeholders

like fishers laboring fishers, fish traders and fish retailers. The special characteristic of fish product is particular freshness helped to promote fresh fish marketing channel.

Save energy

The installation of set net fishing gear is located very near to coastal area within distance of three kilometers from the shoreline. As its location is so close to the shoreline, the set net group members shortly cruise their boats to harvest fishes. Therefore, this fishing operation does not move around the sea to hunt fishes as other type of traditional fishing gear likes crab gill net, shrimp gill net and fish gill net. Such kinds of gill net are usually spent higher amounts of oil for cruising than the set net fishing operation. Therefore, the group members pool using fishing boats to go fishing together. This is additional reason to save energy and cost to operate the set net fisheries. This reason is strong point to promote set net fisheries operation and management.

Conclusion

The set net fisheries and management is an alternative way to tangibly develop local fishers' participation in more modern type of fishing gear with responsible manner. Regarding on fishers' participation in set net fisheries management, fishers have received a good lesson and experience to balance fish demand and supply through daily harvest to get better and more reasonable benefit. Besides, fishers have learnt to carefully plan to go fishing with effective means. This practice is displayed that fishers' performance is in cost and return management to maximize the group member's benefit. A better benefit coming from the set net fisheries is major factor to gradually facilitate the current group member to longer encounter in the set net fisheries and management. Recently, the group members have shifted the status of the group from fishers' group to be small business enterprise.

Remark

Reference [1] Morisawa, M., Short, K. and Yamamoto, T.1991.

Reference [2] The World Humanity Action Trust.

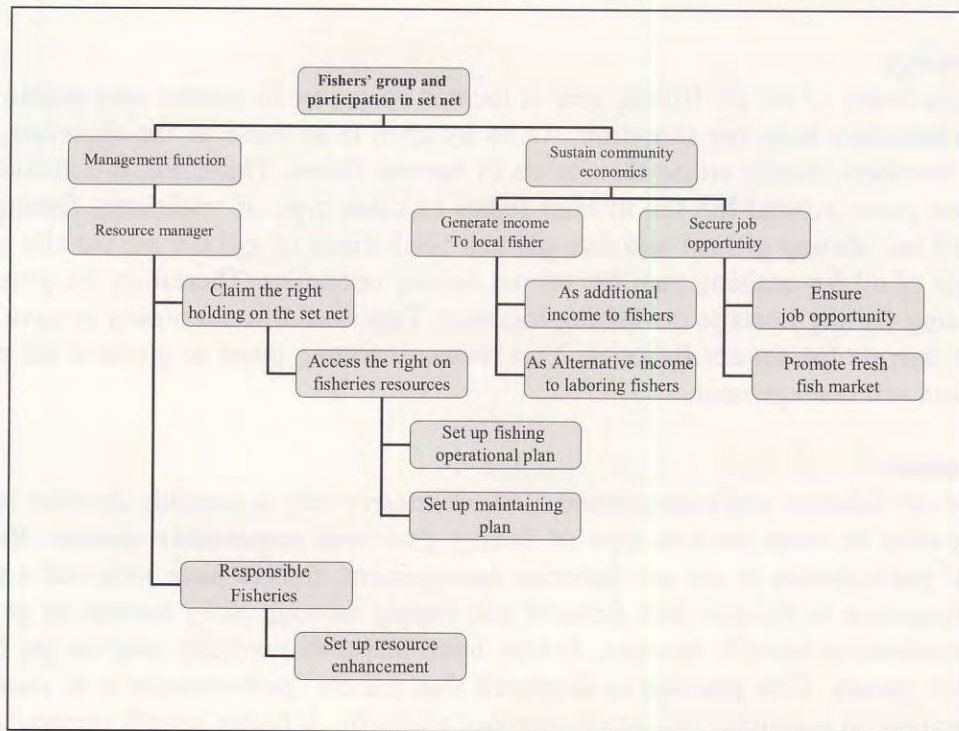


Fig.1 Fishers' group and participation in set net fisheries to change of social and economic criteria in fishing community.

Cooperative Management

by Pattaratjit Keawnurachadasorn

This part review cooperative management aspect in the set net activities as it is one of the project objectives. As the set net is a collaborative work that is needed the good participation among members and good administrative management. This part provide an overview in the development of the set net fisher's group in Mae Rumphueng, catch distribution and marketing as well as cost benefit management.

The Importance of group cooperative

It is likely that local fishermen in the Southeast Asian Region, in particular small scale fishermen are engaged individually subsistence fishing. For the implementation of set net fishery, which is a kind of joint work, requires a lot of manpower in constructing, deploying, operating, managing and maintaining the gear, the necessity of organizing fishermen group, collective work, and management in fisheries operation is, therefore, concerned. Like, the set net project introduced to Mae Rumphueng small-scale fishers who voluntarily participated in the project, a path of their working has been changed. The set net operation can be carried out effectively according as members have to learn and follow with the conditions of the group. In addition, if fishermen who engage in the set net project understand the importance of collective approach and have well practices, the group will be strong and strengthened in which can be developed to be fisheries cooperative in the future for sustainable fisheries development.

The development of the set net fisher's group

The Set Net fisher's group is a key body in acting as a part of the set net collaborative frame work and good participation among members can be generated the effectiveness of the project implementation. In the Mae Rumphueng, for example, they have gradually come about the learning process from lesson learnt and experiences from the past. The structure of the organization chart in the Mae Rumphueng set net fisher's group, therefore could be reorganize for appropriation, accordingly. Moreover, the existing members are the people who are capable to follow the group condition, as it was required in the kind of group work fishing.

At the beginning of the project, various activities and information were input to the member. The groups were divided into 7 fishing group, according to number of fishing village and leading by group leader of each village (Fig.1). Later on, the first "Mae Rumphueng Beach Set Net Fishing Group Committee" was set up in September 2003. They performed their function to carry out the set net implementation by self-learning and leading by the chairman. According to the study by Suanrattanachai et al. 2008 [1], revealed that the job description of the former committee still had not clearly defined. They experienced and learned by their own to justify their role and function to support the group administrative and management. However, the administration and management system had not been yet in systematic and several troubles occurred in the first year.

From the problems found in the first year of operation, 26 members remained in the set net group in the 2nd year of the project, which started from October 2004 to April 2005. According to lesson learnt and advice from the working group, the process was changed and the committee chart was reformed as shown in Fig. 1B. The working team was divided into two groups and operated by rotation. The committee members have specific function. Some

problems were solved such as locating a landing place only at Ban Pa Kan and recording system when they are on duty. The catch report was improved, and the gear maintenance was also carried out systematically. It seemed that the management system was improved.

After the completion of the project in 2005, it was transferred to local fishers under the assistance of DOF, with support funding by JICA. In the 3rd year of the project, 11 remaining in the set net group. The management system has been well improved from the past years. They have learned and experiences in the set net operation and management system. Consequently, new leader was elected by the committee members.

Catch distribution and marketing channels

The catch distribution and marketing channel is one of the key components that the set net fisher's group should be considered. For the Mae Rumphueng set net fisher's group, at present, after finishing the set net operation each time, the catches are identified and separated by fish species at the sea, and landed at Village no.9 (Ban Pa Kan). The catches are mainly distributed to fish retailers, tourists, fish traders, as well as to Ban Phe Fresh market. The marketing price of fish catches depends on fish species and quantity in each day. Besides the marketing plan for catch product, the group should also consider the catch management such as value added catch, if the fish is excessive in a day.

Cost Benefit Management

Cost benefit management is important part for the cooperative management of the set net fisher's group, which is required clear and transparency in the set net fisher's group. The lesson learnt and experiences from the implementation of the Mae Rumphueng Set net fisher's group, finally could come up as in Fig.2, inputs of the set net operation are composed of fisher group investment, project investment (materials and project implementing cost, fishermen investment (fishing effort, maintenance cost, construction cost, operating cost) and fishing boat hire cost. According to the set net operation, net income is total income deduct operation cost as mentioned. This net income will be divided into operation and maintenance fund for the following year (40%), provident sharing of member (50%), incentive spending for administrative committee members (5%) and public administrative fund (5%), which the committee shall allocate for this divided payment to members annually.

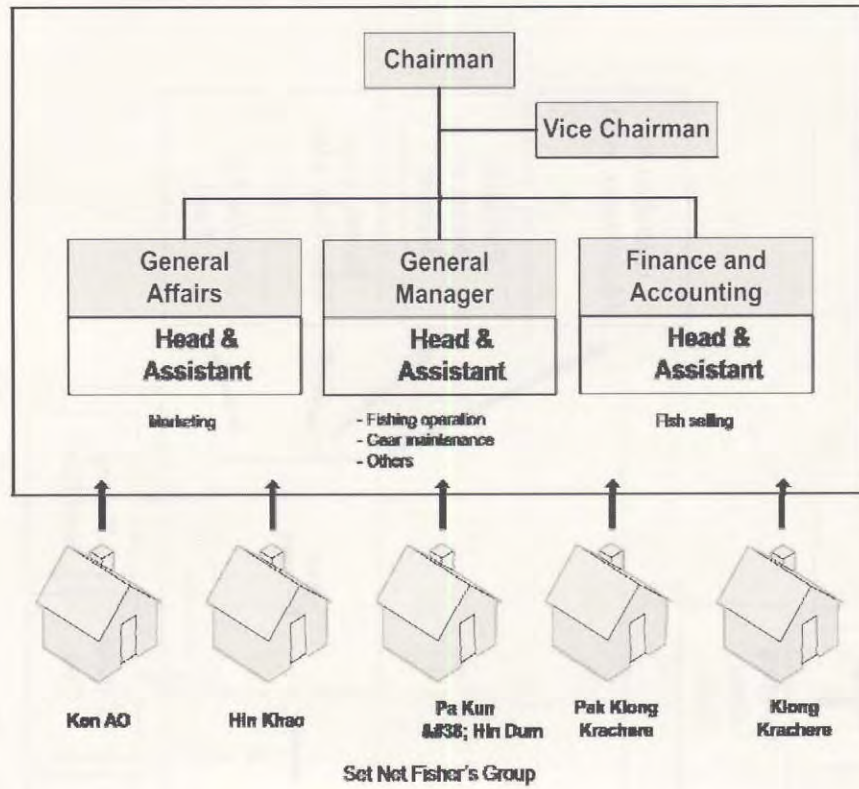
Since the set net installation, there have agreement among group member for the payments for workers. They are paid 200 baht per a trip if members attain in fish operation, pay for rental boat 100 baht per a boat. In practical, workers received only 100 baht because low incomes which were not enough to pay for working force according to agreement. Even though, the cost benefit management was unsystematic in the past, at least in the present, the group is able to show that it has better and clear accounting. As the group has deposited the benefit in saving account, and has registered as a member of local organization.

Remark

Reference [1] Suanrattanachai P., P. Kaewnuratchadasorn and N. Thapthim, 2008.

**Mae Rumphueng Beach Set Net Fishing Group Committee
2003**

A.



**Mae Rumphueng Beach Set Net Fishing Group Committee
2004 - present**

B.

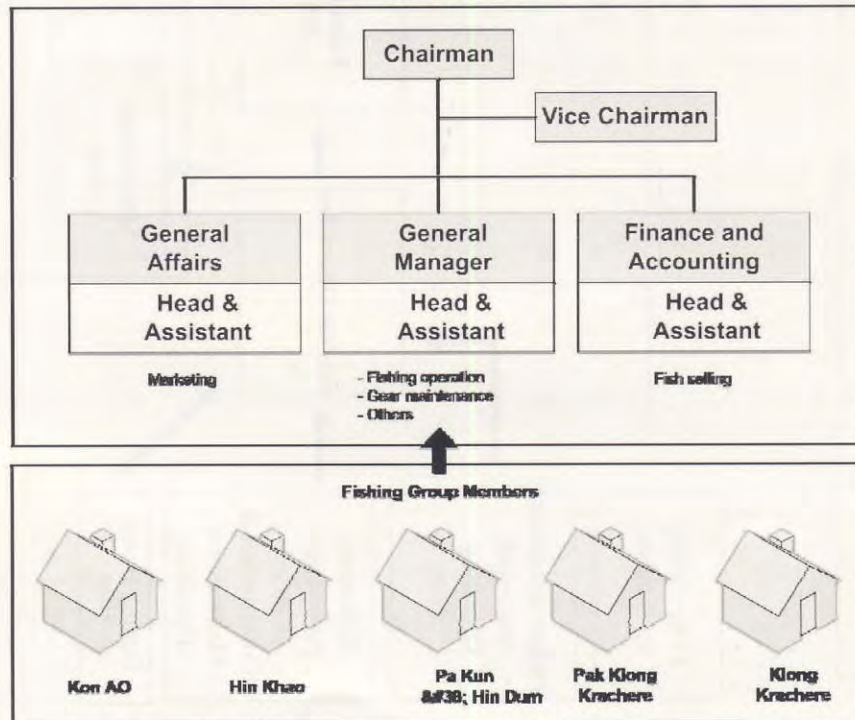


Fig. 1 Organization Chart of set net fisher's group: example of the Mae Rumphueng Beach Set Net Fishing Group Committee: A) in 2003, B) in 2004- present

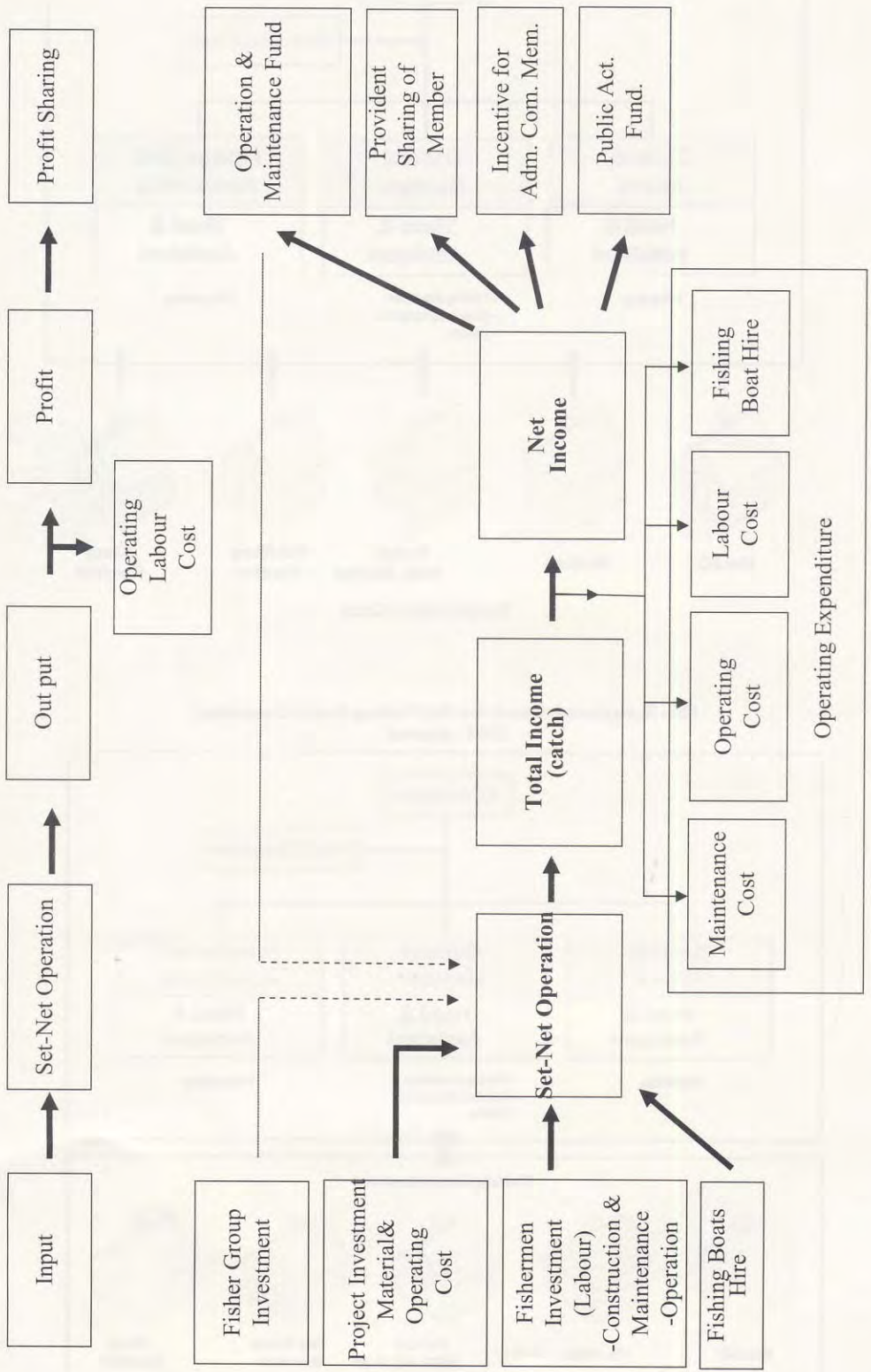


Fig. 2 Administrative Cost Management of fisher group in the set net project

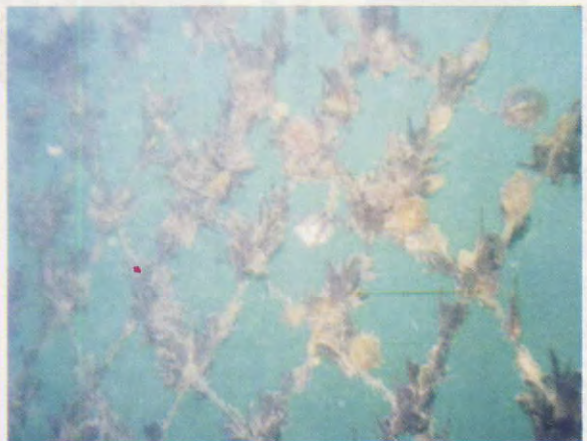
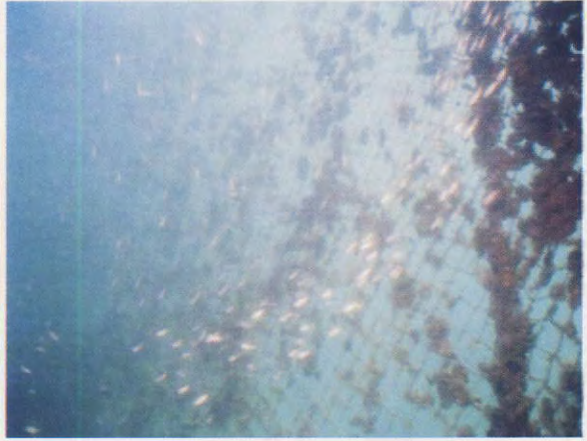
Sustainable fisheries impact



Social and group cooperation impact



Environmental impact



Mae Rumpheung Set-Net Fisher Group Administrative Management Committee Rayong Province in 2007



Conclusion and Recommendation

The Baygora 2007 project had been completed in October 2007. The Working Group and several members of the Baygora 2007 project team, including the project manager, the project sponsor, the project steering committee and other participants, held a meeting to discuss the project's progress and to identify the next steps. The project was successful in its objectives and the project team is proud of their achievements.

PART III : Project Conclusion

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• Conclusion and Recommendation	54-57
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Conclusion and Recommendation

The Rayong Set-Net project had been evaluated two times, first in October 2004, by project Working Group and second in November 2004, through the technical seminar with many valuable comments and suggestions from specialists and related participants. So in conclusion we could say that the project was satisfactory at the beginning stage which it could meet with the objectives item by item as follows:-

1. **Set-Net is an appropriate fishing gear, which could be used in the coastal fishing ground** with consideration of the environmental condition and community participation.
2. **High bio-diversity of fisheries resources are found in the catch of Set-Net** and occurred on and around set-net construction. **Fisheries resources in the coastal fishing ground could be enhanced by Set-Net fishing gear installation too.**
3. Almost of the **catch from Set-Net are good quality, fishermen could increase their catch value** by improving their fish handling techniques and marketing management. **Fishermen in the project are now being learnt and trained through their practical work in the project** with appropriate advice from experience persons (project's experts and advisors).
4. **Fishermen in the project have started learning and practice in the group cooperation and management, which it could be developed to be a cooperative in future.**
5. **Fishermen in the project have gained more knowledge on fisheries resources of their coastal fishing ground and think about how to deal with those resources under responsible manner of the group.**

We are on behalf of Working Group of the project would like to recommend that:-



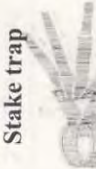

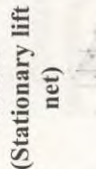
1. **Set-Net is an applicable fishing gear to promote coastal fisheries management and resources enhancement.**
2. **Set-Net fishing management should be handled by small-scale fishermen group and/or local responsible agencies such as fisheries association and cooperative.**
3. **Local government agencies should give support to the fishermen group's activities.**
4. **In order to develop an appropriate fishing techniques for the Tropical waters, Set-Net fishing should have more study to reduce the operation and maintenance cost, reduce immature catch and also increase fishermen income by value added of the catch and make use of unexploited resources.**

Set-Net fishing was concluded in many meeting seminars and in the last regional workshop in December 2007 at Eastern Marine Fisheries Research and Development Center (EMDEC), Rayong Province. Participants from SEAFDEC member counties and resource person from Japan, Taiwan and the Philippines had given a lot of useful information, contributed their ideas and comments to the discussion on "the use of Set-Net fishing gear as a tool of coastal fisheries management in the region". Information and starting ideas on stationary fishing gear in the Southeast Asia was compiled as the following tables.

Present situation of Stationary Fishing Gear in Southeast Asian Region

Southeast Asia Countries	Stationary Fishing Gear						Remark How many units for Otoshi-ami? How many years ago?
	Fyke Net	Shallow Water Stake Trap	Deeper Water Stake Trap	Set-Net Otoshi-ami	Other		
1. Brunei Darussalam	none	Lintau, Tabeh, Kabai	Tugu, Kilong	none	(Lift net) Kilong	For inland fisheries and coastal	
2. Cambodia	Dai	Lop-Nov-Rao, Phong Phang	none	none	Lift net		
3. Indonesia	Togo, Gombang	Kelong, Balat	none	*Otoshi-ami	(Lift net) Jermal	*Just start the Project	
4. Japan	Hari-ami, Machi-ami	Sudate or Eri	none	34,000 (Otoshi-ami)	-	There are various type of set-net in Japan.	
5. Myanmar	Kyar-pa-zut	?	?	none	Sandard Garphong-		
6. Malaysia	Gombang, Ngian	Kelong, Kering	Kelong	none	(Lift net) Kelong		
7. Philippines	Tangad	Bakatot, Baklad	Baklat	* 89 Lumbaklad	?	* Over 40 years Experience	
10. Thailand	Pongpang	Poknumhaeng	Poknumloog	* 2 Pokcheung	(Lift net) Yoy, Bam	* , 50,24 years ago of 1 st & 2 nd trail had been conducted. Now 4 years Experimental stage	
11. Vietnam	Day	Lo, Sao	none	?	(Lift net) Voden		

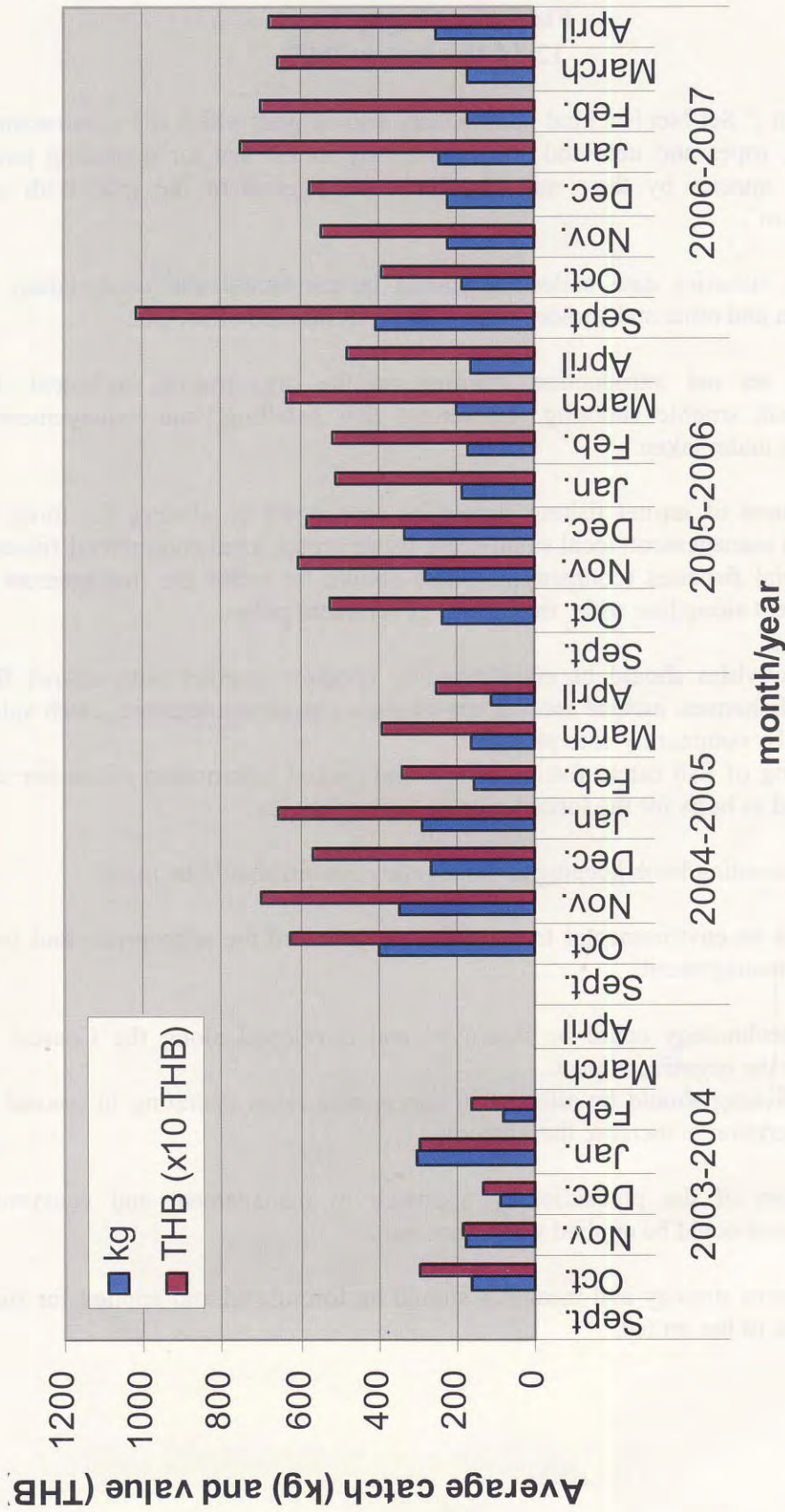
Characteristic of Stationary Fishing Gear in the Southeast Asia

Factor Gear	Fishing Ground	Target Catch	Capture function	Mixed-catch condition	Resource Enhancement Effect	Environment Impacts	Management	Regulation
Fyke net 	River and river mouth area	Small shrimp	Filtering with river flow, current flow	High with juveniles	None	Negative	Traditional operation	Banned, Illegal operation
Shallow water Stake trap 	Close to the shore inter-tidal zone	Shrimp	Tidal current and barrier	High	None	Negative	Traditional operation	Approved area, More illegal operation
Deeper water Stake trap 	Deeper water away from shore over 5 meters depth	Small pelagic fish in the coastal	Migration behavior and barrier	Low depending upon mesh size	Demersal and Habitat species	Positive	Individual ownership	Approved area and Licensing
Set-Net Otoshi-ami 	Deeper water away for shore over 5 meters depth	Small and big pelagic, highly migratory	Migration behavior and barrier	Lower depending upon mesh size	Demersal and Habitat species	Positive	Cooperative and Private management	License, Study, Experiment and Promotion stage
Others (Stationary lift net) 	River bank, River mouth and Coastal water	Pelagic species	Light & bait attracting	High depending upon mesh size	Negative	Less	Traditional operation	Licensing and none

**Recommendation from the Regional Workshop on
Set-Net Fishing Technology Transfer for Sustainable Coastal
Fisheries Management
12-14 December 2007**

1. Definition ;” Set-Net is a kind of stationary fishing gear which it’s construction consist of floats, ropes and nets and set permanently in the sea for collecting pelagic and demersal species by their migration behavior against to the gear with entrapped mechanism”.
2. Baseline fisheries data collection should be conducted and consultation with the fishermen and other stakeholder prior to the introduction of set-net.
3. Prior to set net introduction, training on the organization, technical, financial, operational, trouble shooting, marketing, fish handling, and management aspects should be under taken.
4. Management of set-net fishing should be considered in advance for three levels of operation management, local small-scale fisher group, local commercial fisherman and commercial fisheries (company). These should be under the management of local government along line with the central government policy.
5. Others activities should be encouraged to conduct together with set-net fishing to increase fishermen income such as eco-tourism, marine aquaculture, catch value added products by community enterprise, etc.
6. Monitoring of fish catch, fishing efforts and related information of set net should be conducted as basis for the formulation of future policies.
7. Good accounting/book keeping and budgetary system should be made.
8. Set-Net is an environmental friendly fishing gear and the appropriate tool for coastal fisheries management.
9. Set-Net technology could be improved and developed along the Coastal water to minimize the negative impact.
10. Set-Net fishing should be allowed in appropriate areas operating in coastal water in group operation to increase their income.
11. Application of the precautionary approach to management and ecosystem-based management could be applied when necessary.
12. Management strategy and measures should be formulated and applied for sustainable operations of the set net.

The average catch and value in month/year



Four years catch of Rayong Set-Net project

Main catch of Rayong Set-Net



Yellowstrip scad (*Selaroides leptolepis*)



Round herring (*Dussumieria* sp.)



Gar fishes (*Tylosurus* sp.)



Indian mackerel (*Rastrelliger kanagurta*)



Indian threadfish (*Alectis indicus*)



Black pomfret (*Parastromateus niger*)

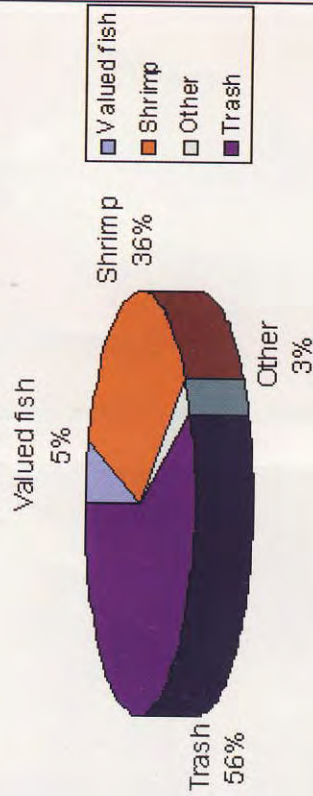


Barracuda (*Sphyraena* sp.)

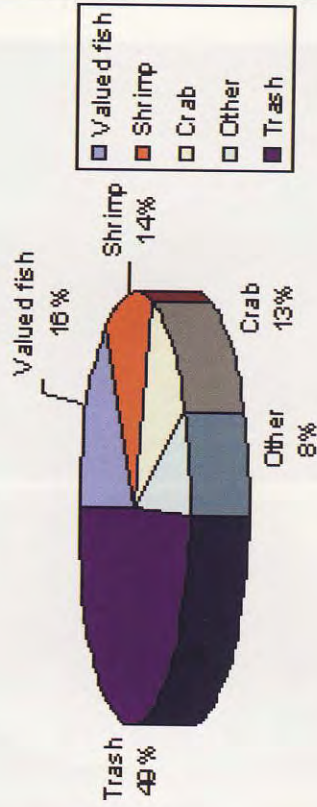


Bigfinreef squid (*Sepioteuthis lessoneana*)

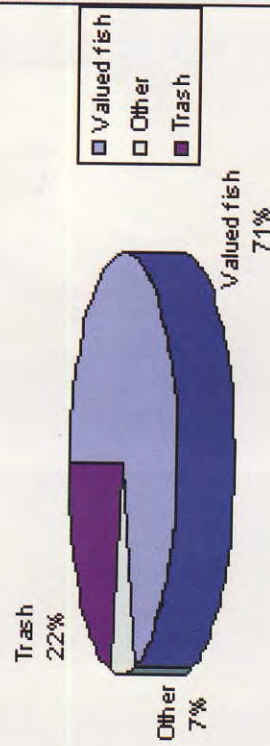
Fyke-Net



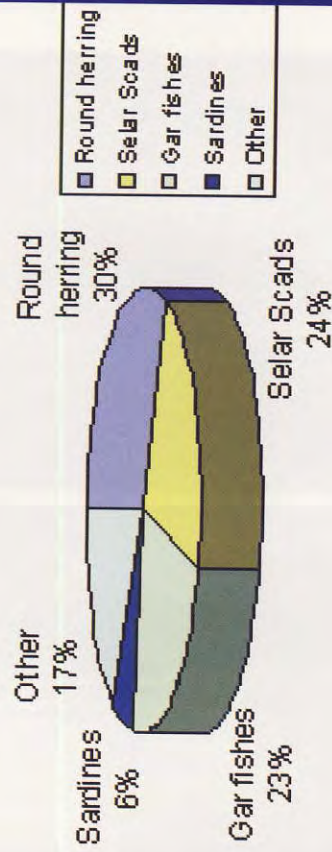
Shallow water bamboo stake trap



Deep water bamboo stake trap

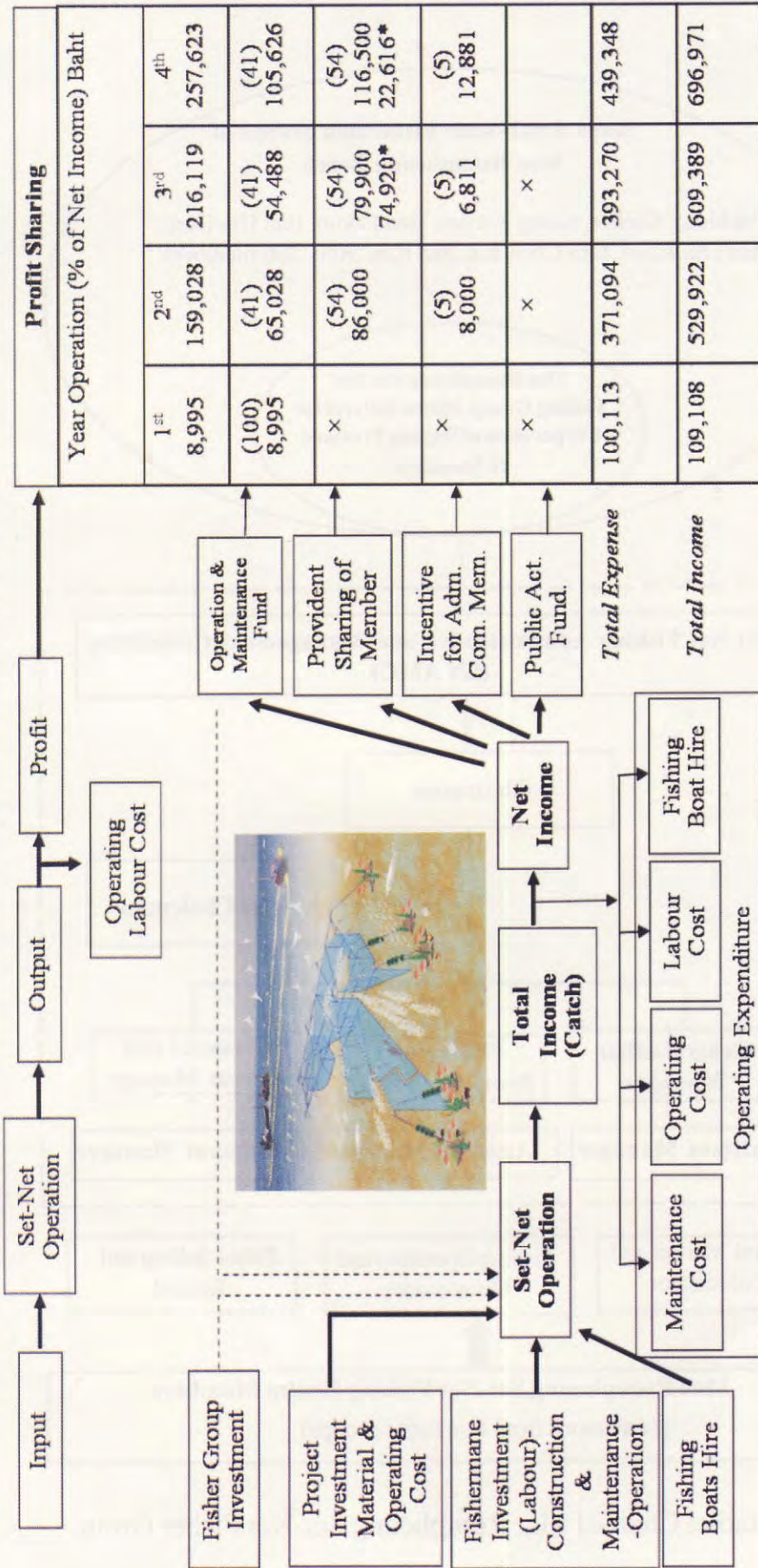


Set-Net



Catch comparison of stationary fishing gear in Thailand

Administrative Cost Management of Fisher Group in the Set-Net Project



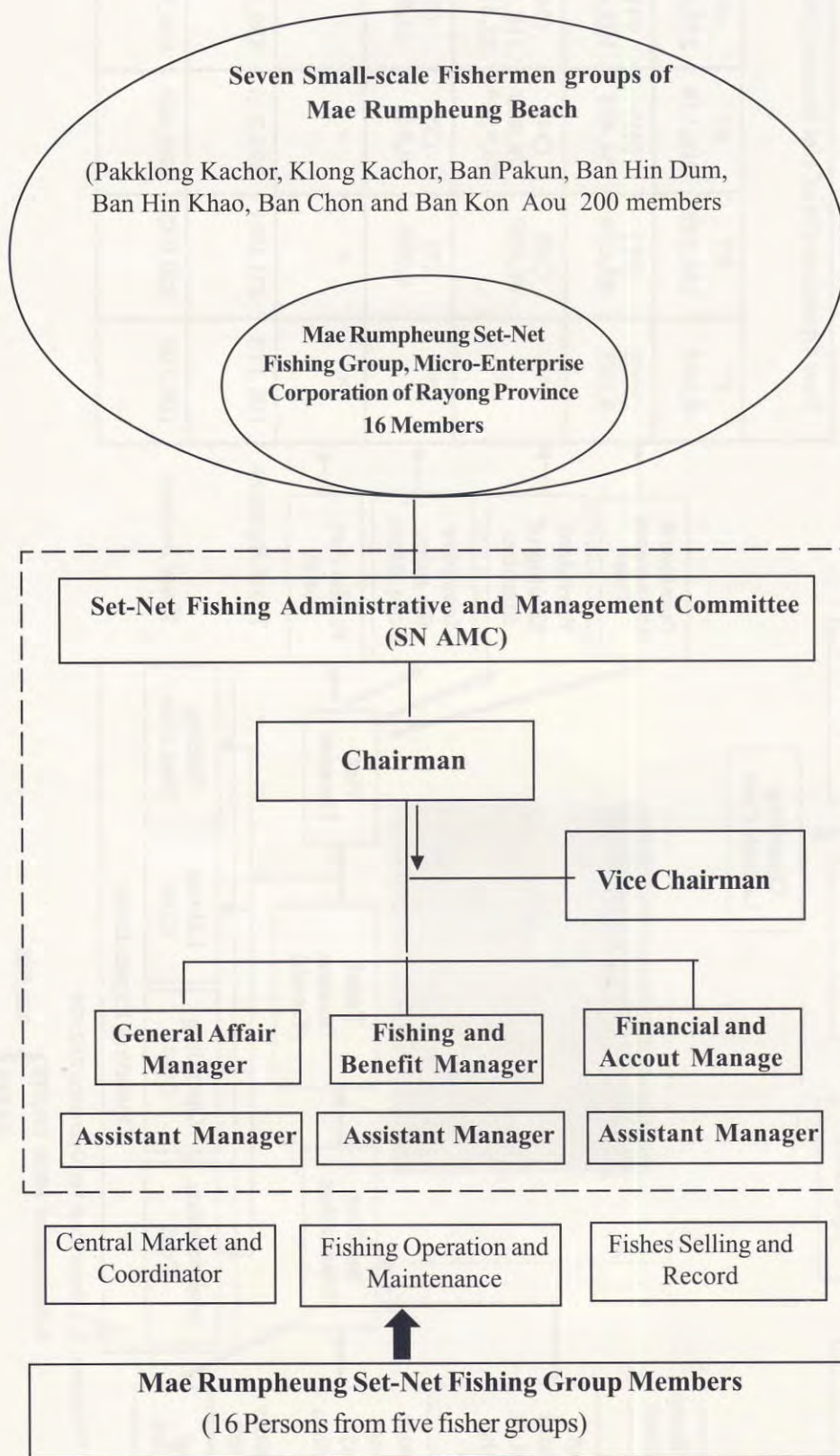
**Remark: 1. Labour Cost for Operation 212,400

2. Expenses of 2006: 166,098 } 226,948
60,850 }

3. Incentive Adm. Com. Mem. 7,000

4. Labour Cost for Maintenance 116,500 (or Provident Sharing of Member)

*2nd Provident



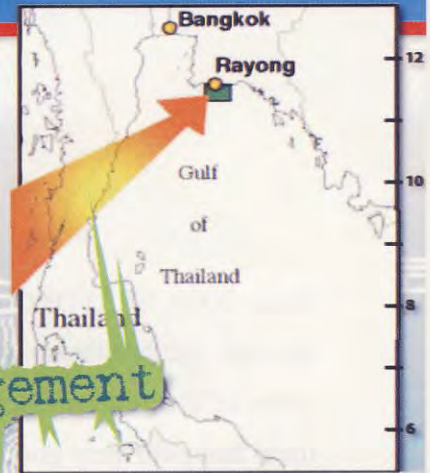
Administrative Chart of Mae Rumpheung Set-Net Fisher Group

Set-net fishing technology transfer



Set-Net

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An Eco-Friendly Fishing Gear for Sustainable Coastal Fisheries Management

BACKGROUND

Most of coastal fisheries resources of the developing countries are over exploited; it was caused by various factors. Environmentally friendly fishing technology is highly demanded for the situation of excessive fishing efforts, conflicts among the different types of fishing gear and methods, energy-saving effort for fishing operation, quality improvement of catch freshness for high-price marketing and environmental conservation requirement. Collaboration among local fishermen is an important key to success of the sustainable coastal fisheries management. Set-net fishing has recently been reconsidered and introduced to the coastal fishing ground, as it is believed to conserve marine resources environment and energy saving fishing gear. The pilot project has conducted in Rayong Province, Thailand.



OBJECTIVES

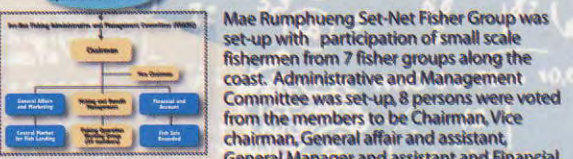
Introduction of Set-net as Community-base Management is purposed to:

- 1) Reducing the fishing pressure on coastal fisheries resources
- 2) Alleviating the fishing competition among the gear types
- 3) Organizing the group cooperation for fishing operation
- 4) Developing the common policy concept for coastal management
- 5) Enhancing the community concept for coastal conservation

IMPLEMENTATION



FISHER GROUP



OPERATION

FISHING GEAR
 30 x 150 x 250 meters of Otoshi-ami type set-net was introduced to 13 meter deep coastal waters of Mae Rumphueng beach. Construction of the whole gear was completed by 40 volunteer fishermen within 2 months. Fishing material was supplied by SEAFDEC/TD under Japanese Trust Fund program and Himi City, Toyama, Japan.

FISHING OPERATION & MARKETING

One operation in every two days was conducted. 10 – 12 fishermen and 3 – 4 boats were required for the 30 – 50 minute fishing operation. 2 – 3 hours is required for each fishing trip, catch was preserved by ice-water in the containers. Catch was sold directly to customers and dealers, and the fish price was decided by the group (semi-auction).

SET-NET 未来へ向かう環境に優しい漁具の先駆者
 An Eco-friendly Fishing Gear for the Future
 持続可能な漁業 SUSTAINABLE FISHERY
 共同管理 COOPERATIVE MANAGEMENT
 漁場保護 FISHING GROUND PROTECTION
 資源増進 RESOURCES ENHANCEMENT
 環境に優しい漁具 ECO-FRIENDLY
 生物多様性 HIGH BIODIVERSITY

ACHIEVEMENTS

- #### I. SUSTAINABILITY
- 1) Set-Net Fishery**
 - Average catch of 215 kgs. or 6,500 Baht per operation was recorded.
 - An economic return point was 110 kg. or 3,200 Baht per trip, at an average price 30 Baht/kg. of fish.
 - Various kinds of fish were caught with selective manner and well-handling for the high quality fish to gain highest income.
 - 2) Artisanal Fishery**
 - The artisanal fishermen are very happy to have more spot fishing ground, safety zone for their fishing gear (trawler protection).
 - An additional job could be created (sport fishing, fishing tour, etc.)

II. MANAGEMENT AND OWNERSHIP

Cooperative Management System :
 The system has been started and developed. Mae Rumphueng Set-Net Fisher group was established and managed by "Administrative and Management Committee".

Administrative Cost Management of Fisher Group

Input	Set-Net Operation	Output	Profit
Project Investment			
Project Investment Material & Operating Cost			
Fishermen Construction & Maintenance			
Fishing Gear			
Operating Labor Cost			
Net Income			
Profit Sharing			
Profit			

III ENVIRONMENTAL CONSERVATION APPROACH

Fishing Ground Protection :
 The active fishing gear are kept out of set-net area, such as trawler, purse seine, light fishing etc.

Resources Enhancement :
 Coastal marine fisheries resources could be gained as By-Product of Set-Net.

Rehabilitation :
 Coastal fishing ground could be developed for nursery and spawning ground of fish, squid, crab and shell etc.

Energy Saving :
 With set-net fishing, fuel oil consumption, fishing time and working hour of fishermen can be greatly reduced with better living condition of their families. of fuel energy, man power and working hour can be reduced by set-net fishing.

Acknowledgement

Since 2003, SEAFDEC Set-Net Project was continuously supported by Japanese Trust Fund through the Southeast Asian Fisheries Development Center (SEAFDEC) until 2008. Five years of this pilot project was carried out in collaboration of many parties, which all most of them had paid very good cooperation all the time.

Firstly, we would like to thank the fishermen of Mae Rumpheung Set-Net fisher Group who have paid fully and continuously cooperation to both SEAFDEC and Rayong set-net project from 2003 until 2008. Secondly, thank to staff of the Eastern Marine Fisheries Research and Development Center (EMDEC) and SEAFDEC who always gave very good cooperation and strongly support to the project. Special acknowledge to project's technical advisors Prof. Dr. Takafumi Arimoto, Mr. Tadashi Hamaya and Mr. Isao Hamano for a lot of useful technical advice both in practical and theoretical of Set-Net fishing. Also special acknowledgement would be made to Himi City for conducting the JICA grass-root partnership program in parallel with Rayong Set-Net project to provided technical and material support to local fishermen of Rayong Province. And the most special acknowledge to Japanese Trust Fund Manager who had allocated budget to support the project from the beginning until 2008 (2003-2008).

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**Regional Workshop
on Set-Net Fishing Technology Transfer for Sustainable Coastal Fisheries
Management in Southeast Asia
Eastern Marine Fisheries Research and Development Center (EMDEC)
Rayong, Thailand
12 - 14 December 2007**

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Report of Meeting

I. Introduction

1. The Regional Workshop on set-net fishing technology transfer for sustainable coastal fisheries management in Southeast Asia was held from 12-14 December 2007 at Eastern Marine Fisheries Research and Development Center (EMDEC), Rayong, Thailand. The meeting was conducted by the Southeast Asian Fisheries Development Center (SEAFDEC) and co-hosted by Eastern Marine Fisheries Research and Development Center (EMDEC), Department of Fisheries, Thailand.
2. The regional workshop was held with the objectives to collect and share the information of set-net fishing and stationary fishing gear operated in the Southeast Asia, to observe the set-net project site and exchange the technical opinion among participants, to discuss the difficulties and constraints for trouble-shooting on set-net fishing technology transfer, to evaluate the response for possible acceptance from local fishers and technical staff concerned on set-net fishing technology transfer as well as to initiate the regional future plan to promote the set-net fishery for sustainable coastal fisheries management.
3. The workshop was attended by representatives from the Department of Fisheries of Member Countries (Brunei Darussalam, Cambodia, Japan, Indonesia, Malaysia, Myanmar, The Philippines, Thailand and Vietnam) including 10 set-net project advisors and experts from Tokyo University of Marine Science and Technology(TUMSAT) and Himi city, Japan and 16 Technical staffs from EMDEC and SEAFDEC. The list of participants appears as **INF02**.

II. Opening of the Meeting

4. Mr. Manoch Rungratri, the EMDEC Director, expressed his warm welcome and a great pleasure to all participants of the workshop.
5. Mr. Hideki Tsubata, Deputy Secretary-General of SEAFDEC gave a speech and declared opening the workshop.

III. Adoption of Agenda and Arrangement of the Meeting

6. The agenda and arrangement of the Meeting, which appear in WP01, was adopted.

IV. Review on Set-Net and Stationary fishing gear in Southeast Asia

• **SEAFDEC/TD**

7. Mr. Aussanee Munprasit showed VDO on the set net fishing management started with the establishment, setting up the net, and the net hauling and harvesting yields to all

participants. The important point of the set net fisheries management is focused on the biological criteria. The criteria can give a tangible outcome that the set net can play role as fish habitat to enhance aquatic resource surrounding the set net fishing gear. This point is useful to promote this type of fishing gear to enrich aquatic resources.

8. Mr. Aussanee gave more presentation on the set net (**Annex WP02-1**). He explained the set net project introduction and present status of the set net in Thailand. The positive outcome of set net fishing gear mainly relied on sustainable coastal fisheries resources. Meanwhile, the objective of the project is drawn an emphasis on reducing fishing pressure on aquatic resources and alleviate the fishing competition among the fishing gear types as major objective of the project.
 9. He added more information about the set net design and establishment and settlement with local fisher's participation. The project staff joined with local fishers to learn how to mend the set net based on the technical transfer on set net from Japan. Local fishers have practiced to haul and harvest fish yields after they and the project staff deployed the set net into the sea. Local fishers have used their boats to go to the net for harvesting fish yield. The first installation of the set net design was followed the guideline from Dr. Inoue when a meeting was arranged in the Himi city. The result of the set net harvest recorded by EMDEC landing survey team found that the yield was very low in the first year of the net installation. The yields increased in number which volume was getting high and higher in the next two-three years later.
 10. On the economic criteria, he presented that the set net should be promoted. This is because the set net operating cost is economic. This means this fishing operation can be save cost of fuel oil in particular. Fishers did not suffer from high oil price crisis. Furthermore, he explained the set net on environmental criteria that the set net fishing gear installation proved to be a instrument for resource conservation. This is because the gear can be obstacle to the encroachment of commercial fishing gear to operate in the coastal areas.
 11. Before he ended his presentation, he clarified that the set net fisher's group has made registration with the Department of Community Development. The registration shifted the group's status from the traditional system management to be small enterprise system management at recent.
 12. Dr. Jonathan O. Dickson, resource person from the Philippines, said congratulation to SEAFDEC according to the project success as pilot project of the Thailand.
 13. He understood that the project success happened by the participation and collaboration among SEAFDEC, EMDEC and local government organization and certainly with local fisher's group participation. He suggested that species composition of yields harvested from the set net should be an indicator to check impact of the set net fisheries operation and management.
- **Country paper of Brunei Darussalam**
14. Mr. Brunei greeted all participants. He introduced that the set net fishing gear in Brunei experiences (**Annex WP03**). The set net in Brunei is called the conical tidal trap and inter-tidal barricade net is popular. These two types of the set net can catch a lot of fishes because they used small mesh sized nets to trap fishes. But these gears have given negative impact to destroy fish fingerling and fish larvae. This causes to the decline of aquatic resources.

15. He illustrated that the set net in Brunei installed along the path of current tidal water which changes up and down daily. He added more information on the settlement of the set net have to consider an appropriate location, number of units to deploy, appropriate modification and the availability of netting material and its accessories in the areas. The set net here usually deploys in the shallow areas as nursery ground. This area is very critical areas to cause destructive and over-fishing problems to fish juveniles and fishes in particular.

- **Country paper of Cambodia**

16. Mr. Buoy Roitana, representative of Cambodia, presented a review of set net fishing in Cambodia (**Annex WP04**). Fisheries sector is important to national economics of Cambodia. The inland fisheries are major sector of her. The minor is coastal fisheries. He illustrated that the set net fisheries is not handled in marine fisheries sector. Stationary gill net nevertheless commonly and popularly found in inland fisheries sector. In the marine fisheries sector, swimming crab gillnet is popularly used. This type fishing gear is classified by mesh size of the net into three categories are 1). 40-100 mm operated in coastal and off shore fishing ground areas; 2) 40-80 mm which 60 mm averagely demonstrated in the shallow water areas and mainly targeted swimming crab. Other fish composition species was demersal fishes; and 3) 80-100 mm is used in off shore areas.

17. Stationary gill net is well-known and used in inland fisheries as previous present. This gear chiefly found in Tonle Sap lake, Tonle sap river, Mekong/ Basic flood plains and Upper Mekong and Tributetaries. Considered on the stationary gill net, type is categorized into three types by the mesh size are smaller that 50 mm.; mesh size between 50-70 mm. and mesh size bigger than 70 mm. under legal aspects, this gill net is enforced by the Fiat Law limited the length of the net is less than 10 m as family fishing gear use. However, the definition of family fishing gear will be revised and consulted soon. In addition, a small mesh size is smaller than 15 mm and larger than 150 mm is restricted by Fisheries Laws, 05/2006.

- **Country paper of Indonesia**

18. Mr. Zarochman, representative of Indonesia (**Annex WP05**) gave introduction about the Indonesian profile such as the main island areas, population, etc. Regionally marine fishing area management is divided into nine zones. Coral reefs are major and attractive marine resources. The richest coral reef found in Sulawesi, Maluku and Papua. The main issue of marine fisheries of her country is how to maintain this kind of resources for sustainability. To alleviate these problems, trawling fishing operation is banned to operate in the coastal areas. Other measures is done through demarcated and limited fishing ground areas, stopped illegal fishing and reforest mangrove forest areas. The set net is introduced to help alleviate the problems recently. The classification of tidal traps is prime divided into two types. One is tidal traps with leader-net. Other is tidal traps without leader-net. The first type mainly targeted capturing prawns. The second type is mainly targeted fishes.

19. He introduced many kinds of tidal traps used in the Indonesian sea such as tidal traps without leader-net is very popular. This gear is set in the critical areas such as in nursery ground. The size of this gear is as commercial scale fisheries. This gear targeted shrimp and some demersal fish. This gear is set in very and very shallow water. Other type of set net is the tidal traps with leaders-net. Tidal Traps seems to give negative impact to fisheries resources because the net location in the critical areas such as in shallow water.

20. He also provided the comparison between tidal traps and set net in various criteria such as depth of sea water, structure, location for the fishing gear installation. The tidal traps located in tidal movement of water mass carrying fish entering into the gear. The set net fixed on the route of fish swimming blocked and aimed by leader-net into trap of set net. He shows that there are many type of Japanese set net introduced to Indonesian fisheries sectors such as otoshi-ami of medium scale attached at Gam isle waters, west Irian Jaya.
21. He also added more information on the installation of the otoshi-ami into the Indonesian sea. The strategy of set net development is the government facilitated the private sector to join the operation at earlier stage. The government emphasizes on the set net friendly environment to fisheries development. Other positive factor is economically consumed fuel oil for fishing operation and security as well as responsible methods through selected fishes. He gives requirement point for setting up the set net. He ended his presentation with note that the set net installation should be modify and adapt to capacity and availability of the setting location of those communities.
22. Ms. Munthana, Thailand, questioned how the Indonesian government allocates location for setting up and deploy the set net. The presenter answered that mainly consider on the type of set net then allowed the fisher to deploy the set net, but it prohibited to install in the shallow water areas and far from coral reef areas. Dr. Yuttana Theparoonrat, SEAFDEC/TD wondered that there were many kinds of set net, along these types of the set net what target species is suitable to use which type of set net. He answered that pelagic fishes is main target species of the set net.

- **Country paper of Malaysia**

23. Mr. ABD. Haris Ahmad Arshad, Malaysia, roughly introduced the profile of fisheries sector in Malaysia (**Annex WP06**). Then, he reviews the importance of marine fisheries sector amounted of 1.08 % as a part contributed to GDP of Malaysia. Main issues of fisheries sector such as resource degradation, competition between traditional and commercial fisheries for utilizing fishing ground, etc. He also explains fishing zones in territories of Malaysian sea divided into three zones are zone A with less than 5 nautical miles, zone B with more than 5 nautical miles ,zone C with more than 12 nautical miles and zone C2 with more than 30 nautical miles.
24. The definition of set net or stationary trap is gear that are set or stationed in the water for certain period of time with regardless of the kind of materials used for their construction. The main types of set net employed in Malaysia are Pompang and Gombang. The operations of Pompang are stakes deployed in the seabed areas. The change of tidal water force to the mouth of Pompang opened. Gombang is two stakes emerged with water surface. Other type is Ngian (bag net) in Sarawak. Penaeid shrimp is targeted by Gombang in Perak. Main species composition harvested by Pompang is trash fishes species and acetes, respectively.
25. Kelong (fishing stake) structure is basically composed of set net and hut using for living and recreational activities such as restaurant found in the East Coast of Pennisular Malaysia. However, the issues of the set net has undoubted that it is not economic such as high cost of gombang with low returns, depended on tidal current, destroyed by trawling fishing operation, etc. This issues were remarked and tooh action by the DoF, Malaysia. The DOF stopped issuing new license to any type of set net, just transferred the ownership of license to their successors. This solution has main objective to conserve marine resources for the next generation.

- **Country paper of Myanmar**
26. Mr. San Aung, representative from Myanmar, firstly reviewed marine fisheries and the management measures in Myanmar. He presented type of stationary fishing gears in Myanmar which is composed of stow net, stationary set bag net and lift net (Sandar and Gar Phoung). Lastly, he concluded that set net fishery has not developed yet in Myanmar; however, it would be good if Myanmar coastal community could have good cooperation with SEAFDEC in the technology transfer of set net, see **Annex WP07**.
- **Country paper of the Philippines**
27. Mr. Benebert R. Fernando, representative from the Philippines kindly briefed the background of the set net fishery in the Philippines, mostly use the set net for catching the high class fish species like tuna. He also highlighted advantages of set net fishing gear as this gear is environmental friendly, passive fishing gear, good quality of catch, durable life of materials, seedlings for aquaculture, shorter working time, less fuel consumption and preserves the marine resources. He explained factors that need to be considered in set net operation like selection of fishing grounds, design and construction, setting and hauling and maintenance and monitoring. According to the monitoring, there have 89 units of set net fishing ground that existing in the Philippines. However, still some problem encountered for example; fishing condition, high investment cost, political interventions and disorganized cooperatives. He recommended that management plans should be developed for the sustainability, appear as **Annex WP08**.

Discussion

28. Mr. Buoy Roitana asked questions to the presenter regarding the depth of set net first, nowadays how deep of set-net fishing ground in the operation.
29. Mr. Fernando explained that set net in the Philippines depend on the areas. The set net are located at 20-45 meters depth, but already deep, and find it difficult for cleaning the net due to the strong current. Regarding the set net operators in the Philippines, he explained that 60% operated by private sector and 40% by cooperative.
30. Mr. Aussanee stated additionally that the fishing grounds in the Philippines are different from the Gulf of Thailand. Therefore, condition of the fishing ground in deeper water differ from the shallow water, however this topic will be discussed the following day.

- **Country paper of Thailand**

31. Mr. Kanit Chuapun introduced the pound nets or set nets in Thailand which can be categorized by water level into 2 types- shallow waters pound nets and deep waters pound nets, as appear in **Annex WP09**.

Discussion

32. Mr. Okamoto asked the question. Dr. Anucha responded that as his experience about set net in Thailand is prohibited, to the question that according to his experience of fisheries in Thailand, as the set net fishery is new concept, Department of Fisheries has been done a lot to more permission of related to the law, promote the fishing gear.

33. Mr. Aussanee responded additionally about stationary fishing gear in Thailand. He also mentioned that more than 80% illegal fisheries. Bamboo stake trap are located in the shallow waters, sometimes has no water that it is illegal. Some confusion of Regulation, The Set-Net project have been tried to provide information to the Department of Fisheries to reconsider about regulation in some type of set net should be allowed that why it take a long steps to consult with the Department. At the present, they tried to control number but for small scale, local fishermen still the illegal fishing set in the areas.

- **Country paper of Vietnam**

34. Mr. Nguyen Phi Toan presented the study results of set net in Khanh Hoa province, Vietnam by interview fishermen, details as shown in **Annex WP10**. He mentioned that conflicts among type of fishing gears often occurred that caused number of net decline.

V. Summarization of country report, and Discussion for identifying the difficulties and constraints for technology transfer, with resource information on the Rayong Set-net Project

- **Set-Net Fishery in Japan**

34. Mr. Nguyen Phi Toan presented the study results of set net in Khanh Hoa province, Vietnam by interview fishermen, details as shown in **Annex WP10**. He mentioned that conflicts among type of fishing gears often occurred that caused number of net decline.
35. Prof. Yashiro Inoue presented on the Commercial Set-nets in Japan and a new training set-net, the “Kago-net” was introduced and described, appear in **Annex WP11**. Prof. Yoshihiro Inoue, Kagoshima University, briefed that the set net fishing gear is popular in Japan and it has long history of set nets. He presented types of Japanese set nets for example: Oshiki-ami (Dustpan-net), Daibo-ami (Trick set-net), Otoshi-ami (Fall into-net) and etc. He briefed on the introduction of the new training set net “ Kago-Net”, to install the set net by perform the following works: fishing ground survey, marking location, setting of rope frame, setting net and test operation (Annex WP11).
36. The set-net in Japan which is one of the “passive” fishing gears most popularly used in coastal area which has a long history and has been developed with large variations in its structure and size. The catch of the set-net fishery depends on the relative abundance of fish and the behavior of the fish, especially on the migration route of the fish. And it is also influenced by various natural factors, like current conditions and seasonal changes that affect the migration patterns of fish. Therefore, the set-net fishery is one of the most resource and environmentally friendly fishing practices.
37. The history of the development of the set-net in Japan was presented, a prototype set-net known as Oshiki-ami, was used during the Edo period or after AD 1,600. From this early net a new set-net with a box-shaped bag, called Daibo-ami, appeared around 1,900. Daibo-ami was improved and the new Otoshi-ami was developed around 1,910, which is presently the most popular type of set-net in Japan.
38. “Otoshi”, consists of a leader net, playground, an outer and inner slope funnel nets, and a box chamber. Fish that migrate into the main bag are entrapped in the final box chamber after being guided into it by the slope funnel nets.

39. There are many other types and sizes of set-nets nowadays in Japan, the numbers are 1,700 large set-nets and 14,000 small ones which the Otoshi-ami and Bottom type set-nets are predominant in the category of large-sized set-nets and it used as the fundamental structure on every net type. The Tsubo-ami are the main ones found in the category of small-sized set-nets.
40. In recent years, the catch of the set-net fishery has been about 500,000t - 600,000t. The large-sized salmon set-nets supply 150,000t stably. It is about 120 billion yen annually. The total amount of money generated has been decreasing slightly over the years. But not much difference can be seen when looking at the different types of set-net, which is very unusual for other fisheries.
41. Each fisher's enterprise or individual fisherman has an average of 1.4 large or 1.6 small set-nets. The amount of money earned by a large set net is 63 million yen /year or 88.2 million yen per Fishermen's enterprise or fisherman while a Small set-net is only 3.4 million yen or 5.4 million yen per enterprise or fisherman.
42. The jobs set-nets provide in remote regions where there are no other job opportunities are very important. Large set nets will employ 10-30 men, and this accounts for 17,000-51,000 working people. Smaller set-nets only provide jobs for 3-10 people, but all together this adds up to a labor force of 42-140,000 workers.

Mr. Zoroman To ask for sure that (Vo9)

- Kago net is a model using for training at the University, for catching squid
- Selection of type of set net in order to proper for fishing ground. This is depend on the commercial species, Answer: depend on commercial and species if you want to catch. This Kago net sardine use. Water depth 12 Depth of set net 10 m
- Anchor, when do u use iron anchor, concrete anchor or sand bags, Kago net use sand bag as anchors this use for trainee which heavy.

• **Set-Net Fishery in Taiwan: " Development and Practices of Set-Net Fishery in Taiwan"**

43. Dr. Huoo-Yuan Sunny Jenq, resource person from the center for set-net fishery technologies, Marine University, Kaohsiung, Taiwan, R.O.C presented the developments and practices of set-net fisheries in Taiwan. According to the study, he concluded that this gear can be selective fishing gear method, eco-friendly fishing gear, see **Annex WP12**
44. Mrs. Muntana asked the presenter that whether the set net location asking for authorities? Is it open to everybody? The presenter responded that it is needed to ask license from Government which is a 5 year permission that owner has to get new license, Regarding to location of set net, is it decide by application from the fisher, what are criteria that government allow for fishermen? Set net location come from father, if it is new location, need to evaluate, however, government has problem to evaluate where is suitable.

• **Set net fishery in the Philippines**

45. Dr. Jonathan O. Dickson as resource person from the Philippines, He reviewed the background of set net that firstly Otoshi-ami was introduced to the country. He highlighted the existing set net are mostly located in East side of the Philippines He also mentioned that there are 2 type of ownership: fisheries association/ cooperative and individual or private ownership. He emphasized problems of management occurred such as unclear responsibility of owner, limited knowledge, improper

scheduling, political interventions and environmental impacts due to the set net, details as in **Annex WP13**. He emphasized that milkfish is mainly found in the Philippines, but this species incidentally caught by set net, fishermen or owner should released. This should make a clear management to government, sea turtle or non target species has to be released. Policy use of set net in the Philippines will be discussed next year.

46. Prof. Dr. Osamu Baba, TUMSAT questioned that has all units in the Philippines been developed the management scheme. Dr. Jonathan answered those unit are suggested to implement the project by the Government. Set net is being as alternative livelihood in the Philippines. Whether set net can be located in the particular area, if not it will promote gill net. So, Government will identify for suitable.
47. Mr. Okamoto asked relating to the ownership, Any priority to whom if both ask for authority? Dr. Jonathan kindly explained that it is depend on how big is the area? If area can accommodate for both, they will allow both to be owner. In case in one province, prior to private sector. Association has own unit in particular area. They can put association in the same area.

- **Technical Training Course in Himi, Japan**

48. The technical training in Himi City, Japan was presented to the workshop by Mr. Nopporn Manajit. His presentation concluded the training course on Set-net Fisheries from the year 2005 to 2007 for the project staff and also fishermen who involved the Set-net fisheries project in Rayong. The training has focused on the technical part than any aspect. Then the workshop suggested that the training should be also including the financial aspect as well as the marketing in order to strengthen the financial management system of the fisher group which still has some difficulty. After that the video of the set-net in Japan was shown and introduced to the participants.

- **Set-Net Fishery in the region by SEAFDEC/TD**

49. Mr. Aussanee Munprasit made a presentation on the set-net and stationary fishing gears in the Southeast Asian region particularly set-net in Thailand. Its history and development was also included. At the final the workshop was requested to recommend on the important criteria or data of the present operation and characteristic of stationary fishing gears in the region which should be accommodated and compiled for future development of the set-net fisheries in the Southeast Asian Region.
50. The participants of the workshop suggested as the follows;
 - a. In the term of fishing ground development, Mr. Aussanee explained that this meaning was shifting function of the bamboo stake trap from trapping fishes to be an obstacle to protect the fishing ground according to the gear structure. Mr. Etoh suggested that the word of fishing ground development should be change to be protected area.
 - b. The economical aspect, budget requirement or cost investment when fishermen want to start the set-net fisheries should also be added in order to support the policy maker for making a decision
 - c. The degree of eco-friendly fishing gear have to be added
 - d. The institutional or organizations should be mentioned. The clarification of the institutional system and management cost are needed.
 - e. The Column of "License" should be added.
 - f. In the title "Gear" should be revised in the term of group of fishing gear and
 - g. gear suppose to be a definition

51. The criteria or data of the present operation and characteristic of stationary fishing gears in the region which mostly concerned of the coastal fisheries than inland fisheries. It will be raised and discuss to get more information later.

- **Rayong Set-Net Project by EMDEC**

52. The representative from EMDEC, Dr. Anucha Songjitsawat briefed on the Rayong Set-net Project for information of the workshop. It consist of the history, background and the project implementation during the year 2003 to 2007 with the collaboration among other agencies as well as DOF (EMDEC), SEAFDEC and JICA (**Annex WP16**).

V. Question & Answer on Rayong Set-Net Project for operation and management, and for the Project Concept in relation to the eco-friendly aspects for Sustainable Fisheries Management in Tropical waters (V01-20:29)

Question	Answer
<i>Mr. Etoh-</i> What does the net incomes changes since the project started in each year?	The set net fisher group itself has recorded the incomes everyday. This data also provide the support by EMDEC staff.
<i>Mr. Zorocman-</i> How different of catch composition compared between the first and second set net units?	It compared at the first 5 months of each set found that the catch composition harvested from the first unit was not stable according to the incomplete installation of the net. Unfortunately, the catch composition of the second unit at the same period did not carefully record, so the catch composition these units were mixed together, then the exact data of catch composition could not rectify.
<i>Mr. Aussanee-</i> Added information concerning the administration cost management in every year.	The administration cost management composed of maintenance and repair cost, material cost and logistic cost, total expenses, total incomes.
<i>Mr. Etoh-</i> ask for the clarification regarding the administration cost management in the year 3, why the cost becomes double.	Chairman suggested that the clarification should be done out round.
<i>Mr. Etoh-</i> also pointed out that the income is important indicator on the socio-economics aspects to evaluate the project. He also mentioned that the share incomes per head per year.	Each member earned about 32000-40000 baht per head per year.
<i>Mr. Etoh-</i> How to calculate the incomes share per head per year.	Per head is an incentive that fisher participate in fishing operation daily. The Chairman suggested that the social assessment should be conducted before and during the project implementation, income in particular is credible indicator to perform the implication of the project implementation.

Question	Answer
<i>Mr. Buoy-</i> commented on the perception of other stakeholder around the area that should be conducted.	Mr. Okamoto strongly agreed with the comment that the survey should be demonstrated in order to alleviate the conflicts among stakeholders. Chairman also agreed and suggested the local government officer and agency concerned should be conducted this aspect.
<i>Mr. Etoh-</i> ask confirmation from the fisher group regarding to the amount of incomes that they earn from the activities.	The representative of the fisher group answered that the incomes gain from the activity is 200,000 baht per year and 34,000 baht per head.
<i>Mr. Etoh-</i> Is there any problems or conflict among the group member?	They are happy to work together, even sometimes some problems encountered but they can solved the problem easily because the friendship.
<i>Mr. Etoh-</i> How the group institution caused any impact to the community.	The representative of the group accepted that the group has faced both positive and negative impacts, in fact they really harmonize working in a group even sometimes they have different ideas.
<i>Mr. Etoh-</i> Are there negative factors or foreseen in the future?	They afraid of an increasing number of the set net invested by the private sector nearby or surround their set net.
<i>Mr. Etoh-</i> Does the set net help to reduce the conflicts with other fishing gears?	As the set net is the stationary fishing gear and longer utilize, so other fishing gear such as trawler realized the location of the set net. They avoid to do fishing operation in that area.
<i>Mr. Fernando-</i> How does the fishermen group manage the set net by their own without any government support?	As they had gained knowledge and experiences, they have skill to conduct this activity by themselves. Mr. Fernando added information that in case of the Philippines the set net fishers were trained at the beginning, then local government unit take responsibility to monitor the set net management after the project terminated.
<i>Dr. Inuoe-</i> How much does the incomes of fishermen in Rayong province per year?	200,000 baht/head/year, and 30000-40000 per head per year as supplementary of the set net incomes, Meanwhile general small scale fishermen earned incomes 600,000 baht.

Question	Answer
<i>Mr. Brunei-</i> What is the prediction of the association of the set net in the future with out support from any agency?	They assured that they will operate by themselves and will try to have more members in order to have more money to have more unit of set net.
<i>Mr. Buoy-</i> Do they receive any complaints from the other stakeholders living or operating around the set net?	Some stakeholders would like to join but they do not have enough time to join according to their own business in fishing.
<i>Dr. Jonathan-</i> What is big problem from the set net operation?	The fish price is cheap, according to this problem is the group looking for the new market channel
Is the group looking for the new market channel?	Of course, they do but the problem is the amount of the catch is not to much enough for supplying to the market. Mr. Etoh added information that there are 400 Japanese restaurants in Bangkok are very interested to buy catch even double price but the problem is the fish handling methods and high transportation cost.
<i>Mr. Anukorn-</i> concerned about the high price of fuel nowadays, is there any impacts?	They considered but they will find good solution.
<i>Mr. Okamoto-</i> What kind of fishing gears can increase their incomes to 200,000 baht?	Crab bottom gill net, Squid trap, mackerel gill net.
<i>Mr. Brunei-</i> From his observation, How to promote fish market shifting from beach to the better condition of fish market place?	They customarily used sea water to clean fish.
<i>Dr. Jonathan-</i> What about the money matter management problems?	Dr. Jonathan recommended that the systematic clear financial management should be credible tool sustain the group to progress their work and management with daily record and checking balance of the group account.
<i>Mr. Aussanee-</i> how much does the saving money of the group deposit in the bank?	104,834 baht for the latest. Mr. Aussanee added that the group registered as the community enterprise in order to get the loans.
<i>Dr. Jonathan-</i> as the group member came from different villages? Any problem to work together?	No problem at all.

Question	Answer
<p><i>Mr. Fernando-</i> Does the group formulate the procedure or system to manage and administrate the group member?</p>	<p>On management aspect, they have to mandate the group member but in practical they normally mutual help to each other. Mr. Fernando shared his experience in the Philippines that unclear responsibility of member could create the problem.</p>
<p><i>Mr. Aussanee-</i> How can they get the permission to legally operate the set net?</p>	<p>Dr. Jonathan recommended that they should make a letter of permission to the government for operating the set net with the recommendation from EMDEC, SEAFDEC. This can pass through Rayong province.</p> <p>Mr. Aussanee suggested that the group should take action in requesting its need to the official.</p> <p>Mr. Okamoto mentioned that the DOF has a difficulty to manage this type of fishing gear, he also added information the DG of DOF Thailand also thought about this issue to promote the fishing gear to legally operate. However, the DOF needed more time to seriously consider impacts of the set net.</p> <p>Dr. Yuttana commented that the project could be under the Thai fisheries law but actually, the project is a pilot project under collaboration between EMDEC and SEAFDEC/TD, There are various aspects to be considered, but the most important point is whether the gear will be harmful to the fisheries resource which this is needed to prove.</p>
<p><i>Mr. Zorocman-</i> How deep does the local government get involved to the project?</p>	<p>Chairman suggested that the politician will be the last expectation to consider.</p>

VI. Discussion on the use of set-net fishing gear as a tool of coastal Fisheries management in the region

1. Technical aspects

(Resource by Prof. Dr. Arimoto; Catch efficiency, Dr. Miyamoto; GPS-Depth, Prof. Dr. Sunny Jenq; Raft boat)

During the plenary discussion presentations were shortly presented to the workshop. The presentations were concerned to the technical aspects which presented by Dr. Takafumi Arimoto, Dr. Yoshinori Miyamoto and Dr. Huooyuan Sunny Jeng on the set-net fishing impact, a simple method fir seabed topography drawing along the coast and raft boat for set-net fisheries in Taiwan respectively.

Mr. Zarochman, questioned to Dr. Miyamoto, how large of the areas do the survey method. Miyamoto said that the time consuming depended on the needed details for example 1 square kilometers spent around 6-9 hours.

How to find the appropriate location to deploy the set net? Dr. Arimoto said that should consider on geography of seabed, local fishermen 's wisdom and knowledge and included the speed of water current.

Regarding to the Raft boat issue, In case of Taiwan, the catch products is different according to fishing capacity and effort. However, Mr. Aussanee commented that it should be mainly considered on the capacity of local fishermen in the Southeast Asian region.

Dr. Jonathan suggested that a training on the set net operation should be included the knowledge on conservative endanger species should be not harmful incidentally.

2. Management aspects

A. Fishing ground protection for coastal management

B. Cooperative Management of fishermen's group

(Resource by Prof. Dr. Baba and Prof. Okamoto)

Then Dr. Osamu Baba concisely explained about the set-net fisheries which concerning the management aspects after that the workshop was commented how to allocate the set-net permission for fishermen and what criteria have to be consider and which priority to get a permission. Additional comment as well as the set-net is not exactly eco-friendly and also very much effect surrounding fishing gears.

Mr. Okamoto added more information should be considered for the set net operational promotion as follows:

- a. Set net is productive fishing gear. This point is not necessary to eco-friendly viewpoint.
- b. This kind of fishing gear is costly such as case in Japan spent huge investment amounted to 80 millions yen for small-scale set net.
- c. Design of the set net affected to other fishes species surrounding set net
- d. If there is not enough space for installing set net, probably cause serious conflict of space allocation.
- e. Priority order, focus on equity of entry in fisheries, the FCA firstly receive the chance.
- f. Should mandate regulation system on space allocation for setting up the set net.
- g. An investment cost found in Japan is also varied area by area and company.

3. Resource Enhancement and Higher Bio-diversity (Resource by Dr. Yuttana)

Dr. Yuttana Theparoonrat had a concisely explanation to the workshop on the resource enhancement and bio-diversity and the environmental friendly aspects was raised by Mr. Aussanee Munprasit to the workshop.

According to Dr. Yuttana presentation, Dr. Arimoto concluded that flat area is suitable to deploy the set net. However, the negative impact to sedimentation occurred after the artificial reef installation should be considered. Compared with grain size of sedimentation change found in the set net, should be relied on the reference data at beginning stage.

Dr. Yuttana gave an example gained from the case of artificial reef installation in Chumphon province, Thailand. The concrete structure of the artificial reef help attracted the fish school to living around. He commented that particular shape of artificial reef is suit to a particular target species.

Ms. Munthana, suggested that the impact of set net operation to ecosystem might not be serious issue because the set net did not operate in the whole year round.

Dr. Arimoto added information that the impact of the Japanese set net operation to ecosystem is positive longer 400 years implementation as long history.

Dr. Jonathan said that the ecosystem impact is still big issue. In case of the Philippines, it has clear regulation on the releasing sea turtle milk fish, however, this workshop should consider on the management strategy in the region as reminding to Indonesia to pay much attention on this matter.

4. Environmentally friendly aspects (Resource by Mr. Aussanee)

Mr. Aussanee expressed his idea on securing an environment. He urged the meeting to think about the issue of global warming due to deforestation found in many countries around the world. In the past, the structure of set net or stake trap was used bamboo as material which cause to the world issue. At recent, the net was used as main material of the set net construction so that it could reduce impact reversed to the global warming issue. Furthermore, the surrounding location of set net could perform as mutualism system among various kinds of sea birds in particular.

Mr. Okamoto said the set net cost is more expensive than other traditional fishing gear used in the coastal fisheries. It should be considered

5. Positive impact aspects (Resource by Mr. Etoh)

Mr. Etoh highlighted on four aspects as follows:

A. *On social economic aspect,*

- When project started, many people confused, after four year passed, CBRM gained good experience to practice this activity,
- promote fisher` s participation and experience will be useful to develop the group institution from tradition to be Coop in the future.
- Local business development is chance to promote this business.

B. *On Financial management,*

- The cost of investment is not matter as far as you can get money. But actually, transparency is very important to sustain the group management.
- On the way of good financial amanager3ment. Can calculate and plan the business activity and analysis. Initiate use friendly accounting system.
- Report of the account should be submitted to the member to understand the status and capacity of the group.

C. *On marketing aspect,*

- Consumer needed more education to buy fished from the responsible fishing operation and this should be one factor to upgrade fish price, quality of catch.

D. *On legal aspect,*

- Fisheries laws of Thailand are old fashionable and not allowed to the set net to operate. The alternative way should be defined the project or activity as experimental activity according to a Difficulty of changing the fishing law.
- Let them approve the activity at provincial level as case of Chumphon project. However, an incentive may not contributive the activity as experimental activity.



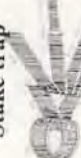



Present situation of Stationary Fishing Gear in Southeast Asian Region

Please answer "Yes" if you have in your country, and name it in your local language in alphabet.

Southeast Asia Countries	Stationary Fishing Gear					Remark How many units for Otoshi-ami? How many years ago?
	Fyke Net	Shallow Water Stake Trap	Deeper Water Stake Trap	Set-Net Otoshi-ami	Other	
1. Brunei	none	Lintau, Tabeh, Kabai	Tugu, Kilong	none	(Lift net) Kilong	
2. Cambodia	Dai	Lop-Nov-Rao, Phong Phang	none	none	Lift net	For inland fisheries and coastal
3. Indonesia	Togo, Gombang	Kelong, Balat	none	*Otoshi-ami	(Lift net) Jermal	*Just start the Project
4. Japan	Hari-ami, Machi-ami	Sudate or Eri	none	34,000 (Otoshi-ami)	-	There are various type of set-net in Japan.
5. Myanmar	Kyar-pa-zut	?	?	none	Sanndar Garphong-	
6. Malaysia	Gombang, Ngian	Kelong, Kering	Kelong	none	(Lift net) Kelong	
7. Philippines	Tangad	Bakatot, Baklad	Baklat	* 89 Lumbaklads	?	* Over 40 years Experience
8. Singapore	-	-	-	-	-	
9. Taiwan	-	-	-	Many	-	

Southeast Asia Countries	Stationary Fishing Gear					Remark How many units for Otoshi-ami? How many years ago?
	Fyke Net	Shallow Water Stake Trap	Deeper Water Stake Trap	Set-Net Otoshi-ami	Other	
10. Thailand	Pongpang	Poknumhaeng	Poknumloog	* 2 Pokcheung	(Lift net) Yoy, Ba m	* , 50,24 years ago of 1 st & 2 nd trail had been conducted.
11. Vietnam	Day	Lo, Sao	none	?	(Lift net) Voden	Now 4 years Experimental stage

Characteristic of Stationary Fishing Gear in the Southeast Asia

Factor Gear	Fishing Ground	Target Catch	Capture function	Mixed-catch condition	Resource Enhancement Effect	Environment Impacts	Management	Regulation
Fyke net 	River and river mouth area	Small shrimp	Filtering with river flow, current flow	High with juveniles	None	Negative	Traditional operation	Banned, Illegal operation
Shallow water Stake trap 	Close to the shore inter-tidal zone	Shrimp	Tidal current and barrier	High	None	Negative	Traditional operation	Approved area, More illegal operation
Deeper water Stake trap 	Deeper water away from shore over 5 meters depth	Small pelagic fish in the coastal	Migration behavior and barrier	Low depending upon mesh size	Demersal and Habitat species	Positive	Individual ownership	Approved area and Licensing
Set-Net Otoshi-ami 	Deeper water away for shore over 5 meters depth	Small and big pelagic, highly migratory	Migration behavior and barrier	Lower depending upon mesh size	Demersal and Habitat species	Positive	Cooperative and Private management	License, Study, Experiment and Promotion stage
Others (Stationary lift net) 	River bank, River mouth and Coastal water	Pelagic species	Light & bait attracting	High depending upon mesh size	Negative	Less	Traditional operation	Licensing and none
								

VII. Recommendation for set-net fishing technology transfer for sustainable coastal fisheries management

1. Definition ;” Set-Net is a kind of stationary fishing gear which it’s construction consist of floats, ropes and nets and set in the sea for collecting pelagic and demersal species by their migration behavior against to the gear with entrapped mechanism”.
2. Baseline fisheries data collection should be conducted and consultation with the fishermen and other stakeholder prior to the introduction of set-net.
3. Prior to set net introduction, training on the organization, technical, financial, operational, trouble shooting, marketing, fish handling, and management aspects should be under taken.
4. Management of set-net fishing should be considered in advance for three levels of operation management, local small-scale fisher group, local commercial fisherman and commercial fisheries (company). These should be under the management of local government along line with the central government policy.
5. Others activities should be encouraged to conduct together with set-net fishing to increase fishermen income such as eco-tourism, marine aquaculture, catch value added products by community enterprise, etc.
6. Monitoring of fish catch, fishing efforts and related information of set net should be conducted as basis for the formulation of future policies.
7. Good accounting/book keeping and budgetary system should be made.
8. Set-Net is an environmental friendly fishing gear and the appropriate tool for coastal fisheries management.
9. Set-Net technology could be improved and developed along the Coastal water to minimize the negative impact.
10. Set-Net fishing should be allowed in appropriate areas operating in coastal water in group operation to increase their income.
11. Application of the precautionary approach to management and ecosystem-based management could be applied when necessary.
12. Management strategy and measures should be formulated and applied for sustainable operations of the set net.

I. Closing of the Meeting

Secretary General and Department Chief of SEAFDEC, Mr. Siri Ekmaharaj, Ph.D. expressed his sincere thanks and wish all participants enjoy coming the Christmas day with follow up new year celebration and closed the meeting

Prospectus

Regional Workshop on Set-net Fishing Technology Transfer for Sustainable Coastal Fisheries Management in Southeast Asia at Eastern Marine Fisheries Research and Development Center (EMDEC) Rayong, Thailand 12 - 14 December 2007

Background

Since the Resolution and Plan of Action on sustainable Fisheries for Food Security for the ASEAN Region was adopted in the ASEAN-SEAFDEC Millennium Conference in November 2001, SEAFDEC Training Department has implemented a project on Coastal Fisheries Management under ASEAN-SEAFDEC Fisheries Consulting Group (FCG) scheme.

In 2003, a project on Introduction of Set-net Fishing was initiated to support the development of Sustainable Coastal Fisheries Management in the coastal area of Rayong Province, through the Japanese Trust Fund I Program (Coastal Fisheries Management). The project has been carried out for 2 years during 2003 – 2005, with the achievement and satisfaction by the small-scale fishermen who participated the project. Then the project has been continued under the collaboration between local fishermen from Mae Rumpheung beach small-scale fisher group, and local technical officers of the Department of Fisheries, Thailand (Eastern Marine Fisheries Research and Development, EMDEC) of Rayong Province. The project has been renamed as to be “Rayong Set-Net project” under the technical supports and advices from Himi set-net fisheries cooperative, Tokyo University of Marine Science and Technology (TUMSAT) and SEAFDEC Training Department (SEAFDEC/TD). The concept of Set-Net was recommended to be applicable for promoting the coastal fisheries management and resources enhancement, with the understanding of needs to have further study for developing appropriate fishing techniques for the tropical waters in the region.

SEAFDEC/TD has been conducting the follow-up activities and Improvement of Set-Net fishing technology transfer for Sustainable Coastal Fisheries Management in collaboration with Rayong Set-Net project since 2005 until the present. It was found that set-net plays an important role for establishing the core as the fishermen’s cooperative activities. It could create the opportunities for many collaborative works among the fishermen and also the local officers. However, the set-net fishing gear is still a new fishing technique for the coastal fishermen in this area, Yet, it also affects the present fishing activities and coastal environment. Therefore, it needs more improvement in both fishing techniques and operation methods.

This workshop will be organized with the aims to evaluate the implementation of Set-Net fishing technology transfer for Sustainable Coastal Fisheries Management, as well as to discuss the faced constraints and future plan for further promotion of an appropriate fishing gear to the fisher in the region, and then to ensure the responsible and collaborative fisheries practices towards the sustainable coastal fisheries management in Southeast Asia. Three-

day workshop including half-day on boarding activity for inspecting the fishing operation and marketing management in Rayong Set-Net project will be arranged for giving the full-understanding of on-going project in Rayong, and for gathering the comments and suggestions from the experts and researchers concerned on Set-Net Fishing Technology and Coastal Fisheries Management in the region. An issue on “*Can set-net fishing be recommended as an alternative eco-friendly fishing gear for coastal fisher community or not?*” will be focused in the wrap-up discussion among participants.

Objective

1. To collect and share the information of set-net fishing and stationary fishing gear operated in the Southeast Asia;
2. To observe the set-net project site and exchange the technical opinion among participants;
3. To discuss the difficulties and constraints for trouble-shooting on set-net fishing technology transfer;
4. To evaluate the response for possible acceptance from local fishers and technical staff concerned on set-net fishing technology transfer; and
5. To initiate the regional future plan to promote the set-net fishery for sustainable coastal fisheries management.

Date and Venue

The workshop is scheduled during the period of 12 – 14 December 2007 and will be held at Eastern Marine Fisheries Research and Development Center (EMDEC) Ban Phe, Rayong Province, Thailand.

Participants

A representative from Department of Fisheries of Member Countries (Brunei, Myanmar, Indonesia, Vietnam, The Philippines, Thailand, Cambodia and Malaysia) including Advisors from Japan, Technical staffs from EMDEC, Rayong Provincial Fishery Office and SEAFDEC/TD will participate in the workshop.

Country report with the paper and 20-min power point presentation on set-net/stationary fishing and their management in the country is required for each participant from SEAFDEC member countries.

Expected Outputs :

1. Sharing the project concept on set-net technology transfer as an Eco-friendly fishing gear for sustainable coastal fisheries management;
2. Data and information sharing on set-net and stationary fishing gear in the region;
3. Updating the situation of set-net fishing in each country;
4. Summarizing the achievements of Set-Net project during the past 4 years; and
5. Future planning of set-net fishing technology transfer in Southeast Asian region.

Provisional Agenda and Timetable

- 11 December 2007** : Arrival of the Participants, Proceed to Rayong Province.
- 12 December 2007**
- 0900 – 0930 hrs. : Registration
- 0930 – 1000 hrs. : Opening address by SEAFDEC DSG/DTDC
- 1000 – 1015 hrs. : VDO-show “Introduction to Rayong Set-Net Project” and Group Photograph
- 1015 – 1030 hrs. : Coffee Break
- 1030 – 1230 hrs. : Review on Set-Net and Stationary fishing gear in Southeast Asia;
- SEAFDEC/TD
 - Country paper of Brunei Darussalam
 - Country paper of Cambodia
 - Country paper of Indonesia
 - Country paper of Malaysia
- 1230 – 1400 hrs. : Lunch Break.
- 1400 – 1515 hrs. : Review on set-net and stationary fishing gear in Southeast Asia (Cont.)
- Country paper of Myanmar
 - Country paper of the Philippines
 - Country paper of Thailand
 - Set-Net fishery in Vietnam
- 1515 – 1530 hrs. : Coffee Break.
- 1530 – 1700 hrs. : Summarization of country report, and Discussion for identifying the difficulties and constraints for technology transfer, with resource information from other country and Rayong Set-net Project
- Set-Net Fishery in Japan
 - Set-Net Fishery in Taiwan
 - Set-Net Management in the Philippines
 - Technical Training Course in Himi, Japan
 - Set-Net Fishery in the region by SEAFDEC/TD (Stationary Fishing Gear)
 - Rayong Set-Net Project by EMDEC
 - Briefing on Rayong Set-Net fishing observation
- 1730 – 2000 hrs. : Welcome Party at EMDEC’s canteen
- 13 December 2007**
- 0530 – 0600 hrs. : Leave Hotel for EMDEC.
- 0600 – 0645 hrs. : Onboard at EMDEC’s pier for set-net fishing observation.
- 0645 – 0830 hrs. : Set-Net fishing observation.
- 0930 – 1000 hrs. : Catch landing and selling observation at beach side.
- 1100 – 1200 hrs. : Visit Rayong aquarium and museum.
- 1200 – 1300 hrs. : Lunch at EMDEC.

1300 – 1515 hrs. : Question & Answer on Rayong Set-Net Project for operation and management, and for the Project Concept in relation to the eco-friendly aspects for Sustainable Fisheries Management in Tropical waters with Rayong Set-Net Project staff

1515 – 1530 hrs. : Coffee Break

1530 – 1630 hrs. : Continue discussion and opinion exchanging with Rayong Set-Net fisher group (Mae Rumpheung Set-Net Fisher Group)

14 December 2007

0900 – 1015 hrs. : Discussion on the use of set-net fishing gear as a tool of coastal Fisheries management in the region

1015 – 1030 hrs. : Coffee Break

1030 – 1130 hrs. : Recommendation for set-net fishing technology transfer for sustainable coastal fisheries management

1130 – 1200 hrs. : Closing Ceremony by SG/TDC

1200 – 1300 hrs. : Lunch

1300 - 1600 hrs. : Excursion in BanPhe, Saun Son

1800 – 2100 hrs. : Farewell party for Rayong Set-Net Project

15 December 2007

0300, 0700 hrs. : Leave for Suvarnabhumi Airport and Bangkok

Commercial set-nets in Japan and the new training set-net “Kago-net”

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Introduction

The set-net is one of the fishing gears most popularly used in coastal fisheries in Japan. It has a long history and has been developed with large variations in its structure and size. They have been adapted to different coastal environments, different species and different scales of business. Similar fixed fishing gears are used over the world; however, there is no doubt that Japan is the country where the set-net fishery is the most prevalent. This is, of course, supported by the Japanese coastal environment, which is surrounded by nutrient-rich waters where both warm and cold currents travel along the coast and a variety of fish migrate from one season to the next.

The set-net fishery is a typical “passive” one which contrasts with aggressive or active types of fishing gear like the trawl or boat seine, where nets are directed at the moving schools of fish. Of all types of fisheries that depend on the relative abundance of fish, the set-net fishery is most subjective to the influence of various natural factors, which include sea-bottom characteristics, current conditions and seasonal changes in migration patterns of fish. Impacts by set-net fishing to the above environmental factors are minimal and; therefore, this fishery is known as one of the most resource and environmentally friendly fishing practices.

Commercial set-nets in Japan Technical history of set-nets

A variety of stationary fishing gears resembling the set-nets presently used appeared in Japan in the early years of the second millennium. A prototype of set-net known as Oshiki-ami (Fig.1), which means “dustpan-net”, was used during the Edo period or after AD 1,600. It had simply one main bag net of a triangular shape with a leader net. A similar set-net with a box-shaped bag called Daibo-ami (Fig.2), which is “trick fish-net” in English, appeared around 1,900. The shape of this net was; however, liable to deformation by currents, which resulted in the escape of fish. Therefore, the net and fish schools had to be closely monitored by watchers, and the net had to be hauled after the entry of every fish school into the net. Much labor and many boats were required to haul the whole net.

Daibo-ami was improved and the new Otoshi-ami (Fig.3), which is “fall into-net”, was developed around 1,910, which is presently the most popular type of set-net in Japan. Otoshi-ami has an additional box chamber that is hauled only during the fishing operation. In comparison to Daibo-ami, fish escape is also effectively prevented; therefore, the hauling of the net could be done at a certain time of the day periodically. These new characteristics considerably reduced the labor requirement. There are many other types and sizes of set-nets nowadays. While the Otoshi-ami and Bottom type (Fig. 4) set-nets are predominant in the category of large-sized set-nets. Similarly, four kinds of set-nets, the Otoshi-ami, the Bottom type, the Choko-ami (Fig. 5) and the Tsubo-ami (Fig. 6) are the main ones found in the

category of small-sized set-nets. The Otoshi-ami is used as the fundamental structure on every net type. This set-net has a complex structure that consists of a three-box chamber, and it is the final stage of structural improvement. The hauling method accompanying the structure of the net can be either one that lifts the net using the ropes attached to it, or using a ball roller. Although small improvements will continue in the future, no further large ones will take place. The simplification of the structure and reduction in size of the set-net aiming to save energy will start in the future.

Variation of Japanese set-nets

Oshiki-ami (Dustpan –net)

This is the prototype of the set-net, and it consists of a leader net and a dustpan shaped net, which is directly hauled up at the entrance. The net and the fish schools had to be continuously watched by the fishermen and it was hauled after a fish school entered the net. (Fig.1)

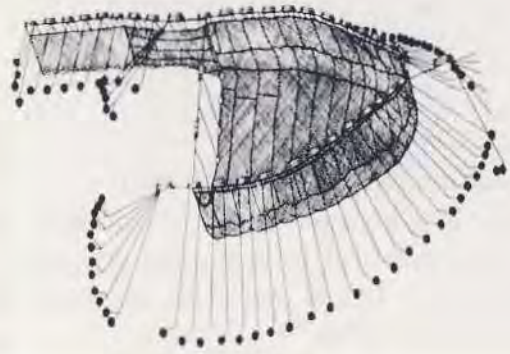


Fig.1 *Oshiki-ami*

Daibo-ami (Trick fish-net)

The Oshiki-ami was improved into the Daibo-ami, which is a prototype of the Otoshi-ami. It consisted only of one main box-shaped bag net of a triangular shape with a leader net. The Daibo-ami had a smaller entrance, which could be closed easily to trap the fish so that hardly any could escape. Nets were hauled after a fish school entered the net and watchers from a lookout confirmed its presence. The entrance was then closed and the fish captured. (Fig. 2)

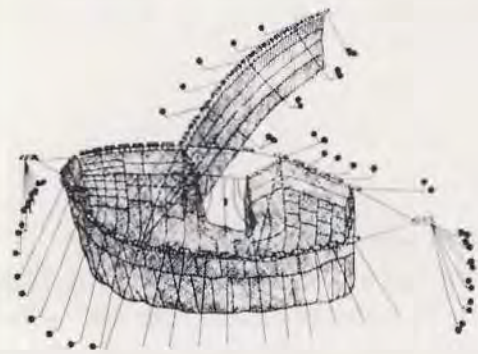


Fig.2 *Daibo-ami*

Otoshi-ami (Fall into-net)

The Otoshi-ami is basically composed of a leader net, a main bag net (playground), an outer and inner slope funnel nets, and a box chamber. The most distinctive character of this set-net is that it has a slope funnel net and a box chamber. Fish that migrate into the main bag are entrapped in the final box chamber after being guided into it by the slope funnel nets. 'Otoshi' means trapping by falling down in Japanese. (Fig. 3)



Fig.3 *Otoshi-ami*

Bottom set-net

The bottom set-net is located underwater on the sea bottom or found in the mid-layer of the water column. This set-net has a box chamber with a ceiling net and non-return funnels nets that act as escape prevention devices. (Fig.4)

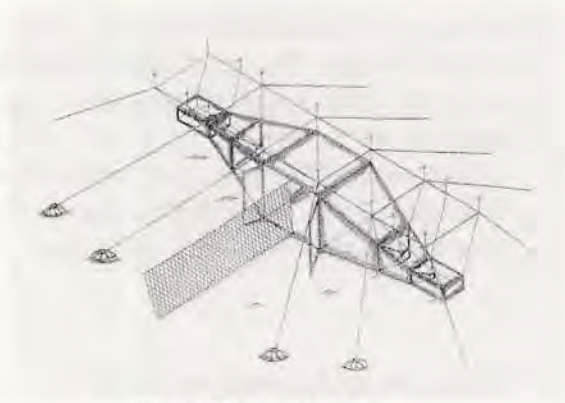


Fig.4 Bottom set-net

Choko-ami (Narrow neck-net)

This is a variation of the Otoshi-ami, and it may have a small or no main bag net, while retaining the slope funnel net and box chamber of the Otoshi-ami. (Fig. 5)

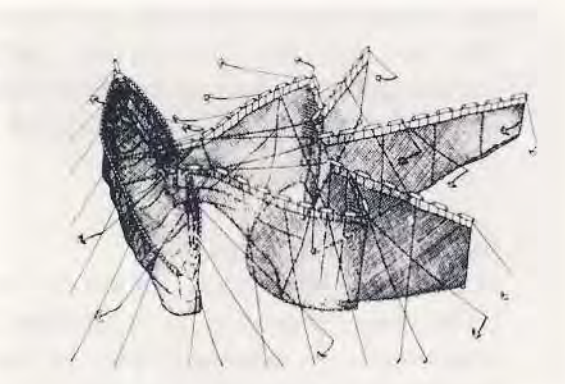


Fig.5 Choko-ami

Tsubo-ami (Fyke-net)

Instead of a box chamber, they are fitted with two or more fykes or tubular trap nets with funnel nets inside that prevent fish escape. Its name comes from the fykes, which are called tsubo in Japanese. (Fig.6)

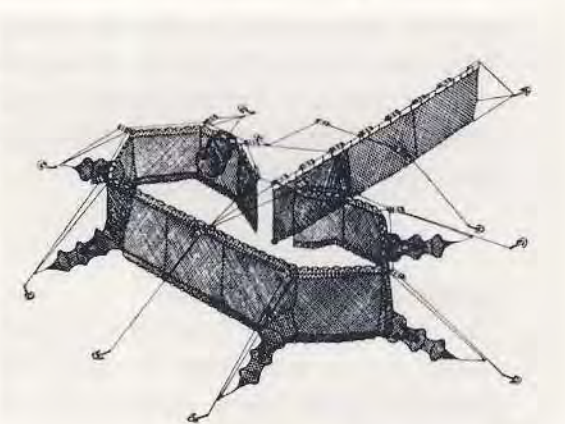


Fig.6 Tsubo-ami

Catch of set-net fisheries

Now, in Japan there are about 1,700 large-sized set-nets, which include 800 salmon set-nets, and about 14,000 small fixed nets. In recent years, the catch of the set-net fishery has been about 500,000t - 600,000t, and this accounts for 10-15% of the total fisheries catch in Japan. The large-sized salmon set-nets supply 150,000t stably. These salmon set-nets have been subjected to resource control management for years, such as fishing season restrictions, protection of upstream migration of salmon into rivers and artificial salmon stock enhancement. The number of juveniles released in the regions where salmon set-nets are found is over 1,100 million every year, and the salmon set-net fishermen cover the cost.

Socioeconomic aspects

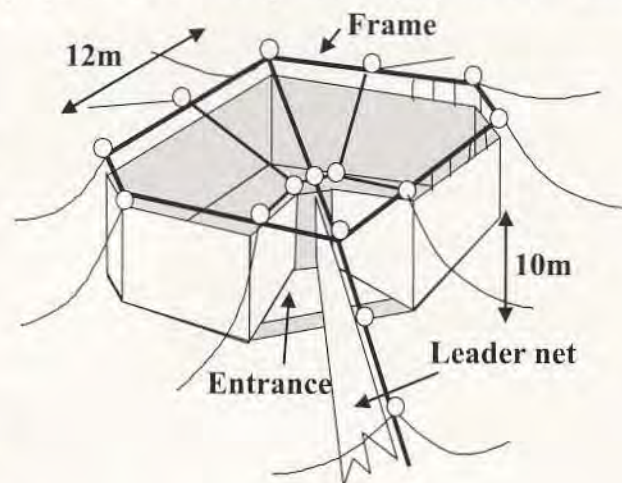
The set-net fishery is performed in regions or fishing villages distant from large cities. The catch (landing) value generated by a set-net is an essential fund for the region, which flows directly into the community. The average amount of money generated by the set-net fishery in recent years is about 120 billion yen annually. The large-sized set-nets, including those of salmon, have earned about 63 million yen on the average for each set-net, while each small set-net has earned approximately 3.4 million yen. These funds are very important for the regional economy in an area where industry is scarce. As for the management of the set-net fishery, the entry into the set-net fishery of a major company from a large city is legally controlled, and priority is given to the local fishermen. This prevents the flow of funds from the rural area into a large city directly. However, the supply of funds required to buy the gear and equipment for set-net fishing becomes difficult. Moreover, the restrictions imposed by local conservative views also limit technical improvement or organizational reform.

Although many people working in the set-net fishery are old, it is a type of activity that can be continued at an advanced age. Since complex technology is not required, only a few experts are needed in set-net fishing, and even people who are inexperienced are also able to work in this fishery. Since fewer than 100 fishermen are required for the operation of a set-net, which is unlike in ancient times, local job generation has become small. However, many coastal fisheries are performed by a small labor force of one to three persons. A large-sized set-net requires a 10-30 fishermen labor force, and even small-sized set-net needs 3-10. Therefore, the importance of employment by a set-net fishery does not change in the local region in which the population is decreasing even now. The employment number of the large-sized set-net fishery is presumed to be 17,000 - 51,000 persons, and that of the small set-net is presumed to be 42,000 to 140,000.

The training set-net "Kago-net"

Its name derives from both "Kagoshima" and "Kago", the former being the name of the location where this set-net is located and the later meaning "basket". Various fishing gears and methods have been developed for the coastal fishery, offshore fishery and distant sea fishery in Japan. However, in Japanese fishery education (high school as well as university), almost all practical training is limited to otter trawl and tuna longline fishing. These fishing technologies were usually used by major companies involved in the offshore and distant sea fishery. However, nowadays it is the coastal fishery that generates around 60% of the Japanese fish catch, and the set-net fishery supplies about 500,000t of fish every year. Consequently, the role that set-net fishing plays in the economy and employment of rural villages is more important than the other fishing methods mentioned above.

Since fishing rights become a problem when an educational institution wants to get involved in the set-net fishery, as well as the hindrance they may cause to other fishing operations, it was very difficult for a university to obtain the fishing permit required from fishermen. Since the local fishermen's cooperative association understood and supported this educational practice, the new training set-net "Kago-net" was developed



- 97 - Fig.7 General View of Kago-net

starting in August, 2006. This small net has a simple structure so it can be used also as a model for technology transfer to overseas participants from developing nations as well as university students. The basic structure of the "Kago-net" was the Daibo-ami, or "trick fish-net", which is the prototype of the Otoshi-ami. It had simply one box-shaped main bag net (body net) of a triangular shape with a leader net (Fig. 7). The body net is 25m in length and 10m in depth, and it has only one bag net with side flap nets (flappers) on both sides and a bottom flap net at the net mouth. In the "Kago-net", the method for attaching the net to the rope frame was done imitating that of the commercial Otoshi-ami. Although sandbags are usually used during the installation of the rope frame, in this case iron anchors were used instead, so they could be repeatedly used while conducting a training. Unlike the commercial large-sized set-net, which has a complicated structure, this simple training set-net can be operated by a few persons. Therefore, students can understand the structure of the fixed net and learn fundamental work technology easily.

The installation of the set-net during training can be performed according to the following work sequence:

- 1) Fishing Ground Survey: Deciding the location of the set-net by investigating the nature of the bottom conditions with an echo sounder and SCUBA divers.
- 2) Marking of location: Fixing marker buoys in their exact position according to the plans.
- 3) Setting of Frame: On the basis of the locations of the marker buoys connected to the anchors the frame for the body net and leader net are attached.
- 4) Setting of Net: Hanging the body net and the leader net to the rope frame.
- 5) Test operation: Operating and lifting the net so that fish do not escape.

Acknowledgements

The author is grateful to Dr. Miguel Vazquez Archdale, from the Fishing Technology Lab of the same institution, for his improvements of the original manuscript.

Developments and Practices of Set-Net Fishery in Taiwan

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Abstract

Being an island state, the fishing industry is obviously an important source of essential animal proteins for Taiwanese as a majority of them prefer fish to meat due to their religious and cultural background.

A set-net is a passive and ecologically-benign fishing gear which depends on the fishes' inherent movement. Set-net fishing has a demonstrably low impact on the environment and ecosystem, including minimal seabed impact, utilization of the entire catch, and low by-catch. Set-net fisheries have economic and energy-related advantages over active search and capture fisheries.

Through questionnaire of census to set-net fishery related fishermen/industries, and SWOT/TOWS analysis, set-net fishing will continue to be a vital source of high quality, fresh fish for Taiwanese people. Furthermore, the method provides substantial community employment and income, and the regular nature of fishing method assists the maintenance and development of local communities. In the future it is likely that this fishing method will provide additional benefits such as opportunities for marine ranching, aquaculture and ecotourism in Taiwan.

Keywords: *Set-net fishery, questionnaire of census, environmentally and ecologically-friendly fishery, SWOT/TOW analysis*

Introduction

The island of Taiwan of the Republic of China has by nature very good conditions for harvesting and production of seafood. Taiwan locates at margin of Asia continent, between N 21° 45' to N25°35' and L 120°02' to L122° 05'. It is a fairly small country with a total area of 36,000km², having a coastline of 1,566.3 km., is situated in the sub-tropical zone, between the East China Sea and the Bashi Channel, with the Pacific Ocean to the east and the Taiwan Strait to the west (Figure 1).

The sea floor of west coast is wide continental shelf connected with China Mainland, of which average water depth is about 60 meters. In contrast, because of the sea floor of east coast is subject to permanent Kuroshio Current effects, it is so deep that it lacks of continental shelf (Figure 2). As a boundary of Kuroshio Current (warm water) and Oyashio Current (cold water), Kuroshio Current makes the temperature of the coastal waters to fluctuate between 12° C to 26° C (Lin et al. 1983). Running along the east coast is the highly productive Kuroshio Current which is the route for many migratory fish species (Hwang 1986). The Taiwan Strait, about 300 kilometers long and 180 to 200 kilometers wide, between the island and the China Mainland is rich in marine organisms, and provides

excellent breeding and feeding grounds for many demersal species. With our long coast, sheltered coastal water and temperature range we are blessed with very good conditions for fishing and aquaculture (Su et al. 2004).

With its convenient geographical location accessing to the world's major fishing grounds, the hardworking fishermen with good fishing techniques having utilized the favorable natural conditions of Taiwan for development of fisheries. Historically, Taiwan has always been a significant fishing nation. The total catch has been fairly stable the last decades. The fishing community has been changing tremendously during time and especially from the 1970s and onward.

The value of catch data in interpreting trends in commercial fisheries has been questioned by both the scientific community and the fishing industry (Hilborn 1992, Hilborn and Walters 1992). Professional fishermen in Taiwan have pointed out that changes in fishing practices influence the relationship of catch and fishing effort data and the status of the fishery (e.g. biomass of residual stocks). Yet, in most cases, catch and effort data (reported by fishers) are the only source of information on fishery status. In this study, extensive interviews with Taiwanese set-net fishermen were conducted to gather detailed descriptions of fishing practices and to identify and describe temporal changes in fishing practices. This provides for a more informed basis to analyse logbook information and developing policy relating to set-net fishery in Taiwan.

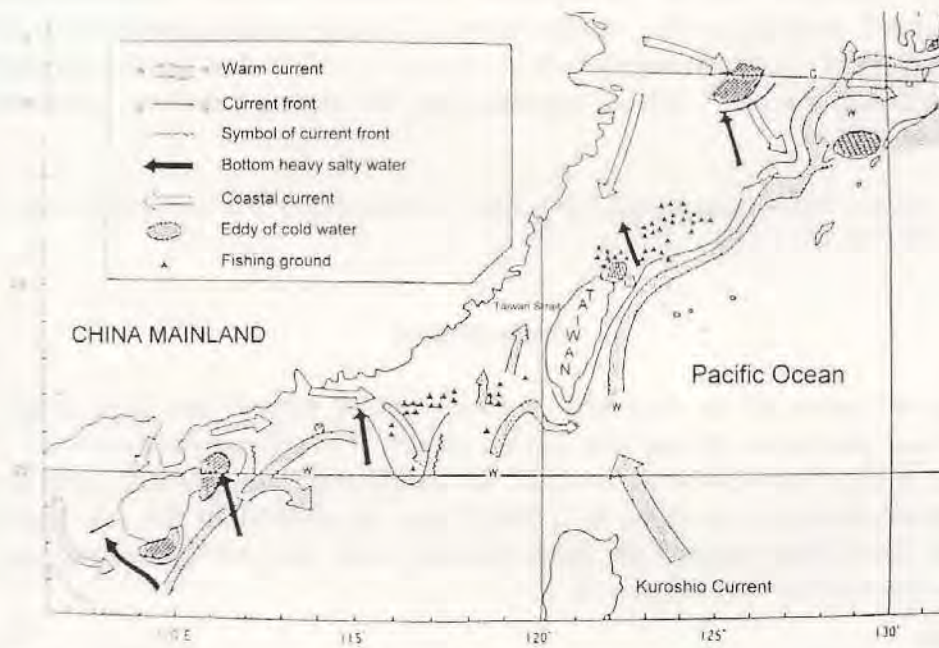


Figure 1 geographic location of Taiwan and its surrounding environment (imitating from Uda, 1968)

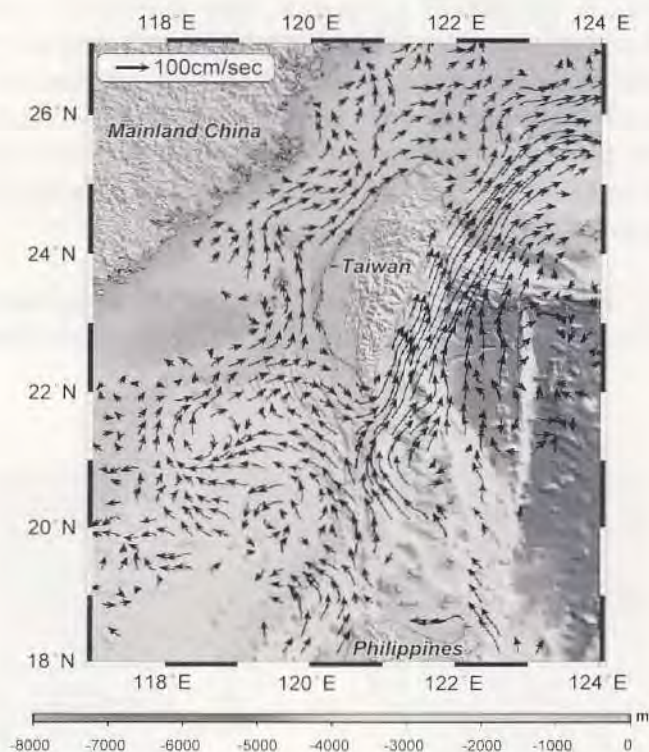


Figure 2 Distribution of current condition at 30-m depth around Taiwan (Liu et al, 2002)

Materials and Methods

Several factors can influence the efficacy of information provided by fishers. In the Taiwanese set-net fishery, unpopular management decisions have created deep frustration and distrust of fishery managers reflecting the perception among participants that limited and poor scientific results drives management decisions. It is not the aim of this study to comment on whether or not industry's perceptions are justified. However, contextually fishermen's discontent was evident during the interviews.

Even so, the fishermen's response to the interview was very positive and most of those who were approached agreed to take part in the interviews. Fishermen welcomed an opportunity to describe their fishing experience and knowledge.

Preliminary interviews were conducted during June with a 2-week round of interviews with fishermen to first identify what were the important issues to be addressed. Set-net fishing companies located at Pingtung, Hualien and Ilan Counties and companies' owners, skippers and fishermen were visited (figure 3). Interviews were conducted one on one with selected fishers or in groups, and included skippers and boat or company owners of set-net fishery. Ten company owners (comprising about 20 % of the total set-net fishing companies) and forty fishermen (including skippers, comprising about 10 % of fishing employees) were sampled and interviewed.

Based on these discussions, detailed questionnaire subjects were designed reflecting the identified issues for the formal interview sessions undertaken from July in three months. The questionnaire focused on set-net fishing gears and fishing practices, commercial status of the fishery, and perceived environmental influences on fishing patterns (the questionnaire

subjects are provided in APPENDIX). Face to face interviews were preferred to mail questionnaires because they were considered to yield better response rates and provide a basis to build mutual recognition and trust. Because the author had formerly provided technical advice to set-net companies and had acted as a chief consultant of Taiwan Set-net Fishery Association, company owners were cooperative in the provision of relevant information e.g. fishing effort logbook data including production and value (although much of these data are commercial in confidence) for analysis.

Although the same questionnaire was used throughout, industry participants were encouraged to contribute additional information that they considered relevant in the context of set-net fishery.



Figure 3 Main distribution of set-net fishing companies in Taiwan

Results

(1) *Distribution of set-net fishing grounds/companies*

The Taiwanese government authorities had issued 77 commercial permits for set-nets, in which 63 sets were currently operating shown in Figure 4. Fifty set-nets (representing about 79 % of the total) are located on the east coast and the other 13 sets (representing about 21 % of the total) on the west coast of Taiwan.

(2) *Set-net fishery management*

Most of the set-nets (49) are co-operations established as companies, including members of Fisheries Association as stewards. The remainder (14) are managed by individual fishers.

The set-net companies manage multiple nets: three companies manage four nets; five companies manage three nets; twelve companies, manage two nets and the remaining companies (5) manage one net.

(3) *Sea bottom topography of fishing ground*

18 companies (72 %) provided information of fishing site, oceanic conditions (i.e. current, tide, water temperature, salinity, depths, seabed conditions), meteorological factors. The others (7 companies) had no detailed information.

(4) *Water depth of fishing ground and scale of set-net*

Thirteen set-nets were situated in depths less than 22 m, twenty-two set-nets were situated in depths between 22 to 30 m, eleven set-nets were situated between 30 to 38 m and seventeen set-nets were situated in waters more than 38 m in depth. Of the set-nets surveyed, 48 sets included two traps and 15 sets with a single trap. There were 40 large-scale set-nets in which the length of body net (including the playground, funnel net and bag-net) was longer than 300 m. The remaining nets had body nets less than 300 m.

(5) *Fishing periods*

Some companies (5) operate year round, eleven companies for eleven months, six companies for ten months, one for nine months, and the remaining two companies operated for less than nine months of each year.

(6) *General seasonal major species during fishing periods*

Logbook records reveal dominant species caught by set-nets (Table 1). Fish belonging to the families Istiophoridae, Xiphiidae, Coryphaenidae, Molidae, Priacanthidae and Exocoetidae were mainly caught in the east coastal waters; whereas fish species of Sciaenidae, Sparidae, Haemulidae, Stromateidae and Polynemidae were caught in the west coastal waters. Some species, such as Scombridae, Carangidae, Belonidae, Monacanthidae, Serranidae, Sphyraenidae, Lutjanidae and Trichiuridae were prevalent in both the east and west coastal waters.

The 20 dominant fish species caught by the set-net fishing companies surveyed in 2002 or 2003 for examples are shown in Figures 5 to 10, respectively. The figures reveal that catches of largehead hairtail (*Trichiurus japonicus*) and blue mackerel scad (*Decapterus maruadsi*) were dominant species, at both the Hsiaher and Fulu Set-net Fishing Companies; catches of skipjack tuna (*Euthynnus pelamis*), frigate mackerel (*Auxis thazard*) and black skipjack (*Euthynnus affinis*) were dominant species at the Mangfong Set-net Fishing company; catches of bullet tuna (*Auxis rochei*) and ocean sunfish (*Mola mola*) were dominant species, at the Chianchun Set-net Fishing Company; catches of bullet tuna (*Auxis rochei*) and stripped bonito (*Sarda orientalis*) were dominant species, at both the Joungmu and Tsuantan Set-net Fishing Companies.

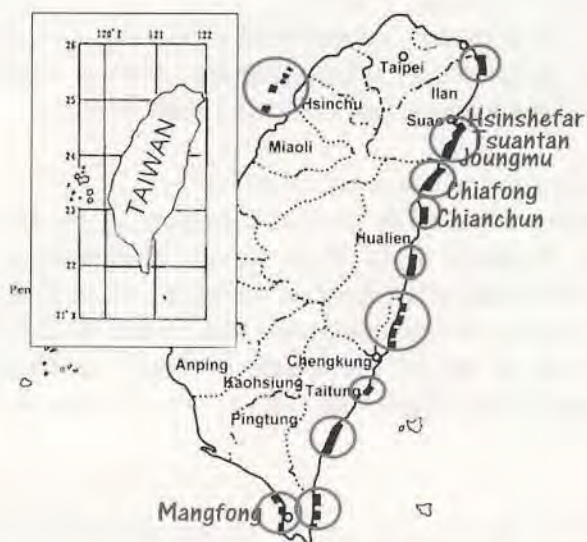


Figure 4 Map of Taiwan with black areas along the coastline showing set-net fishing grounds in the Miaoli, Hsinchu, Ilan, Hualien, Taitung, Pingtung, and Penghu County coastal areas (: Represents set-net fishing grounds)

Table 1 Comparison on seasonal dominant species generally caught by set-nets between the east and west coast of Taiwan (from fisher logbooks)

Seasons	Name of dominant species	
	East coast of Taiwan	West coast of Taiwan
Spring	Skipjack tuna, Black skipjack, Stripped bonito, Jack mackerel, Japanese Spanish mackerel, Horse mackerel, Dolphin fish, Largehead hairtail, Narrow barred, Spotted flyingfish, Redtail scad, Grouper, and yellowfin tuna.	Largehead hairtail, Blue mackerel scad, Black skipjack, Black trevally, Jack mackerel, Japanese Spanish mackerel, Horse mackerel, Narrow barred, Spotted flyingfish, Yellowtail Barracuda, Black scraper and croaker.
Summer	Dolphin fish, Skipjack tuna, Stripped bonito, Spotted flyingfish, Sword fish, Sail fish, Jack mackerel, Ocean sunfish, Narrow barred, Black skipjack, Red Bulleye and horse mackerel.	Blue mackerel scad, Black barred halfbeak, Black trevally, Black scraper, Yellowtail barracuda, Black skipjack, Japanese Spanish mackerel, Stripped bonito, Greater amberjack, and sail fish.
Autumn	Narrow barred, Horse mackerel, Greater amberjack, Black scraper, Sword fish, Sail fish, Ocean sunfish, Jack mackerel, Horse mackerel, Dolphin fish, Red bulleye and sword fish.	Giant mackerel, Greater amberjack, Black scraper, Japanese Spanish mackerel, Black barred halfbeak, Yellowtail barracuda, Largehead hairtail, and horse mackerel.
Winter	Ocean sunfish, Black skipjack, Stripped bonito, Horse mackerel, Largehead hairtail, Black scraper, Yellowtail barracuda, Grouper, Sea perch, Narrow barred and Red scad.	Largehead hairtail, Black mackereck scad, Croaker, Pomfret, Black seabream, Torpedo scad, Giant trevally, Greater amberjack, Japanese Spanish mackerel, Red seabream and Black seabream

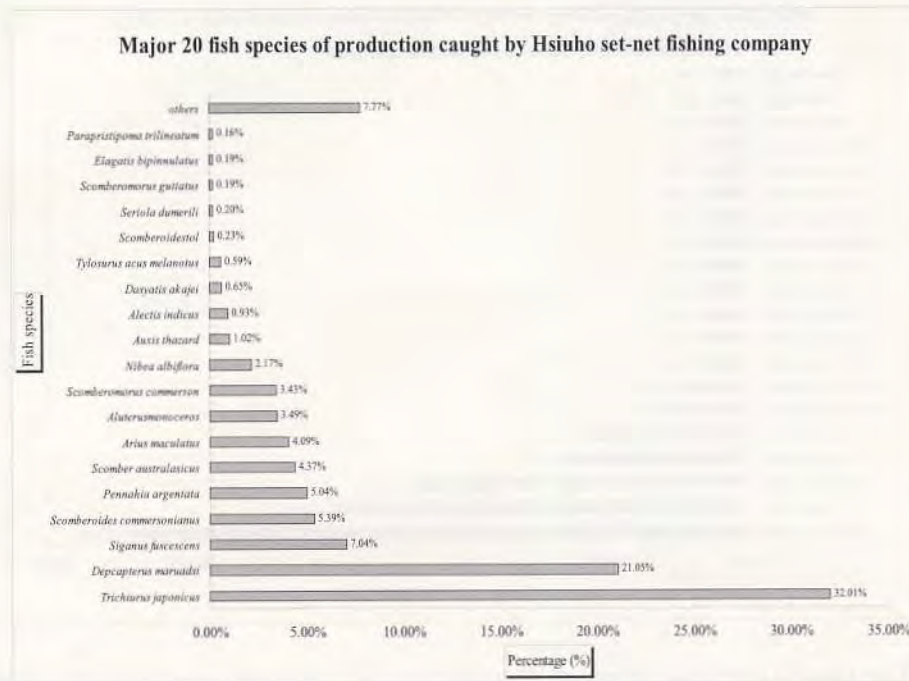


Figure 5 The top 20 catching species of production (by weighty proportion) caught by the Hsiaher (also known as Hsiuho) Set-net Fishing Company in 2003

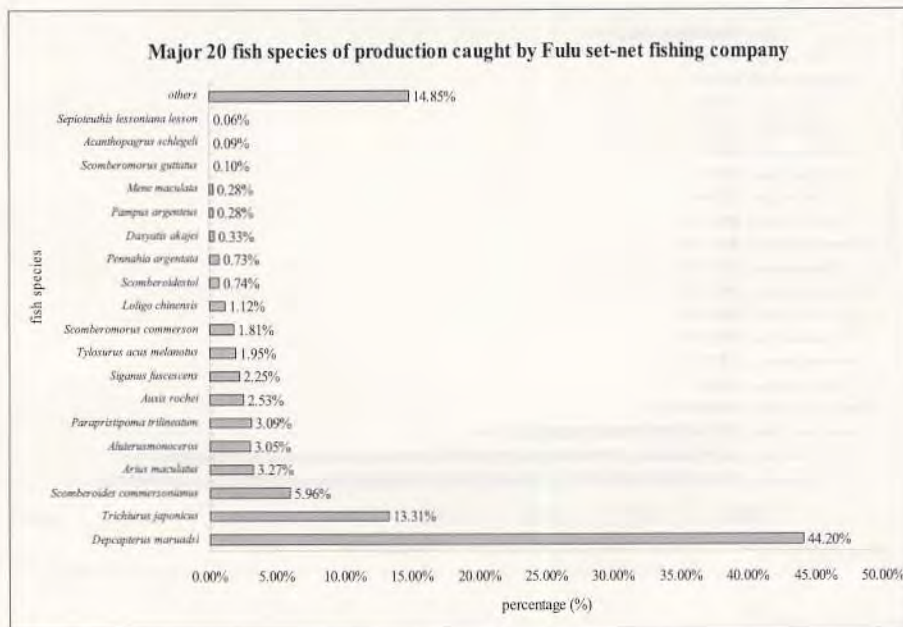


Figure 6 The top 20 catching species of production (by weighty proportion) caught by the Fulu Set-net Fishing Company in 2003

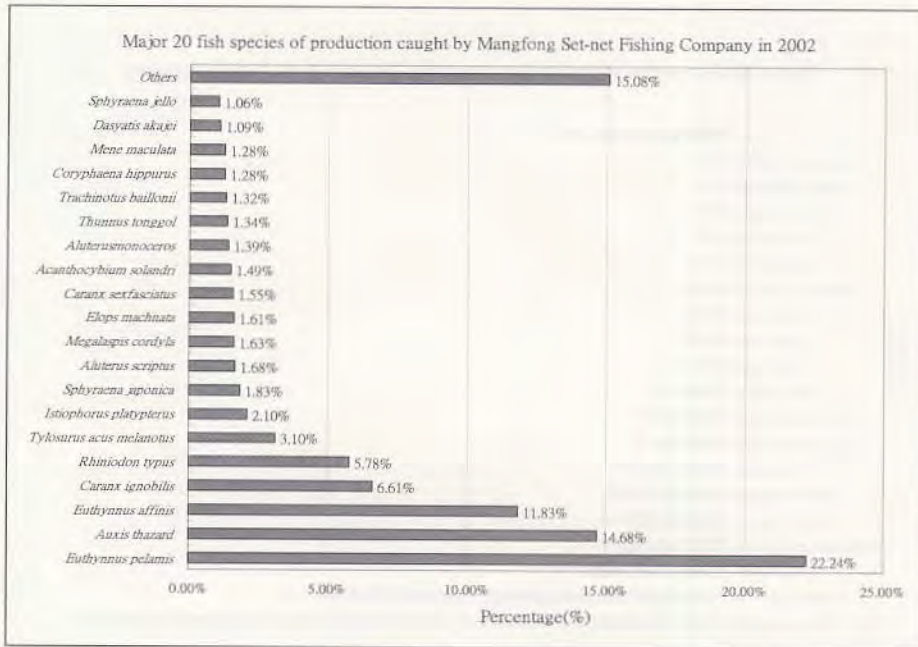


Figure 7 The top 20 catching species of production (by weighty proportion) caught by the Mangfong Set-net Fishing Company in 2002

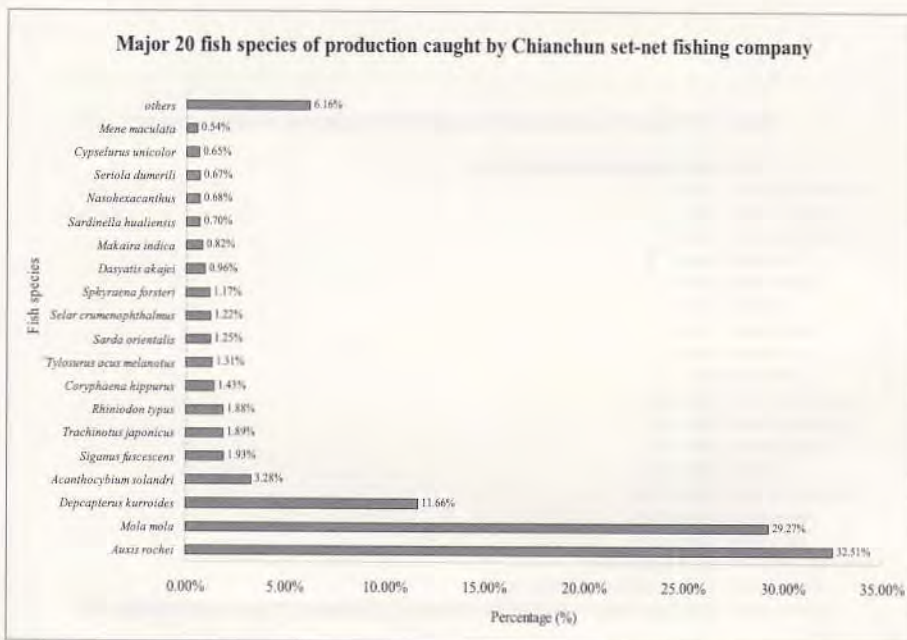


Figure 8 The top 20 catching species of production (by weighty proportion) caught by the Chianchun Set-net Fishing Company in 2002

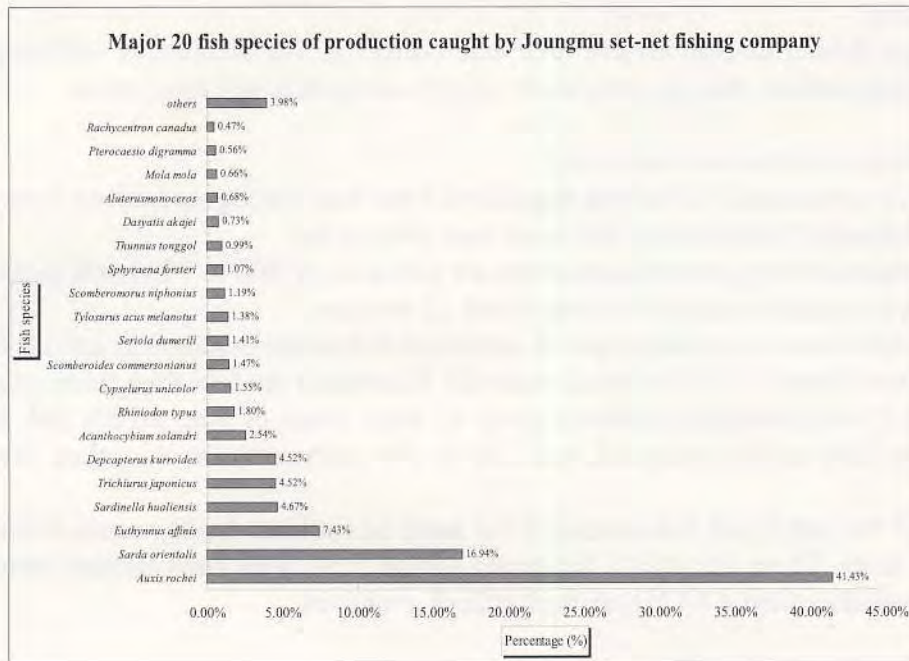


Figure 9 The top 20 catching species of production (by weighty proportion) caught by the Joungmu Set-net Fishing Company in 2002

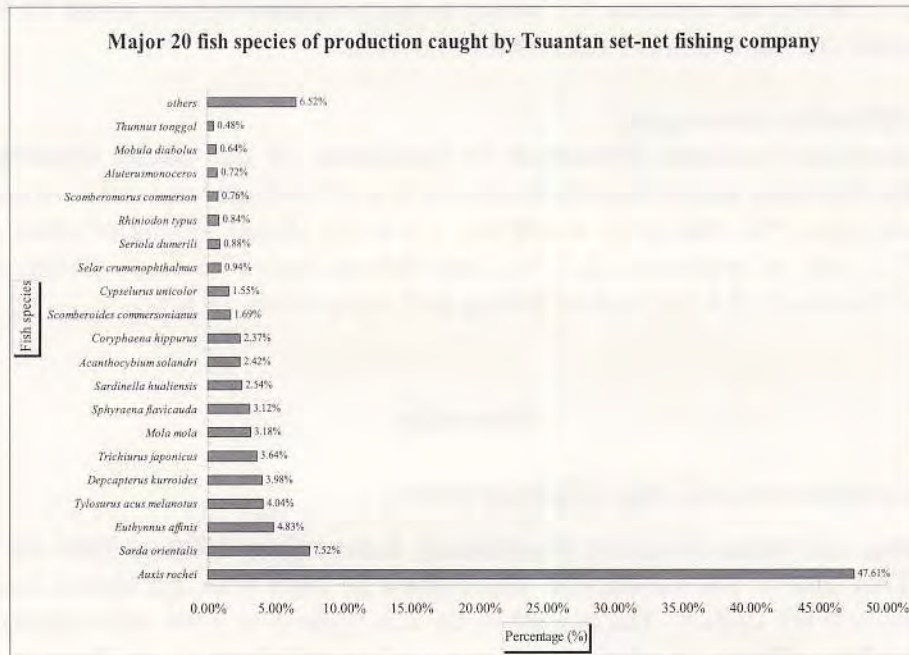


Figure 10 The top 20 catching species of production (by weighty proportion) caught by the Tsuantan Set-net Fishing Company in 2002

(7) *Marketing*

Fourteen fishing companies sell their catch directly, five companies sold their catch to the fishing market, and six companies engage an agent to sell their catch.

(8) *Operating condition and employees*

Most (20 companies) of set-net operations have two fishing operations every day and the remainder (5 companies) fish more than twice a day.

Most boats servicing set-net operations are powered by 300 to 700 horse power engines.

Fishing companies employ between 6 and 12 workers.

The distributions of average ages of employed fishermen engaged in set-net fishing are as follows: about 17.5 % of employees (63 fishermen) are less than thirty years of age, 28.9 % (104 fishermen) between thirty to forty years of age, 26.0% (94 fishermen) between forty to fifty years old, and 27.6 % (99 fishermen) are older than fifty years of age.

Most of the employed fishermen (51 %) have educational backgrounds below primary school level. There are only 7 fishermen (about 5 %) who have tertiary education and the remainders (about 44 %) are high school graduates.

(9) *Annual value of production*

The annual value of production (per fishing company) usually varies between NT five million and NT thirty million dollars. Annual average value of production described as follows: about 4 % of all companies (1 company) is below NT five million dollars; about 18 % of all companies (4 companies) are between NT five to ten million dollars; about 28 % of all (7 companies) are between NT ten to fifteen million dollars; about 20 % of all (5 companies) are between NT fifteen to twenty million dollars; about 20 % of all (5 companies) are between NT twenty to thirty million dollars; about 10 % of all (3 companies) are more than NT thirty million dollars.

(10) *Main difficulties of managing*

The interviews revealed differences in perception of the issues involving set-net fisheries. The main issues identified included (by percentage response) marine resource depletion, (21.1 %); fish price instability, (17.4 %); illegal fishing of other fishermen (12.8 %); lack of employees (8.3 %); high fishing costs (7.3 %); pollution impacts (6.4 %); financial, (5.5 %); lack of fishing port equipments, (4.6 %).

Discussion

Commercial production and value of set-net fishery

The production and value of set-net (Otoshi-ami) fishery from 1980 to 2006 are shown in Figure 11 (FAA 2007). The production was highest in 2003 with the annual landed value about 800 million NT dollars. The annual value was highest in 2006 with approximately 1 billion NT dollars. There are eleven categories of coastal fisheries in Taiwan. The total production of coastal fisheries in 2006 was 54,381 metric tons (mt), of which the production of set-net fishery was 12,931 mt, representing 23.8 % of the total production of coastal fisheries. The landed value of the total coastal fisheries production amounted to 5961 NT million dollars, of which set-net fishery accounted for 978 NT million dollars, representing 16.4% of the total value. It also shows that production increases about 2.5 times and value increases about 7 times averagely comparing with those in 1980s.

Annual catches from set-nets have varied from 3,800 to 13,000 mt during the last two decades. The main species landed are skipjack, Spanish mackerel, horse mackerel, sword fish, hairtail, sea bream, croaker, groupers, sea bass and ocean sunfish.

Figure 11 shows three stages of development. At first, production and value had increased with the introduction of a trap-typed set-net (also named Otoshi-ami in Japan) from Japan in 1980 replacing traditional and less efficient set-nets.

Second, the growth in fisheries development was affected by factors including smuggling, increasing cases of international fisheries disputes caused by detention of distant water fishing boats in foreign waters, and technical difficulties with aquaculture in the late 1990s (including the occurrence of massive shrimp disease) (COA 1993).

The number of set-net fishermen also decreased at that time. Cost efficiencies have been introduced including the reduction of the number of both fishing vessels and employees engaged in set-net fishery.

Changes in fishing policy included the establishment of conservation areas, placing of artificial reefs to improve habitat environment, release of artificially hatched fry, publicity on protection of fisheries resources, strict enforcement of illegal fishing, drafting rules on proprietary fisheries, and approval of recreational fishing (COA 1993). Furthermore, the improvement of fishing gear and methods resulted in improved production and value of the set-net fishery up to 1996 after which a labour shortage restricted production.

Finally, the Taiwanese government has approved the employment of foreign labour in coastal fisheries. Labour from mainland China in the early 2000s has seen foreign labour participation in set-net fishery grow.

Although the annual production and value of set-net fishery in Taiwan has increased in recent years, catch per unit effort (CPUE) is still low compared with catch rates from Japan (Jenq 1995, Jenq and Ou 1995). Similarly, Taiwanese set-net operations return less than half comparable Japanese operations (Jenq 1997).

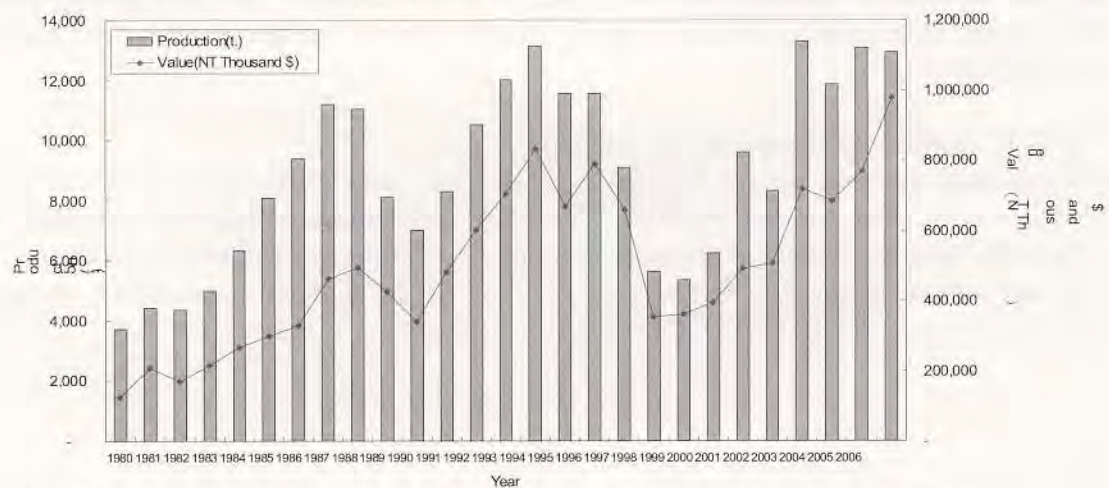


Figure 11 Variation of production (by weight) and value (NTS) of set-net fishery from 1980 to 2006 in Taiwan

Technological factors influencing set-net catches

Set-net fishing operates in the near shore coastal zone. Fishermen usually establish set-nets at fixed location (as authorized by fishery managers) in waters less than 35 m within 3 nm of the shore. Set-nets are serviced by boats operating from shore bases. Since 1995, uniform design has applied to operating boats (based on a Japanese design).

The exclusive operating boat used for set-net fishing is made of fibre reinforced plastics (FRP) is usually 19.9 gross tonnes (reflecting the 20 gross tonnes upper limit by Taiwanese regulations). Service boats include winches, rollers, cranes and jacks, rope stoppers, generators, echo-sounder (fish finder), GPS-plotter, high pressure pumps, fresh or live fish storages, navigational equipments and accommodation for employees. The operating vessel provides for efficient servicing of offshore set-nets consistent with the need for cost-effective operations (Jenq and Jenq 1999).

Fishermen started using the Global Positioning System (GPS) progressively from the mid-1990s in the west coast of Taiwan, at a time when it was only operational for a few hours a day. By the early 2000s most fishermen had acquired GPS.

There is no doubt that, over the last decade, GPS-plotters have greatly facilitated fishing operations by providing greater capacity for targeting productive fishing ground. According to fishers, GPS-plotters do not necessarily increase the fishing efficiency of skilled fishermen. Rather, most fishermen surveyed claimed that GPS improves the fishing efficiency of less skilled fishermen.

Better positioning of set-nets on fishing grounds has obvious effects on set-net yields. Set-net fishing had concentrated in calm waters. However, fishers set nets closer to rough grounds where some fish species are more abundant. The navigational accuracy provided by GPS-plotters, together with the ability to record the exact position, allow fishermen to set up their set-nets closer to rough grounds without excessive net damage.

Before widespread adoption of GPS-plotters, echo-sounders were used to help locate a fishing ground by following the contour of the bottom (i.e. isobaths). Colour echo sounders provide a means of detecting fish and observing fish behaviour on encountering a set-net. This assists in designing set-nets to more efficiently herd fish for capture (Jenq and Liu et al. 1996, 1997).

“SWOT” analysis of set-net fishery in Taiwan

The building up of a set-net fishery in the coastal areas may create causes of possible conflicts with other coastal fisheries. The main (potentially competing) activities of the Taiwanese oceans and coastal areas are fishing, aquaculture, gas and shipping/transport.

The analysis of fishing industry surveys provides for an analysis of strengths, weaknesses, opportunities and threats (SWOT) of set-net fishery shown in Table 2.

Table 2 SWOT analysis of set-net fishing industry

Internal Environment	External Environment
<p><u>Strengths</u></p> <ul style="list-style-type: none"> (i). fuel efficiency; (ii). making coastal fisheries into commercial industry; (iii). sustainability; (iv). additional functions of the set-nets as fish reefs; (v). quality of product; (vi). regulation of product; (vii). regular schedule of operation; (viii). maintenance of fishing communities; (ix). support of related industries; (x). sea cage culture; (xi). encouraging development of inshore fisheries. 	<p><u>Opportunities</u></p> <ul style="list-style-type: none"> (i). highly potential development; (ii). technological improvement; (iii). making marine ranching development; (iv). raising relating industries development.
<p><u>Weaknesses</u></p> <ul style="list-style-type: none"> (i). marine resource depletion; (ii). fish price instability; (iii). illegal fishing of other fishermen; (iv). lacks of employees; (v). high fishing costs; (vi). water pollution impacts; (vii). fishing practices been disturbed; (viii). lack of fishing information; (ix). lack of capitals; (x). lack of fishing port equipments; (xi). poor fishing techniques; (xii). short term of fishing license period. 	<p><u>Threats</u></p> <ul style="list-style-type: none"> (i). typhoon disaster effects; (ii). fishing areas conflict with other coastal fishermen; (iii). fishing practices impact on marine ecosystem; (iv). issues of bycatch and discards.

“TOWS” matrix analysis

Moreover, comparison on Threats, Opportunities, Weaknesses and Strengths (TOWS) matrix analysis there are strengths-opportunities (SO) strategy, strengths-threats (ST) strategy, weaknesses-opportunities (WO) strategy and weaknesses-threats (WT) strategy been integrated and shown in Table 3.

Table 3 TOWS matrix analysis according to set-net fishery development

External Internal	Opportunities	Threats
Strengths	<p>SO strategy (enforcing internal strengths by means of external opportunities):</p> <ul style="list-style-type: none"> • to establish marine farming • to set up marine protected areas. • to develop ecological fishing. • to promote standards of living in the fishing community. 	<p>ST strategy (enhancing internal strength and avoiding external threats):</p> <ul style="list-style-type: none"> • to research and develop high-tech and anti-typhoon materials. • to enhance and protect fishing practices within fishing right. • to promote fishery management in accordance with international management instruments. • to extend fish-eating culture.
Weaknesses	<p>WO strategy (reducing internal weaknesses by means of external opportunities):</p> <ul style="list-style-type: none"> • to build up set-net fishery database service center. • to develop relating marine industries. • to encourage mutual cooperation between academy and enterprises. • to revise fisheries regulations and to ensure fishery industry development. 	<p>WT strategy (reducing external threats and internal weaknesses):</p> <ul style="list-style-type: none"> • to research and develop new techniques for set-net fisheries. • to establish healthy fishing communities. • to revise fisheries and marine management instruments. • to encourage marine industries based on coastal fisheries. • to educate and cultivate high level fishing labour.

Characteristics of set-net fishery and currently management practices

There are many advantages and characteristics of set-net fishery (Chiang and Jenq 1991, Inoue et al. 2002, Jenq and Ou 1993a, 1993b, Jenq and Eayrs et al. 2005). Advantages of set-nets include:

(i). fuel efficiency

The set-net fishing ground is generally located close to a fishing port or fishing operation base resulting in short excursion times. Pelagic distant water fisheries are less efficient in regard to fuel than are near shore fisheries on the same groups of fisheries. Large-scale set-net fishery is an order of magnitude more fuel efficient than any other Japanese fisheries, whether measured in terms of value or production per unit fuel consumption (Nomura 1980).

(ii). making coastal fisheries into commercial industry

Set-nets provide for continuity of supply as fish can be regularly harvested (often twice daily) providing for regular income for fishermen and economic support of local coastal communities.

(iii). sustainability

A relatively small proportion (0.3 – 10 %) of a school or migratory group of fishes are typically caught in set-nets (Jenq 2005). The relatively low proportions of non-target species (by-catch) (Jenq 2004), and the non-destructive operation of passive nets, present an ecological sustainable fishery.

(iv). additional functions of the set-net as fish reefs

Set-nets are permanently fixed to the sea floor with anchors. Thus, a set-net deployment can create 5 to 8 hectares of artificial reefs (Jenq and Ou 1993a) attractive to many forms of marine biota.

(v). quality of product

Set-nets target pelagic fish species. As the fishing method is passive, and fish are harvested alive, the quality of the fish is very high.

(vi). regulation of production

As fish are in effect trapped in a set-net, the harvesting of the fish can be regulated according to market demand. Thus, fish can be kept alive in the set-net when market demand is low.

(vii). regular schedule of operation

Fishermen can harvest fish from a set-net up to 3 times a day. As set-nets are generally close to shore and accessible by fishermen, the time spent in harvesting is very short (about 1 to 2 hours). Thus, fishermen can plan their activities around other activities (including alternative employment and family care). Set-net fishermen are often involved in other primary industries including farming.

(viii). maintenance of fishing communities

Set-net fishing practices are safe and physically undemanding providing employment opportunities for all ages (Jenq and Eyars et al. 2005).

(ix). support of related industries

There are many industries complementary to the set-net fishery. These industries include mechanical services, net producers, boat builders, ropes/wires and anchor suppliers (Jenq 2006, Jenq and McShane 2006).

(x). sea cage culture

Opportunities for value-adding including the feeding and growing of fish harvested in set-nets. Thus, some species of high value (such as Cobia, *Rachycentron canadum*, Greater amberjack, *Seriola dumerili*, Giant trevally, *Caranx ignobilis*, Orange-spotted grouper, *Epinephelus coioides*, etc.) can be grown out in sea cages following their capture in set-nets. Grow-out is facilitated by the feeding of low value fish incidentally caught in set-nets (Jenq 1999).

(xi). encouraging development of inshore fisheries

Set-net fishing industries with government helps can stimulate sea-cage farming (see above), marine park and eco-tourism of recreational fisheries.

According to Law of Taiwanese Fisheries and its relating regulations, operating a set-net in Taiwan requires a permit or license from government authorities that gives the licensee the exclusive right to set a set-net fishing gear and operate fishing practices. The suitability of

potential set-net sites is evaluated by several authorities before approval is granted (Jenq 1990, Jenq and Ou et al. 1991, Chiang and Jenq 1991, Jenq and Liu 2005). The license terms for set-net fishing practices are regulated for five years. The owners of fishing company are not required to pay licence or management fees. Some minor service charges are payable to local government for licence application. The Taiwanese government authorities had issued 77 commercial permits for set-nets, in which 63 sets were currently operating.

Taiwan is located in the west Pacific Ocean boundary. Accordingly the coastal environment in which set-nets operate is often subject to typhoons in the summer months. Typically three to five typhoons affect Taiwanese coastal waters each year. Typhoons can cause serious damage to set-nets particularly on the east coast where waters are more exposed to storm damage. Set-net fishing practices are suspended during typhoons and restricted during the summer months. Major maintenance is usually conducted during this time.

Exclusive operating boats/vessels are more mobile than rafts, which give fishermen the ability to set up their nets to a deeper location within the most productive grounds, and increase the annual operating days of fishing. Typically there are between 250 to 300 operating days annually when fishermen utilize exclusive operating boats (Figure 12)

Variation of operating days at different fishing companies from 1999 to 2003

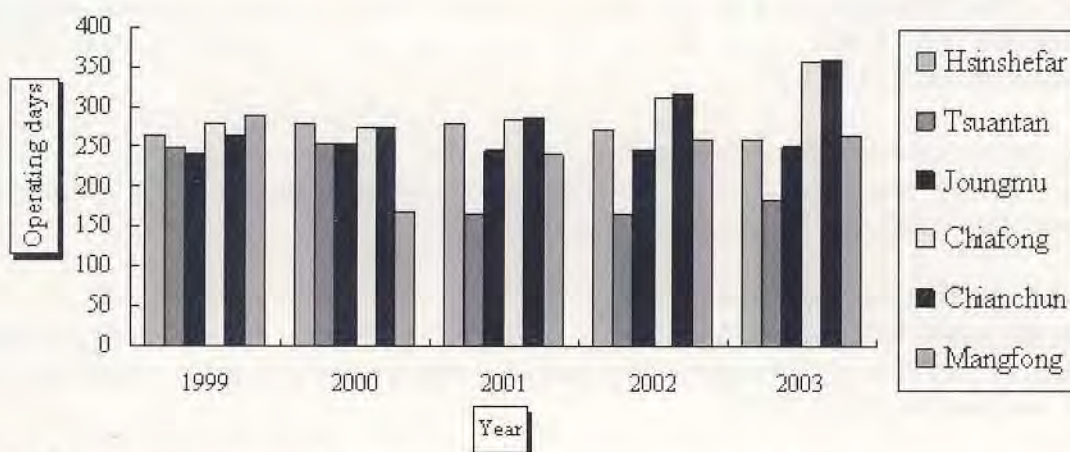


Figure 12 Variation of annual operating days in some sample set-net fishing companies from 1999 to 2003

There are many fishing companies which use mechanical equipment to improve their working efficiency, such as winches, net rollers, cranes, rope stoppers, and using exclusive operating boat with equipping echo-sounders, GPS-Plotters.

Generally, set-net fishing requires more employees than traditional coastal fisheries. Employees are required to handle the net (daily harvest), gear maintenance, repair nets, processing among other tasks (Jenq 2003).

Table 1 shows that most of the species caught in the east coast are pelagic migratory species and rock fishes; whereas most of the fish caught in set-nets on the west coast are resident and demersal species.

Utilizing the fisheries resources of the sea appropriately and reasonably

According to the aforementioned 11 exclusive characteristics of set-net fishery, this is one kind of fishing-right fisheries (Chiang and Jenq 1991, Jenq and Chang et al. 2000). In-depth discuss on the long-term profits suggests that most object species of set-net fishery are migratory fishes. These migratory fishes form the so-called "fish route" in some water areas during their migration (Jenq and Ou et al. 1995). They seldom stay at these areas and just pass by swiftly. It's hard for the fishermen to take opportunities to catch because the opportunities are so elusive.

The water areas selected to install set-net gears are usually in the vicinity of the swimming path of migrating fishes. The highest harvest efficiency of this fishery is estimated to be 10% (Jenq and Chang et al. 2000). It belongs to passive fishing technology and will never fish excessively or overfish. The nets and fishing gears can serve as artificial fish reefs just like an oasis in the sea where migratory fishes can prey, rest and live temporarily in the nearby. It can prolong the fishing operation periods of other net fisheries or angling fisheries and thus provide sufficient time to these fisheries.

The compatibility of set-net fishery with other fisheries such as aquaculture and recreational fisheries is high. Japan is a power of the world in fisheries products; there are 16,600 units of set-net fishing gears of different sizes (Akiyama 2004). Almost the whole region of off-shore Japan is surrounded by set-nets except shipping channels. The distribution of fishing areas is well planned to facilitate the reform of off-shore and coastal fishing grounds and the cultivation and maintenance of fisheries resources.

Set-net fishing gears as fish reefs

The set-net gears are apt to incur the adhesion of many organisms such as ocean animals and plants on nets, ropes, floats and surfaces because they are anchored to specific positions and immersed into the sea for a long term. Presently, Taiwan's set-nets are laid down to a depth of 18 m to 40 m. Due to the abundant sunlight and high intensity of light exposure, photosynthesis is vigorous in these layers of water. So they are ideal places for the formation of fish reefs. As set-net fishing gears are laid down from sea surface to sea bottom, they can serve as fish aggregation devices and bottom fish reefs (Jenq and Ou 1993a).

A set of set-net covers an area of approximately 2 to 5 hectares. Sato (1984) reported that 1 cubic meter of artificial fish reef can generate an artificial fishing ground of 1.837 cubic meters. A set of set-net can create a marine ranch covering an area of approximately 2.5 to 8.5 hectares, and the area of that water can be utilized three dimensionally. So set-nets are quite beneficial to the cultivation of marine biological resources. They can protect the ecological environment of the sea as a whole.

Relationship between set-net fishery and cage aquaculture

The cage aquaculture will become a major food production industry in the future and the fishing behavior of humankind will change from the original fishing (i.e. hunting) into aquaculture (i.e. cultivation) (FAO 1995). As regard to aquaculture, the scale of aquaculture at sea is larger than that on the land. During the planning of cage aquaculture areas distributed at sea, oceanic conditions need to be considered are almost the same as set-net fishery. As regard to issues like the types of fishing gears, their installment and anchoring,

the scales of cage aquaculture at offshore areas are much smaller than those of set-nets. While its structure and installing and anchoring methods identify with those of set-nets, sometimes its requirements are even lower than that of set-nets. Furthermore, the concept prototype of soft cage commonly adopted in Taiwan is originated from the structure of set-net.

The interaction between set-nets and cage aquaculture at offshore areas can be depicted as follows:

1. Set-nets are installed at sea and cage nets are set up to its inner side. This method can ease the affect of resistance directly exerted by current pressure on cage at sea and protect the safety of the cage's materials and structure and stabilize the structure of the cage.
2. Fish fries are trapped by set-nets can be used for cage aquaculture. Some fishes of artificial breeding in recent years in domestic market such as greater amberjack, cobia, red sea bream, blue-spotted snapper, striped piggy and giant trevally, even tuna etc., their fries come from set-net fishery. Set-net fishery is the exclusive fishery that can provide healthy and naturally matured fries.
3. Set-net fishery can provide harvested juveniles of valuable species to marine cage aquaculture. The domestic aquaculture of cobia, pinnate batfish and four-finger threadfin were results of the promotions of early success on their juveniles are trapped by set-nets. By doing this, the prices of these fishes can be raised multiply. The fisheries resources are fully utilized and incomes of fishermen will be increased.
4. Trash fishes are trapped by set-nets can serve as fresh feed and forages to aquaculture fishes in cage for that they are not only fresh and highly rich nutritious and thus can enhance the conversion coefficient (i.e. conversion rate) of cultured fishes but also can save forage costs for proprietors.
5. The setting of cage around set-nets can not only provide a habitat as fish aggregation device. Once aquaculture fishes escape from cage under the effect of external forces, set-nets can give full play to their function as traps and induce the fishes into traps and be captured so as to decrease the fishermen's losses.

Conclusion

Because fish caught by set-net are fresh and of good quality (no net damage compared with demersal trawling), most landings are sold whole direct to the fishing market. Set-net fishing industry can integrate fishery and aquaculture to maximise value.

Medical studies from all over the world are in full agreement that we should eat more fresh and live fatty fish. Fatty fish are good for the heart and circulation, thus preventing human beings from inflammatory diseases and certain types of cancer. Fatty fish are also beneficial to mental health. The fatty acids in fish oil are essential for brain development and have of hyperactivity.

Set-net is a passive fishing gear which depends on the fishes' inherent movement. Increasing the effectiveness of set-net fishing requires detailed information on the behavior of fishes and in particular, their distribution and movements in the coastal waters and their behavioral response to the set-net itself.

The fishing society had through centuries exploited the coast and near sea, and the ocean was look upon as being common property. This also has a legal base in Taiwan. When set-net fishing started, fishermen and residents suddenly had installations that were supposed to be at the same place for a long period (in good places almost indefinite). This was a new situation and had to be dealt with. But before we go into possible conflicts, the contribution and benefits the coastal community and society has will be focused on because of the development of set-net fishery.

The issue that the effects of fishing on marine ecosystems and fish communities are much concern and being widely studied (FAO 1994, 2003). There have been great improvements in our understanding of community level changes in response to fishing recently (Hall 1999). The intensive exploitation of marine fish has led to substantial reduction in the abundance of some commercially important species (Tang 1989, Liu and Wu et al. 1990, Jin 1996). One of the most likely direct effects of fishing on fish communities will involve the selective removal of larger or higher trophic species, and the reduction in abundance of vulnerable species, resulting in changes in overall biomass, in species composition and in size structure (Xu and Jin 2005).

It is stated that fisheries have rarely been "sustainable" (Pauly 2002, Pauly and Christensen et al. 2002). Rather, fishing has induced serial depletions, long masked by improved technology, geographic expansion and exploitation of previously spurned species lower in the food web. They also figure that reducing fishing capacity to appropriate levels will require strong reductions of subsidies. Zoning the oceans into unfished marine reserves and areas with limited levels of fishing effort would allow sustainable fisheries, based on resources embedded in functional, diverse ecosystems (Commonwealth of Australia 1991).

Pauly and Christensen et al. (2002), Browman and Stergiou (2004) also suggested that marine protected areas (MPAs), with no-take reserves at their core, combined with a strongly limited effort in the remaining fishable areas, have been shown to have positive effects in helping rebuild depleted stocks. In most cases, the successful MPAs were used to protect rather sedentary species, through eco-labeling and other market-driven schemes, rebuild their biomass, and eventually sustain the fishery outside the reserves by exporting juveniles or adults.

Amongst set-net fishery experts it is widely believed that less than 10% of a fish school enters a set-net and might be captured. While the actual figures are unknown, the capture of such a small proportion of a fish school may mean that the risk of overfishing is low. By comparing set-net fishing method with other marine active fishing, such as bottom trawling, ecosystem effects of fishing by set net are relatively low and less impacts on marine resources (Brewer and Eayrs 1994, Broadhurst and Kennelly 1994, Jenq and Eayrs et al. 2005). Therefore, it can be useful for sustainable harvests and appropriate exploitation of marine resources to human beings, and regions around set-net fishing ground may play the similar role and function of MPAs.

Set-net fishing can be one of selective fishing methods; it is one of conservative fishing gears. The gear is recognized for its low impacts on the environment and ecosystem, also known as one of environmentally and ecologically-friendly fishing gears, including minimal seabed impact, utilization of the entire catch, and almost absence of discarding of non-target fish and acting as functions of fish reefs. The catch of fish from set-nets is landed on board live and therefore fish quality and freshness is excellent. Set-nets are sometimes referred to

as “the mother of marine cage culture” because many commercial fish species caught by this fishing gear are suitable for use in cage farming practices. Some fish caught in set-nets can be used as a source of food for fish held in cages.

Set-net fishing will continue to be a vital source of high quality, fresh fish for Taiwanese people. Set-net fishery will continue to be the main “engines” of Taiwanese fisheries for many years to come. However interesting developments are happening in other areas of coastal fisheries. It can create and will provide plenty of fishing-related jobs for fisheries community and society. That is, it provides substantial community employment and income, and the regular nature of fishing method assists the maintenance and development of local communities. In the future it is likely that this fishing method will provide additional benefits such as opportunities for marine ranching, aquaculture and ecotourism in Taiwan and coastal countries all over the world.

Acknowledgments

The authors would like to take this opportunity to express our sincere gratitude to Dr. Paul McShane, who was a former vice president of Australian Maritime College (AMC) for his patience time and valuable comments. Many people contributed indirectly or directly to this study, including owners, captains and fishermen of many set-net fishing companies for their assistance and advice whilst at sea, as well as providing a friendly working environment in an ever changing state of the sea; staff and members of Taiwanese Set-net Fishery Association for their providing useful fishing data logbooks. Many companies provided catch data, assistance and encouragement which are invaluable to the completion of this study, especially the Hsiaher, Hsinshfar, Chiafong, Chianchun, Shin-adjue and Mangfong Set-net Companies provided their set-nets and equipments and assisted in many aspects of the study, thank you.

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APPENDIX : Questionnaire of census

1. Name of Set-net Fishing Company:
2. Date/year of Company starting:
3. With whom is in charge of the company:
4. With whom is the Captain:
5. Duration and number of license and the authority:
6. Location of fishing site:
7. Models of set-nets deployed:
8. Fishing seasons:
9. Types of managing:
10. Procedure of harvest process:
11. Scale of set-nets:
12. Depth/ isobaths of fishing ground:
13. Main species of fishing practices:
14. Fishing labors, including numbers, educational background, age, distribution of residence etc.
15. Fishing vessels, including amount, tonnage, materials, building year, horse power of main/auxiliary engine, equipments of fishing and navigation etc.
16. Time/duration of fishing practices:
17. Fishing ports/harbors:
18. Distance/ sailing time away from nearest fishing port:
19. Conditions of nets with antifouling paint:
20. Chart of fishing ground, including topography, current and tidal analysis, sedimentary survey, fish's resources detection, meteorological and oceanic factors investigation, traffic conditions etc.
21. Other fishing condition around/outside the fishing site
22. Production and value of main species in the last fishing term:
23. Annual income in the latest three years:
24. Annual costs of company running, including fishing practices, maintenances of fishing vessels and fishing gear, charges for catches transportation and sale, wages of labors and payment for management, etc.
25. Current difficulties and aspiration in the future:
26. Plans of company management;
27. Condition of cooperation between industry and academy:
28. Others:

Set-Net Fishing Technology Transfer and Development for Tropical Coastal Waters

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Abstract

The third introduction of set-net to Thailand was started on July 2003; "Technical Guide for set-net fishing" from the International Set-Net Fishing Summit in Himi 2002 was used as a main construction design guide. 40 fishermen from 7 small scale fisher groups of Mae Rumphueng Beach, Rayong Province had completed construction of Otoshi-ami 45×150 m body net with 250 m of leader net within 2 months. It was installed at 13 m depth of their fishing ground and operated by the group. Its construction design and operation techniques have been developed year by year. 6 fishermen leaders were trained in Himi City for 2 weeks in 2005, 2006 and 2007, so Himi's set-net fishing techniques were transferred to Rayong set-net and developed for a proper use in shallow waters of the Gulf of Thailand.

Poor catch and hard maintenance were observed for the first year, because of inappropriate design and unskilled fishermen. In 2004, the second year fishing operation, three major construction parts were improved; slimmer body net, lower and narrower inner entrance and all iron anchors were replaced by 800 pcs of 60 kg sandbags. So its catch was improved from 174 to 255 kgs/haul with a maximum catch of 1,650 kgs/haul, 100 fishing operations were conducted. In 2005, the third year operation was further developed in fishing operation techniques; alternative use of the net parts was introduced for a proper maintenance as 3 weeks, 2 months and 3 months for chamber net, playground and leader net respectively. 110 fishing operations were conducted with an average catch of 250 kgs/haul and its value was increased from 5,000 to 5,500 Baht/haul. This was due to shorter operation time per haul (30 min), better fish handling onboard and marketing improvement. In 2006, the second set of Otoshi-ami was employed on nearby fishing ground at depth of water 14 meters. With improved fishing techniques and marketing development, average value of catch was increased to 6,500 Baht/haul while average catch per haul was slightly decreased to 215 kilogram.

Key words: Set-Net, Tropical Coastal Waters

Introduction

Most of coastal fisheries resources of the developing countries are over exploited; it was caused by various factors. Environmental friendly fishing technology is highly demands for the situation of excessive fishing efforts, conflicts among the different types of fishing gear and methods, energy-saving effort for fishing operation, quality improvement of catch freshness for high-price marketing and environmental conservation requirement. Collaboration among local fishermen is an important key to success of the sustainable costal fisheries management. Set-Net fishing has recently been reconsidered and introduce to the coastal fishing ground, as it is believed to conserve marine resources environment and energy saving fishing gear. The pilot project has conducted in Rayong Province, Thailand.

The Set-Net

Set-Net is a stationary fishing gear which could function as an effective tool for coastal fisheries management. Its function and catching mechanism is similar to the bamboo stake trap but differs from it in the construction. The set-net has been considered an appropriate management approach to address the region's declining fish catch from the Gulf of Thailand and the Andaman Sea. The introduction of Set-Net fishing is therefore primarily aimed at promoting responsible coastal fisheries management and conservation of the coastal fisheries resources and the fishing grounds. An Otoshi-ami type of set-net which is 45 x 130 x 250 meters in size was designed and constructed in 2003. And it was installed in the 13 meters deep coastal water of Mae Rumpheung beach in Rayong province and operates by a group of fishermen from small-scale fisher group. Set-Net fishing operation is done during daytime by 9-11 fishermen using 3-4 small-scale fishing boats (6 m long). Their catch comprises of mackerel, sardines, travels, squid, and other fishes. The members of fishers group participating in the project were also trained on the basic concept of fisheries cooperative mechanism and concepts on sustainable fisheries management.

Improvement and development

Result of the first year operation was not good, there was poor catch while a lot of fish was found in the playground but only few of them was trapped in to box chamber. Fishing operation could be done only 5 months with total of 52 operation and total catch of 9 tons, average catch of 175 kg per operation and 2,000.-baht per haul. The first year project evaluation was poor catch and difficult in operation, maintenance was very hard job for them, it took more than one hour for an operation and big boat with hauling device was required for maintenance activities. The improvement of gear construction and development of fishermen skill needed to be done immediately.

Three main construction of Otoshi set-net gear were adjusted, shape of body net (play ground and box chamber) was adjust 30 x 155 meters with 250 meters height of main leader. Entrance of box chamber was adjusted to be narrower and deeper (0.70 m, 8.0 m) and shortening slop net of play ground become 15 meters long. And lastly, replace all anchors to be 1,000 sandbags of 60 kg each. There were many factors affected to the net, fluctuation of the whether and sea conditions are the most important factors. Net construction need to adjust for appropriate to the factors. Sand bag for 6 chamber fixing rope was stted at each Conner of chamber net to prevent the fluctuated current.

Results of all improvement were in the table, the conclusion and recommendation of 4 year experience as follows;

Table

Year of Study & Experiment	Fishing Condition	Problem & Obstacle	Correction & Improvement	Result	Remark
First year (2003-2004)	<ul style="list-style-type: none"> ● Fishing only 5 months ● Poor catch ● ore operation time (Over 60 minute) 	<ul style="list-style-type: none"> ● Not good design ● Fishermen have no experience ● Poor group management 	<ul style="list-style-type: none"> ● Correct gear design ● slimmer shop of body net adjusted entrance ● More fishermen training ● Improve group management 	<ul style="list-style-type: none"> ● 52 operations ● Total catch 9 tons ● Average catch 175 kgs /time ● Income 109,000 B. average 2,000 B/T 	<ul style="list-style-type: none"> ● 5 team of fishing ● Separate catch selling place ● no account system
Second year (2004-2005)	<ul style="list-style-type: none"> ● 7 months fishing season ● Better maintenance ● Better catch ● Better incentive 	<ul style="list-style-type: none"> ● Low fish price ● Poor fish handling ● high growth rate of fouling organism ● week group management 	<ul style="list-style-type: none"> ● Obtain spare set of gear for maintenance ● Set maintenance course ● Improve fish handling ● Strengthen Admin. Committee ● Fishermen training 	<ul style="list-style-type: none"> ● 101 operation with 25.7 tons average catch 255 kilogram/time ● Total income 520, 930 B. average 5,157 b/time 	<ul style="list-style-type: none"> 20 fishing teams (24 fishermen). ● Central fish landing ● Concentrate on account system
Third year (2005-2006)	<ul style="list-style-type: none"> ● 7 Months fishing season ● Better maintenance ● Catch slightly decreased ● Better fish prize ● Easy handling of operation 	<ul style="list-style-type: none"> ● No good response from government ● Week financial and account system ● More income 	<ul style="list-style-type: none"> ● More meeting ● Strengthen finance and account system ● Increase one set for better management ● Fishermen training 	<ul style="list-style-type: none"> ● 108 operations with 24.3 tons average of 255 kg/T ● Total income of 597,786 baht avenge 5,500 B/T 	<ul style="list-style-type: none"> ● Only one fishing team ● Corrected main leader direction
Fourth year (2006-2007)	<ul style="list-style-type: none"> ● Try extend fishing season to 8 months ● Sea condition has some fluctuated ● Better maintenance ● Fishermen have higher income 	<ul style="list-style-type: none"> ● Still has no response from the government ● Group management has developed but could not solve ● Some conflict among members 	<ul style="list-style-type: none"> ● Register the fisher group ● Strengthen finance & account ● Improve construction of the second set ● Fishermen training 	<ul style="list-style-type: none"> ● 110 operation with 23.5 tons, average 215 kg/time ● Total income of 696,970 baht average 6,453 B/T 	<ul style="list-style-type: none"> ● one fishing term ● 2 set of gear ● Continue fishermen training

Conclusions

From 4 years experience of Set-Net operation through the project, its conduction could be as follows:

1. Otonshi type of set-net is an appropriate type for open fishing ground.
2. On the cross sand bottom character of fishing ground, sand bag is suitable for fixing material of the gear.
3. In the shallow fishing ground, the chamber entrance should be deep and narrow.
4. For the tropical shallow water, chamber net mesh size should not smaller than 25 mm.
5. Set-Net should not locate too close to the shore (less than 1,000 meters.)
6. Distance between each set should not less than 1,000 meters.
7. Tropical set-net fishing needs regularly maintenance.
8. Proper fish handling should be seriously considered to gain higher price of catch.
9. Submersible cod-end type set-net should not recommend for tropical shallow water fishing ground.
10. Appropriate fishing techniques should be applied for small-scale fisher group operation, to save energy and easy operation.

Recommendation

1. Set-Net is an environmental friendly fishing gear and the appropriate tool for coastal fisheries management.
2. Set-Net technology could be improved and development for the tropical shallow water operation to increase fishermen income with no trouble on the nature and environment.
3. Set-Net fishing in the coastal should be allowed for local small-scale fishermen in group operation only.
4. Management of set-net fishing should be planned in advance for three levels of operation management, local small-scale fisher group, local commercial fisherman and commercial fisheries (company). These should be under the management of local government or fisheries association or cooperative and control by central government policy.
5. Others activities should be encouraged to conduct together with set-net fishing to increase fishermen income such as; eco-tourism, catch value added by community factory, etc.

Acknowledgement

We would like to thank Mr. Tadashi Hamaya and Mr. Isao Hamano set-net experts from Himi City for provide us the technical assistance to the project. Prof. Dr. Takafumi Arimoto the Rayong Set-Net Project advisor from Tokyo University of Marine Science and Technology (TUMSAT) who give us more good advice and provided us the change to see and discussed with many Set-Net specialize in Japan under the JSPS-NRCT Core University program. Thank to all members of Mae Rumpheung set-net fisher ground who has supported so strong to the project. And lastly Thank to officers and staff of the Eastern Marine Fisheries Research and Development Center (EMDEC), who provide us the facility to the project.

Set-Net : an Eco-Friendly Fishing Gear for Sustainable Coastal Fisheries Management

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Abstract

Set-Net, a stationary fishing gear which could be functioned as a tool of Coastal Fisheries Management program of the region. Sustainable Coastal Fisheries could be developed under the umbrella of Set-Net fishing activities, also the conflicts of coastal fisheries could be solved simultaneously.

Otoshi-ami type of Set-Net was introduced to small scale fisher groups along Mae Rumpheung Beach of Rayong Province Thailand. A total number of 85 small scale fishermen and their families from seven fisher groups have agreed and participated the launching ceremony of "Set-Net study and experimental project" in July 2003. 8 members of the Administrative and Management Committee of the fisher group were set-up to manage all activities of the fisher group. Cooperative management system was introduced gradually, until it met their satisfactory with sustainable coastal fisheries and fisher group development.

Mae Rumpheung small-scale fisher group has satisfactory with set-net fisheries as the past 4 years period of the project the group had deposited their operating fund in the total of 216,119 baht in 2005. And in comparison between the result of 2004 and 2006 the average income per day-trip was increased from 5,000 to 6,500 baht while the average catch per day-trip was decreased from 255 to 215 kilogram. That due to the best quality of catch can get the better price, short period of working hour at sea(3-4 hours/day), energy saving fishing under the high price fuel oil crisis and additional income can be made from part time fishing around set-net construction(300-400 baht/day from squid jigging). Collaborative activities could be created on the coastal fishing ground and its construction can act as a fishing ground protector from other active fishing gear such as trawler and light fishing. Coastal resources could be enhanced around the construction of set-net, therefore it could be assumed as an Eco-friendly fishing gear.

[Key words] *Coastal Fisheries Management, Set-Net*

Introduction

Most coastal fisheries resources of the developing countries including the Southeast Asian countries are overexploited because of the high demand for fishery products and the modernization of fishing technology. Moreover, since most coastal fisheries in the region are small scale fisheries, coastal fishermen are vulnerable to competition and are often confronted with the conflicts in fishing operations with the decreasing resources. In order to cope with such realities, it has become urgent for fishery management authorities to consider and develop various alternative approaches to the existing fishery activities and management considering such real problems in fisheries.

One approach promoted by SEAFDEC to address the critical problems faced by the region's coastal fisheries is the adoption of set-net fisheries. In 2003, SEAFDEC/TD promoted the use of set-net as an environment-friendly and energy saving fishing gear through a pilot project implemented in Rayong Province, Thailand. The project, which received funding from the Government of Japan Trust Fund Program, was a collaborative effort among the small-scale local fishermen of Rayong Province, SEAFDEC and the Fishery Agency of Japan with technical assistance from the Himi City Fishery Agency and Tokyo University of Marine Science and Technology (TUMSAT). Lessons learned from the outcome of the pilot project could be useful for the other countries in the ASEAN region in carrying out their respective activities related to sustainable fisheries management and resources conservation.

Project Objectives

The SEAFDEC/TD pilot project in Rayong Province was generally aimed at promoting the set-net as a tool for sustainable coastal fisheries management. Specifically, the project aimed to introduce the set-net fisheries as means of reducing the fishing pressure on coastal fisheries resources; alleviating the fishing competition among the fishing gear types; organizing group cooperation for fishing operations; developing a common policy concept for coastal fisheries management; and enhancing the community's concept on coastal conservation.

The Set-Net

Set-Net is a stationary fishing gear which could function as an effective tool for coastal fisheries management. Its function and catching mechanism is similar to the bamboo stake trap but differs from it in the construction. The set-net has been considered an appropriate management approach to address the region's declining coastal fisheries resources, e.g. the decreasing fish catch from the Gulf of Thailand and the Andaman Sea. The introduction of Set-Net fishing is therefore primarily aimed at promoting responsible coastal fisheries management and conservation of the coastal fisheries resources and the fishing grounds.

An Otoshi-ami type of net which is 30 x 150 x 250 meters in size, the set-net used in the pilot project was installed in the 13-meter deep coastal waters of Mae Rumpheung beach in Rayong Province and operated by a group of fishermen from the small-scale fishers group in the project area. Set-net fishing operation is done during the day-time by 9-11 fishermen using 3-4 small-scale fishing boats (6 m long). Their catch comprises mackerel, sardines, travelly, squid and other fishes. The members of the fishers group participating in the project were also trained on the basic concept of fisheries cooperative mechanism and concepts on sustainable fisheries management.

Project Outcome

Results of the pilot project proved that the set-net fishing gear is environment-friendly while promoting cooperation among the local small-scale fishermen. The set-net also serves as means of improving the incomes of the fishermen and also performing well as a resource conservation tool. The set-net can be used in coastal fishing grounds with due consideration to the environment and especially in protecting the bio-diversity of the coastal areas and conserving the fisheries resources. From the feedback of the small-scale fishers group participating in the project in Mae Rumpheung beach, there was maximum satisfaction in the adoption of the set-net fisheries by the fishers group during the four years of the project implementation.

Environment-Friendly Fishing Gear

Having no impact on the environment since it does not release wastes into the environment, the set-net is therefore considered an environment-friendly fishing gear. A set-net fishing operation also does not cause any harm on the fisheries resources. While the set-net serves as fishing ground protector from other active fishing gear such as the trawlers and luring light fishing gear, it also enhances the coastal resources around the set-net area making it an environment-friendly fishing gear. From the observations made during the implementation of the pilot project, the bio-diversity around the area where the set-net was installed has been preserved and protected.

Local Fishermen Group Participation and Capacity Building

The operation of set-net fisheries promoted the establishment of a small-scale fishers group, which conducts a form of cooperative fishing since about 10 fishermen are involved in every set-net operation. In the implementation of the project, community participation has been promoted as demonstrated when 40 volunteer fishermen from the project area constructed the set-net fishing gear which they completed in two months.

During the launching ceremony of "Set-Net Experimental Project" in July 2003, about 85 small-scale fishermen and their families from seven fishers groups took part in the ceremonies where the concept of coastal resource management using the set-net was presented and explained in details. As a result, some members of the Administrative and Management Committee of the fishers groups that were set-up by the project agreed to manage the activities of the fishers especially the operation of set-net fishing.

During the implementation of the pilot project, cooperative management system was introduced gradually including the concepts of sustainable coastal fisheries and fisher group establishment and development. Thus, the concept of group cooperation management of the fisheries resources became clear to the fishermen turning the set-net fishing activity as a cooperative venture in fisheries proving that collaborative activities in the set-net area of the coastal fishing grounds could be promoted. Moreover, the operation of the set-net also serves as capacity building for the fishermen raising awareness on environmental issues and the protection of the marine resources. The fishermen became aware of the status of the fisheries resources and on how they could help conserve such resources through the use of responsible fishing practices.

In addition, the managerial skills of the fisher group members through the Administrative and Management Committee have been enhanced as shown in the successful management of their members who showed willingness in accepting the technological innovation which is the introduction of the set-net. The Committee also made efforts to optimize the commitment of the members in the project and boost the solidarity among the fisher group members.

Economic Growth through Increased Income

In the project area, the set-net fishing operation has contributed significantly to the economic growth of the beneficiary fishers group in Mae Rumpheung. Firstly, being an Otoshi-ami type of gear, the set-net is also an energy saving fishing gear since the fishers spend shorter period of working hours at sea (3-4 hours/day). Being stationary, the set-net therefore saves on energy especially during the current high-oil-price crisis.

Secondly, it was noted that during the implementation of the project, the fishers group was able to deposit part of their income in the amount of 216,119 Baht in 2005 which they reserved for their operating funds. Comparing their outputs in 2004 and 2006, it was noted

that the average income per day-trip of a fisherman was increased from 5,000 Baht to 6,500 Baht although the average catch per day-trip decreased from 255 kg to 215 kg.

The good quality of their catch led to the better prices coupled by their efforts to increase the catch value through better fish handling techniques and marketing strategies that the fishers learned from the project. The fishers were also able to earn additional income by doing part-time fishing around the set-net area (e.g. about 300-400 Baht/day from squid jigging). Indeed, fishing near the set-net area becomes a year-round activity.

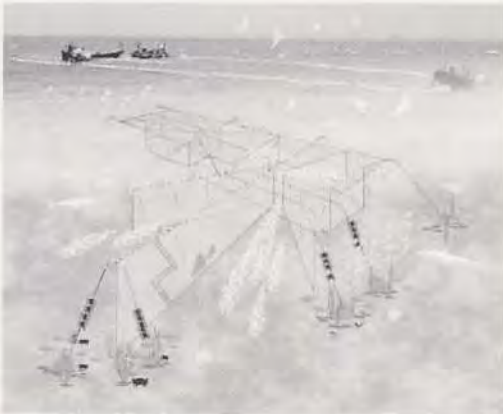
Environment Conservation Tool

The continuing exploitation of the fisheries resources through irresponsible fishing practices by some unconcerned fishermen due to the worsening poverty situation in the coastal areas make it necessary for fisheries administrations to give more focus on fisheries resources management. The set-net fishing gear proved to be a tool for resources conservation as it serves as protector of the fishing grounds because commercial fishing gear such as trawler, purse seine, luring light fishing gear, etc. are kept away from the set-net area. The installation of the set-net makes it impossible for such commercial fishing gear to operate in coastal waters. As a stationary fishing gear, the set-net can also be an enhancement gear because the marine resources can live and survive around the set-net area. Moreover, the set-net area also serves as zone for resources rehabilitation and fish spawning as shown from the result of a survey which indicated the presence of juvenile marine resources around the area.

Acknowledgements

We would like to thank Mr. Songphol Chindakhan illustrator officer of training department for arranging the lay-out of the poster. And Mrs Virgillia T. Sulit fisheries technical officer of "Fish for the people" publication of SEAFDEC, who compile the summary of set-net project through description of the poster.

Picture description



Otoshi-ami type of set net and Local fishermen's participation in set net preparation



Set net operation and fish products from set net



Marine resource rehabilitation around set net area

Fishing Methods and Catch Composition of Stationary Fishing Gear in Thailand

タイにおける定置漁具の漁法と漁獲物組成

Munprasit Aussanee, Amornpiyakrit Taweekiet, Yasook Nakaret, Yingyuad Weerasak (Training Department, SEAFDEC),
and Manajit Nopporn, Takafumi Arimoto (Tokyo Univ. of Marine Sci. & Tech.)

Introduction

Bamboo stake trap and fyke net are the most famous traditional types for stationary fishing gear of Thailand in the past, while they were reduced in number year by year since fifty years ago due to the rapid movement of technology transfer for modern fishing gear and methods. The target catch of bamboo stake trap is Chub mackerel, *Rastrelliger neglectus* and that of fyke net is the coastal shrimps. Fishing ground of bamboo stake trap is located in the coastal water very close to the shore from inter-tidal zone to the depth of 10-15 meters. Then, the bamboo stake trap can be classified into two groups as for the shallow waters and for the deeper waters, both of which are related to the migrating behaviour. Almost of fyke net in Thailand are located in the rivers and at the rivers mouth where the strong current offers the capture function. According to these differences of target species, location and catching mechanism, the fishing impacts on the coastal resources can be differed. Marine Fisheries production from bamboo stake trap and fyke net in 2002 were 1,553 and 9,560 tons respectively, with the decreasing trends for bamboo stake trap since 1993 as peak of 4,388 tons, and with the stable catch for fyke net as 8,398 tons in 1993 (DOF, 2004).

In 2003, Japanese type of set-net (Otoshi-ami) was introduced to Thailand for the objective to develop the sustainable coastal fisheries management. The project was aimed to reduce fishing pressure on the coastal resources, to alleviate fishing competition in the congested fishing ground, to develop common policy concept in fishery management and to enhance the coastal fisheries resources. The result of two years trials of the project has appealed the success of catch trends to obtain the positive evaluation, so that the participated fishermen in the project would like to continue the Set-Net with the cooperative activity as the local community group. For the purpose to examine the present regulation for the stationary gear in Thailand, the comparison of fishing methods and catch composition between bamboo stake trap and set-net is reviewed here for clarifying the eco-friendly level of the stationary fishing gear.



Fig.1 Survey site



Fig.2 Fyke net



Fig.3 Bamboo stake trap



Fig.4 Japanese type of set-net in Rayong

Material and Method

The bibliographic examination and the on-site field survey gave the opportunity to review the historical and present situation of the stationary fishing gear in the area. Two different types of bamboo stake trap were examined, as for the deeper type in Ao Trad, Trad Province and Bangsaen, Chonburi Province, and for the shallower type in Ao Phungnga, Phungnga Province. According to the catch sampling for both types of gear, the catch composition of bamboo stake trap was compared with the catch data of Japanese type of set-net.

Results

Catch composition of set-net shows the good performance with no trash fish, while most of catch are the matured size of pelagic species such as mackerel, sardine, trevally etc. In the case of deep-type bamboo stake trap, the catch consists of 21.85% trash fish and 78.15% of valued species. The shallow type of bamboo stake trap were analyzed as for 49.57% of trash fish, 16.0% of valued fish, 13.5% of shrimps, 13.21% of crabs and 7.71 of squid and cuttlefish. Trash fish from bamboo stake trap are small size of pelagic fish species and the pony fish. The percentage of trash fish is related to the location and season of the fishing ground, as well as the gear designs and capture function. Even with the high percentage of trash fish in the catch, no discarding can be reviewed due to the utilization for cage culture feeding, or baiting for the crab and grouper trap fishing.

Table 1. Catch Composition of 3 types of Stationary Fishing Gear

Type of Gear	Percentage of Major Catch					Total
	Value fish	Shrimp	Crab	Others	Trash fish	
Fyke net	4.60	35.50	-	2.90	57.00	100.00
Shallow water bamboo Stake trap	16.00	13.21	13.21	7.71	49.57	100.00
Deep water bamboo stake trap	70.90	-	-	7.25	21.85	100.00
Set-Net	70	-	-	30	-	100.00

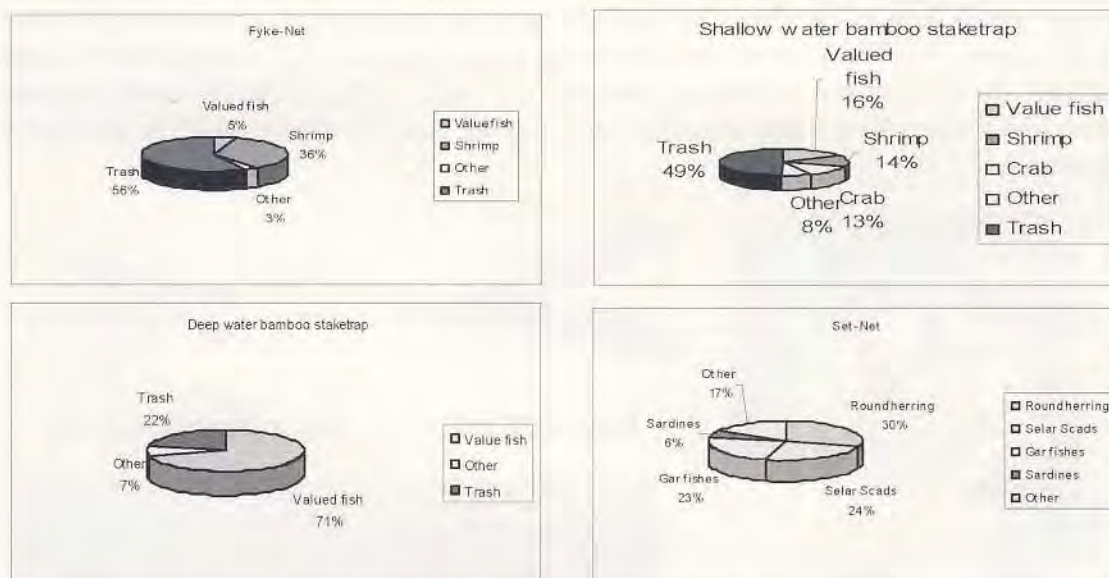


Fig.5 Catch composition for comparing the fyke net, bamboo stake trap (shallow and deep types) and the Japanese type of set-net

SET-NET FISHERY AND THE STRATEGY OF ITS DEVELOPMENT IN INDONESIA

BY ZAROCHMAN

MINISTRY OF MARINE AFFAIRS AND FISHERIES
DIREKTORATE JENERAL OF CAPTURE FISHERIES
MAIN CENTRE FOR CAPTURE FISHERIES DEVELOPMENT
SEMARANG - INDONESIA

Classic Information Indonesian Waters Area (km ²) with Coastal Line Length (km)		
No	Jenis Perairan	Luas Perairan
1.	Luas Laut Indonesia	5.8 juta km ²
a.	Luas Perairan Kepulauan / Laut Nusantara	2.3 juta km ²
b.	Luas Perairan Teritorial	0.8 juta km ²
c.	Luas Perairan ZEE Indonesia	2.7 juta km ²
2.	Panjang Garis Pantai Indonesia	1. 81 290 km (Dishidros TNI-AL, 1987) 2. 95 181 km (World Resources Institute, 1997)

Regionally Marine Fishing Area Management

81000 KM COAST LINE
8853 ANONYMOUS ISLES 92 OUTSIDER
SMALL ISLES 8090
COASTAL VILLAGE
16,42 MILLION POPLES

Keterangan :

WPP I : Selat Malaka	WPP V : Laut Banda
WPP II : Laut Cina Selatan	WPP VI : Laut Seram & Teluk Tomini
WPP III : Laut Jawa	WPP VII : Laut Sulawesi & Samudera Pasifik
WPP IV : Selat Makassar & Laut Flores	WPP VIII : Laut Arafura
	WPP IX : Samudera Hindia

Distribution of Species Coral Reef in coastal waters of Indonesia and The World
(Veron And Stafford-Smith In Rokhmin Dahuri, 2003).

PACIFIC
INDIAN OCEAN

The Richest of Coral Reef :
Sulawesi, Maluku, Papua

Schooling of fish species in coral reef ecosystem
(collection DKP in Rokhmin Dahuri 2003).

HOW TO MAINTAIN THE RESOURCES TO BE SUSTAINABLE

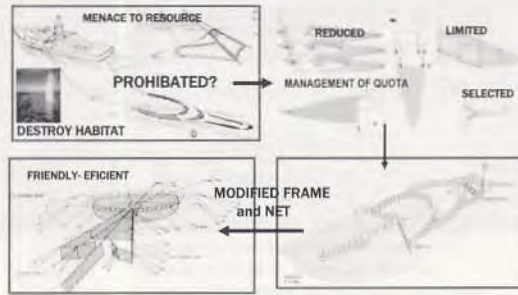
**HOW ABOUT THESE METHODS?
OF COURSE, MUCH MORE DANGER,
AND IT CAN MAKE A DISAPPEAR.**

Rich Forest Mangrove of organic materials of playing a part in of supply detritus to support the detrital food web and fertility in coastal waters (PKSPL, IPB in Rokhmin Dahuri, 2003)

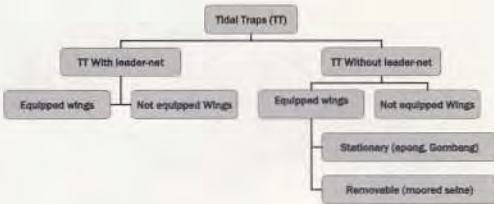
HOW TO PROTECT CRITICAL WATERS AREA?



FINDING ALTERNATIVES TO AVOID FROM ANY ACTIVITIES MAKING DAMAGE TO THE ENVIRONMENT OF WATERS
EXCHANGE TO HABITUAL OF FISHING ACTIVITY ? How?



CLASSIFICATION OF TIDAL TRAPS



TIDAL TRAPS WITHOUT LEADER-NET



TIDAL-TRAPS WITH LEADER-NETS

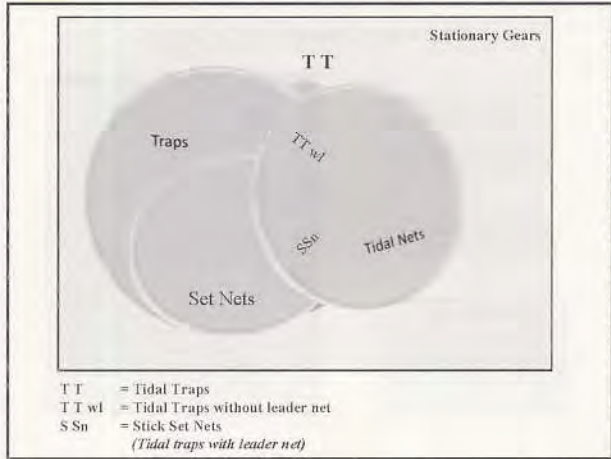


THE DISTRIBUTION OF FISHING SITE OF TIDAL-TRAPS

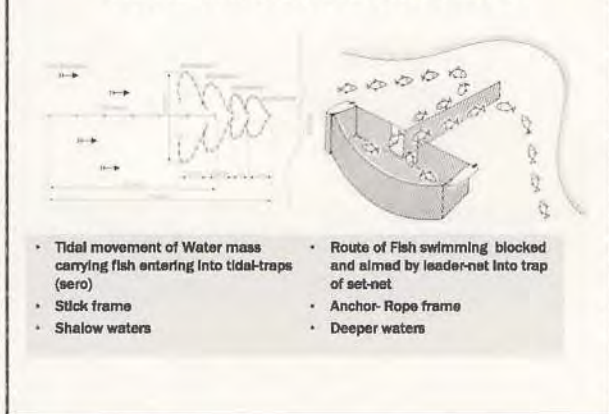


Table Distribution Area of Tidaltraps

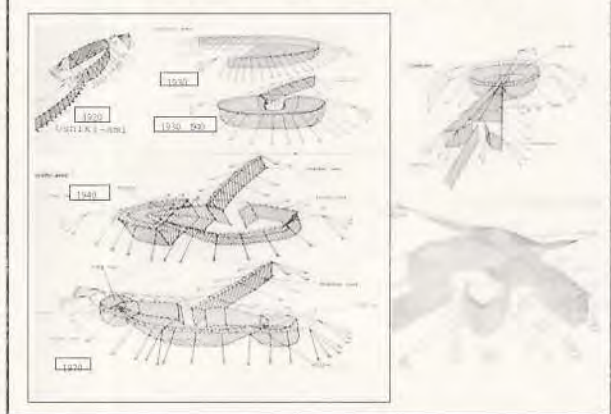
No	Name of Fishing gear and Method	Fishing Village	Waters Fishing area
1	Sero net type 1	Zobel, Southeast Sulawesi	Bone Sea
2	Sero net type 2	Manj, Mamun-Riau, Sumatra	Malacca Strait
3	Sero net type 3	Tip Sebau, Singarang, Palopo, South Sulawesi	Bone Sea
4	Sero net type 4	Jualo Laut, Tarakan, East Kalimantan	Mekassar Strait
5	Sero net type 5	Sarang, Tangerang, West Java	Java Sea
6	Belat type	Pangkalan Susu, Langkat, North Sumatra	Malacca Strait
7	Togo Ikan dan Togo Udang	Pukang Pisau, Middle Kalimantan	Java Sea
7	Togu	Tip Jabung-Jambi, Sumatra Sambas, West Kalimantan	Malacca Strait and Java Sea
8	Togu	Nurukin, east Kalimantan	Mekassar Strait
9	Togok	Langkat, North Sumatra	Malacca Strait
10	Pingerih	Duma, Riau, Sumatra	Malacca Strait
11	Gambang	Riau, Jambi, Sumatra	Malacca Strait
12	Apung	Segara Anakan, Cilacap, Central Java	Lagoon in Central Java
13	Pukat labuh	Tip Bela, north Sumatra	Malacca Strait



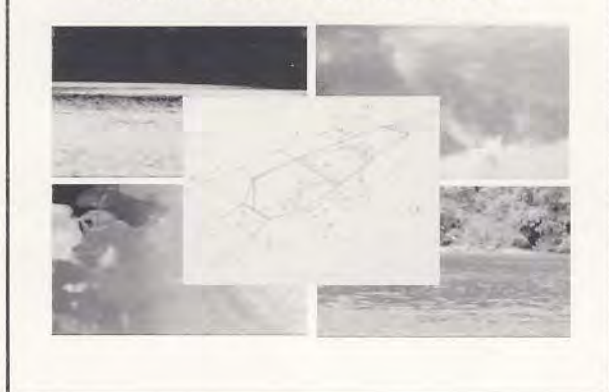
TIDAL-TRAPS AND SET-NETS



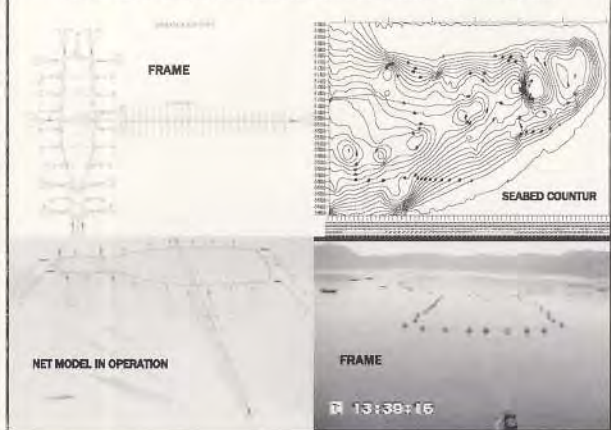
VARIOUS TYPE OF SET-NETS IN JAPAN FROM MEDIUM TO BIG SCALE



OTOSHI - AMI OF MEDIUM SCALE ATTACHED AT GAM ISLE WATERS, WEST IRIAN JAYA



OTOSHI - AMI OF MEDIUM SCALE ATTACHED AT GAM ISLE WATERS, WEST IRIAN JAYA



The Strategy Development for Set-Net

At early stage the Government work along with side of private sector to initiate the development of set-net forwards

Arising issues around benefits of set-nets

- Friendly fishing method
- Consumes less oil
- For security as well as to increasing product of selected fishes

1. Election of location alternative
2. Survey clarify the seabed contour
3. Perception of tidal phenomenon
4. Measurement direction and speed of surface current
5. Assessment of fish density and biomass
6. Netting type and amount of fish group in location
7. Perceiving direction of movement of schooling fish
8. Mapping the traditional fishing gears and fishing activity by local fisher
9. Determining alternative of other location for set-net:
 - a) Effect of current change (annual cycle)
 - b) Anticipate the policy change by local district government/PEMDA to fishery set-net.

NOTES

In specifying choice of design and construction of set-net generally adapted for the nature of swimming school of fish in tropical waters:

- swimming schools of fishes are a relatively small than in temperate zone
- composed of much varieties of fish species

Modify the Set-Net should be fit with the existence of fish in local waters according to varieties of fish species .

SET NET FISHING GEARS IN MALAYSIA



by
ABD. HARIS HILMI AHMAD ARSHAD
 DEPARTMENT OF FISHERIES MALAYSIA

Content

1. Introduction
 - Contribution of Fisheries Sector
 - Issues in Fisheries
 - Fishing Zones
2. Types of Set Net
3. Distribution of set net
4. Catches and species composition of set net
5. Policies by Department of Fisheries on set net

Introduction

- Fisheries sector in Malaysia contributed about 1.08 % of Gross Domestic Product (GDP) in the year 2005. A total of 1,421,402.8 tones of fish valued at RM5,245.68 million were produced in that year.
- Marine capture fisheries contributed 87.1% of the nation's fish production with the coastal fisheries remaining the major contributor at 71.2% of the national fish production (Annon, 2005).
- A total of 90,702 fishermen were recorded working on licensed fishing vessels where as 51,481 fishermen working on traditional fishing vessels and 39,221 fishermen working on trawls and purse seines.
- In Peninsular Malaysia, traditional gears contributed 19.8 % of the marine landings whereas trawlers and purse seines contributed 54.6 % and 25.7 % respectively.
 (Annon, 2005)

Issues in Fisheries

1. Overfishing in coastal areas
2. Competition between traditional and commercial fisheries for fishing ground
3. Competition for the use of coastal zone for compatible purposes
4. Increasing fishing effort because of more efficient technology
5. Use of destructive fishing practices
6. Impact of pollution
7. Habitat destruction

(Ahmad Saklan Langgeng, 2007)

Fishing Zones

Zone A : < 5 nm from the shore, reserved solely for fishermen operating traditional fishing gears and using fishing vessels of less than 40 gross registered tonnage (GRT) and owner operated

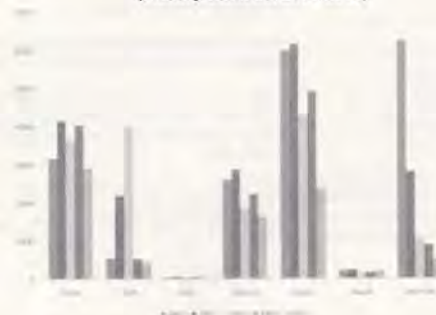
Zone B : > 5 nm for owner operated commercial fishing gears such as trawl nets and purse nets, vessels < 40 GRT. Zone A operators can also fish in this zone

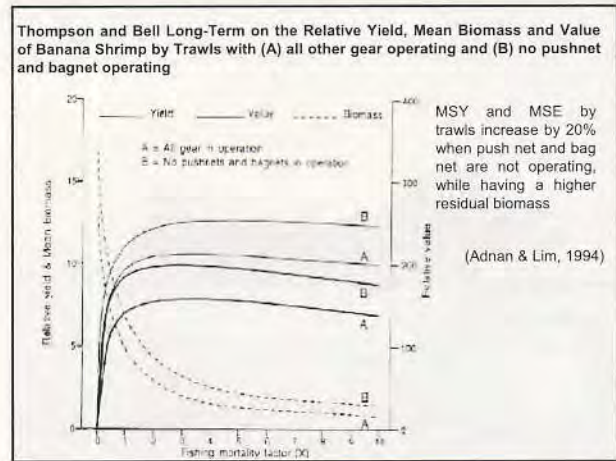
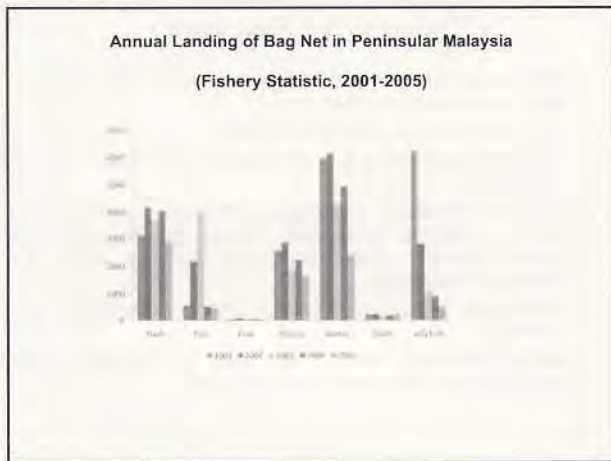
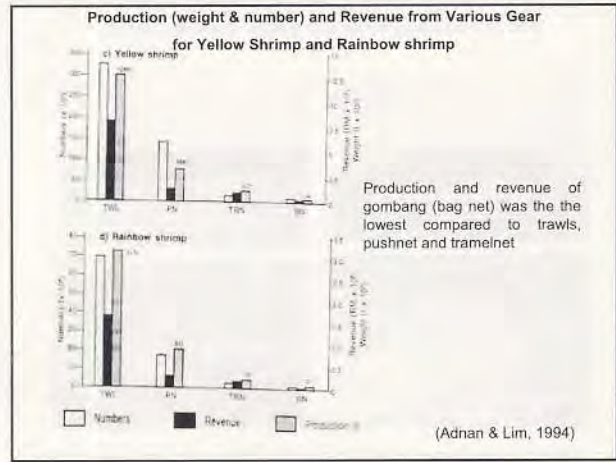
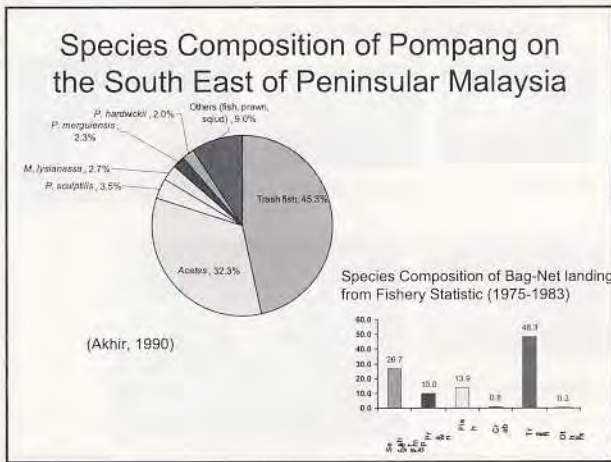
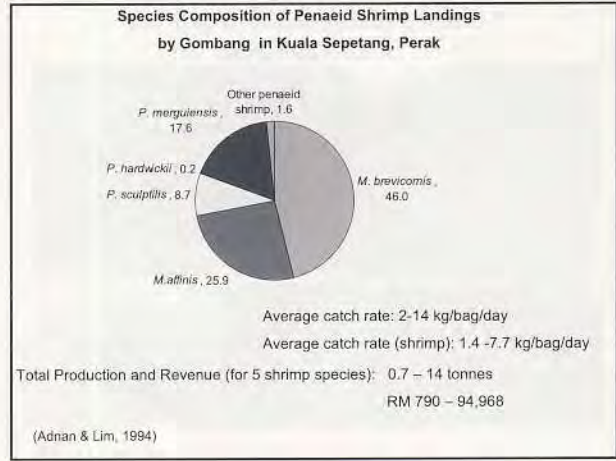
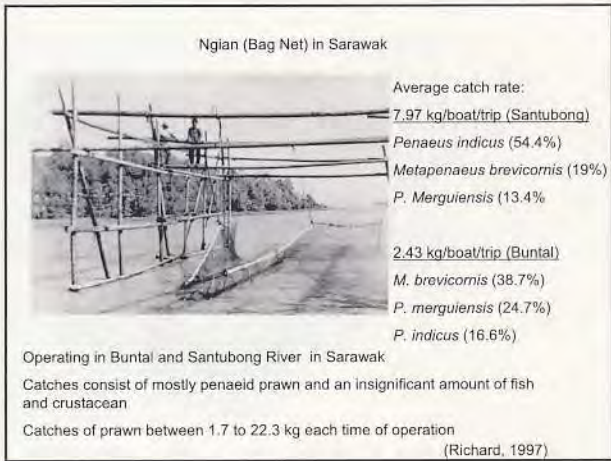
Zone C : >12 nm, for commercial fishing vessels with capacity > 40GRT, Zone A and Zone B operators can fish in this area

Zone C2 : > 30 nm, for deep sea vessels, fishing with vessels of \geq 70 GRT. Zone A, B, and C operators can fish in this zone.

Annual Landing of Bag Net in Peninsular Malaysia

(Fishery Statistic, 2001-2005)

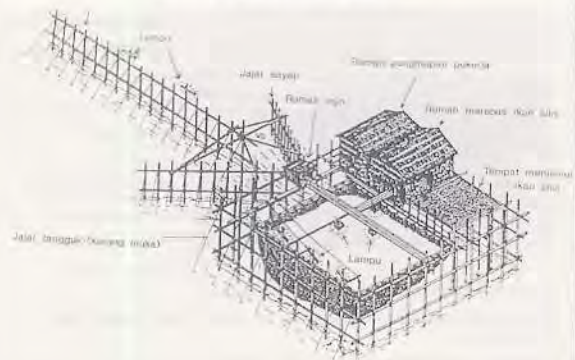




Catches of Pompang (Bag Net) in South-East of Peninsular Malaysia



Structure of Kelong (Fishing Stake)



Structure of Kelong as Tourist Attraction on The East Coast of Peninsular Malaysia



Catches by Kelong or Fishing Stakes



Recreational Kelong In Langkawi Island



Issues of Set Net

- Not economical - cost of gombang to be set-up is high compared to return cost.
- Side-job depend on tidal current.
- Operators are elderly and younger generation is not interested.
- Conflict between pompang, drift-net and ambai (fishing stakes) operators. Same of fishing area which already understood as nursery area for fisheries resources.
- Destroyed by trawlers which often encroached into Zone A.
- Some locations are in the area of shipping path which is very dangerous to both parties.

Actions Taken by Department of Fisheries Malaysia

- High catch of trash (juvenile prawn and fish) caught by these set net (more than 45 % of total catch) contributed to over-exploitation of fisheries resources.
- Stop issuing new license to any type of set net and also transferring the ownership of license to their successors.
- These measures taken to overcome the conflict emerged by set net fishing gears and to conserve fisheries resources for future generation.

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SETNET FISHERIES (Lambaklad) in the Philippines

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I. Description:

- Set net (lambaklad Tagalog Terminology) is a Japanese type of set net.
- It is an adapted technology from typical Otoshi-Ami.
- It is already popular technology used in the Philippines today.
- The fishing gear is composed of the bag, the slope (outer and inner), the playground and the leader.
- It has an box chamber wherein fish is hauled during harvesting operation.



I. Description:

Most viable and durable fishing methods used for catching first class highly migratory fishes

- tuna and tuna-like species
 - ☞ yellow fin
 - ☞ skipjack
 - ☞ marlin
 - ☞ Spanish mackerel
 - ☞ caranx sp.
 - ☞ crevalle
 - ☞ and other migratory fishes



Fish Catch by Set Net in the Philippines



ADVANTAGES OF SET NET:

- Environment friendly** the gear fulfills all requirements stipulated in RA 8550 and other Fishery Laws regarding conservation measures for fishing gears. Its anchors emulates artificial reefs as it is set in clay, sandy and sand- clay bottoms.
- Passive type of gear** the gear is stationary and is anchored at the bottom. It is a "wait and see" type of fishery operated to catch only incoming fishes.
- Good Quality of Catch** can be preserved in the net for a number of days waiting for good market price as being alive and fresh and near to the market.
- Durable life of materials** increased life span of the gear due to the advent of synthetic materials from jute.

Seedlings for Aqua culture

fishes caught alive could be reared in tanks, cages and ponds for marine fish cultivation.

Shorter Working Time

fishermen can attend to other businesses after 2-3 hours of hauling in a day and with the mechanization of the boat, the working time and labor cost is reduced.

Less Fuel Consumption

as compared to trawl and other types of fishing gear, fishermen do not go too far from shore to scout a school of fish.

Preserves the Marine Resources

being a selective and passive gear, it can only fish coming to it with much less possibility of overfishing.

FACTORS TO BE CONSIDERED IN SET NET OPERATION:

1. Selection of fishing grounds;
2. Design and Construction;
3. Setting and Hauling.
4. Maintenance and Monitoring.

Selection of Fishing Grounds

Actual survey within the prospective site must be conducted. Sounding must be done. The following must be considered prior to establishment :

- * Prevailing current speed.
- * Geographic and topographical conditions
- * Type of species present within the area
- * Migration route of the targeted species
- * Should be near coves, bays, rivers or any inlets
- * Sandy, muddy or sandy- muddy bottom
- * Presence of natural estuaries in which abundant of planktons or any fish food
- * At least near commercial establishments and post- harvest facilities

Design and Construction

- The gear has a great effect on the reaction of fish behavior.
- The design of the net is entirely dependent on the fish behavior.
- Pelagic species for instance swim in a very wide area and don't like their body to be in contact with other objects while demersal species are never afraid to be in contact to other objects.
- *Set net* is designed to catch mostly pelagic species while *Choco - Ami* is for demersal species.



Accessories used on the operation of set net:



Banca



Flatboat



Main buoy



Secondary buoy



Boulders



Anchor Bags

Setting and Hauling

- The gear must be set in conformity with the design and plan to resist current, wave action and movement of fish.
- The fixing power of the net is normally computed 6-10 kg. per sq. meter of net (underwater weight).
- The ratio of the length of anchor rope to the sea depth is 1.5- 2.5 of the water depth.



- The total number of anchors are distributed proportionally to the type of anchors and the total net area.
- Hauling operation is done once or twice a day depending on the occurrence of fish and the scale of net.
- It is being hauled by 15- 26 fishermen. Labor had been reduced due to mechanization of their boats.



Gear Maintenance and Monitoring

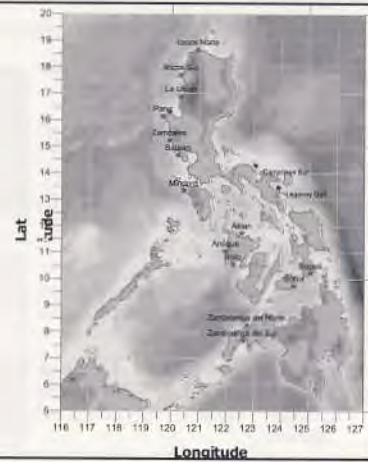
- Regular monitoring of the gears parts particularly its mooring system prolongs its lifespan.
- Gear maybe hauled and dried once every after 25-days operation or once a month to check and mend frayed nettings, reattach removed mooring lines and clear of fouling organisms.
- Monitoring also should involve regular patrolling of the area to avoid intruders and vandalism.
- In the cooperative system member's involvement in the project will be improved.



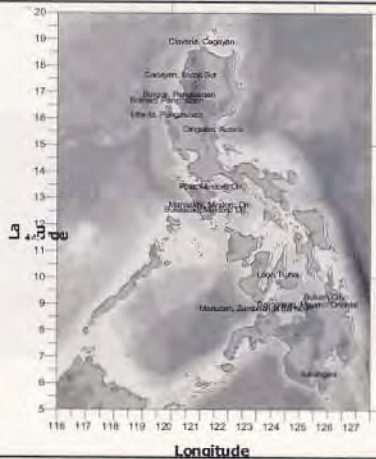
Existing Lambklad

Fishing Grounds

- Pangasinan - 1
- La Union - 1
- Ilocos Sur - 14
- Ilocos Norte - 4
- Bataan - 3
- Zambales - 5
- Mindoro - 4
- Iloilo - 4
- Antique - 18
- Aklan - 23
- Negros Occidental - 1
- Southern Leyte - 2
- Camarines Sur - 2
- Albay - 2
- Bohol - 1
- Zamboanga del Norte - 3
- Zamboanga del Sur - 1
- Grand Total : 89 Units**



Potential Lambklad Sites



Status of Lambklad Fishing in the Philippines



- **Lambklad units can now be installed facing an open sea such as South China Sea as experienced in the Ilocos Region and Zambales Coast.**
- The operation and production of Lambklad projects has an average yield of 200 kgs. per day.
- Payback period takes five (5) months of operation
 - maximum production of 25 tons per day in Antique;
 - 14 tons/day in Zambales;
 - 13 tons/day in Aklan;
 - 6 tons/day in Vigan.

Importance/Benefits:

Economic Benefits

- The project introduced a community-based livelihood program
- the direct beneficiaries of which are the residents of the area
- provide regular source of extra income and additional employment opportunities to the fisherfolks



- better quality of local fish supply will increase with lesser lives' risk considering that it is a coastal type of fishing
- it also increases trade with other communities and other economic activities will generate more revenue to the community and the government



Importance/Benefits:

Environment Aspect

- The introduction of a new, efficient and *environment friendly* fishing method shall boost production and will eventually provide an alternative measure against illegal and highly destructive fishing methods.



- Set-net Fishing, being stationary will serve as buffer or fence against incursion of large commercial fishing vessels in the municipal waters
- The fisher folks cooperators will naturally act as protectors in the nearby vicinity of the project so as to ensure viability and sustainability of their livelihood
- Marine resources will be protected and will be regenerated. The gear also helps in conserving fishes thus serving as sanctuary for small and juvenile species



Importance/Benefits:

Social Benefits

- Cooperative participation in the conceptualization of the project is recognized and highly encouraged
- Dialogue is conducted with the representative from the cooperative with the local residents to final solution of the proposed project site
- It is also through this dialogue that the fishermen are encouraged to form a cooperative to push with the project



- Fisherfolks/Cooperative and Fishermen's Association are integrated to the project
- Their direct and active participation in the project is imperative to insure availability as envisioned that through direct technology transfer and management training fisherfolks cooperators, the project will be replicated in the future
- As to its development effect, the quality of life of the fisher folks organization will improve
- Being a community-based project, their involvement and participation in the cooperative effort will be heightened
- The cooperative will thus be strengthened
- Its capability will be increased and more services will be rendered for more community development endeavors

Problems Encountered:

Technical Aspect

Fishing Condition

The Philippines, being situated within tropical area experiences unpredictable water current especially during inclement weather prompting for the dragging of anchors, loss of buoys and damage of nets.

Financial Aspect

Very High Investment Cost

The large capital cost needed for Lambaklad investment hinders the sustenance and/or small-scale fishermen from investing in the said Fishing Venture.

Continued...

Problems Encountered:

Management Aspect

Political Interventions

Installation of Set-net Projects sometimes includes *Political Affiliation* of the beneficiaries. Some projects were installed within the priority areas of the Local Chief Executives and scientifically recommended.

Humanitarian Aspect

Disorganized Association/ Cooperative

Some of the fishermen have unconcerned attitudes. They also inhabit the "come what may" behavior hence the failure of some projects in other words mismanagement. Mostly their urgency towards individual tasks is only at first phases of the project.

EXISTING PHILIPPINE FISHERY LAWS ON SET NET FISHING

* *Fish and Game Administrative Order # 3 Section 2*

No fish corral or BAKLAD shall be constructed within two hundred (200) meters of another in marine fisheries; or one hundred (100) meters in freshwater fisheries, unless they belong to the same licensee, but in no case shall they be less than sixty (60) meters apart....

* *RA 8550 (Philippine Fisheries Code of 1998) Sec. 103 par. 5 Construction and Operation of Fish Corrals, Traps, Fish Pens and Fish Cages*

It shall be unlawful to construct and operate fish corrals, traps, fish pens and fish cages without a license/ permit.

* *Fisheries Administrative Order # 155 & 153 Sec. 2*

It shall be unlawful for any person, association, corporation, partnership or cooperative to fish in Philippine Waters with the use of fine mesh nets.

Note:

All operation of municipal fishing gears shall be regulated and controlled by the Local Government Units as stipulated under RA 7160 (Local Government Code).

Cost and Return Analysis:

a. Materials and Equipment = USD 30,078.539

b. Labor (30% of Material Cost) = USD 9,023.55

c. Operating Expenses = USD 9,273.8989

d. Estimated Gross Income = USD 49,013.89

d.1) Average catch/ day for one year operation= 200 kegs. @ USD 1.167/ kg.

e. Estimated Net Income = USD 39,739.99

e.1) 60 % Institutional Share = USD 23,843.993

e.2) 40 % Fishermen Share = USD 15,895.993

f. Return of Investment

R.O.I. = $\frac{\text{Net Return}}{\text{Investment}} \times 100\% = 56.6\%$

g. Payback Period = $\frac{\text{Investments}}{\text{Net Income}}$

$\frac{39,102.089}{23,843.993} = 1.64 \text{ or } 2 \text{ years}$

Note:
1USD = Php 42.845
(Nov. 28, 2007)

Recommendations:

- * Technology transfer on this field of Fishing Industry must be encouraged and intensified.
- * The optimistic materialization of proportionately large capital for *Lambaklad* investment will stimulate new projects by investors to boost the fishing business.
- * Management plans should be developed and adopted among project beneficiaries on the proper utilization for its sustainability/continuity.

* Soft expanded loans should be liberalized. Flexible loan programs should be sustained by the government to go hand in hand with the technology and ecological policies.

* Continuous training/ seminar/ workshop on the technical fishing operations.

Endangered Species proclaimed by CITES should be intensified to facilitate their release in case some of them are caught.

* A study on the occurrence of species caught by *Set Net* should be conducted as basis for promulgation of future Fisheries Administrative Orders.

Thank you very much
Maraming salamat

**Regional Workshop
On Set-Net Fishing Technology Transfer
For Sustainable Coastal Fisheries Management in Southeast Asia**

**Eastern Marine Fisheries Research and Development Center (EMDEC)
Rayong, Thailand 12-14 December, 2007**

Rayong Set-Net

Background

Intensive utilization of resources rather than natural sustainability contributes reduction of marine resources, insufficiency of availability, competition and conflicts among the fishers and related to the ASEAN-SEAFDEC Millennium Conference on “Sustainable Fisheries for Food Security in the Region” held in November 2001, the set-net had been raised as a pilot project for sustainable coastal resource management in this region. This project was then approved by the committee of the SEAFDEC (Southeast Asian Fisheries Development Center) for implementation and budget allocation under the Japanese Trust Fund-I for the years 2003-2004 (US\$ 20,000) and 2004-2005 (US\$ 12,000).



Figure 1 Open ceremony of the Set-Net Project “Introduction of Set-Net Fishing to Develop the Sustainable Coastal Fisheries Management in Southeast Asia: Case Study in Thailand 2003-2005” on August 19th, 2003 at EMDEC, Rayong Province.

To achieve target aims, the DOF (Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand) has been requested by the SEAFDEC for facilities, cooperation and co-management the set-net project via the EMDEC (Eastern Marine Fisheries Research and Development Center). The project entitled “Introduction of Set-Net Fishing to Develop the Sustainable Coastal Fisheries Management in Southeast Asia: Case Study in Thailand 2003-

2005” has been carried out progressively in collaboration with the fishermen on Mae Rumphueng Beach, Rayong Province, since then.

Although the SEAFDEC could support the Set-Net Project until the end of 2005, the committee comprising SEAFDEC, EMDEC and Representatives from the fishers had considered that the SEAFDEC should transfer the whole project and equipment to the DOF and EMDEC should continue the Project. Eventually, an official endorsement happened on September 22nd, 2005.



Figure 2 The Set-Net Project of the SEAFDEC was officially transferred to the DOF of Thailand on September 22nd, 2005. The Project was changed its name to “Rayong Set-Net Project” since then.

Collaboration with the Japanese Government (JICA)

Since the Japanese mission visited Rayong Province during September 21st – October 3rd 2004, an agreement to promote the set-net fisheries in Thailand has been approved in collaboration with the Japan International Cooperative Agency (JICA). Per the JICA grass-root Program the Rayong Set-Net Project has been supported by technical assistance and instrumental facilities from the Set-Net Fishing Cooperatives, Himi City, Japan. Consequently, two set-net experts from Himi City come to Rayong yearly to work with Thai fishermen in fixing the set-net fishing gear and then installing it in the sea.

Under the JICA Partnership Program (JPP), Himi City has proposed Thailand a training course entitled “Resource Management Style Coastal Fishery for Thailand” in order that Thailand should send three candidates to take the training course at the Fisheries and Fishing Port Division, Industrial Department, Himi City, Japan. The candidates should be one of the DOF-officials and two fishermen who participate in the set-net project. The trainees are expected to: (1) fully understand the philosophy of the environmentally friendly set-net fishery, (2) obtain techniques on set-net fishery, and (3) obtain the maintenance techniques of set-nets. All costs taken during the training period should be provided by the JICA. This program covers three-year duration from 2005-2007.



Figure 3 Set-Net expert mission from Himi City, Japan visited EMDEC, Rayong during September 21st – October 3rd, 2004.

Project Study Site

The selected project site is located about 4.8 km offshore of Mae Rumphueng Beach, Rayong Province (Figure 4). The SEAFDEC and EMDEC have co-managed the project in collaboration with Rayong Provincial Fisheries Office and the fishermen volunteers from seven villages as Ban Klong Kachor, Bang Kachor community, Ban Pakun, Ban Hin Dum, Ban Hin Khao, Ban Hin Chon and Ban Kon Aou.

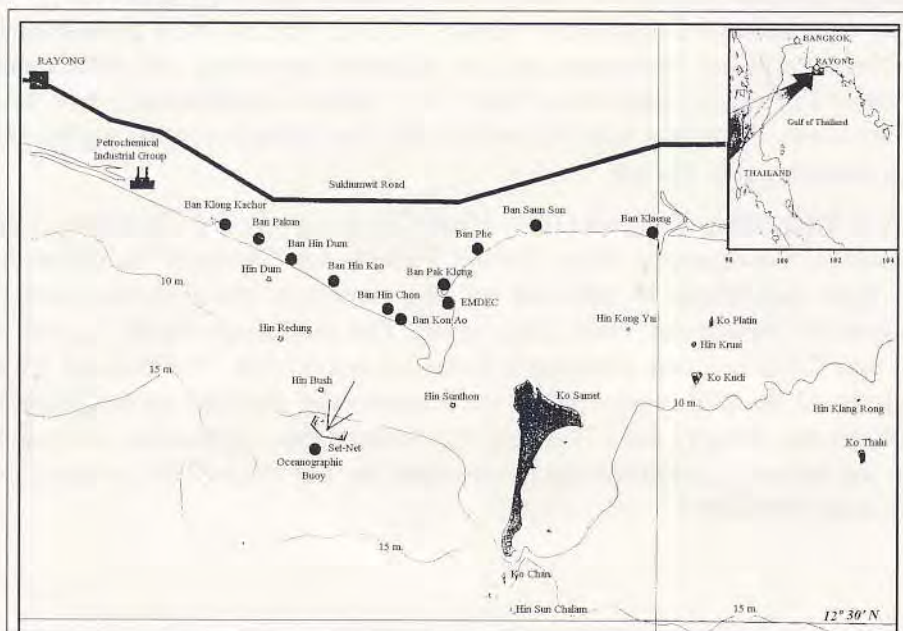


Figure 4 Position of the set-net at Mae Rumphueng Beach, Rayong Province

Objectives

1. To manage cooperative fishing and reduce fishing pressure on utilizing coastal resources
2. To develop fishery management by using a large stationary fishing gears
3. To protect coastal resources from fishing activities with various kinds of gears particularly the destructive ones
4. To provide coastal habitats, hiding shelters and settlement substrates by using set-net area for reproduction, spawning, feeding and hiding etc.

Study survey prior to installation of the set-net

Prior to set-net installation some surveys were carried out by SEAFDEC and EMDEC to get basic information on the study site during July 2003. The survey included an interview on fishing activities of the fishermen from seven groups, namely Ban Klong Kachor, Bang Kachor community, Ban Pakun, Ban Hin Dum, Ban Hin Khao, Ban Hin Chon and Ban Kon Ao, to get information about socio-economics structure. Some ship-board surveys were conducted to examine the sea condition, bottom topography, water quality, current patterns, sediment composition and benthic community. Hand-lines, shrimp trammel nets and crab traps were also used to detect the fishing resources.

1. Oceanographic information

Examination on physical and chemical properties resulted in that the sea bottom is slightly inclined; water levels = 9-12 meters deep; water color = light brown; clearance = 7 meters; water currents = 0.2 m/s in average (0.4 knot); maximal velocity = 0.35 m/s (0.7 knot); homogeneous mixing; average temperature = 30°C; pH = 8.2; salinity = 22.4 part per thousand; bottom sediment = 40.06% of medium sand; benthic biomass = 159.72 Individuals/m² or 5.929 gram/m²; dominant benthic organism = polychaetes (63.0%).



Figure 5 Oceanographic survey at Mae Rumphueng Beach, Rayong Province

2. Socio-economic information

About 57.45% of the Kon Ao – Mae Rumphueng population mainly practiced the fishing profession; the other 42.55% operated fishing for pastime. Various kinds of gears were used for fishing such as squid traps, crab traps, crab nets, fish nets, shrimp nets, squid jigging, hand lines, Acetes push nets, etc. The main fishing grounds located west of Samet Island where water levels were 9-30 meters deep. The fishermen could go fishing the whole year. They usually changed their fishing gears occasionally or seasonally, except for the SW-monsoon period. Important resources were squids, big-fin reef squids, sillagos, threadfin breams, blue swimming crabs and shrimps.



Figure 6 Socio-economic interviewing survey at Mae Rumphueng Beach fishing community, Rayong Province



Figure 7 Fishing operation survey at Mae Rumphueng Beach, Rayong Province

Oceanographic and meteorological records

Besides the above mentioned, during set-net operation oceanographic characteristics in set-net study area were continuously recorded by an oceanographic buoy during the January 16th - November 30th, 2004, established by the “Geo-Informatics and Space Technology Development Agency (Public Organization)” (GISTDA) at 12.578°N latitude and 101.367°E longitude, or about 3.8 kilometers from shore, 10 meters deep and 500 meters southeastern from the set-net.

Data analysis found that near set-net study area; wind velocity varied from 2.0-5.3 m/s, maximal windy was found in June and minimal - in November, wind direction was mainly from the South. Average wave height was fluctuated from 0.23-0.95 m, maximal wave height occurred in August, minimal – in October. Current direction and velocity were influenced by high-low tides, which were classified as mixing tides, 2 rounds/day; maximal velocity = 35 cm/s happened during waxing moon, net water mass moved northwestward and took about 8 km distant. The opposite phenomenon happened during waning period, net water mass moved southeastward and took about 80 km distant. In general, water temperatures were measured about 1°C lower than air temperatures; average air temperatures varied around 26.8-28.7°C, highest temperatures were found in April, lowest – in May. In terms of relationship, fluctuations of wind velocities and directions were considerably closely related to wave heights and directions, so as to the changes of the Southeast Monsoon in Thailand.



Figure 8 An oceanographic buoy was installed nearby the Set-Net for continuously data collection of weather and sea conditions at Mae Rumphueng Beach, Rayong Province

Data analysis found that near set-net study area; wind velocity varied from 2.0-5.3 m/s, maximal windy was found in June and minimal - in November, wind direction was mainly from the South. Average wave height was fluctuated from 0.23-0.95 m, maximal wave height occurred in August, minimal – in October. Current direction and velocity were influenced by high-low tides, which were classified as mixing tides, 2 rounds/day; maximal velocity = 35 cm/s happened during waxing moon, net water mass moved northwestward and took about 8 km distant. The opposite phenomenon happened during waning period, net water mass moved southeastward and took about 80 km distant. In general, water temperatures were measured about 1°C lower than air temperatures; average air temperatures varied around 26.8-28.7°C, highest temperatures were found in April, lowest – in May. In terms of relationship, fluctuations of wind velocities and directions were considerably closely related to wave heights and directions, so as to the changes of the Southeast Monsoon in Thailand.

Structure and installation of the set-net

The set-net was installed at Mae Rumphueng Beach, about 1,500 m westward from Hin Tun, where water depths were about 11-13 m or from latitude $12^{\circ} 35.2' N.$, longitude $101^{\circ} 22.2' E$ (at 11 m deep) to latitude $12^{\circ} 34.6' N.$, longitude $101^{\circ} 22.0' E$ (at 13 m deep). It took about 4,800 m away from the shore of Tapong Sub-District, Muang District, Rayong Province. The set-net implemented in this project was “Otoshi Ami” type, measured 40 x 120 m. The codend was 30 x 35 m., mesh-size = 2.5 cm. The playground was equipped with 8-cm mesh. The left wing = 50 m long, right wing = 100 m long (both wings used 18-cm mesh). The Central wing was 200 m long with 32-cm mesh (figure 9).

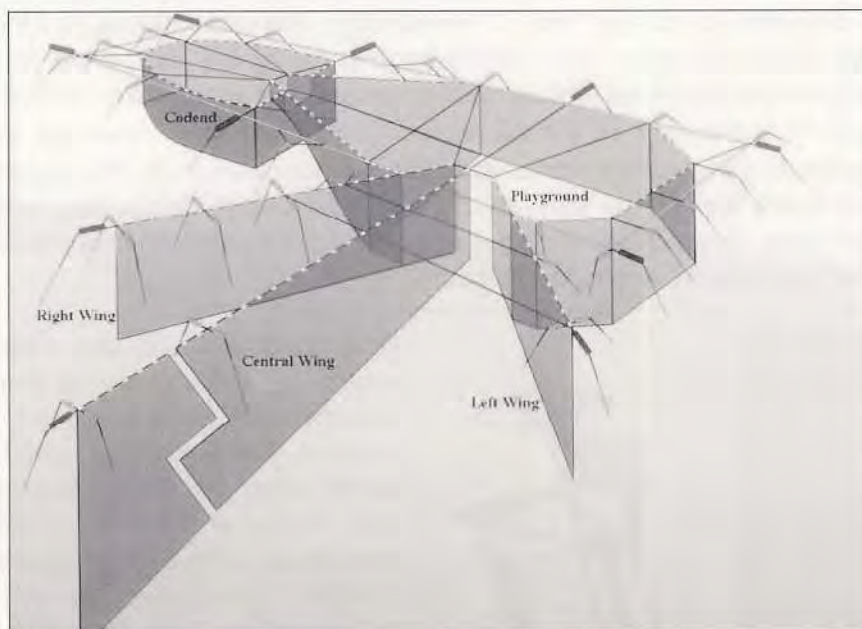


Figure 9 Structure of the “Otoshi Ami” set-net, implemented in this project



Figure 10 Set-net fishing at Mae Rumphueng Beach, Rayong Province

As the project began the fourth years, the fishermen decided to construct the second set-net nearby the previous one that was first operated in December 2006.

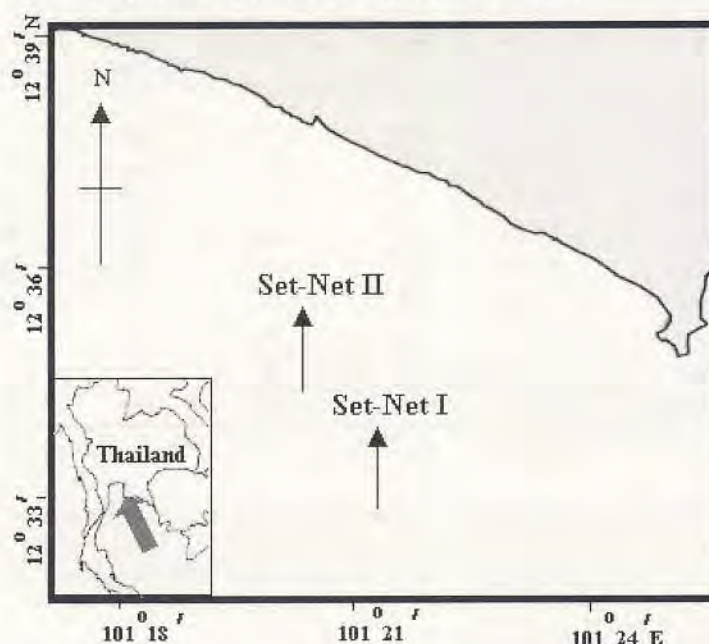


Figure 11 Position of the first and the second set-net in the sea at Mae Rumphueng Beach, Rayong Province

Catch and Value

In the first year, 52 fishing trips were done from October 25th 2003 - February 25th 2004. The total catch of 8,705.9 kg cost 108,902 baht or the average of 167.42 kg/trip and cost 2,094.27 baht/trip.

Some modifications were deployed to the set-net fishing gear in the second year. This could extend the fishing period almost double times longer than the first year. There were 101 fishing operated from October 2nd 2004 - April 28th 2005. The total catch of 25,643.90 kg cost 250,928.00 baht or the average of 253.90 kg/trip cost 5,157.70 baht/trip.

The third year set-net was designed the same way as the second one. There were 110 fishing operated from October 6th 2005 - May 1st 2006. The total catch of 23,045.1 kg cost 609,388.50 baht or the average of 209.50 kg/trip cost 5,539.89 baht/trip.

There were 2 set-nets operated in the fourth year. The first one was fished from September 26th 2006 – May 2nd 2007 covered 109 trips. Its total catch of 19,503.60 kg cost 552,327.50 baht or the average of 178.93 kg/trip cost 5,067.22 baht/trip. The second set-net was operated from December 17th 2006 – April 30th 2007 covered 56 fishing trips. Its total catch of 3,741.90 kg cost 139,532.50 baht or the average of 66.82 kg/trip cost 2,491.66 baht/trip.

There were 428 fishing operations in four fishing seasons during October 2003 to April 2007 (Table 1). In general, the set-net was fished every 2-3 days a month, in case unexpected happenings such as boat collision, the fishing had to stop and the net was to repair.

Table 1 Fishing trips of the set-net at Mae Rumphueng Beach, Rayong Province

Year	2003-2004	2004-2005	2005-2006	2006-2007	
				Set-Net 1	Set-Net 2
Sep.				2	
Oct.	4	15	14	10	
Nov.	15	16	15	14	
Dec.	9	17	17	19	6
Jan.	14	14	18	18	10
Feb.	10	12	14	13	12
Mar.		15	16	17	13
Apr.		12	15	15	5
May			1	1	
Average	52	101	110	109	56

Catch data in weight (kg/trip) and price value (baht/trip) were summarized in Table 2.

Table 2 Catch and value per trip of the set-net at Mae Rumphueng Beach, Rayong Province

Year	2003-2004		2004-2005		2005-2006		2006-2007			
	catch	value	catch	value	catch	value	Set-Net 1		Set-Net 2	
							catch	value	catch	value
Sep.	-	-	-	-	-	-	402.15	10268.00	-	-
Oct.	160.35	2903.50	398.77	6233.13	233.41	5632.64	179.46	3891.10	-	-
Nov.	175.71	1870.67	343.88	6982.13	276.51	6272.80	220.69	5449.57	-	-
Dec.	85.33	206.72	265.64	5656.00	246.50	5763.65	200.64	5126.84	53.68	1860.83
Jan.	274.52	2959.07	290.16	-	184.43	5091.06	207.87	6264.31	60.39	2218.05
Feb.	81.75	1594.05	154.13	3351.83	178.69	5171.79	127.98	4885.69	44.64	2299.33
Mar.	-	-	161.05	3897.10	196.98	6357.31	139.44	4883.24	47.06	2378.00
Apr.	-	-	109.76	2471.13	160.42	4764.53	147.35	3939.80	333.68	9536.20
May	-	-	-	-	59.60	1229.00	17.00	-	-	-
Average	167.42	2094.27	253.90	5157.70	209.50	5539.90	178.93	5067.22	66.82	2491.65

It was remarkable that higher catch rates usually occurred at the beginning of the fishing period each year and dropped somehow with the passing time.

Species Composition

Harvest of the set-net was composed of about 31 kinds or 3 groups of marine animals namely 16 kinds of pelagic fish, 12 kinds of demersal fish and 3 kinds of squids, as shown in table 2.

Table 3 Composition of catch by the set-net at Mae Rumphueng Beach, Rayong Province during 2003 – 2007 (presented in percent weight of total catch)

Year	1 st year	2 nd year	3 rd year	4 th year	
Fish				1 st set-net	2 nd set-net
Pelagic fish	90.13	94.98	88.03	89.75	85.90
<i>Rastrelliger brachysoma</i>	3.02	3.07	4.39	2.21	5.85
<i>Rastrelliger kanagurta</i>	1.07	0.23	0.26	0.63	0.07
<i>Scomberomorus commersoni</i>	0.20	0.01	0.08	0.01	-
<i>Chirocentrus dorab</i>	0.48	0.01	0.23	0.05	-
<i>Atule mate</i>	11.09	1.30	2.85	0.20	2.53
<i>Scomberoides</i> spp.	0.98	0.01	0.09	0.07	-
<i>Selaroides leptolepis</i>	45.12	23.41	30.45	37.69	32.69
<i>Carangoides</i> spp.	1.21	1.97	0.20	0.86	-
<i>Alectis indica</i>	0.99	1.32	3.51	3.20	10.61
<i>Alepes vari</i>	2.63	0.91	3.54	1.06	3.16
<i>Parastomateus niger</i>	0.06	2.90	1.63	0.80	2.28
<i>Amblygaster clupeioides</i>	16.73	30.59	22.59	24.19	7.81
<i>Sardinella gibbosa</i>	2.04	5.78	4.04	7.80	1.63
Fam. Belonidae & Hemiramphidae	3.60	23.31	12.59	9.94	18.91
Fam. Istiophoridae	0.40	0.16	0.97	0.97	0.27
Misc. pelagic fish	0.52	-	0.62	0.07	0.09
Demersal fish	7.60	3.41	9.81	8.91	11.02
<i>Trichiurus lepturus</i>	0.89	0.63	2.19	0.50	1.26
<i>Aluterus monoceros</i>	0.70	0.45	0.05	0.49	0.46
<i>Platax teira</i>	0.04	0.01	0.11	0.04	-
Fam. Sphyraenidae.	0.36	0.81	2.28	5.02	3.51
Fam. Nemipteridae & Scolopsidae	0.14	0.15	0.07	0.01	0.03
Fam. Lutjanidae	0.58	0.11	0.97	0.39	2.38
Fam. Theraponidae	-	0.05	0.16	0.07	0.03
Fam. Sillaginidae	-	-	0.03	0.05	-
Fam. Dasyatidae	-	0.05	0.28	0.25	0.88
Fam. Gerridae	-	0.02	0.56	0.18	0.26
Fam. Siganidae	4.24	0.99	2.41	1.73	2.06
Misc. demersal fish	0.64	0.14	0.24	0.18	0.15
Squids	2.27	1.61	2.16	1.34	3.08
<i>Loligo</i> spp.	0.47	0.54	0.65	0.57	0.87
Bigfin reef squid	1.79	1.04	1.50	0.75	2.21
Cuttle fish	0.01	0.03	0.01	0.02	-
Total	100.00	100.00	100.00	100.00	100.00

Income and Expense

In summary the total income and expense of the set-net operation from October 2003 to May 2006 was shown in the Table 3.

Table 3 Incomes and expense of the set-net during 2003-2007

Details	First year	Second year	Third year	Fourth year (set-net 1+2)
Fishing Trips	52	101	110	165
Total Catch (Kg)	8,705.90	25,643.90	23,045.00	23,245.50
Total Income (baht)	108,902.00	520,928.00	609,389.00	691,860.00
Net profit (baht)	8,995.00	158,828.00*	136,219.00	148,371.00
Capital for next Investment	8,995.00(100%)	64,282.00(41%)	54,487.60(40%)	74,189.00(50%)
Net profit for members	-	86,000.00(54%)	74,920.45(55%)	59,349.00(40%)
Administrative staff	-	8,000.00(5%)	7,000.00(5%)	14,833.00(10%)

*plus the first year capital

Problems and Suggestions

□ Technical problems

1. In the first-year project, the set-net had got problems about the stability. Use of iron anchors on sandy sea-bottom contributed vibrations corresponding to water currents and then the whole set-net gradually lost its balance; this disturbed the catching capacity and shortened the duration of fishing operations. In the second year, sand bags were used instead of iron anchors. The sand bags attached sea bottom more firmly than anchors even against strong currents. Their weight also supported the sinking very well. There were no problems about oxide erosion as in the iron anchors. Use of sand bags and some modification of the fishing gear could extend the period of fishing operations and enhance the catching capacity, as well.



Figure 12 Iron anchors and sand bags used as sinkers for the set-net

2. There were serious problems about settlement of the bivalves as the oysters on net materials, which always happened even in rather short period after the installation. Washing and taking care of cleaning was really hard works for fishermen, who did not operate only the catching but also the washing. This problem could disturb the fishing when the settlement was

heavy enough, it could obstruct the flowing of water currents, and particularly its weight could also sink the net panel part by part in to deeper water and the fish could get away, eventually. Changing of net panels at the certain part was sometimes considered to solve this problem.



Figure 13 Settlement of sediment and organisms such as bivalves on the set-net

3. The problems could be caused by other fishing gears; when the set-net had to stay all the time in water, namely after installation – during the fishing operations – to end of the fishing season. Use of light-buoys and bamboo-pole obstacles around the set-net seemed to be not effective enough against the otter-board trawls. Net-repairing or changing were then accounted for solution.

□ Administration and management problems

As above-mentioned, the main objectives the project expected are to promote and support cooperative managements in the fishery communities on Mae Rumphueng Beach, Rayong Province. Expected participants were the local fishermen who were interested and applied for membership of the set-net project. It was found that the administration and management of the project could not get success when some of the members had resigned. As the results of brainstorm discussion on this topic between SEAFDEC, EMDEC and the fishermen, the facts could be evaluated like this;

1. The fishermen were lacking of knowledge or understandings on administrations and management in terms of responsibility and participation to the project, and the concepts of cooperative organization. Due to the fishing careers are basically independent and self-sufficient; the fishermen never learn how to work together or team-work and easily lost their tolerances and compromise. On the other hand, the fishermen prefer working with their own fishing gears themselves rather than joining the cooperative set-net. All set-net members still practice their own fishing gears during the free time, but when some fishing resources are especially abundant such as the shrimp-like *Acetes* schools, for instance, they do not mind the set-net and had better go fishing *Acetes* with their push net.

2. The fishermen did not believe in the set-net regarding to catch results and profits and due to technical problems and lacking of experience in the set-net technology. In comparison to their own traditional fishing gears, to which the fishermen are more familiar and skillful, therefore they likely practice their fishing gears and lose their interest in the set-net eventually.

3. The fishermen were lack of common senses for ownership of the project, based on the fact that all facilities and equipment belong either to SEAFDEC or EMDEC. Therefore, they did not pay enough attention, concerning or responsibility for the set-net as to their own fishing gears. This could be problematic to the project more or less.

Recommendation for future consideration

1. Set-net is an applicable fishing gear to promote coastal fisheries management.
2. Set-net fishing management should be handled by small-scaled fishermen group and/or local responsible agencies such as fisheries association and cooperative.
3. Local government agencies should give support to the fishermen group's activities.
4. In order to develop an appropriate fishing techniques for the tropical waters, set-net fishing should have more study to reduce the operation and maintenance cost, reduce immature catch and also increase fishermen income by value added of the catch and make use of unexploited resources.
5. The DOF should manage the fishing areas for set-nets and study for suitable measures to suit the management such as suitable size, number, locality and distance, etc.

Set Net Fishery in Vietnam

Introduction

Set-net was a traditional fishing gear of fishermen in Vietnam. Its structure was rather simple, use to exploit coastal area following trap principle. Net was set from coastal towards sea across fish moving to catch pelagic migrate fish flock.

Due to characteristics of nature and living resources of marine areas in Vietnam so the number of Set-net was few and concentrated only in some Central Provinces of Vietnam.

This study only presented some results of set-net in Khanh Hoa province where was mainly set-net fishery in Vietnam.

Methodology

- Investigated to collect information for set-net by directed interview fishermen and the head of cooperatives during field survey. Data collected from Department of Fisheries and Fishing Cooperatives.

- Heritage previous results on investigation of set-net in Khanh Hoa implemented by HonMun Marine Protected areas pilot project.

Status of set-net in Vietnam

1. Fishing gear and techniques

Set net is a very passive form of fishing gear. The net is set at a fixed position and the fishermen wait for the fishes coming in the bag-net and the fishes are caught with the other portable liftnet. Figure 1 shows the structure of the net. As reported by the fishermen, the sizes of the set nets are approximately equal and the only difference is the length of the leader net.

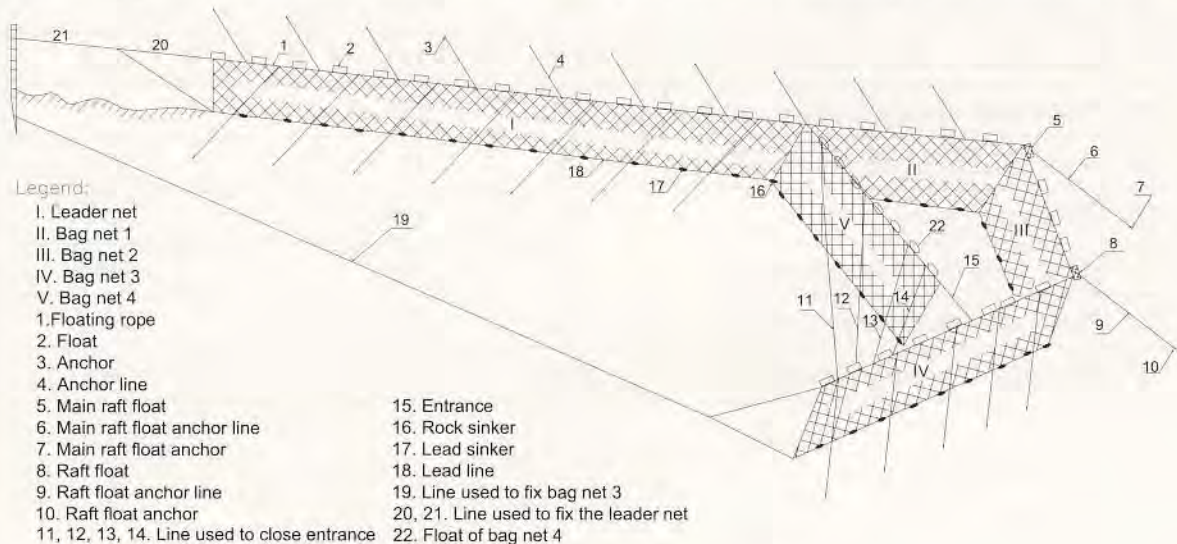


Figure 1A : General view of set-net in Vietnam

Technically, the specification of material making the net is presented in Table 1 and Table 2.

Table 1. Specification of the set-net

<i>No</i>	<i>Specification</i>	<i>Material</i>	<i>Diameter (mm)</i>	<i>Number</i>	<i>Legth (m)</i>	<i>Total length (m)</i>
1	Floating rope of Leader net	PE	20	2	221	441
2	Lead rope of leader net	PE	18	2	221	442
3	Floatingrope of bagnet 1	PE	20	2	102	204
4	Leadrope of bagnet 1	PE	18	2	102	204
5	Floatingrope of bagnet 2	PE	20	2	27.2	54.4
6	Leadrope of bagnet 2	PE	18	2	27.2	54.4
7	Floatingrope of bagnet 3	PE	20	2	68	136
8	Leadrope of bagnet 3	PE	18	2	68	136
9	Floatingrope of sub-lead net	PE	20	2	68	136
10	Lead rope of sub-leader net	PE	18	2	68	136
11	Anchor line of leader net	PE	22	26	150	3900
12	Anchor line of bagnet 1	PE	22	12	150	1800
13	Anchor line of bagnet 3	PE	22	6	150	900
14	Main anchor line	PE	40	1	200	200
15	Raft float anchor line	PE	40	1	200	200
16	Line used to fix bagnet 3	PE	20	1	221	221
17	Line used to close antrance (11)	PE	20	1	68	68
18	Line used to close antrance (13)	PE	18	1	30	30
19	Line used to close antrance (14)	PE	18	1	90	90
20	Entrance line (15)	PE	18	1	25	25
21	Line used to close antrance (12)	PE	18	1	68	68
22	Rope used to fix leader net (20)	PE	22	1	20	20
23	Rope used to fix leader net (21)	Wire	20	1	24	24

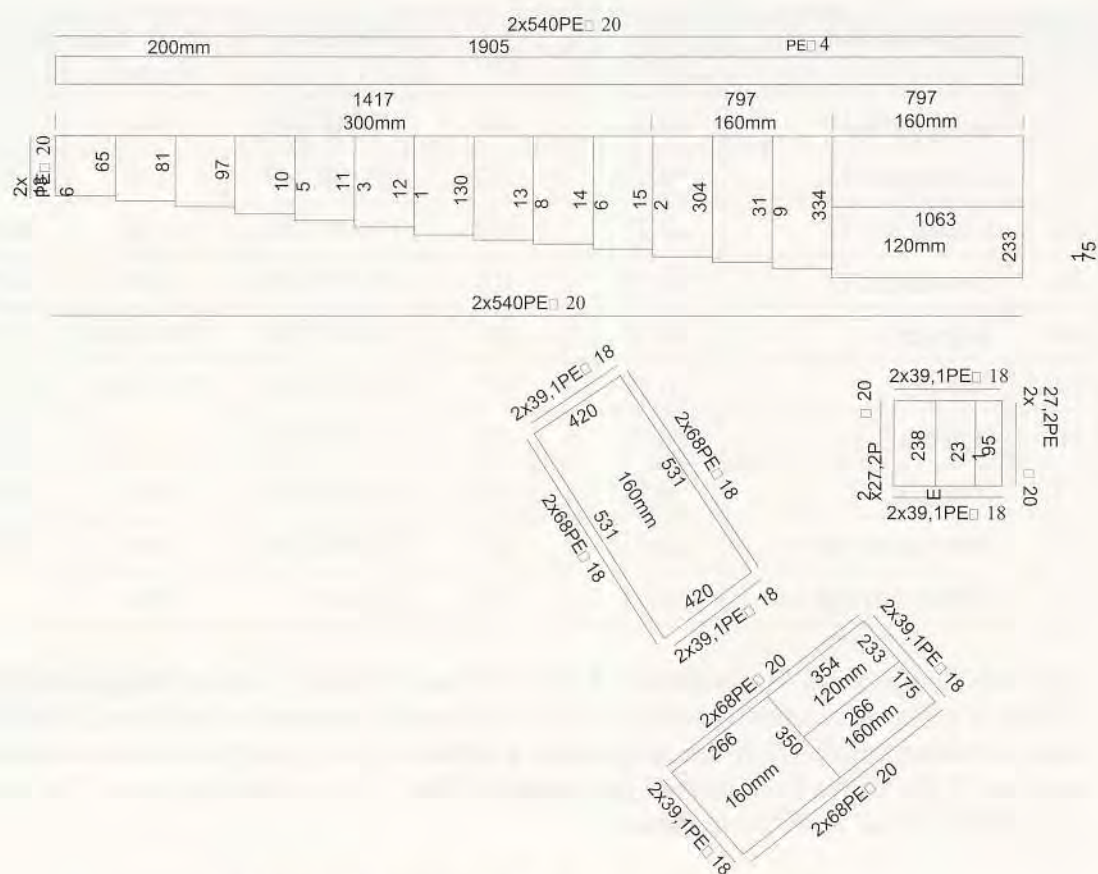


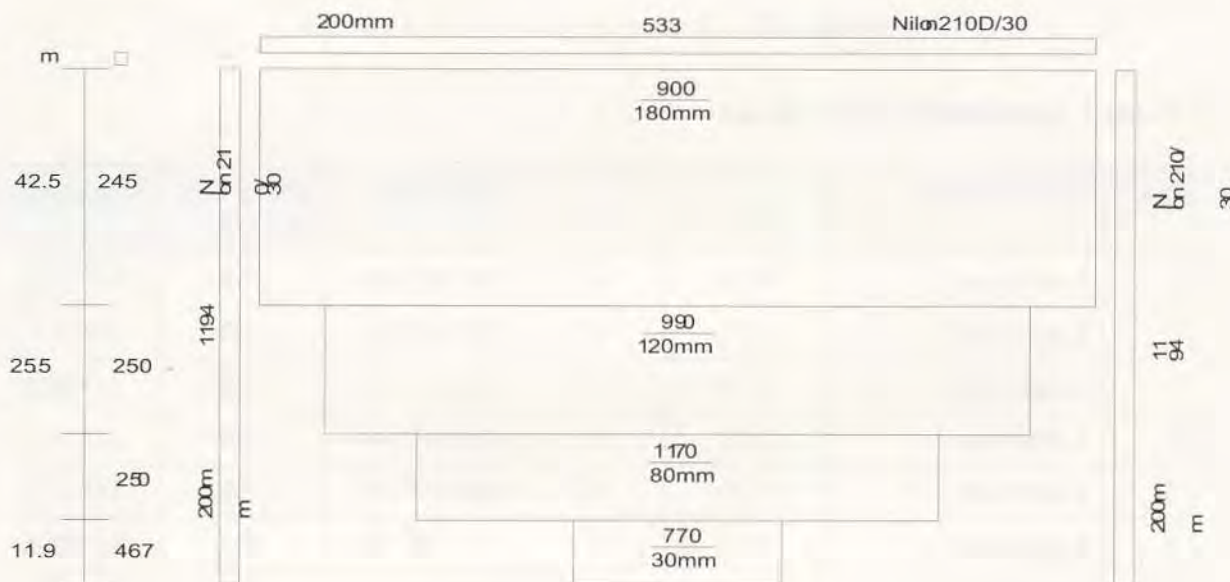
Figure 1B. Detailed design of set-net in Vietnam

Table 2. Specification of the set-net

No	Specification	E ₁	E ₂	Material	Mesh size (mm)	Size (L*H)
1	Leader net 1	0.71	0.7	PE380 ^D /40	300	34*13.6
2	Leader net 2	0.71	0.7	PE380 ^D /40	300	34*17
3	Leader net 3	0.71	0.7	PE380 ^D /40	300	34*20.4
4	Leader net 4	0.71	0.7	PE380 ^D /40	300	34*22.1
5	Leader net 5	0.71	0.7	PE380 ^D /40	300	34*23.8
6	Leader net 6	0.71	0.7	PE380 ^D /40	300	34*25.5
7	Leader net 7	0.71	0.7	PE380 ^D /40	300	34*27.2
8	Leader net 8	0.71	0.7	PE380 ^D /40	300	34*28.9
9	Leader net 9	0.71	0.7	PE380 ^D /40	300	34*30.6

No	Specification	E ₁	E ₂	Material	Mesh size (mm)	Size (L*H)
10	Leader net 10	0.71	0.7	PE380 ^D /40	300	34*32.3
11	Leader net 11	0.71	0.7	PE380 ^D /40	300	34*34
12	Leader net 12	0.71	0.7	PE380 ^D /40	160	34*35.7
13	Leader net 13	0.71	0.7	PE380 ^D /40	160	34*37.4
14	Bag net 1	0.71	0.7	PE380 ^D /40	120 - 160	102*39.1
15	Bag net 2	0.71	0.7	PE380 ^D /40	120 - 160	27.2*39.1
16	Bag net 3-1	0.71	0.7	PE380 ^D /40	120 - 160	34*39.1
17	Bag net 3-2	0.71	0.7	PE380 ^D /40	160	34*39.1
18	Sub-leader net	0.71	0.7	PE380 ^D /40	169	68*39.1
19	Upper selvage net	0.71	0.7	PE□ 4	400	

The fishing operation is conducted during the daytime only. Inside playground cage there always is a person swimming with a mask on the surface to observe the fishes. When there is a signal of fishes inside. They are caught with a portable liftnet. And the scoopnets and hooks are used to lift the fishes from bunt of the portable liftnet to the harvesting boats. The structure of the portable liftnet is shown in Figure 2.



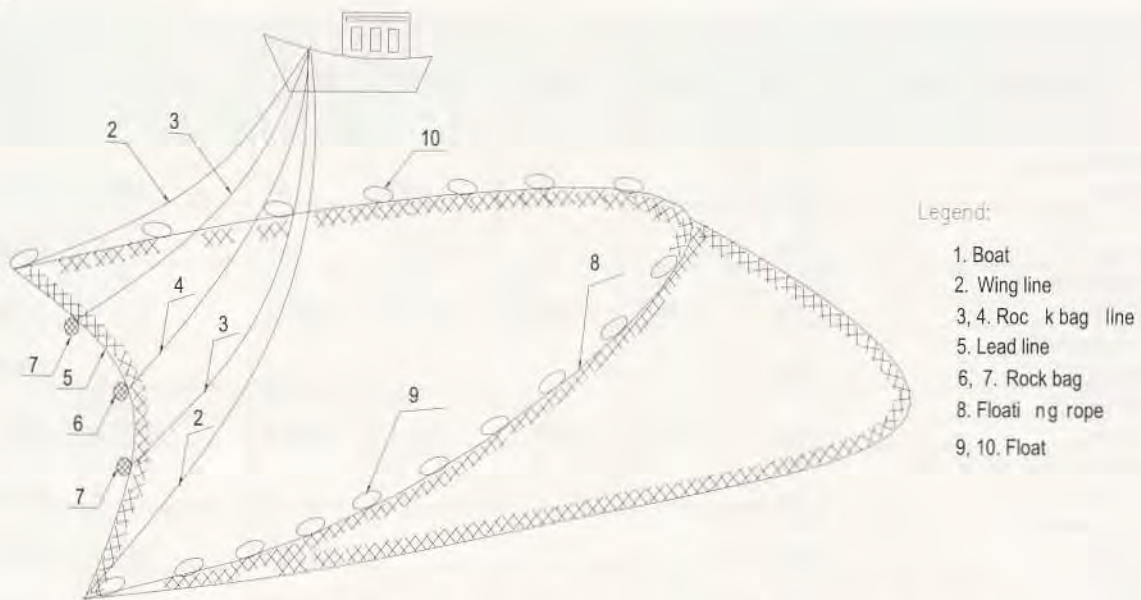


Figure 2. General view and detailed design of the portable liftnet

Boat size: the fishing operation is conducted with 3 boats, of which one is motorized (16 - 45 hp), length 10-15m, width 2.2-2.6 m and two are non-motorized boats (length 15-18 m, width 4 m). The fishermen are living and working in the two non-motorized boats all the fishing season. The motorized boat functions as a towing boat and transport the catches to the shore every day.

2. Target species

According to statistical data of some set-nets during 1999 - 2001 showed that Spanish mackerel and tuna were main target species. So the Spanish mackerel and tuna were considered as key role in term of both value and catch of the fishery.

Species composition of target species group during 1998 - 2001 presented at table 3.

Table 3. List of species caught with their catch during 1998-2001

Scientific name	C&V	1998	1999	2000	2001	Total	% of grand total
<i>Somberomorus commerson</i> Spanish mackerel	N Kg	14484 31032.1	9992 27268.6	23380.4 52120.3	15402 34926.8	63258.387 145347.8	74.321
<i>Acanthocybium solandri</i> Wahoo	N Kg	205 1500	53 487.8	205 1725.1	116 913.9	579 4626.8	2.363
<i>Alutera monoceros</i> Unicorn filefish	N Kg				3 5	3 5	0.003
<i>Atule mate</i> Yellowtail scad	N Kg			20 16.8	857	20 873.8	0.446
<i>Carangoides spp</i> Trevally	N Kg		425 236	171 118	118 100.4	714 454.4	0.232
<i>Coryphaena hippurus</i> Dolphin fish	N Kg	37 105.1	3 5	22 85.1		62 195.2	0.1

<i>Scientific name</i>	<i>C&V</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>Total</i>	<i>% of grand total</i>
<i>Decapterus sp</i> (Scad)	N Kg			995	49	1044	0.533
<i>Exocoetidae</i> <i>Flying fish</i>	N Kg			107.4	358	465.4	0.238
<i>Istiophorus sp</i> <i>Sailfish</i>	N Kg	100 1546.3	26 420.2	165 2493.3	189 2864.5	480 7324.3	3.741
<i>Leiognathus sp</i> <i>Ponyfish</i>	N Kg				111	111	0.057
<i>Makaia sp</i> (marlin)	N Kg	64 1248.9	86 1788.8	120 3236.3	97 2303.9	367 8577.9	4.381
<i>Megalaspis cordyla</i> (Hardtail scad)	N Kg				8	8	0.004
<i>Mene maculata</i> <i>moonfish</i>	N Kg				1414.5	1414.5	0.722
<i>Mobula sp</i> <i>Devilray</i>	N Kg			1 8		1 8	0.004
<i>Rachycentron canadum</i> <i>Cobia</i>	N Kg	1 7	13 89.6	8 54.8	3 26	25 177.4	0.091
<i>Scomberomorus sp</i> <i>Mackerel</i>	N Kg		54 46.2	46 36.8	95 94.6	195 177.6	0.091
<i>Sphyræna sp</i> <i>Baracuda</i>	N Kg	100 700				100	0.051
<i>Stolephorus sp</i> <i>Anchovy</i>	N Kg			1012	38	1050	0.536
<i>Stolephorus + Decapterus</i> <i>Anchovy + Scad</i>	N Kg				406	406	0.207
<i>Stolephorus + Leiognathus</i> <i>Anchovy + Ponyfish</i>	N Kg		30			30	0.015
<i>Tylosorus sp</i> <i>Needlefish</i>	N Kg			26 5		26 5	0.003
<i>Auxis rochei</i> <i>Bullet tuna</i>	N Kg	300 100				300 100	0.051
<i>Auxis thazard</i> <i>Frigate tuna</i>	N Kg	819 764.8	1734 1579.1	2177 1897.7	1069 1028.1	5799 5269.7	2.691
<i>Euthynnus affinis</i> <i>Bonito</i>	N Kg		461 688.4		192 371	653 1059.4	0.541
<i>Katsuwonus pelamis</i> <i>Skipjack tuna</i>	N Kg	196 369	267 551	170 330.9	255 346	888 1596.9	0.816
<i>Thunnus albacares</i> <i>Thunnus obseus</i> <i>Yellowfin tuna. bigeye tuna</i>	N Kg	38 1061.2	3 128.6	7 29.2	10 251.3	58 1470.3	0.751
<i>Thunnus albacares (small)</i> <i>Thunnus obseus</i> <i>Yellowfin tuna. bigeye tuna</i>	N Kg	400 292		96 68		496 360	0.184
<i>Thunnus tonggol</i> <i>Longtail tuna</i>	N Kg	5199 5471	6268 5360.7	1021 1353.3	1649 1340.2	14137 13525.2	6.908

Thus, there were 26 species/genera recorded in the catch of Nha Trang set-net since 1998. In term of catch, there were 6 species/genera that consisted of over 1% of grand total catch.

Spanish mackerel (*Scomberomorus commerson*) contributed 74% of total catch, followed by longtail tuna (*Thunnus tonggol*) - 6.9%, marlin (*Makaira mazana*) 4.3%, sailfish (*Istiophorus* sp) 3.7% frigate tuna (*Auxis thazard*) 2.7% and wahoo (*Acanthocybium solandri*) 2.4%. This figure strongly confirms the conclusion mentioned above.

3. Catch productions.

Statistical results on catch of set-net during 1985 - 2001 presented at figure 3.

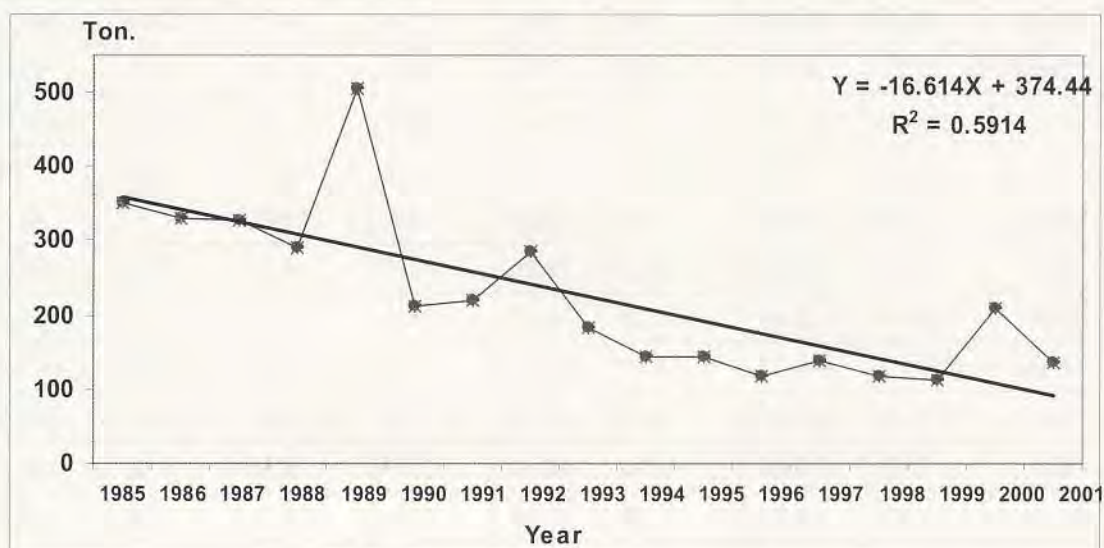


Figure 3. Fluctuation in yearly catch data during 1985-2001

From above results implied that:

- Total catch in strong decreasing trend annually. During 1985- 2001, the highest catch in 1989 was 505 tons and the lowest in 1999 was 114.4 tons.

- The total catch is about 224.9 Ton per year on average. Generally, during last 17 years the catch shows a decreasing trend with rate of 16.6 Ton per year.

Catch on target species groups during 1999 - 2001 of four set-nets in Honmun MPA - Nhatrang as below

Table 4: Catch on target species group during 1999 – 2001

Year	Month	Mackerel		Tuna		Fixed fish		Total	
		Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)
1999	Feb	0.02	0.47	0.11	1.32	0.06	0.69	0.19	2.49
1999	Mar	10.36	226.40	2.13	17.68	3.80	31.61	16.29	275.69
1999	Apr	16.81	332.60	3.99	52.54	3.62	36.15	24.42	421.28
1999	May	3.54	72.00	10.79	80.91	1.87	14.86	16.20	167.77

Year	Month	Mackerel		Tuna		Fixed fish		Total	
		Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)	Catch (Ton)	Value (Mil. VND)
1999	Jun	3.94	83.72	5.41	42.11	1.44	12.14	10.79	137.97
1999	Jul	7.85	177.23	3.36	31.63	2.41	12.79	13.62	221.66
1999	Aug	8.05	178.28	1.30	9.96	3.14	18.79	12.49	207.03
1999	Sept	2.11	44.99	0.43	3.06	2.04	10.49	4.59	58.53
Total		52.69	1,115.68	27.52	239.22	18.38	137.52	98.59	1,492.42
%		53.44	74.76	27.91	16.03	18.65	9.21	100	100
2000	Feb	0.30	8.62	0.17	2.03	1.65	19.92	2.12	30.57
2000	Mar	5.81	118.63	2.12	19.06	9.03	53.26	16.96	190.95
2000	Apr	68.74	1,328.44	12.26	74.15	8.56	81.33	89.56	1,483.92
2000	May	25.77	498.13	18.87	108.51	4.26	35.66	48.90	642.29
2000	Jun	10.09	189.69	8.15	55.70	2.21	20.19	20.45	265.58
2000	Jul	5.49	110.43	2.90	18.49	1.03	9.34	9.42	138.27
2000	Aug	6.93	146.21	1.73	12.44	2.50	26.26	11.16	184.92
2000	Sept	0.29	6.51	0.23	1.87	0.69	6.60	1.20	14.97
Total		123.41	2,406.67	46.41	292.25	29.94	252.56	199.76	2,951.47
%		61.78	81.54	23.24	9.90	14.99	8.56	100	100
2001	Feb	0.11	2.87	0.14	1.48	3.00	14.62	3.24	18.97
2001	Mar	8.65	191.49	0.56	5.65	6.16	40.30	15.38	237.44
2001	Apr	27.80	603.51	12.53	79.66	4.40	49.06	44.73	732.23
2001	May	6.61	129.68	3.77	26.78	2.80	24.47	13.18	180.94
2001	Jun	11.01	220.64	2.10	17.36	1.57	18.12	14.68	256.12
2001	Jul	6.87	149.10	2.33	17.04	4.18	42.76	13.38	208.91
2001	Aug	4.68	98.79	0.84	6.49	3.61	26.56	9.14	131.84
2001	Sept	3.80	81.51	1.19	10.20	2.25	21.96	7.24	113.68
2001	Oct	0.51	10.53	0.01	0.13	0.17	2.37	0.70	13.03
Total		70.04	1,488.13	23.48	164.79	28.13	240.23	121.66	1,893.15
%		57.57	78.61	19.30	8.70	23.13	12.69	100	100

The above results showed that:

- Catch obtained of four set-net areas surrounding Honmun was the highest in 2000 with 199.76 tons, and the lowest was 1999 with 98.59 tons. So, catch among years was in irregularly fluctuation.

+ Catch of species during 1999 - 2001 presented in figure 4.

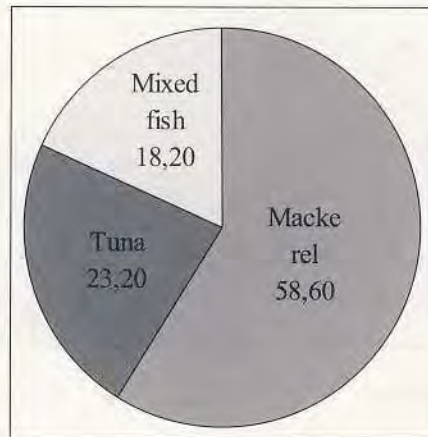


Figure 4: Catch by target species

Thus, Mackerel and tuna provided the highest yield. Catch of mackerel took 58.6% of total catch, and tuna took 23.2%. The remains took 18.2 %.

Catch by months presented in figure 5.

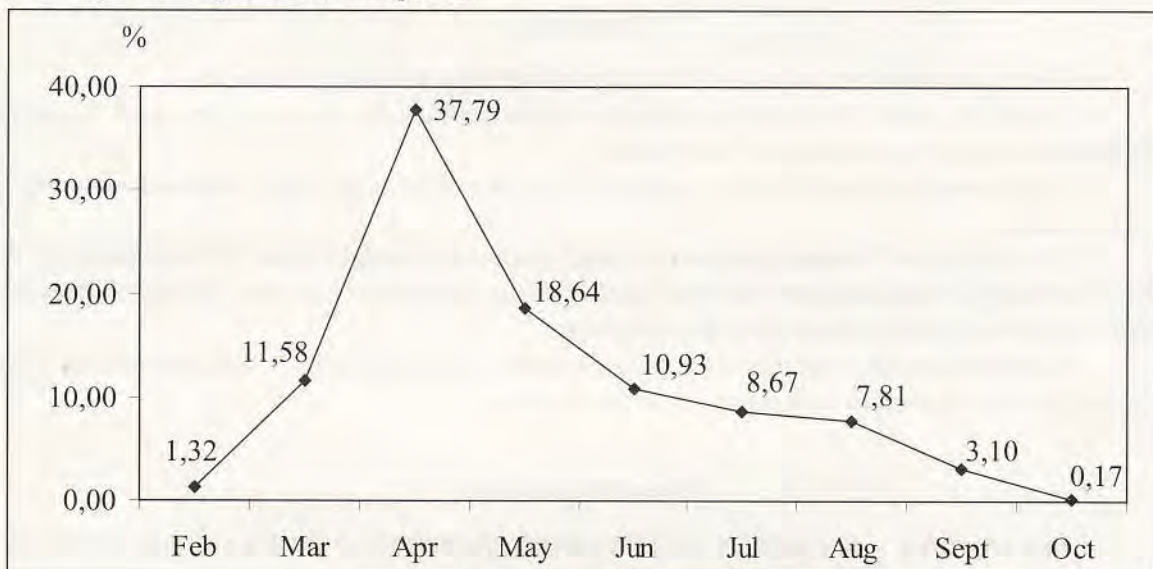


Figure 5: Catch of by months during 1999 - 2001

The result revealed that the catch was fluctuated by timing in a year. Yield increased gradually at starting months and peaked in April and May, then decreased in the end of fishing season.

The fluctuation by months on catch of target species presented in figure 6

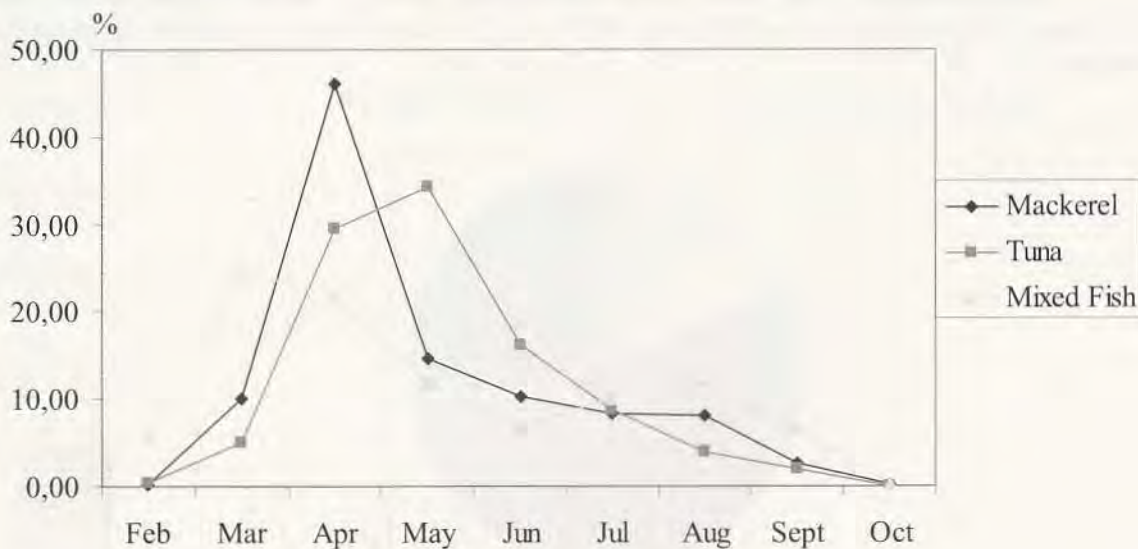


Figure 6: Catch by months of target species

The target species, therefore, were tuna and mackerel in which of contributing high yield from March to June. This time also was main fishing season of the fishery in Vietnam.

Conclusion

- The set-net acted as high selective gear to fish high value target species.
- Could be seen 26 species in batches of the set-net, in which of tuna and mackerel contributed dominant percentage of total catch.
- Catch was fluctuated during months in the year. The high catch obtained annually in March to June.
- The set-net in Vietnam operated in small scale and coastal region. Effectiveness of the fishery, although, was excellent but the marine living resources now are facing to decrease rapidly therefore number of nets also are cut down.
- Conflicts among fisheries such as purse seine, trawl and gillnet with the set-net often occurred so it is a reason to make number of net decline.

Recommendations

- Investigation, assessment overall of natural characteristics in areas where potentially can develop the set-net to plan detail for fishery promotion.
- Should investigate and assess status of set-net activities in order to show an overall picture on fishery effectiveness and from that the State should have support policies to encourage fishery development.

**The Technical advisory visit to the Member Countries
Indonesia Set-Net project; the fourth activity of Set-Net 2007
Under Japanese Trust Fund in the period of 20 – 30 October 2007**

Introduction

Set-Net 2007 project is the fifth year of “Set-Net Fishing Technology Transfer to Develop Sustainable Coastal Fisheries Management in Southeast Asia” project. It was found the successful in many aspects such as sustainable fisheries, cooperative management of the fisher group and coastal resource enhancement etc. Then the project has proposed to extend the result to member countries and compile their experience in set-net and stationary fishing gear too.



Indonesia by Hasanuddin University in collaboration with Tokyo University of Marine Science and Technology and local fishermen of Pallettee, Bone in south Sulawesi, Indonesia has created the project on “Japanese type set-net Technology transfer” which supported by JICA SEAFDEC set-net project was requested to give technical support and advice to Indonesian Set-Net project. So Mr. Aussanee Munprasit and Dr. Taweekiet Amornpiyakrit were approved to conduct the technical support and advice to the project activity in October 2007 during the period of 20-30 October in the program activity of local fishermen training on Net construction.

1. Summary of Activities

There were two main activities had conducted in this trip

- 1.1 To participate the opening ceremony of Set-Net project by Local governer of the area and join the meeting of the responsible staff of the project and local fishermen at Pallettee fisheries high school, to express the opinion from Rayong Set-Net project. Working group was composed of 6 teams from TUMSAT, Himi City Japan, Hasanuddin University, Pallettee fisheries hig school, SEAFDEC/TD and local fishermen of Pallettee village, Bone.



The meeting of working was conducted on 22 October and Opening Ceremony of the project was conducted on 23 October 2007.

1.2 Local fishermen training on Set-Net gear construction after the project working group meeting in the morning of 22 October 2007, the arrived fishing material from Indo-Neptune net factory were checked and move to the place for gear construction, training was started on 23 October, from the cod-end chamber with material of Tetraron net (Polyester) 32 mm. mesh size and Poly propylene rope for frame rope, 26 fishermen, 20 fisheries high school students, 15 of fisheries staff from the area and 15 staff from the project teams (TUMSAT, Himi city, Hasanuddin University and SEAFDEC/TD) participated at the first day training and the fishermen was divided into two groups for make alternation in coming for net construction practice every day. Cod- end chamber net was completed with in 9 days with average work labors of 25 person per day. Then SEAFDEC/TD teams have to returned to Bangkok before the group's scheduled on 30 October 2007.



Conclusion

Indonesia Set-Net project has started in October 2007, it is conducted in collaboration with 5 agencies, TUMSAT, Himi city, Hasanuddin University, Pallettee fisheries high school and local fishermen of Pallettee, Bone.

The members of this project are the member of village, most of them are employees of raft lift-net and sea-weed culture. Most of the fishing ground of the village was shallow, deep water is located on east side of the area. Pallettee is a pointed with rocky bank and muddy bottom. Landing base of the project is quite difficult, it need to be modified. Net operation boat is designed to construct at the local place. The project will take a few months to complete facilities. The next trip for construction and installation of the gear was scheduled in January 2008.



**The Technical Survey visit to the Member Countries on
Set-Net Fishing; the Philippines, the fourth activity
Of Set-Net 2007 project under Japanese Trust Fund
20 – 25 August 2007**

Introduction

The year 2007 is the fifth year of “Set-Net Fishing Technology Transfer to Develop Sustainable Coastal Fisheries Management in Southeast Asia” project, it was found the successful in many aspects such as sustainable fisheries, cooperative management of the fisher group and coastal resource enhancement etc. Then the project has proposed to extend the result to member countries and compile their experience in set-net and stationary fishing gear at the same time. It was proposed to develop the technical manual guide for the region. Two member countries were proposed to visit in 2007; Indonesia and the Philippines, Mr. Aussanee Munprasit and Mr. Weerasak Yingyuad were approved to carry out the first trip to the Philippines during the period of 20 – 25 August 2007.

1. Summary of Activities

There were three main activities had conducted in this trip

1.1 Discussion and exchange experience and idea with the experience staff concerned

of the Philippines set-net project, Dr. Jonathan O. Dickson Chief of Capture Fisheries Division, Bureau of Fisheries and Aquatic Resources of the Philippines was conducted at his office in Manila and a long the trip to the sites. He gave a lot of information and his opinion in set-net fishery of the Philippines, and he support the idea of “Introduction of set-net fishery to develop sustainable coastal fisheries management in the region”. The discussion was also made to the fishermen



project leaders and set-net operators at the sites too. They are all satisfactory with set-net fishing on their coastal area, few sites was not success due to week management of the fisher group, less well trained members and poor resource on the area.

1.2 Carry out observation survey to the set-net fishing sites in the northern of the Philippines, the survey trip was conducted a long the west coast of Luzon island 7 projects sites were visited, the project leaders and operators were interviewed at Bataan, Potolan, Iba-city of Zambales; Santalucia of San Fernando and Vigan-city, Bancho and Santacruz of Ilocas Sir. Site



location, fishing gear and fishing community were observed. Size and type of gear, fishing operation and management of income of the project was discussed and noted.

- 1.3 Set-Net fishery information collection was conducted through interviewing, photo taking and documentary copy. Several set-net papers of the Philippines, photo at the site and information were collected.

Conclusion

Set-net fishing was introduced to the Philippines longtime ago in 1956 by Japanese fishing company. Target of the Philippines set-net are high migratory fishes like yellowfin tuna, skipjack, bonito and frigate tuna etc.

Set-net fishery in the Philippines could be classified into 3 type of management:-

- 1) **Fisherman Association management**; the project was supported by BEFAR in team of materials supplied and gear construction and operation training. Then the project is now run by **Fishermen association**, people of the municipals were the members of the group, averaged catch and income was about 100 - 200 kg/day and 4,000 – 8,000 Peso/day.
- 2) **Private owner with share labor of fishermen**, the project was supported by private personal in the municipal in term of gear material, BEFAR support technical training to the members. And it was managed by the private personal who has support fund to the project.
- 3) **Private operator, Commercial set-net operator**, there are three sets of gears belonging to one operator in Iba-city, Zambales the owner has satisfactory with the set-net fishing. Fishermen can earn their better live with set-net and try to develop it techniques year by year.

Almost of the Philippines set-net project were not aimed to the coastal fisheries resources management, their purposed for the municipal live development by fishery program. The other main area of Philippines set-net is around Panay Island, Iloilo-city which this survey has not covered it.

Weight gain on set-net netting panels as a result of marine fauna growth

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Introduction

The Set-Net Project in Rayong Province, Thailand has been being carried out since 2003. The operation season is about 7 months that starts from October to April annually. A current problem is the fast growing rate of marine fauna and sediment accumulation on the netting panels, especially at the leader net and the first chamber part. The marine fauna and sediment on the net causes the netting panels clogged up, weight gained and finally against the current. If they are left for long period, the shape of set-net will be changed by current and weight. These problems have the direct affect to the catch performance and the maintenance.

The aim of this study was to find out the suitable period for maintenance of the Set-Net by studying the increased weight on the net especially from the marine fauna and the species composition of them.

Materials and Methods

The study was conducted at the set-net site, which was located at 5 km from Hat Mae Ramphueng Beach, Muang District, Rayong Province, during the Set-Net operation season started from October 2006 to May 2007. The depth of the sea water was ranged from 12 to 15 m. Twelve pieces of the experimental netting panels (1 × 10 m²) were suspended vertically underneath the frame rope of the right sub leader and fixed with a 40 kg of sand bag (Fig.1). Two different mesh sizes of experimental netting panels were used in this study namely, PE 700d/18 with mesh size of 8 cm that used in the first chamber and PE 700d/80 with mesh size of 32 cm that used in the main leader net. The study net, 1 m wide and 10 m long, was stretched with two PVC pipes (□ 1.25cm, 1 m long) at the upper and lower part and fixed the sampling positions with one square meter of the same size of PVC pipe. The sampling positions were 4 m and 8 m from sea surface. The lower part was anchored with a 3 m singer rope (PP, □ 8mm) and attached to a sand bag (Fig.2).

The sampling nets were monthly sampled after starting the fishing season. The samples were weighed in sea water immediately to obtain real weight in water (Fig.3). Then, hung the samples for a half an hour to make it damp and weighed again for the weight in air. Then kept the samples in plastic bags and preserved with ice. Bring the samples to laboratory and dehydrated in an oven at 60 to 80 °C about 8 to 10 hours. The dried marine fauna were collected from the net and classified to group compositions for finding the weight of each.

The increased weights of each month were tested by the One-way ANOVA statistical method and compared the mean difference by the Scheffe method. The increased weight on different depth and mesh size were compared by the Independent t-test method.

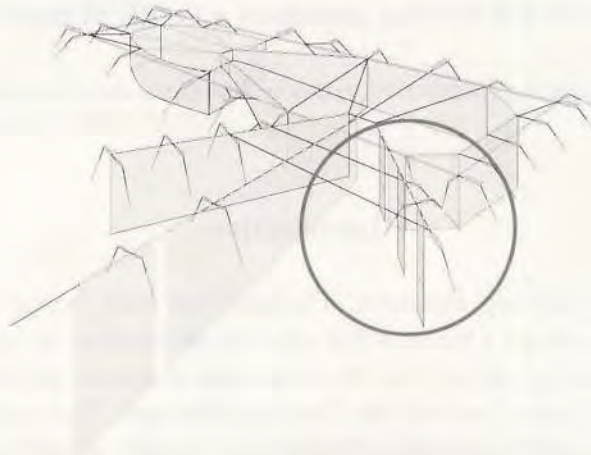


Fig.1. The experimental netting panels were suspended vertically underneath the frame rope of the right sub leader and fixed with a 40 kg sand bag.

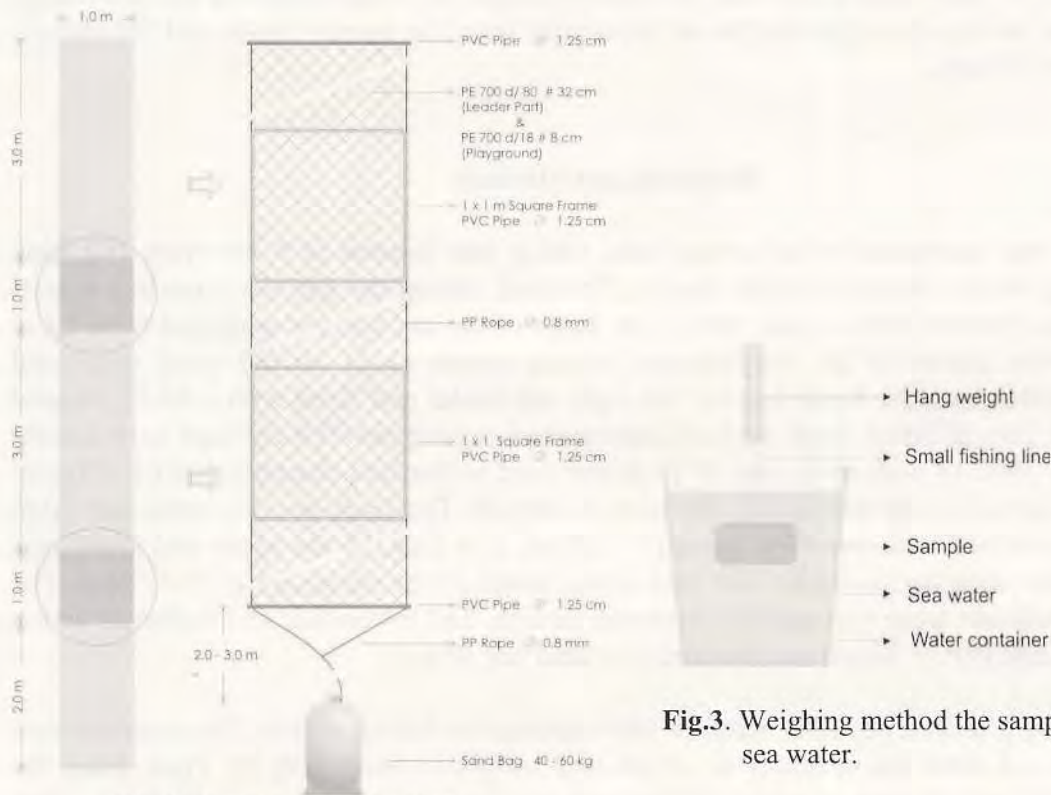


Fig.2. Study net construction.

Fig.3. Weighing method the sample net in sea water.

Results

The weight of accumulation of marine fauna and sediment of all samples were shown in Table 1. The weight of the experimental panels increased every month until the fifth month after starting the season. The frame ropes could not support the sinking weight and gradually sank in to the water. This resulted in ceasing of the growth of some marine fauna and finally died and came off the netting panels that indicated by the decreased weight of samples in the fifth and sixth months.

The average weight in water and air of each month were shown in fig 4. Both of increased weights were significantly different ($P < 0.01$). The average weight in water of the first, second, third and fourth months were not significantly different and the average weight of the fourth, fifth and sixth month were not significant different also ($P > 0.05$), but the average weight of the first second and third month were significantly different from the fifth and sixth month ($P < 0.05$). The comparison among the depth and mesh size were not significantly different ($P > 0.05$).

The study of species composition of the marine fauna (by number) on set net in year 2004 revealed that there were 44% of Arthropods, 31% of Mollusks, 14 % of Cnidarians, 11% of Annelids and the group of Sponges, Flatworms, Peanut Worms and Brittle Star were less than 1%. This study was divided into three groups, classified by dry weight that was shown in the biggest pie chart in Fig. 5. There are 66.5% of shell, 17.1% of barnacle and 16.4% of the others. The average increased weight of each group was shown in Fig.6.

There were three species of shell found in this study that were shown in small pie chart in Fig.5 (by number), *Saccostrea commercialis* (Oyster) was 66%, *Pinctada margaritifera* (Pearl Oyster) was 16.4% and *Pteria penguin* (Penguin Wing Oyster) was 17.6%.

Table 1. The weight of marine fauna and sediment sampled from one square meter of the experimental netting panels.

Month	Mesh size 8 cm				Mesh size 32 cm			
	Weight in water (g)		Weight in air (g)		Weight in water (g)		Weight in air (g)	
	Depth 4 m	Depth 8 m	Depth 4 m	Depth 8 m	Depth 4 m	Depth 8 m	Depth 4 m	Depth 8 m
1 st	2	10	270	490	0	6	180	300
2 nd	48	92	800	2250	22	60	290	1300
3 rd	50	140	800	1400	21	54	400	700
4 th	190	420	2000	2700	160	250	1100	1600
5 th	500	410	3300	1700	370	600	2100	2500
6 th	850	600	5200	3800	600	140	3100	700

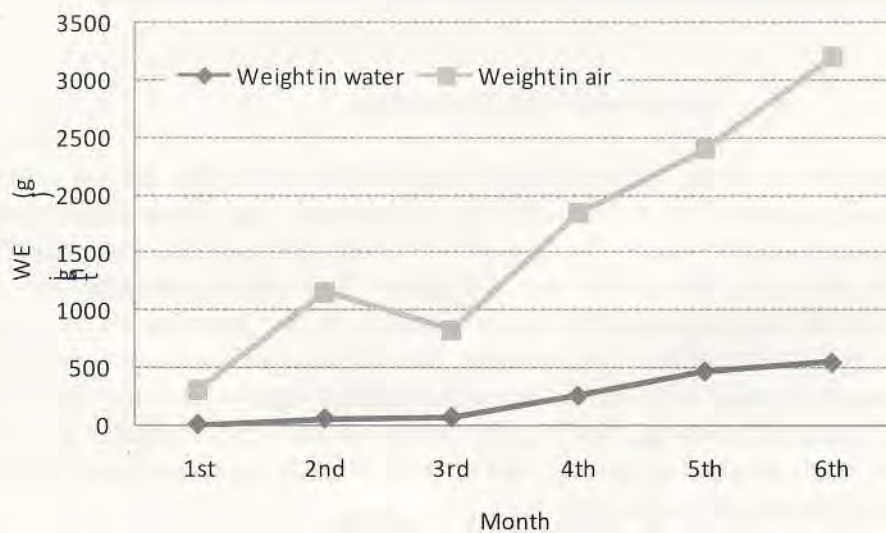


Fig.4. Average increased weight in water and air in each month.

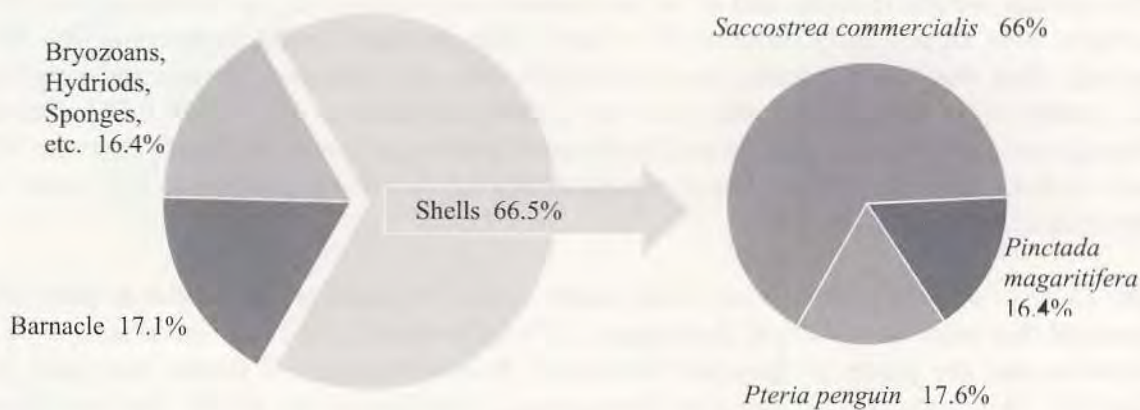


Fig.5. The biggest pie chart showed the species composition of marine fauna were found on the set-net netting panels and the additional small chart showed the species composition of shell

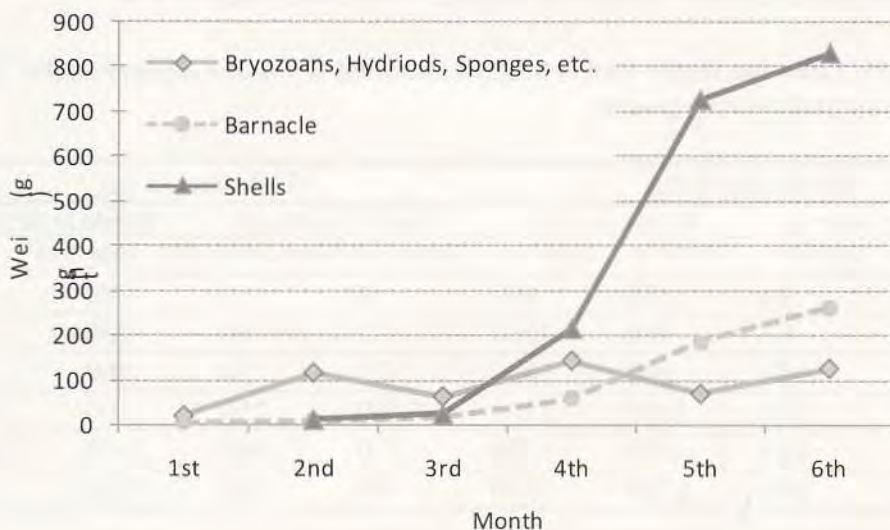


Fig.6 The average increased weight of marine fauna (dry weight) in each month.

Conclusion and Discussion

The weight increased slowly in the first to the third month after starting the set-net operation then it increased rapidly in the fourth month until the fifth month. The frame ropes failed to support the nets and sank into the water. The growth rate of the marine fauna on the different mesh size and net depth did not show any difference. Sea shells occupied the most cumulative weight on the nets although they were found after two months, but the growth rate was very high. Oyster, *Saccostrea commercialis*, was found to be the most abundant and firmly attached to the net meshes followed by barnacles and the other organisms. The weight of barnacle slowly increased from the first month and there was approximately 1/3 of the shell weight in the sixth month, while the others marine fauna and sediment occupied approximately 15% of the weight on the net.

However, from diving observation, massive marine fauna were obviously seen on the set-net more than the study net. It can be roughly assumed that the growth rate of them is much faster than that of the experimental netting panels due to the larger area and more stable. This can facilitate the veliger stage larva to settle and grow up.

Therefore, the suitable period to maintain set-net is recommended for every two months or not later than three months before the fast development of shells and barnacles. This would be much easier to remove them from the net since the nets are not too heavy.

This is the preliminary study of the increased weight on set net in this site, further study must be continued to confirm the findings and obtain more information.

Acknowledgements

I would like to thank M. Aussanee for this opportune study, A. Taweekiet, Y. Weerasak and Researchers and staff of EMDEC for kindly support during field trips and Data collecting, and many thank to everyone who participate in this study.

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Catch Analysis of Set-net Fisheries in Rayong Province

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Abstract

Studies on catch of the Otoshi-ami set-net that was installed in coastal waters at about 13-m depth and practiced by the local fishermen from Mae Rum Phueng Beach during October 2003 to May 2007, 4-year operations, resulted in an average catch per year of 19,224.60 kg or 447,886.62 baht valued. The highest catch was found in 2nd year followed by the 3rd, 4th and the 1st year, which were 25,630.90, 23,045.00, 19,503.60 and 8,705.90 kg respectively. Fishing income was highest in the 3rd year followed by the 4th, 2nd and 1st year, which were 609,389.00, 552,327.50, 520,928.00 and 108,902.00 baht, respectively. 91.09% of economic catch was the pelagic fish, 7.17% was demersal fish and 1.74% was cephalopods. Fish species including *Selaroides leptolepis*, *Amblygaster clupeioides*, Belonidae & Hemiramphidae (e.g. *Hemiramphus far*, *Tylosurus acus melanotus*, *Ablennes hians*), *Rastrelliger brachysoma* and *Sardinella gibbosa* were the dominance in the catch of this gear. Analysis of sizes in length resulted in that the average total lengths of *Tylosurus acus melanotus*, *Siganus canaliculatus*, *Alectis indicus* and the Bigfin Reef Squid were different among months and years even significantly at 95% confidence.

Key words: Set-net, Catch, Species composition, Thailand
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Introduction

The set-net is one of the fishing gears most popularly used in coastal fisheries in Japan. The set-net fishery is known as one of the most resource and environment-friendly fishing practices. It is also suitable to be integrated in coastal zone development and management. The gear was introduced to the small-scale fishermen in Mae Rum Phueng Beach, Rayong Province, Thailand since 2003 by the collaboration of Southeast Asian Fisheries Development Center/Training Department (SEAFDEC/TD) and the Eastern Marine Fisheries Research and Development Center (EMDEC) under the project entitled "Introduction of Set-Net Fishing to the Development of Sustainable Coastal Fisheries Management in Southeast Asia: Case Study in Thailand. This project was implementation and budget allocation under the Japan Trust Fund-I and a technical advice. Until September, 2005 the SEAFDEC should transfer the whole project and instrument to the DOF and EMDEC should continue the project and entitled "Rayong Set-Net Project". This project under the Japan International Cooperative Agency (JICA) Partnership Programme, supported by technical assistance and instrument facilities from the Set-Net Fishing Cooperatives, Himi City, Japan since 2005-2007.

The set-net is "Otoshi-ami" type, which is medium size. The gear was installed at latitude 12° 34.6'N and longitude 101° 21.8'E (figure1), Water depth was 11-13 m. The net design was targeting the pelagic species. Set-Net was fishing operated by the fisher group. Fishing operation could be done 5-9 months during September-May except for the South-west Monsoon periods by the fishermen 8-10 persons (SEAFDEC/TD and DOF, 2005)

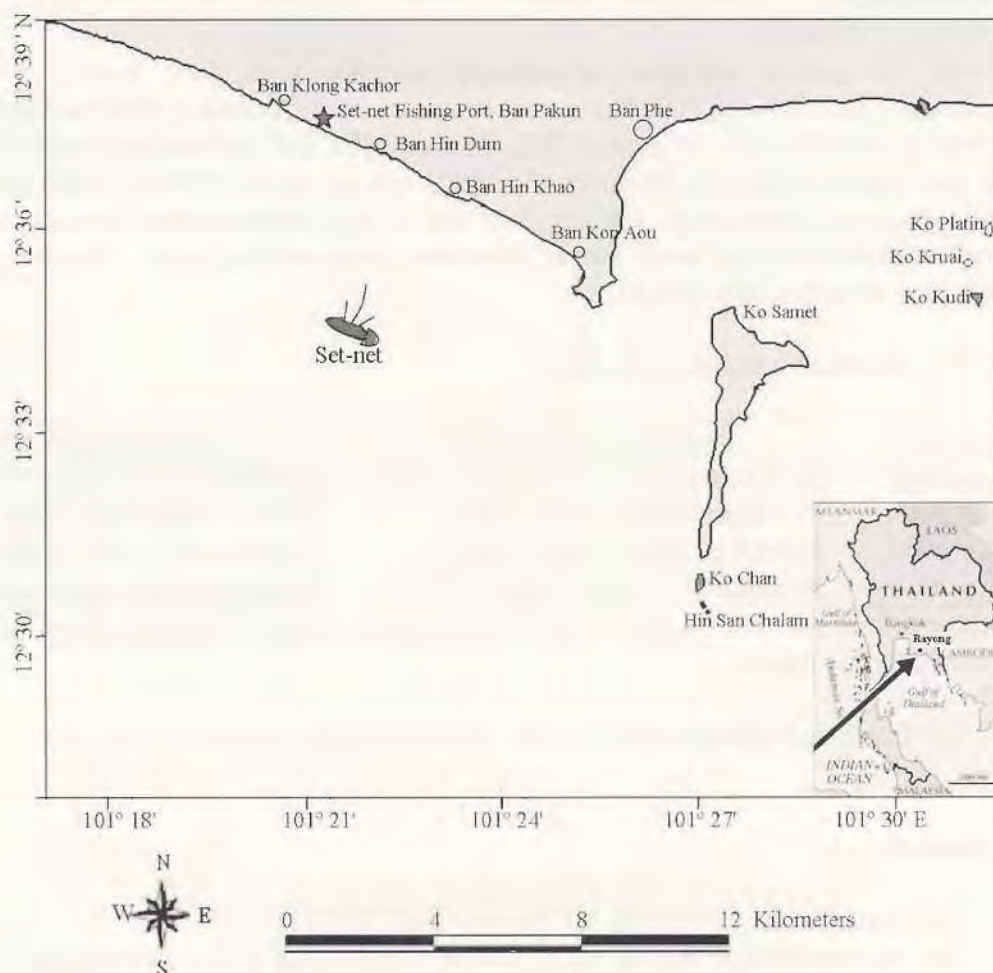


Figure 1 Position of the set-net and its landing on Mae Rum Phueng Beach, Rayong Province.

Study results on implementation of the set-net for development of sustainable coastal resources management involved the total catches, species and size compositions would become important index of the set-net fishing experiments in terms of efficiency of the fishing gear in general and its selectivity of suitable utility on the catch. Regarding to fishing experience, suitable size and design of the set-net should be regulated and further developed in harmony of the environmental factors in fishing area.

Objectives

1. To compare about catches and values contributed by the set-net year by year
2. To study on species and size composition
3. To analyze on coincidence of fishing seasons and catch of predominant species

Materials and Methods

1. Data Collection

1.1 For species and size composition, sampling were done weekly at set-net fishing port, Mae Rum Phueng Beach, Rayong Province from December 2003 to May 2007. Samples were grouped into 3, i.e. pelagic fish, demersal fish and cephalopods referenced by Carpenter and Niem (1998), De Bruin *et al.* (1994) and Isa *et al.* (1998). Total length of fish, Mantle length of cephalopods and length of disc of ray were recorded for each big size of specimen in centimeter and small size of specimen use punching paper. Weight of each species was also recorded total weight.

Table 1 The operation and sampling period

Operation year	Fishing operation time	Sampling time
1 st year in 2003	25 October 2003-25 February 2004	December 2003-February 2004
2 nd year in 2004	2 October 2004-1 May 2005	October 2004-April 2005
3 rd year in 2005	4 October 2005-2 May 2006	October 2005-April 2006
4 th year in 2006	26 September 2006-2 May 2007	September 2006-April 2007

Note: Although 2 set-nets were tested in the 4th year operation, only data from the 1st one were presented in this report

1.2 Catch and selling records by the fisher group were collected for catch comparison.

2. Data Analysis

2.1 Total Catch

For the comparison of total catch, data on weights and prices were averaged in kg/trip and baht/trip, respectively.

2.2 Catch Composition

For the comparison of catch composition, data on weights by fish groups and by species were calculated in percent.

2.3 Size Composition

For the comparison of catch by sizes, data on weights in each total length class interval were calculated in percent, in case of dominant species.

2.4 Coincidence Analysis

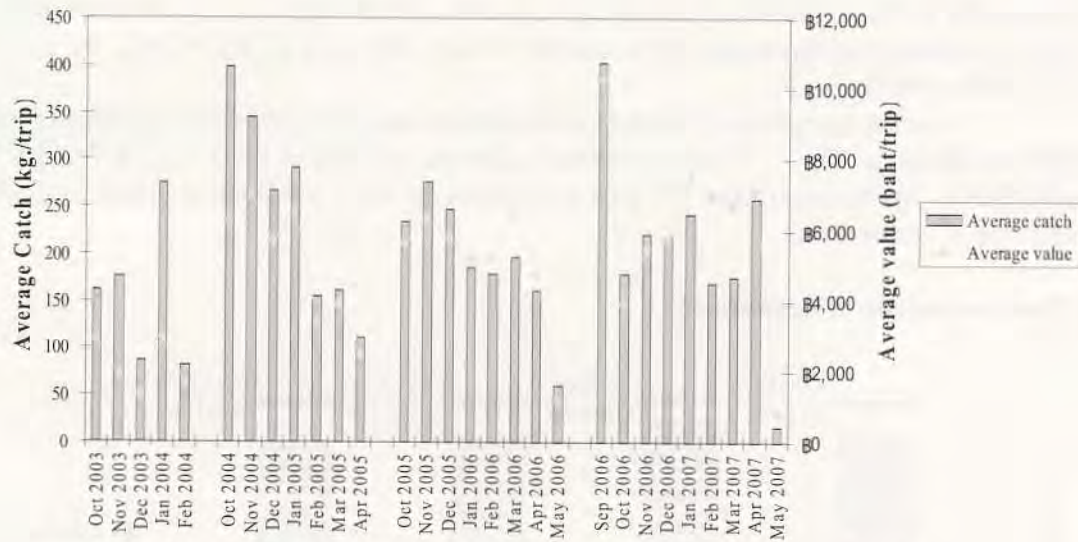
On the fact that some certain fish occurred in the set-net regularly year by year, data on weights and sizes of these fish were analyzed whether these trends relate to the fishing dates by the methods of ANOVA and Tamhane's T2 multiple comparison.

Results

1. Comparison of catch and value

About 4-year studies on set-net fisheries that covered 372 fishing trips resulted in the total catch of 76,898.40 kg valued 1,791,546.50 baht, or average 19,224.60 kg/year valued 447,886.62 baht/year. Yearly fluctuations were found in fishing operations from 52-110 trips, total catches from 8,705.90 – 25,643.90 kg and fishing prices from 108,902.00 –

608,389.00 baht. Each operation, the total catch of 206.72 kg valued 4,815.99 baht was gained. Catch and income resulted from the set-net fisheries were present in Figure 2.



	1 st year	2 nd year	3 rd year	4 th year	Total
Fishing operation (trip)	52	101	110	109	372
Total catch (kg)	8,705.90	25,643.90	23,045.00	19,503.60	76,898.40
Average catch (kg./trip)	167.42	253.90	209.50	178.93	206.72
Total value (bht.)	108,902.00	520,928.00	609,389.00	552,327.50	1,791,546.50
Average value (bht./trip)	2,094.27	5,157.70	5,536.62	5,067.22	4,815.99

Figure 2 Average catch and value per fishing operation during the 1st to the 4th year

1st year

From 52 trips of 5 months set-net operation, the total catch was 8,705.90 kg with 108,902.00 baht income. Maximum catch rate was 274.52 kg/trip with 2,957.07 baht/trip income in January 2004, followed by 175.71 kg/trip with 1,870.67 baht/trip in November 2003 and 160.35 kg/trip with 2,903.50 baht/trip in December 2003.

2nd year

The 101 trips in 7 months were operated for set-net fisheries. There were 25,643.90 kg total catch and 520,928.00 baht income. The maximum catch rate was 398.77 kg/trip with 6,233.13 baht/trip income in October 2004, followed by 343.88 kg/trip with 6,982.13 baht/trip in November 2004 and 290.16 kg/trip with 6,516.64 baht/trip in January 2005.

3rd year

From 110 trips of 8 months set-net operation, the total catch was 23,045.00 kg with 609,389.00 baht income. The maximum catch rate was 276.51 kg/trip with 6,272.80 baht/trip income in November 2005, followed by 246.50 kg/trip with 5,763.62 baht/trip in December 2005 and 233.41 kg/trip with 5,632.64 baht/trip in October 2005.

4th year

The 109 trips in 9 months were operated for set-net fisheries. There were 19,503.60 kg total catch and 552,326.50 baht income. The maximum catch rate was 402.15 kg/trip with 10,268.00 baht/trip income in September 2006, followed by 220.69 kg/trip with 5,449.57 baht/trip in November 2006 and 207.89 kg /trip with 6,264.31 baht/trip in January 2007 (follow by figure 2).

For the comparison of total catch, data on weights and prices, maximum total catch was found in the 2nd year operation followed by those of the 3rd, 4th and 1st year, respectively. An income of the 3rd year was found the most followed by those in the 4th, 2nd and 1st year, respectively.

2. Species and size composition

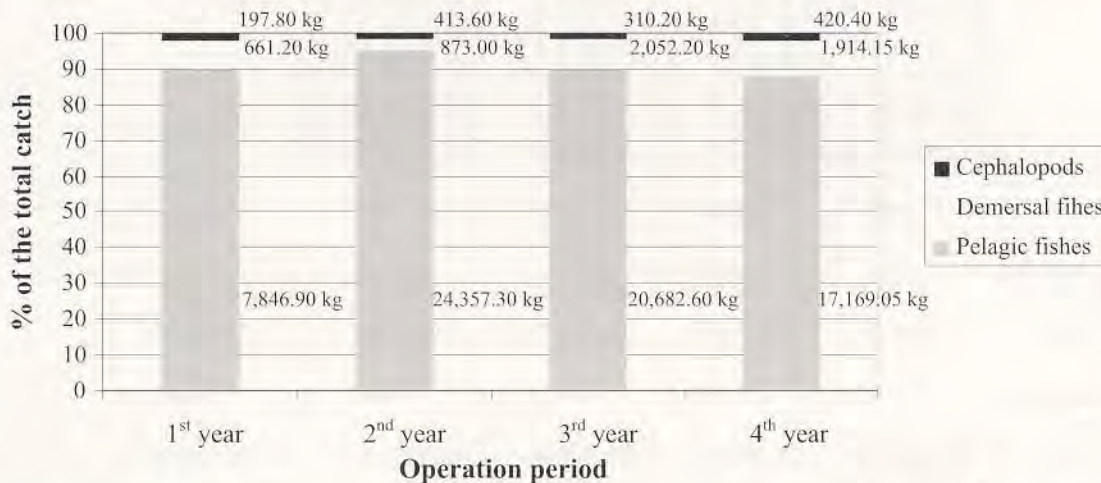


Figure 3 The percentage of total catch set-net fisheries during the 1st to the 4th year

There were 61 species of fish caught by the set-net, which were categorized into 3 groups; 28 species of pelagic fish, 30 species of demersal fish and 3 species of cephalopods Table 2 shown, Pelagic fish was dominant of total catch mostly composing of *Selaroides leptolepis*, *Amblygaster clupeioides*, Belonidae/Haemiramphidae (*Tylosurus acus melanotus*, *Ablennes hians* and *Hemiramphus far*), *Rastrelliger brachysoma*, *Sardinella gibbosa*, *Alepes vari*, *Alectis indica*, *Atule mate* and *Parastomateus niger*, respectively. Demersal fish comprised 3.41-9.81 % of total catch, of which Siganidae (*Siganus javas*, *S. canaliculatus* and *S. guttatus*, Sphyraenidae (*Sphyraena jello*, *S. putnamae* and *S. obtusata*) and *Trichiurus lepturus*, respectively. Of cephalopods having the catch percentage of 1.34-2.27, Bigfin reef squid was dominant species. Detailed catch composition could be explained as follow;

1st year

Catch was composed of 7,846.90 kg of pelagic fish, 661.20 kg of demersal fish and 197.80 kg of cephalopods, the percentages of which were 90.13 %, 7.60 %, and 2.27 %, respectively (figure 3). There were 16 species of pelagic fish, 9 species of demersal fish, and 3 species of cephalopods. Species and size composition are shown in table 3.

The highest catch of pelagic fish was 45.12% of *Selaroides leptolepis* followed by 16.73 of *Amblygaster clupeioides*, 11.09% of *Atule mate*, 3.60% of Belonidae/Hemiramphidae, and 3.02% of *Rastrelliger brachysoma*. The highest catch of demersal fish was 4.24% of Siganidae followed by 0.89% of *Trichiurus lepturus* and 0.70%

of *Aluterus monoceros*. For cephalopods, there were 1.79% of Bigfin reef squid, 0.47% of Squid, and 0.01% of Cuttlefishes (table 2).

2nd year

Catch was composed of 24,357.30 kg of pelagic fish, 873.00 kg of demersal fish and 413.60 kg of cephalopods, the percentages of which were 94.98 %, 3.41 %, and 1.61 %, respectively (figure 3). There were 46 species in the catch consisted of 19 species of pelagic fish, 24 species of demersal fish, and 3 species of cephalopods. Species and size composition are shown in table 4.

For pelagic fish, the highest catches were 30.59% of *Amblygaster clupeioides*, 23.41% of *Selaroides leptolepis*, 23.31% of Belonidae/Hemiramphidae, 5.78% of *Sardinella gibbosa*, and 3.07% of *Rastrelliger brachysoma*. Demersal fish were more diverse than the 1st year; the most was 0.99% of Siganidae, followed by was the most 0.81% of Sphyreanidae, and 0.63% of *Trichiurus lepturus*. Cephalopods were 1.04% of Bigfin reef squid, 0.54% of Squid, and 0.03% of Cuttle fishes (table 2).

3rd year

Catch comprised 53 species of 20,682.60 kg of pelagic fish, 2,052.20 kg of demersal fish and 310.2 kg of cephalopods, the percentages of which were 89.74 %, 8.92 %, and 1.34 %, respectively (figure 2). There were 53 species in the catch consisted of 24 species of pelagic fish, 26 species of demersal fish, and 3 species of cephalopods. Species and size composition are shown in table 5.

The highest catch was 37.68 % of *Selaroides leptolepis*, 24.18 % of *Amblygaster clupeioides*, 9.93 % of Belonidae/Hemiramphidae, 7.80 % of *Sardinella gibbosa*, and 3.20 % of *Alectis indica*. Sphyreanidae was the highest catch at 5.02%, followed by 1.73% of Siganidae, and 0.50% of *Trichiurus lepturus*, For cephalopods were 0.75% of Bigfin reef squid, 0.57% of Squid, and 0.02% of Cuttle fishes (table 2).

4th year

Catch was 54 species of 17,169.05 kg of pelagic fish, 1,914.15 kg of demersal fish and 420.40 kg of cephalopods, the percentages of which were 88.03 %, 9.81 %, and 2.16 %, respectively (figure 3). There were 55 species in the catch consisted of 26 species of pelagic fish, 26 species of demersal fish, and 3 species of cephalopods. Species and size composition are shown in table 6.

Pelagic fish, the highest catch were 30.45% of *Selaroides leptolepis*, 22.59% of *Amblygaster clupeioides*, 12.59% of Belonidae/Hemiramphidae, 4.39% of *Rastrelliger brachysoma*, and 4.04% of *Sardinella gibbosa*, Demersal fish were 2.41% of Siganidae, 2.28% of Sphyreanidae, and 2.19% of *Trichiurus lepturus*, respectively. Cephalopods were 1.50% of Bigfin reef squid, 0.65% of Squid, and 0.01% of Cuttlefishes (table 2).

Table 2 The total catches of set-net fisheries during the 1st to the 4th year

Group/Family/Species	1 st year		2 nd year		3 rd year		4 th year		Total	
	kg	%	Kg	%	kg	%	kg	%	kg	%
Pelagic fishes	7846.90	90.13	24,357.30	94.98	20,682.60	89.74	17,169.05	88.03	70,055.85	91.09
<i>Rastrelliger brachysoma</i>	262.70	3.02	787.40	3.07	508.60	2.21	855.30	4.39	2,414.00	3.14
<i>Rastrelliger kanagurta</i>	92.90	1.07	60.00	0.23	145.60	0.63	50.20	0.26	348.70	0.45
<i>Scomberomorus commersoni</i>	17.80	0.20	4.00	0.01	3.50	0.01	16.30	0.08	41.60	0.05
<i>Chirocentrus dorab</i>	41.40	0.48	2.00	0.01	10.90	0.05	45.60	0.23	99.90	0.13
<i>Atule mate</i>	965.30	11.09	333.30	1.30	46.20	0.20	555.50	2.85	1,900.30	2.47
<i>Scomberoides</i> spp.	85.40	0.98	2.50	0.01	16.90	0.07	18.10	0.09	122.90	0.16
<i>Selaroides leptolepis</i>	3,927.70	45.12	6,002.40	23.41	8,684.20	37.68	5,938.00	30.45	24,552.30	31.93
<i>Caranxoides</i> spp.	105.80	1.21	505.60	1.97	197.40	0.86	38.20	0.20	847.00	1.10
<i>Alectis indica</i>	86.50	0.99	337.40	1.32	738.40	3.20	685.30	3.51	1,847.60	2.40
<i>Alepes vari</i>	228.70	2.63	232.60	0.91	243.20	1.06	690.90	3.54	1,395.40	1.81
<i>Parastomateus niger</i>	5.50	0.06	744.10	2.90	184.20	0.80	318.00	1.63	1,251.80	1.63
Belontiidae&Hemiramphidae	313.60	3.60	5,978.80	23.31	2,289.30	9.93	2,454.95	12.59	11,036.65	14.35
Istiophoridae	35.00	0.40	42.00	0.16	224.30	0.97	189.00	0.97	490.30	0.64
<i>Amblygaster clupeioides</i>	1,456.30	16.73	7,843.90	30.59	5,572.50	24.18	4,405.40	22.59	19,278.10	25.07
<i>Sardinella gibbosa</i>	177.30	2.04	1,481.30	5.78	1,797.00	7.80	787.80	4.04	4,243.40	5.52
Misc. pelagic fishes	45.00	0.52	-	-	20.4	0.09	120.50	0.62	185.90	0.24
Demersal fishes	661.20	7.60	873.00	3.41	2,052.20	8.92	1,914.15	9.81	5,500.55	7.17
Sphyreanidae.	31.60	0.36	209.10	0.81	1,156.80	5.02	445.00	2.28	1,842.50	2.40
Nemipteridae/Scolopsidae	12.50	0.14	37.70	0.15	2.20	0.01	14.00	0.07	66.40	0.09
<i>Trichiurus lepturus</i>	77.50	0.89	160.50	0.63	114.40	0.50	426.30	2.19	778.70	1.01
Lutjanidae	50.30	0.58	27.40	0.11	91.10	0.40	190.10	0.97	358.90	0.47
Theraponidae	-	-	12.30	0.05	15.30	0.07	30.50	0.16	58.10	0.08
Sillaginidae	-	-	0.50	0.00	12.10	0.05	5.10	0.03	17.70	0.02
Dasyatidae	-	-	12.30	0.05	58.00	0.25	55.20	0.28	125.50	0.16
Gerridae	-	-	4.40	0.02	41.10	0.18	109.55	0.56	155.05	0.20
Platax teira	3.50	0.04	2.50	0.01	8.60	0.04	22.20	0.11	36.80	0.05
Siganidae	368.80	4.24	253.30	0.99	398.00	1.73	470.80	2.41	1,490.90	1.94
<i>Aluterus monoceros</i>	61.30	0.70	115.90	0.45	113.10	0.49	98.20	0.05	388.50	0.51
Misc. demersal fishes	55.70	0.64	37.10	0.14	41.50	0.18	47.20	0.24	181.50	0.24
Cephalopods	197.80	2.27	413.60	1.61	310.20	1.34	420.40	2.16	1,342.00	1.74
Squid	41.10	0.47	137.80	0.54	131.90	0.57	126.00	0.65	436.80	0.57
Bigfin reef squid	155.70	1.79	266.80	1.04	173.60	0.75	292.10	1.50	888.20	1.15
Cuttle fishes	1.00	0.01	9.00	0.03	4.70	0.02	2.30	0.01	17.00	0.02
Total	8,705.90	100.00	25,643.90	100.00	23,045.00	100.00	19,503.60	100.00	76,898.40	100.00

Table 3 Species and size composition from the sampling of total catch on the 1st year

Group/Family/Species	Sampling weight (kg)	Number of sample	Min (cm)	Max (cm)	Mean \pm SD (cm)	Mode (cm)
Pelagic fishes						
<i>Rastrelliger brachysoma</i>	4.10	87	14.00	21.00	16.40 \pm 1.47	15.50
<i>R. kanagurta</i>	2.33	51	13.00	24.50	16.53 \pm 1.94	16.00
<i>Chirocentrus dorab</i>	2.36	14	28.00	61.00	37.95 \pm 8.88	28.00
<i>Atule mate</i>	0.52	3	22.50	27.00	24.42 \pm 2.47	-
<i>Scomberoides tol</i>	1.02	19	20.00	24.00	22.01 \pm 1.07	22.00
<i>Selaroides leptolepis</i>	11.20	790	9.00	16.50	11.43 \pm 0.94	11.00
<i>Caranxgoides</i> spp.	1.18	4	23.00	30.50	27.13 \pm 3.07	27.00
<i>Alectis indica</i>	0.70	2	31.00	31.50	31.50 \pm 0.35	-
<i>Alepes vari</i>	0.89	10	17.50	26.50	21.90 \pm 3.44	18.50
<i>Parastomateus niger</i>	2.80	2	37.50	42.00	40.00 \pm 3.18	-
<i>Hemiramphus far</i>	1.90	5	58.00	66.00	61.85 \pm 2.97	62.00
<i>Tylosurus acus melanotus</i>	13.38	24	47.50	84.00	62.71 \pm 9.44	55.00, 57.00, 62.00, 67.50
<i>Ablennes hians</i>	13.89	26	23.00	87.00	72.83 \pm 13.05	73.00, 75.00, 76.00, 78.00, 84.00, 86.00
<i>Istiophorus platypterus</i>	2.40	2	195.00	198.00	196.75 \pm 2.12	-
<i>Amblygaster clupeioides</i>	7.86	136	12.50	21.00	18.10 \pm 1.92	19.50
<i>Sardinella gibbosa</i>	8.96	328	11.50	19.00	14.87 \pm 1.60	13.00
Demersal fishes						
<i>Sphyreana obtusata</i>	0.45	10	19.00	21.50	20.60 \pm 0.75	20.50
Nemipteridae	0.27	3	20.00	20.50	20.42 \pm 0.29	20.00
Pentapodidae	0.72	15	6.50	17.00	15.15 \pm 2.68	15.50, 17.00
<i>Trichiurus lepturus</i>	2.50	14	58.00	69.00	62.00 \pm 3.60	59.00
Lethrinidae	1.00	5	21.00	24.50	23.55 \pm 1.40	24.00
<i>Platex teira</i>	0.85	2	18.00	21.50	20.00 \pm 2.47	-
<i>Siganus javas</i>	0.71	11	8.50	19.00	15.80 \pm 3.07	14.50
<i>Aluterus monoceros</i>	4.60	5	40.00	48.50	44.95 \pm 3.35	-
Monacanthidae	6.86	34	6.50	57.00	18.84 \pm 15.09	9.00, 13.00
Cephalopods						
Squid	0.44	7	7.00	21.00	14.25 \pm 5.30	13.00
Bigfin reef squid	17.85	99	6.50	26.50	15.82 \pm 4.36	12.00
Cuttle fishes	0.56	2	13.50	18.50	16.25 \pm 3.54	-

Table 4 Species and size composition from the sampling of total catch on the 2nd year

Group/Family/Species	Sampling weight (kg)	Number of sample	Min (cm)	Max (cm)	Mean \pm SD (cm)	Mode (cm)
Pelagic fishes						
<i>Rastrelliger brachysoma</i>	18.25	500	10.00	24.50	15.09 \pm 2.00	15.00
<i>R. kanagurta</i>	16.50	325	10.50	26.00	16.32 \pm 3.00	16.50
<i>Scomberomorus commersoni</i>	2.40	3	48.00	57.00	52.42 \pm 4.54	-
<i>Chirocentrus dorab</i>	4.75	25	31.50	84.00	56.37 \pm 15.97	31.50, 37.00, 40.50
<i>Atule mate</i>	30.21	370	9.00	27.50	18.17 \pm 5.01	21.00
<i>Scomberoides lysan</i>	0.12	2	19.00	24.50	22.00 \pm 3.89	-
<i>S. tol</i>	2.50	11	32.00	36.00	34.34 \pm 1.32	34.50
<i>Selaroides leptolepis</i>	4.90	2,339	9.50	15.50	12.61 \pm 0.82	12.50
<i>Caranxgoides</i> spp.	30.14	98	13.50	50.00	27.91 \pm 4.57	26.5,30
<i>Alectis indica</i>	54.89	29	44.00	101.00	64.20 \pm 12.34	61.0, 62.0, 69.5
<i>Alepes vari</i>	43.86	290	17.00	43.00	25.32 \pm 3.68	24.00
<i>Parastomateus niger</i>	159.65	165	16.50	44.50	37.32 \pm 3.68	38.0,39.0
Leiognathidae	0.32	16	8.50	15.50	10.91 \pm 1.69	10.00
<i>Tylosurus acus melanotus</i>	209.60	358	47.00	135.00	68.56 \pm 10.82	64.00
<i>Ablennes hians</i>	230.88	350	24.50	99.50	77.29 \pm 11.45	73.00, 78.00, 84.00
<i>Istiophorus platypterus</i>	23.50	2	173.00	208.00	190.75 \pm 24.75	-
<i>Amblygaster clupeioides</i>	81.94	1,301	6.00	22.00	18.18 \pm 2.27	19.00
<i>Sardinella gibbosa</i>	35.70	1,146	11.00	19.50	15.25 \pm 1.34	15.00
<i>Thryssa mystax</i>	2.62	83	13.50	18.50	16.21 \pm 1.14	16.50
Demersal fishes						
<i>Sphyreana jello</i>	38.61	26	13.50	117.00	58.10 \pm 23.62	37.00, 37.50, 50.00, 57.50
<i>S. putnamae</i>	5.93	5	56.00	82.00	66.45 \pm 10.02	-
<i>S. obtusata</i>	23.55	332	11.50	23.00	19.13 \pm 1.57	18.50
Nemipteridae	2.11	21	11.50	24.50	18.37 \pm 3.77	14.50
Scolopsidae	3.79	30	10.00	27.50	21.03 \pm 1.05	20.00, 20.50
Pentapodidae	5.64	105	11.50	19.50	16.02 \pm 1.68	16.00
Ambassidae	0.30	2	20.00	21.00	20.75 \pm 0.71	-
<i>Trichiurus lepturus</i>	46.52	178	52.50	80.00	67.34 \pm 6.11	68.00
<i>L. vitta</i>	1.93	21	10.00	23.50	17.75 \pm 3.82	18.50
<i>L. lineolatus</i>	5.67	104	9.50	23.50	15.50 \pm 2.76	16.00
Theraponidae	1.78	11	17.00	30.50	21.20 \pm 4.90	18.00, 30.50
Sillaginidae	0.45	6	16.00	22.50	20.08 \pm 3.01	16.00
Dasyatidae	8.15	24	7.00	31.00	19.44 \pm 4.65	16.50, 18.00, 22.00
Serranidae	0.34	2	20.00	32.00	26.25 \pm 8.49	-
Lethrinidae	0.15	3	8.50	19.50	13.42 \pm 5.69	-
Mullidae	1.37	58	9.50	19.50	12.84 \pm 2.22	10.50, 12.00
<i>Plectorhynchus pictus</i>	1.07	3	25.50	33.50	30.42 \pm 4.16	-
Gerridae	1.43	19	15.00	19.50	17.04 \pm 1.45	15.50
<i>Siganus javas</i>	6.23	57	9.50	26.50	18.14 \pm 4.12	15.50
<i>S. canaliculatus</i>	36.83	530	7.00	27.50	15.96 \pm 4.32	13.50
<i>S. guttatus</i>	8.19	55	16.00	27.00	23.35 \pm 2.21	21.50, 23.00
<i>Aluterus monoceros</i>	28.07	38	32.00	52.00	38.98 \pm 5.68	34.50
Monacanthidae	5.35	58	8.50	21.00	14.87 \pm 2.75	16.00
<i>Caesio cuning</i>	1.61	11	1.00	25.00	21.21 \pm 5.17	23.50
Cephalopods						
Squid	18.60	467	4.50	21.00	10.84 \pm 3.04	9.50, 10.00
Bigfin reef squid	52.47	397	5.00	27.00	12.37 \pm 3.27	23.00
Cuttle fishes	1.87	4	8.00	55.50	23.38 \pm 21.83	-

Table 5 Species and size composition from the sampling of total catch on the 3rd year

Group/Family/Species	Sampling weight (kg)	Number of sample	Min (cm)	Max (cm)	Mean \pm SD (cm)	Mode (cm)
Pelagic fishes						
<i>Rastrelliger brachysoma</i>	22.65	659	4.50	26.50	14.61 \pm 2.69	13.00
<i>R. kanagurta</i>	27.52	752	9.50	25.50	14.94 \pm 1.96	13.50, 14.00
<i>Scomberomorus commersoni</i>	2.18	4	14.00	67.00	33.63 \pm 23.80	-
<i>Chirocentrus dorab</i>	8.24	81	18.50	76.00	34.34 \pm 14.20	22.00, 22.50, 23.00
<i>Thunnus tonggol</i>	1.55	2	37.50	38.50	38.25 \pm 0.71	-
<i>Atule mate</i>	9.98	102	8.00	31.00	13.96 \pm 3.74	30.00
<i>Megalaspis cordyla</i>	1.17	22	9.00	19.50	18.11 \pm 2.35	18.50
<i>Scomberoides lysan</i>	0.09	3	18.50	20.00	19.42 \pm 0.76	-
<i>S. tol</i>	1.25	8	16.00	30.50	21.94 \pm 5.84	30.50
<i>Selaroides leptolepis</i>	60.19	5,438	10.00	17.00	11.75 \pm 1.61	11.00
<i>Caranxgoides</i> spp.	48.43	185	18.00	51.00	26.24 \pm 3.53	26.00
<i>Alectis indica</i>	197.62	54	31.50	92.00	75.08 \pm 14.66	83.00, 87.00
<i>Alepes vari</i>	36.10	169	10.00	47.00	27.45 \pm 6.12	27.00
<i>Parastomateus niger</i>	19.69	16	32.50	54.00	44.34 \pm 6.34	40.00, 41.50, 44.00, 50.00
Leiognathidae	3.64	123	7.50	15.50	11.78 \pm 1.45	12.00
<i>Hemiramphus far</i>	8.80	71	24.00	39.00	31.62 \pm 4.40	26.00, 28.00, 37.00
<i>Tylosurus acus melanotus</i>	196.93	394	38.00	96.00	68.95 \pm 12.31	64.00, 65.00
<i>Ablennes hians</i>	154.75	256	39.00	105.00	76.94 \pm 11.99	82.00
<i>Tetrapturus audax</i>	54.25	3	194.00	210.00	201.75 \pm 8.05	-
Exocoetidae	0.03	2	11.00	11.50	11.50 \pm 0.35	-
<i>Amblygaster clupeioides</i>	92.40	1,998	4.00	21.00	15.99 \pm 3.22	17.00
<i>Sardinella gibbosa</i>	54.42	2,223	10.50	19.00	14.29 \pm 1.17	13.50
<i>Thryssa mystax</i>	1.89	61	13.00	18.00	16.25 \pm 1.19	17.00
<i>Scatophagus argus</i>	0.09	6	7.00	9.50	8.58 \pm 0.98	9.00
Demersal fishes						
<i>Sphyreana jello</i>	26.97	52	11.50	85.00	44.42 \pm 10.64	47.00, 50.00
<i>S. putnamae</i>	144.34	143	31.50	99.00	60.13 \pm 14.69	47.50
<i>S. obtusata</i>	40.35	965	13.50	28.00	19.77 \pm 1.50	19.00
Nemipteridae	0.37	5	13.00	21.50	18.25 \pm 3.48	-
Scolopsidae	2.41	33	9.00	27.50	15.86 \pm 6.07	11.50
Pentapodidae	0.99	23	11.00	21.50	15.25 \pm 2.43	14.50
<i>Trichiurus lepturus</i>	31.83	115	18.50	86.50	66.63 \pm 10.67	68.00, 70.00
<i>Lutjanus vitta</i>	4.12	49	13.50	22.00	18.20 \pm 1.83	18.50
<i>L. lineolatus</i>	19.37	407	6.00	24.50	14.68 \pm 2.59	13.00
Theraponidae	5.98	49	8.50	29.50	16.78 \pm 6.35	9.50
Priacanthidae	0.68	47	7.50	14.00	9.66 \pm 1.10	10.00
Sillaginidae	2.33	35	13.50	25.00	19.08 \pm 3.06	19.50, 20.00, 20.50, 21.00
Dasyatidae	25.17	17	18.00	64.00	30.25 \pm 15.02	19.50
Cynoglossidae	0.08	2	10.50	17.00	14.00 \pm 4.60	-
Lethrinidae	1.12	6	14.00	29.00	22.67 \pm 5.19	-
Mullidae	1.67	64	9.50	22.50	12.76 \pm 2.92	10.50, 11.50
<i>Plectorhynchus pictus</i>	0.48	3	21.00	23.50	22.42 \pm 1.26	-
Gerridae	8.77	152	2.00	22.00	15.07 \pm 3.81	16.00
<i>Platax teira</i>	1.30	3	21.00	22.00	21.92 \pm 0.58	22.00
Labridae	0.03	3	10.00	12.00	11.42 \pm 1.04	-
<i>Siganus javas</i>	32.29	280	6.00	28.50	17.06 \pm 6.27	7.00, 22.00, 23.00
<i>S. canaliculatus</i>	42.12	363	6.00	29.50	14.43 \pm 5.83	7.50, 14.00
<i>S. guttatus</i>	6.77	61	7.00	26.50	17.83 \pm 5.76	19.00
<i>Aluterus monoceros</i>	33.86	80	14.00	47.50	33.91 \pm 7.27	36.00
Monacanthidae	3.87	65	7.50	19.00	12.86 \pm 3.09	10.50
<i>Caesio cuning</i>	0.07	2	12.00	15.00	13.75 \pm 2.12	-
Cephalopods						
Squid	30.73	803	4.50	50.00	11.04 \pm 3.61	9.50
Bigfin reef squid	41.66	383	11.50	34.00	22.05 \pm 4.52	21.00
Cuttle fishes	2.69	8	8.50	22.50	17.19 \pm 4.52	19.50

Table 6 Species and size composition from the sampling of total catch on the 4th year

Group/Family/Species	Sampling weight (kg)	Number of sample	Min (cm)	Max (cm)	Mean \pm SD (cm)	Mode (cm)
Pelagic fishes						
<i>Rastrelliger brachysoma</i>	37.04	800	10.50	25.00	16.32 \pm 2.00	16.00
<i>R. kanagurta</i>	26.02	763	9.00	26.50	14.62 \pm 2.61	14.50
<i>Scomberomorus commersoni</i>	4.21	21	8.50	74.00	15.06 \pm 17.50	9.00
<i>Chirocentrus dorab</i>	7.51	59	20.00	55.00	35.09 \pm 6.46	32.00
<i>Atule mate</i>	60.85	1,047	13.50	25.50	19.72 \pm 3.01	20.00
<i>Megalaspis cordyla</i>	0.34	7	8.50	20.50	15.96 \pm 4.59	12.50
<i>Scomberoides commersonianus</i>	5.30	2	39.00	88.00	63.75 \pm 34.65	-
<i>S. tol</i>	0.09	2	19.00	24.00	21.75 \pm 3.54	-
<i>Selar crumenophthalmus</i>	0.54	8	18.00	20.00	19.19 \pm 0.73	18.00,19.00,19.50
<i>Selaroides leptolepis</i>	57.49	2,968	6.50	17.50	12.17 \pm 1.55	12.00
<i>Caranxgoides</i> spp.	10.43	48	14.50	32.00	24.32 \pm 4.74	22.50
<i>Trachinotus botta</i>	0.75	3	29.00	34.00	31.92 \pm 2.52	-
<i>Alectis indica</i>	314.60	80	28.50	100.00	76.39 \pm 16.00	80.00
<i>Alepes vari</i>	88.93	799	8.50	53.00	23.24 \pm 6.97	19.00
<i>Parastomateus niger</i>	53.10	41	32.00	49.00	41.16 \pm 4.02	42.00
Carangidae	2.50	57	12.50	26.00	16.98 \pm 2.70	16.50
Leiognathidae	1.52	84	7.00	15.00	11.35 \pm 2.01	9.0,12.5
<i>Hemiramphus far</i>	14.38	96	18.00	68.00	36.98 \pm 10.43	34.00
<i>Tylosurus acus melanotus</i>	186.28	344	20.00	93.00	64.86 \pm 11.15	64.00
<i>Ablennes hians</i>	42.06	97	56.00	92.00	68.94 \pm 8.75	65.00
<i>Istiophorus platypterus</i>	51.80	5	130.00	181.00	153.25 \pm 19.51	-
Exocoetidae	0.25	3	17.50	25.50	20.92 \pm 4.25	-
<i>Amblygaster clupeioides</i>	82.88	1,614	10.50	22.00	17.18 \pm 1.75	18.00
<i>Sardinella gibbosa</i>	41.23	1,185	10.50	20.50	15.91 \pm 1.25	15.50
<i>Thryssa mystax</i>	1.08	31	14.50	18.50	16.93 \pm 0.94	16.50
<i>Scatophagus argus</i>	0.05	4	6.00	8.50	7.50 \pm 1.04	-
Demersal fishes						
<i>Sphyreana jello</i>	70.36	124	32.00	105.00	48.47 \pm 10.53	41.00
<i>S. putnamae</i>	79.08	66	17.00	95.00	66.06 \pm 16.53	59.00
<i>S. obtusata</i>	21.14	524	12.00	25.00	16.80 \pm 4.66	19.00
Scolopidae	4.03	22	12.50	30.00	21.66 \pm 4.67	22.50
Pentapodidae	1.07	23	11.50	19.50	15.03 \pm 2.03	14.00
Ambassidae	0.18	3	14.50	19.00	17.42 \pm 2.36	-
<i>Trichiurus lepturus</i>	38.74	173	50.00	79.00	65.41 \pm 5.16	65.00
<i>Lutjanus russelli</i>	0.66	2	24.00	26.00	25.25 \pm 1.41	-
<i>L. vitta</i>	13.66	98	14.50	25.00	20.51 \pm 2.13	20.50
<i>L. lineolatus</i>	37.12	805	8.50	23.00	14.06 \pm 2.85	16.00
Theraponidae	12.04	62	15.00	32.00	22.62 \pm 5.76	15.00
Sillaginidae	1.55	26	14.50	50.00	24.44 \pm 12.63	-
Dasyatidae	12.32	17	19.00	32.00	25.63 \pm 3.74	21.00
<i>Rachycentron canadus</i>	10.83	6	20.00	93.00	49.58 \pm 32.91	-
Lethrinidae	0.54	12	7.50	22.00	12.38 \pm 4.16	9.00
Mullidae	0.75	29	12.00	16.50	14.73 \pm 1.12	14.5,15.5
<i>Plectorhynchus pictus</i>	2.39	10	19.50	39.00	25.20 \pm 6.39	23.50
Gerridae	22.42	415	13.50	22.50	16.07 \pm 1.30	16.00
<i>Platax teira</i>	8.94	22	16.50	38.00	21.30 \pm 4.33	21.5,23.5
Scaridae	0.06	7	6.00	11.50	8.54 \pm 1.75	7.50
<i>Siganus javas</i>	16.67	244	5.00	33.00	12.84 \pm 5.97	8.00
<i>S. canaliculatus</i>	55.25	643	4.50	28.50	16.54 \pm 6.17	7.0,20.0
<i>S. guttatus</i>	6.79	39	13.50	31.50	21.94 \pm 6.50	20.00
<i>Aluterus monoceros</i>	6.74	22	10.00	48.00	28.09 \pm 10.56	32.00
Monacanthidae	0.54	8	11.50	18.00	15.19 \pm 2.73	11.50
<i>Caesio cuning</i>	0.49	15	10.50	22.50	13.68 \pm 3.53	12.0,13.5
Cephalopods						
Squid	26.05	575	10.00	28.50	19.81 \pm 3.28	17.00, 17.50, 18.00
Bigfin reef squid	40.87	526	10.00	22.50	18.51 \pm 3.35	19.00
Cuttle fishes	0.69	2	15.00	17.00	16.25 \pm 1.41	-

3. Coincidence Analysis

Studies on catch data from the set-net found that occurrences of some fish were monthly variable within the fishing seasons, as shown in Figure 4.

October - December
 October - April
 October - April
 November - January

November – January, March-April
 November, March
 November - April
 November, April
 December - April
 December, April
 March

Atule mate
 Siganidae
 Bigfin reef squid
Selaroides leptolepis, *Amblygaster clupeioides*
 and *Parastomateus niger*
Rastrelliger brachysoma
Sphyreana jello
Sardinella gibbosa, *Alectis indica*
 Belonidae & Hemiramphidae
Alepes vari
S. obtusata
S. putnamae

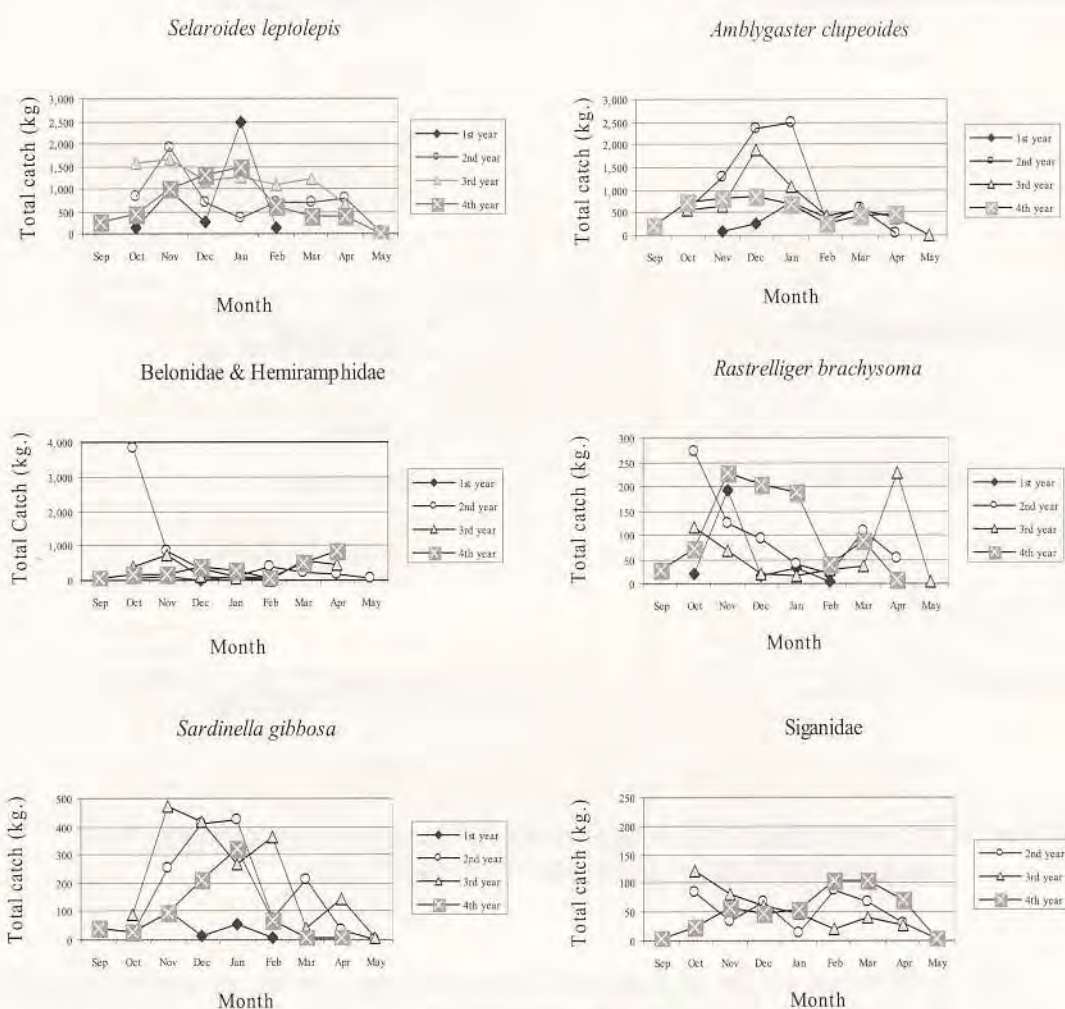


Figure 4 The coincidence of fishing seasons of the highest catch species from catch set-net fisheries during the 1st to the 4th year

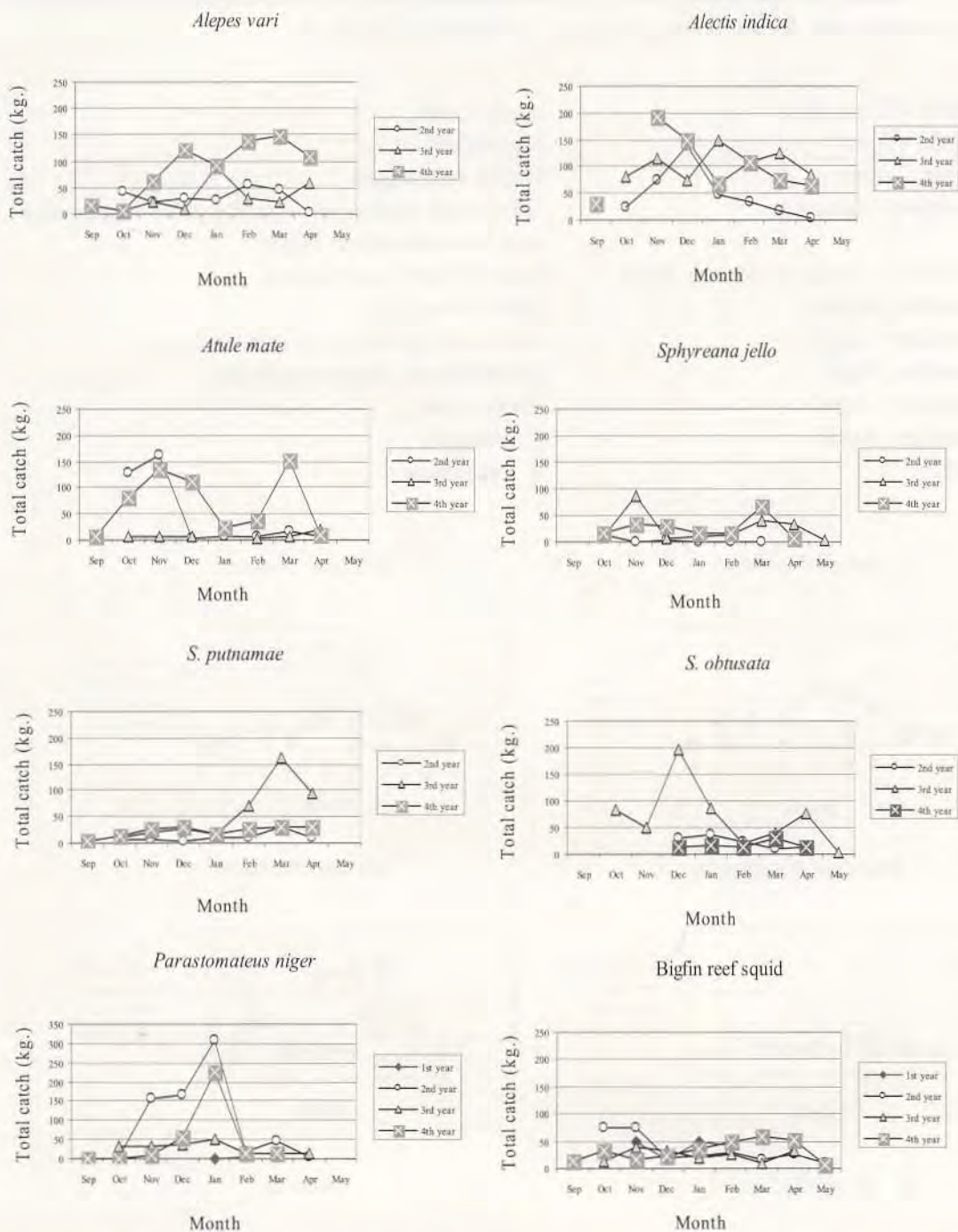


Figure 4 (cont.) The coincidence of fishing seasons of the highest catch species from catch set-net fisheries during the 1st to the 4th year

Size distribution of the highest catch species were shown in table 7 and 8. Monthly average sizes of the majority of highest catch species were not significantly different ($p > 0.05$). The significant differences in monthly average sizes were found in 2 species: *Tylosurus acus melanotus* which was the longest in October, followed by that in November and *Siganus canaliculatus* which had the smallest size in April.

Table 7 Size of highest catch species from set-net fisheries showing monthly differences at 0.05 significant levels

Species	Mean \pm SD (cm)						
	October	November	December	January	February	March	April
<i>Setaroides leptolepis</i>	11.71 \pm 1.18 ^a	12.53 \pm 0.08 ^a	12.23 \pm 0.69 ^a	12.62 \pm 0.63 ^a	12.37 \pm 0.78 ^a	12.02 \pm 0.85 ^a	11.29 \pm 1.11 ^a
<i>Amblygaster clupeioides</i>	17.48 \pm 2.50 ^a	18.80 \pm 0.96 ^a	18.05 \pm 0.62 ^a	17.93 \pm 1.05 ^a	16.83 \pm 1.38 ^a	15.77 \pm 1.19 ^a	15.85 \pm 1.38 ^a
<i>Hemiramphus far</i>	-	31.75 \pm 7.78 ^a	37.86 \pm 12.16 ^a	33.56 \pm 2.75 ^a	47.37 \pm 2.48 ^a	55.25 \pm 7.07 ^a	-
<i>Tylosurus acus melanotus</i>	75.56 \pm 4.39 ^{a,c}	74.79 \pm 3.36 ^{b,c}	68.90 \pm 5.67 ^{b,c}	64.34 \pm 2.57 ^{a,b,c}	60.72 \pm 7.87 ^{a,b}	60.97 \pm 4.29 ^{a,b}	59.85 \pm 6.13 ^a
<i>Ablemes hians</i>	74.74 \pm 7.58 ^a	79.37 \pm 10.83 ^a	73.48 \pm 4.72 ^a	68.26 \pm 7.59 ^a	67.63 \pm 1.77 ^a	74.55 \pm 5.46 ^a	74.99 \pm 2.63 ^a
<i>Rastrelliger brachysoma</i>	17.82 \pm 5.07 ^a	15.92 \pm 1.15 ^a	16.75 \pm 1.16 ^a	16.77 \pm 0.73 ^a	16.16 \pm 2.02 ^a	17.30 \pm 3.18 ^a	13.62 \pm 0.25 ^a
<i>Sardinella gibbosa</i>	15.03 \pm 1.42 ^a	15.17 \pm 1.32 ^a	15.45 \pm 1.09 ^a	15.26 \pm 0.88 ^a	15.09 \pm 0.71 ^a	14.65 \pm 0.75 ^a	14.52 \pm 0.06 ^a
<i>Siganus javas</i>	19.82 \pm 2.85 ^a	23.21 \pm 3.72 ^a	20.31 \pm 2.08 ^a	19.76 \pm 3.83 ^a	14.56 \pm 4.42 ^a	16.79 \pm 5.09 ^a	15.11 \pm 3.13 ^a
<i>S. canaliculatus</i>	17.47 \pm 1.39 ^{a,b}	18.66 \pm 2.02 ^{a,b}	20.53 \pm 1.60 ^b	18.13 \pm 3.83 ^{a,b}	17.09 \pm 2.63 ^{a,b}	13.09 \pm 6.00 ^{a,b}	8.63 \pm 0.71 ^a
<i>S. guttatus</i>	-	18.38 \pm 3.09 ^a	23.58 \pm 2.57 ^a	21.63 \pm 1.59 ^a	19.84 \pm 6.91 ^a	20.00 \pm 3.13 ^a	20.21 \pm 2.35 ^a
<i>Alepes vari</i>	21.30 \pm 5.21 ^a	22.82 \pm 2.07 ^a	22.63 \pm 1.21 ^a	27.11 \pm 3.86 ^a	22.96 \pm 2.81 ^a	29.04 \pm 6.49 ^a	29.59 \pm 10.06 ^a
<i>Alectis indica</i>	65.58 \pm 19.80 ^a	71.34 \pm 4.16 ^a	79.63 \pm 5.52 ^a	74.48 \pm 8.95 ^a	60.87 \pm 21.06 ^a	63.47 \pm 5.28 ^a	75.60 \pm 7.99 ^a
<i>Atule mate</i>	19.00 \pm 4.89 ^a	19.75 \pm 4.59 ^a	20.47 \pm 3.53 ^a	20.15 \pm 3.46 ^a	22.60 \pm 2.57 ^a	19.16 \pm 1.32 ^a	15.04 \pm 4.52 ^a
<i>Sphyræna jello</i>	39.97 \pm 3.93 ^a	46.22 \pm 3.72 ^a	47.64 \pm 0.73 ^a	55.35 \pm 3.50 ^a	52.68 \pm 5.73 ^a	48.64 \pm 14.27 ^a	45.85 \pm 3.03 ^a
<i>S. putnamae</i>	60.23 \pm 16.65 ^a	68.52 \pm 2.91 ^a	61.45 \pm 2.66 ^a	56.14 \pm 13.97 ^a	75.78 \pm 14.00 ^a	70.12 \pm 0.40 ^a	70.17 \pm 12.30 ^a
<i>S. obtusata</i>	19.90 \pm 0.22 ^a	18.52 \pm 0.57 ^a	19.68 \pm 0.82 ^a	19.64 \pm 1.61 ^a	19.28 \pm 1.72 ^a	17.28 \pm 3.57 ^a	18.12 \pm 0.69 ^a
<i>Parastomateus niger</i>	39.67 \pm 5.07 ^a	38.67 \pm 1.30 ^a	39.56 \pm 2.42 ^a	38.69 \pm 2.09 ^a	44.92 \pm 3.79 ^a	44.04 \pm 9.07 ^a	37.75 \pm 1.47 ^a
Bigfin reef squid	10.70 \pm 2.89 ^a	12.08 \pm 0.73 ^a	12.96 \pm 1.07 ^a	13.26 \pm 1.87 ^a	13.97 \pm 3.10 ^a	9.73 \pm 1.69 ^a	9.94 \pm 1.50 ^a

The yearly differences in average sizes were found significantly in other 2 species: *Alectis indica* which had their smallest size in the first year, and Bigfin reef squid having the smallest size in the second year. They were shown in table 8.

Table 8 Size of highest catch species from set-net fisheries showing yearly differences at 0.05 significant levels

Species	Mean±SD (cm)			
	1 st year	2 nd year	3 rd year	4 th year
<i>Selaroides leptolepis</i>	11.43±0.94 ^a	12.61±0.82 ^a	11.75±1.61 ^a	12.17±1.55 ^a
<i>Amblygaster clupeioides</i>	18.10±1.92 ^a	18.18±2.27 ^a	15.99±3.22 ^a	17.18±1.75 ^a
<i>Hemiramphus far</i>	61.85±2.97 ^a	-	31.62±4.40 ^a	36.98±10.43 ^a
<i>Tylosurus acus melanotus</i>	62.71±9.44 ^a	68.56±10.82 ^a	68.95±12.31 ^a	64.86±11.15 ^a
<i>Ablennes hians</i>	72.83±13.05 ^a	77.29±11.45 ^a	76.94±11.99 ^a	68.94±8.75 ^a
<i>Rastrelliger brachysoma</i>	16.40±1.14 ^a	15.09±2.00 ^a	16.36±7.66 ^a	16.32±2.00 ^a
<i>Sardinella gibbosa</i>	14.87±1.60 ^a	15.25±1.34 ^a	14.29±1.17 ^a	15.91±1.25 ^a
<i>Siganus javas</i>	15.80±3.07 ^a	18.14±4.12 ^a	17.06±6.27 ^a	12.84±5.97 ^a
<i>S. canaliculatus</i>	-	15.96±4.32 ^a	14.43±5.83 ^a	16.54±6.17 ^a
<i>S. guttatus</i>	-	23.35±2.21 ^a	17.83±5.76 ^a	21.94±6.50 ^a
<i>Alepes vari</i>	21.90±3.44 ^a	25.32±3.68 ^a	27.45±6.12 ^a	23.24±6.97 ^a
<i>Alectis indica</i>	31.50±0.35 ^a	62.20±12.34 ^b	75.08±14.66 ^b	76.39±16.00 ^b
<i>Atule mate</i>	24.42± 2.47 ^a	18.17±5.01 ^a	13.96±3.74 ^a	19.72±3.01 ^a
<i>Sphyreana jello</i>	-	58.10±23.62 ^a	44.42±10.64 ^a	48.47±10.53 ^a
<i>S. putnamae</i>	-	66.45±10.02 ^a	60.13±14.69 ^a	66.06±16.53 ^a
<i>S. obtusata</i>	20.60±0.75 ^a	19.13±1.57 ^a	19.77±1.50 ^a	16.80±4.66 ^a
<i>Parastomateus niger</i>	40.00±3.18 ^a	37.32±3.68 ^a	44.34±6.34 ^a	41.16±4.02 ^a
Bigfin reef squid	15.82±4.36 ^{a,b}	12.37±3.27 ^a	22.05±4.52 ^b	18.51±3.35 ^b

Discussion

Catch and value

Throughout the studies, highest catch in weight was found in the 2nd year operation, whereas the fishing income was highest in the 3rd year. This is due to the fluctuation of fish prices in the market namely fish prices in 2005-2006 were better than other years. Not only the market prices but also values of fish themselves affected this fact, that meant more economically important species or individuals were caught in the 3rd year rather than the others.

The 1st year operations resulted in lowest catch and fishing income because of insufficient experiences in fishing techniques and management in general (SEAFDEC/TD and DOF, 2005). Trial in the 2nd year seemed to be able to successfully reduce some problems as the catch was higher and fishing was longer. In the 2nd year the organization of fishermen group had been reformed. Originally, the group had divided into 5 sub-groups and each of them worked separately that meant too hard-worked and not enough labors. In the 2nd year, the 5 groups joined together into one group so that they could work more efficient than the previous year. According to marketing demands, prices per kg of fish were increased during the 3rd year operation and that became the reason why fishing income of the 3rd year was higher than the 2nd, although its catch was a bit smaller. Catch and income of the set-net in 4th-year operation was not so high as the previous years. It may be the cause that the fishermen had set up the new set-net unit not so far from the first one and that may cause some competition.

Species Composition

Most catch of the set-net was composed of pelagic fish that were usually economically important. Not only pelagic fish, but also demersal fish and cephalopods were retained in the net. After modification of the set-net since the 2nd year, number of fish species seemed to be increased, included economic species e.g. *Alectis indica*, *Parastomateus niger* and *Carangoides* spp.

In general, sizes of fish in average total length were similar year by year. Except for the *Tylosurus acus melanotus*, *Siganus canaliculatus*, *Alectis indica* and the bigfin reef squids whose average total lengths were different among the years of operations.

As the report of catch composition by bamboo stake traps in Trat Province, 21.85% of which were categorized into trash fish (Boonpukdee and Sujittosakul, 2004). So long as the studies were carried on, none of fish caught by the set-net were sold as trash. Although the set-net was located not so far from shore, its catch retained mostly marketable sizes. Whether the gear itself is selective, needs more information

Acknowledgement

We would like sincerely thank to project's technical advisors Prof. Dr. Takafumi Arimoto from Tokyo University of Marine Science and Technology (TUMSAT), Mr. Tadashi Hamaya and Mr. Isao Hamano set-net experts from Himi City for provide us the technical assistance to the project. Fisheries and fishing Port Division of Himi City for supporting instrument of set-net. Finally we would also like to thank the Rayong Set-Net fisher group for provide us the facility to the project.

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Table 9 List of the species composition

Scientific name	Common name	Family
Pelagic fishes		
<i>Rastrélliger brachysoma</i>	Short mackerel	Scombridae
<i>R. kanagurta</i>	Indian mackerel	Scombridae
<i>Scomberomorus commersoni</i>	Narrow-barred Spanish mackerel	Scombridae
<i>Thunnus tonggol</i>	Longtail tuna	Scombridae
<i>Chirocentrus dorab</i>	Dorab wolf-herring	Chirocentridae
<i>Atule mate</i>	Yellowtail scad	Carangidae
<i>Megalaspis cordyla</i>	Torpedo scad	Carangidae
<i>Scomberoides commersonianus</i>	Talang queenfish	Carangidae
<i>S. lysan</i>	Doublespotted Queenfish	Carangidae
<i>S. tol</i>	Needlescaled queenfish	Carangidae
<i>Selar crumenophthalmus</i>	Bigeye scad	Carangidae
<i>Selaroides leptolepis</i>	Yellowstripe scad	Carangidae
<i>Caranxgoides</i> spp.	Trevally	Carangidae
<i>Trachinotus botta</i>	Largespotted dart	Carangidae
<i>Alectis indica</i>	Indian threadfish	Carangidae
<i>Alepes vari</i>	Herring scad	Carangidae
<i>Parastomateus niger</i>	Black pomfret	Carangidae
Leiognathidae	Slimys, slipmouths, or ponyfishes	Leiognathidae
<i>Hemiramphus far</i>	Blackbarred halfbeak	Hemiramphidae
<i>Tylosurus acus melanotus</i>	Agujon needlefish	Belonidae
<i>Ablennes hians</i>	Flat needlefish	Belonidae
<i>Istiophorus platypterus</i>	Indo-Pacific sailfish	Istiophoridae
<i>Tetrapturus audax</i>	Striped marlin	Istiophoridae
Exocoetidae	Flyingfish	Exocoetidae
<i>Amblygaster clupeioides</i>	Bleeker's smoothbelly sardinella	Clupeidae
<i>Sardinella gibbosa</i>	Goldstripe sardinella	Clupeidae
<i>Thryssa mystax</i>	Anchovies	Engruariae
<i>Scatophagus argus</i>	Spotted scat	Scatophagidae
Demersal fishes		
Ambassidae	Perchlets	Ambassidae
Scaridae	Parrotfishes	Scaridae
<i>Sphyreana jello</i>	Pickhandle barracudas	Sphyreanidae
<i>S. putnamae</i>	Sawtooth barracudas	Sphyreanidae
<i>S. obtusata</i>	Obtuse barracudas	Sphyreanidae
Nemipteridae	threadfin bream	Nemipteridae
Scolopsidae	monocle bream	Nemipteridae
Pentapodidae	Whiptail	Nemipteridae
<i>Trichiurus lepturus</i>	Largehead hairtail	Trichiuridae
<i>Lutjanus russelli</i>	Russell's snapper	Lutjanidae
<i>L. vitta</i>	Brownstripe snapper	Lutjanidae
<i>L. lineolatus</i>	Biggeye snapper	Lutjanidae
Theraponidae	Largescaled terapon	Theraponidae
Priacanthidae	Bigeyes or catalufas	Priacanthidae
Sillaginidae	Smelt-whitings	Sillaginidae
Dasyatidae	Rays	Rays (familys)
Cynoglossidae	Tonguefishes	Cynoglossidae
<i>Rachycentron canadus</i>	Cobia	Rachycentridae
Lethrinidae	Emperors or scavengers	Lethrinidae
Mullidae	Goatfishes	Mullidae
<i>Plectorhynchus pictus</i>	Spotted sweetlip	Haemulidae
Gerridae	Mojarras	Gerreidae
<i>Platax teira</i>	Teira batfish	Ephippidae
<i>Siganus javas</i>	Streaked spinefoot	Siganidae
<i>Siganus canaliculatus</i>	Whitespotted spinefoot	Siganidae
<i>Siganus guttatus</i>	Orangespotted spinefoot	Siganidae
<i>Aluterus monoceros</i>	Unicorn leatherjacket	Monacanthidae
Monacanthidae	Leatherjacket	Monacanthidae
<i>Caesio cunning</i>	Fusiliers	Caesiodidae
Serranidae	Groupers	Serranidae

ANALYSIS OF DAILY CATCH DATA IN RAYONG SET-NET

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and

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Japanese type of set-net was firstly installed on 2003, at Mae Rumpheung beach, Rayong Province of Thailand which is on the East Coast of the Gulf of Thailand. Mae Rumpheung beach covers 140-160 km² of the coastal waters, with 20 km coastline, where 7 groups of fishermen distributed along the coastline which compose of 150-200 fishermen engaging in small-scale fishing. Of those, 70% were bottom gill net and squid trap operation, 20% were squid jigging and handlines, the remains are fish trap, crab trap, etc. Almost of their fishing boats were small-scale as 6-7 meters long with 18-65 HP inboard engines. One or 2 fishermen were engaging the daily fishing activity on each boat. Among those fishermen, 60% were full time fishermen and 40% were part time ones. Fishing operation could be done throughout the year; however, the peak season was during the Northeast monsoon season, October to May.

The Otoshi-ami type set-net was designed for the fishing ground of 14m depth, according to the data and information from the on-board/on-shore baseline survey, with the "Technical guide for set-net fishing" from International Set Net Fishing Summit in HIMI on 2002. The net design was targeting the small pelagic species such as mackerel and sardine, with 25mm mesh size of nylon net is used for the catching chamber. The overall scale of gear was 45 m wide and 140 m long, for the fish court and catching chamber, with the slope net of 80mm mesh size polyethylene net. The leader net was 250 m long of polyethylene 320 mm mesh, while the wing-nets was 50 m and 100 m of polyethylene 180 mm mesh for establishing the net entrance opening. In the 2nd year after the first fishing season trial, it was found that there were some disadvantage parts of the original designed. Then, the modification plan for the gear design was developed through the advice from Himi city experts, as being the slim style as 20 m wide and 155 m long, with the wider net entrance, but shorter wing-net. The anchors were replaced by sand bags for using total of 1,000 pieces of 60 kg sand bags.

The catch data during 3 years from October 2003 to May 2006 were collected for the 1st year from October 22, 2003 to February 25, 2004, for the 2nd year from October 2, 2004 to May 1, 2005, and for the 3rd year from October 6, 2005 to May 2, 2006, for 5-7 months in each year until the gear retrieval before the start of monsoon season. Among 47 species listed, the dominant 9 species were Yellowstripe scad (*Selaroides leptolepis*), Round herring (*Amblygaster clupeioides*), Sardinella (*Sardinella gibbosa*), Gar fish (*Ablennes hians* and *Tylosurus acus melanotus*), Trevallies (*Carangoides spp.*), Indian threadfish (*Alectis indicus*) Barracuda (*Sphyraena obtosata*, *S. putnamiae* and *S. jello*) Black pomfret (*Parastromateus niger*) Big fin reef squid (*Sepiotheuthis lessoniana*)

The annual number of hauls ranged from 51 to 110 with the total of 262 hauls for 3 years. The annual total catch ranged from 6,222.26 to 25,108.30 kg with the total of 54,306.36 kg. The average catch per haul ranged from 122.01 to 248.60 kg/haul with 207.28 kg/haul in average for 3 years. These are shown in the Table 1.

Table 1 Statistics of 3 years operation

Year	No.of hauls	Total catch (CPUE)	Total income (per haul)	Baht /Kg
2003.10- 2004.2	51	6.2 ton (122.1Kg)	86,246Baht (1,691Bt)	13.86
2004.10-2005.5	101	25.1 ton (248.6Kg)	512,446Baht (5,074Bt)	20.41
2005.10-2006.5	110	23.0 ton (208.9Kg)	600,077Baht (5,455Bt)	26.12

The daily catch data were analyzed for understanding the catch pattern in Rayong set-net, for the following points of view.

- 1) Comparison of average catch per haul among 3 years, for major dominant species
- 2) Daily catch analysis for total catch and major dominant species
- 3) Catch frequency distribution according to the operation interval days from 3 years; the normal day, one day-off and two day-off were 31, 201 and 24 hauls and the average total catch were 139.80, 230.36 and 201.10 per haul respectively.
- 4) Catch frequency distribution for each year.
- 5) Accumulated catch amount and operation days.
- 6) Unit market price analysis from 3 years operations; the average price per haul (Baht/kg) of the first, second and third were 13.86, 20.41 and 26.12 Baht/kg respectively. The average price per haul from 3 years was 22.07 Baht/kg.

ANALYSIS OF DAILY CATCH DATA IN RAYONG SET-NET

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OBJECTIVES

To compare catch composition of Rayong set-net from 3 years operation

To understand catch pattern and give an idea of catch pattern to Rayong fishermen

CONTENT

- 1) Total catch composition and total value from Rayong set-net
- 2) Comparison of average catch per haul among 3 years
- 3) Daily catch analysis for total catch and major dominant species
- 4) Catch frequency distribution according to the operation interval days
- 5) Catch frequency distribution for each year
- 6) Accumulated catch amount and operation days
- 7) Unit market price analysis from 3 years operations

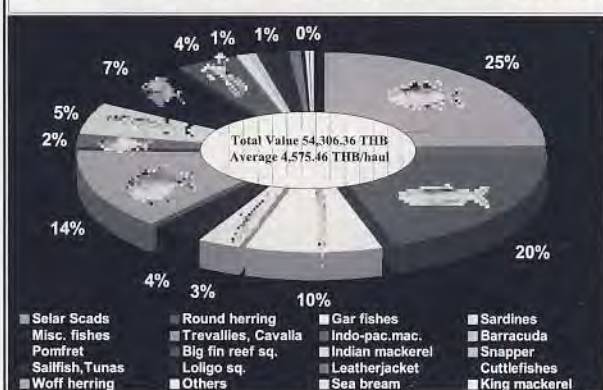
Total catch, total value and number of operations for the respective 3 year period from 2003-2006

	Total catch Kg	Total value THB	Total No. of operation haul	Average catch Kg/haul	Average value THB/haul
First year					
Second year					
Third year					
Total					
<i>Remark</i>					
First year :	October 2003 – February 2004				
Second year :	October 2004 – May 2005				
Third year :	October 2005 – May 2006				

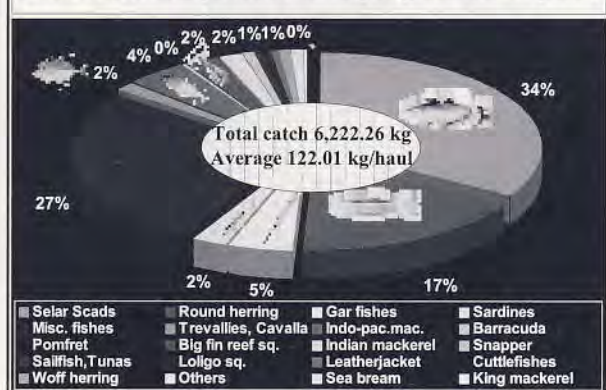
Total catch composition of Rayong set-net 3 years



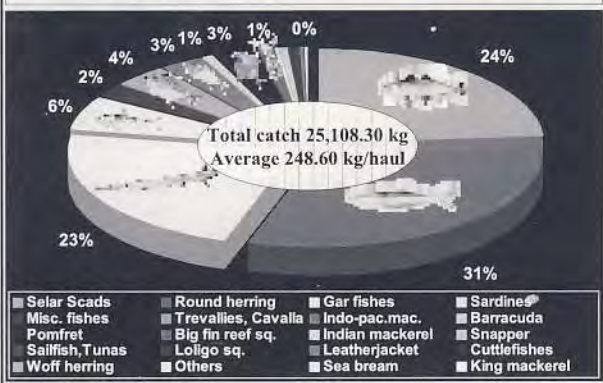
Total value composition of Rayong set-net 3 years



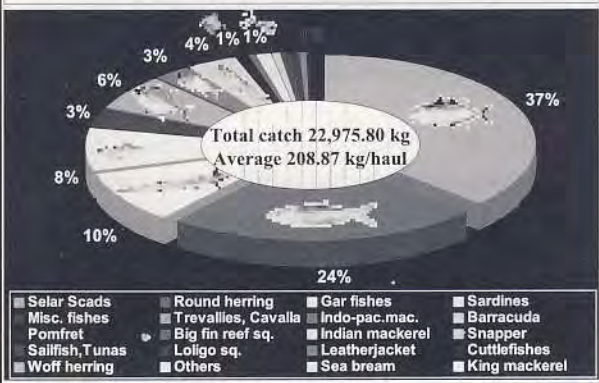
Total catch composition of Rayong set-net 1st years



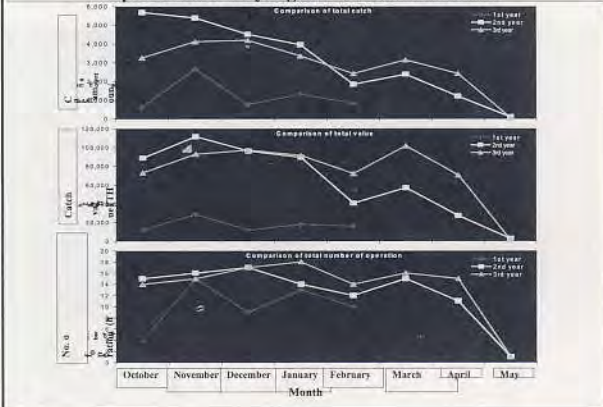
Total catch composition of Rayong set-net 2nd years



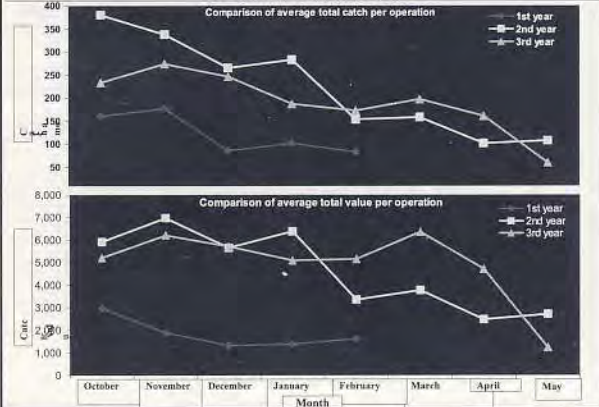
Total catch composition of Rayong set-net 3rd years



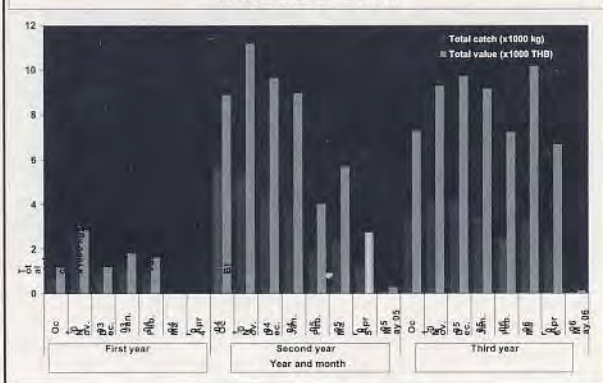
The comparison of total catch, total value and number of operations of Rayong set-net from 2003-2006



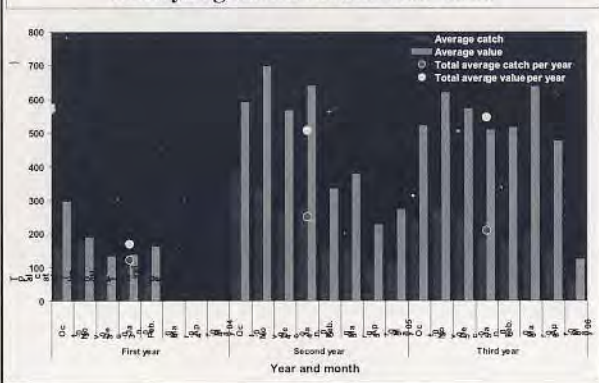
The comparison of average catch and value per haul of Rayong set-net from 2003-2006

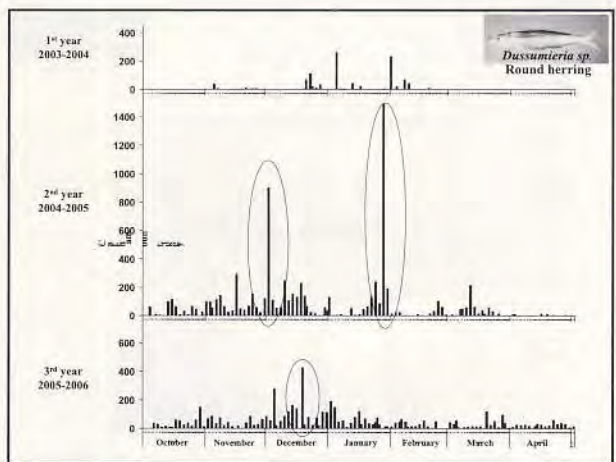
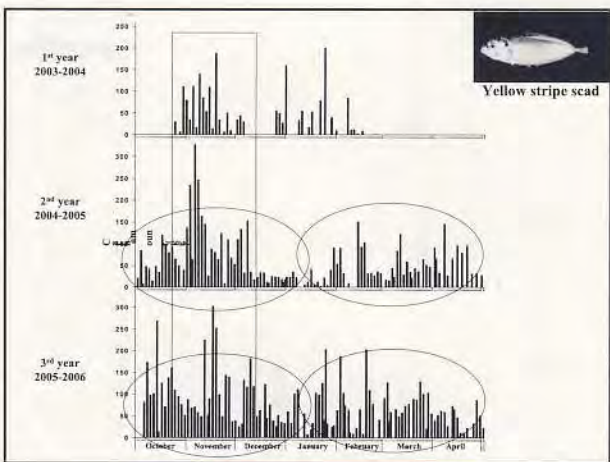
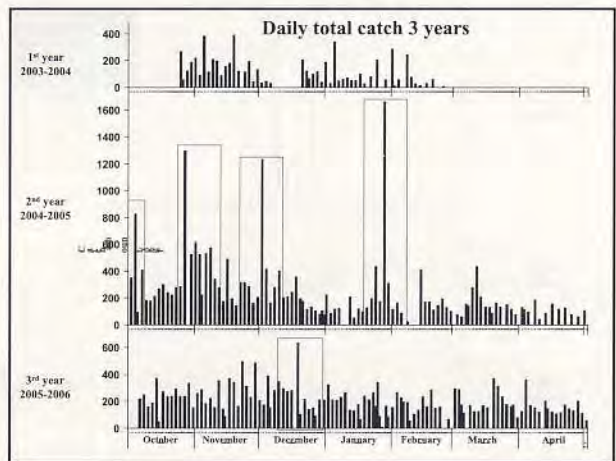
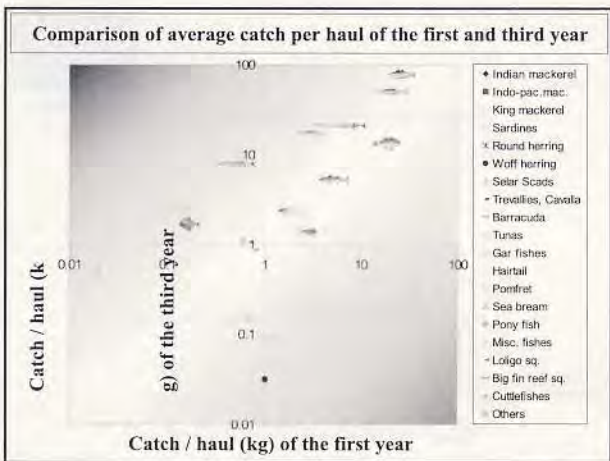
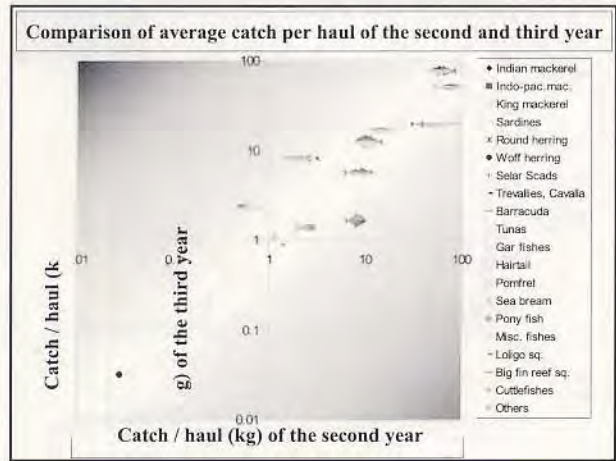
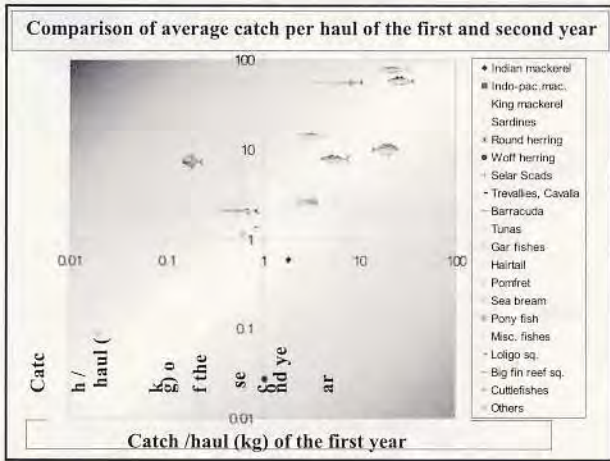


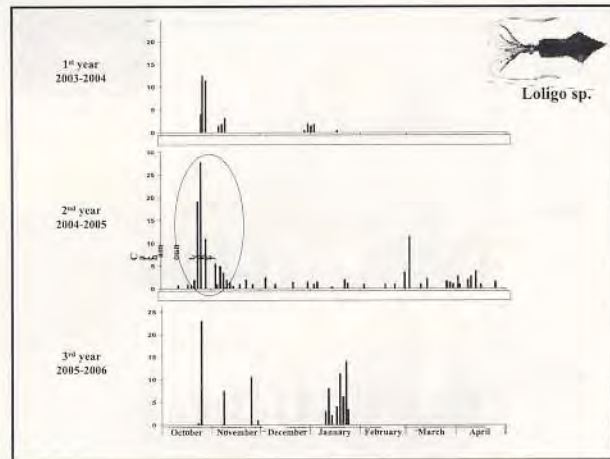
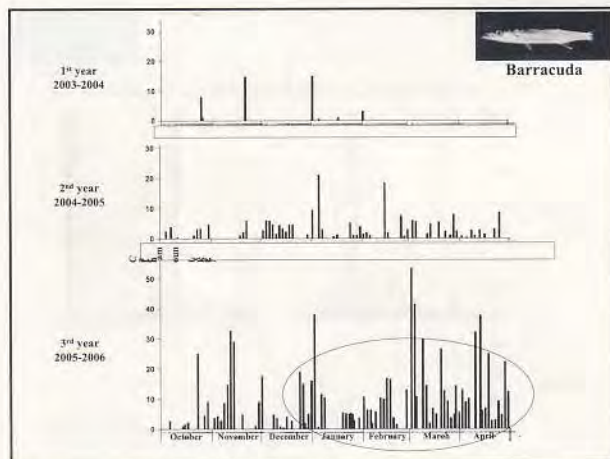
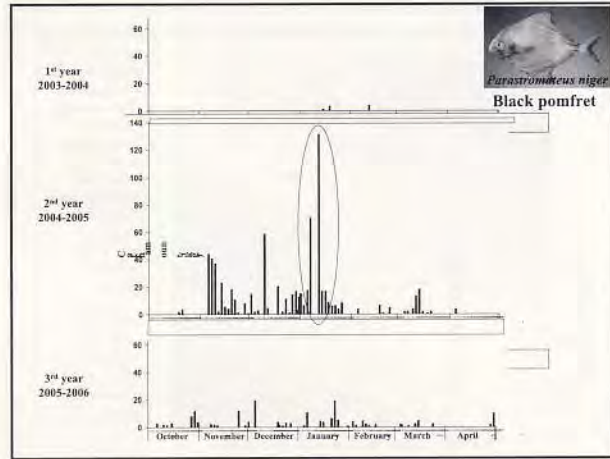
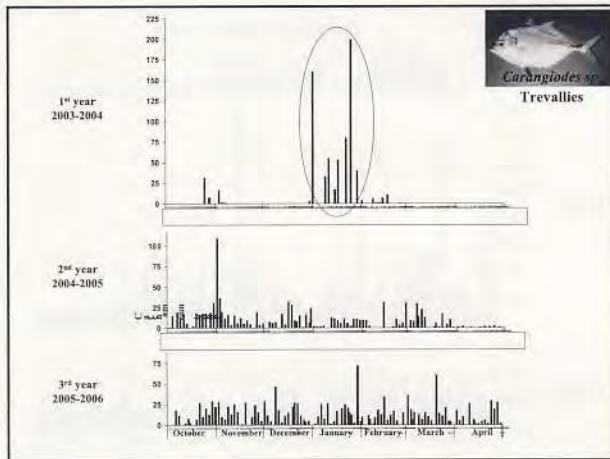
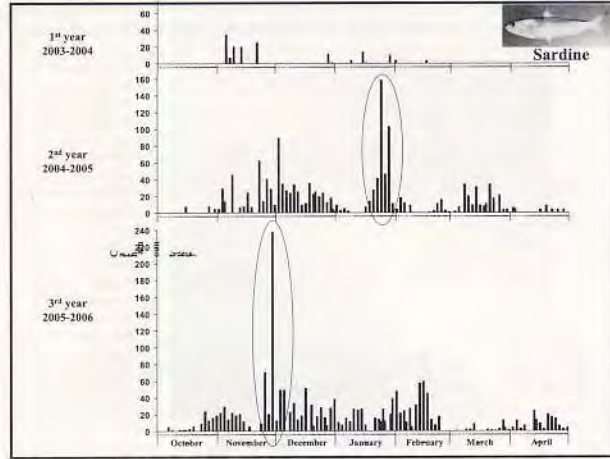
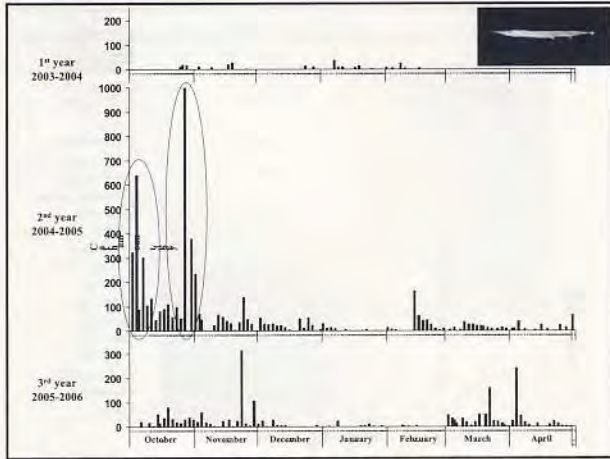
The total catch and total value of Rayong set-net from 2003-2006

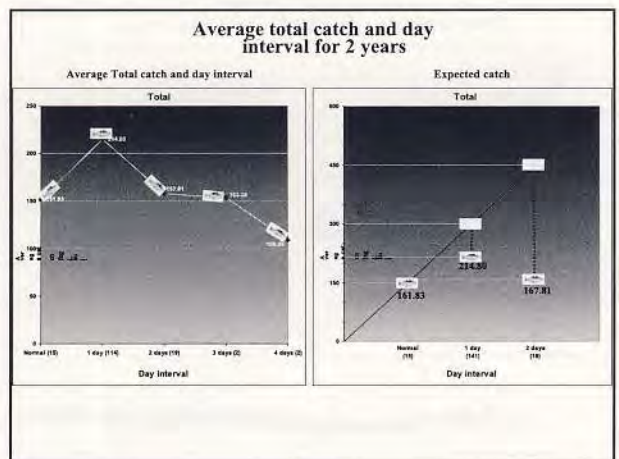
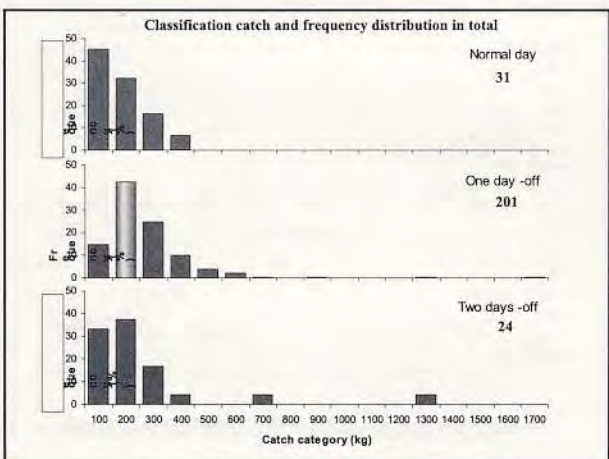
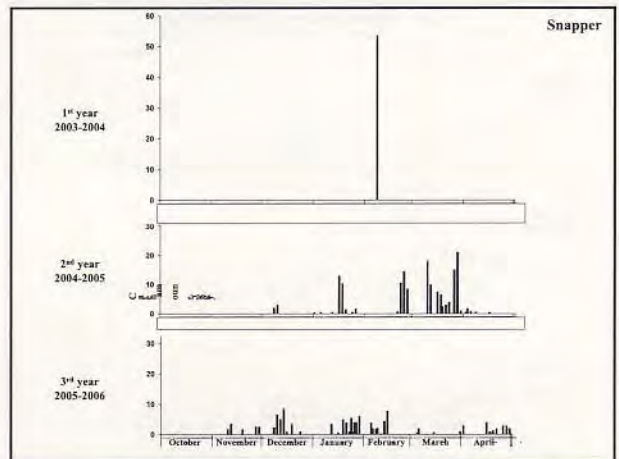
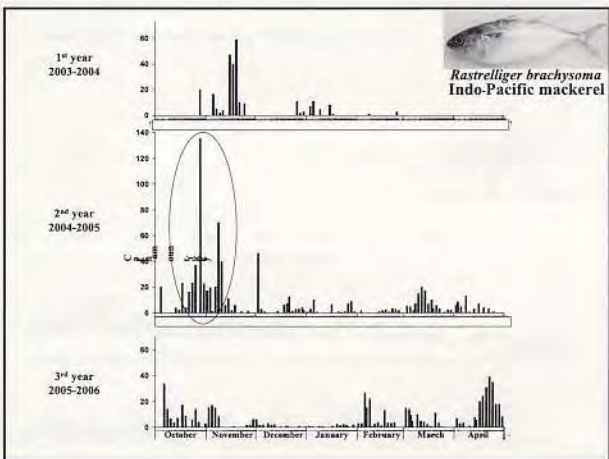
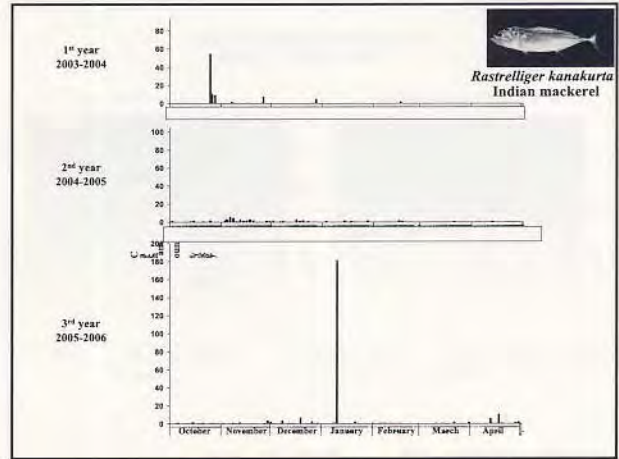
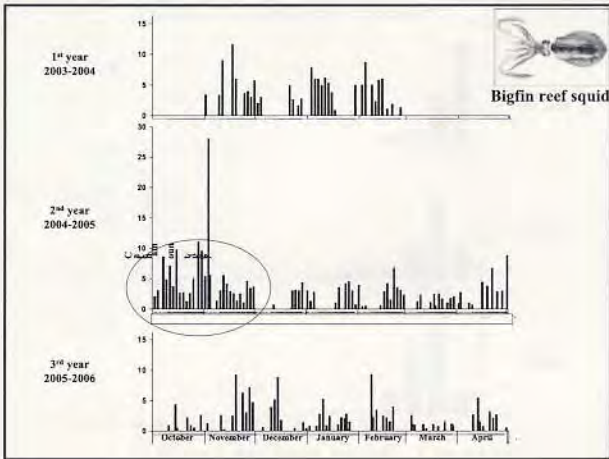


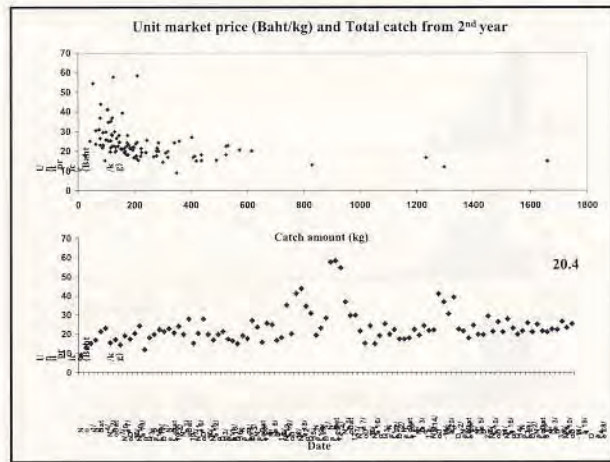
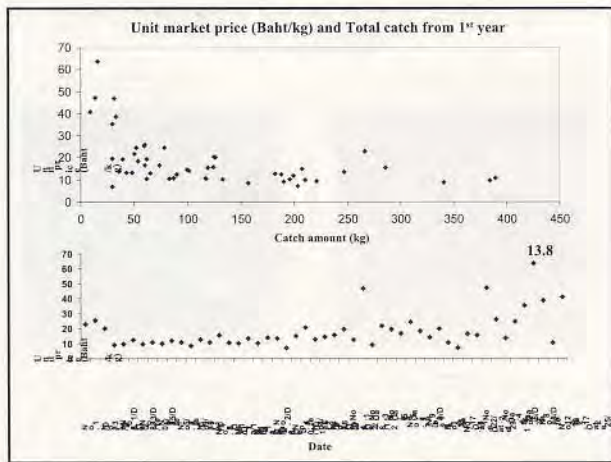
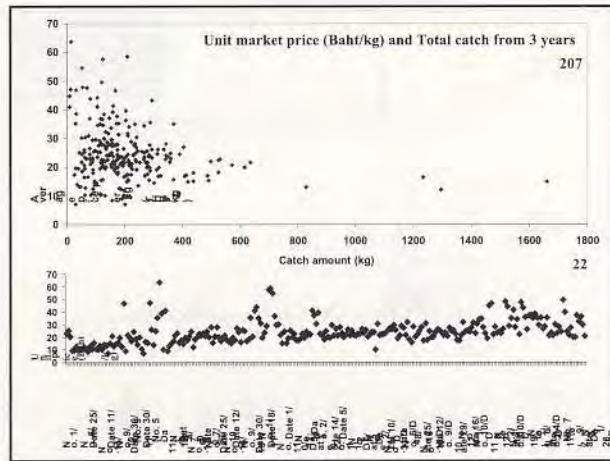
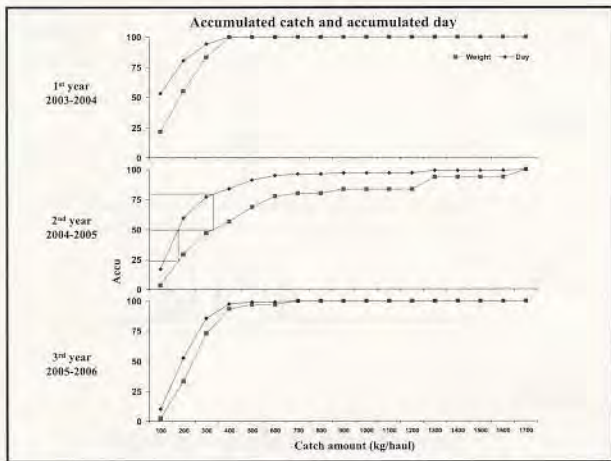
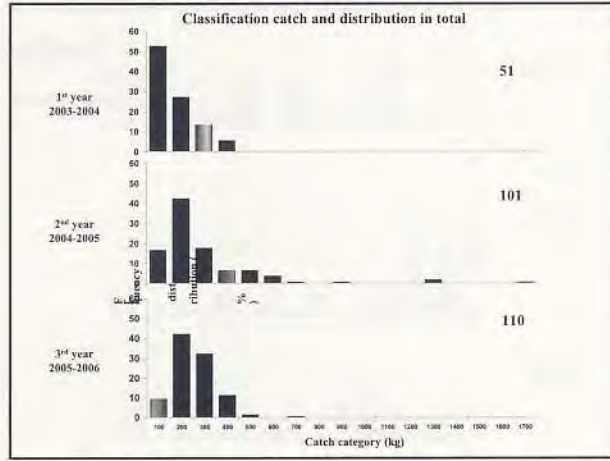
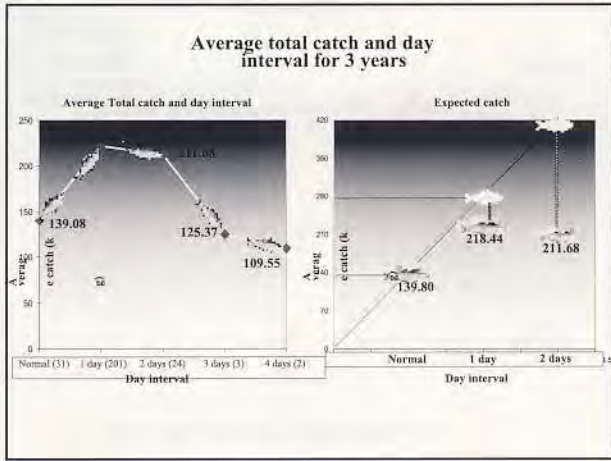
The average catch and value per haul of Rayong set-net from 2003-2006

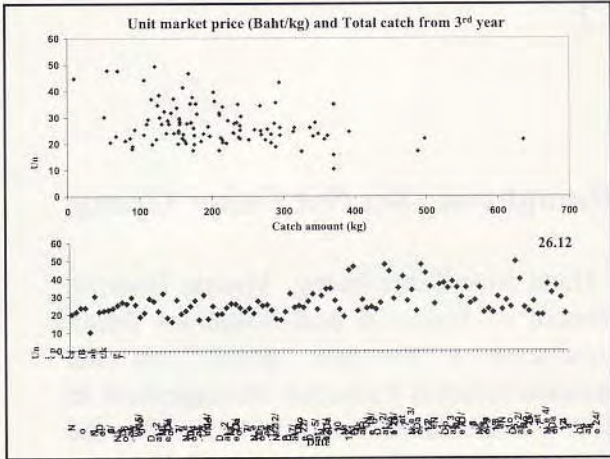












Annex : 2

Draft

The Administration Regulations of Mae Rumpheung Set Net Fisher Group

As according to the Small-Scale Fisheries Group- Hadd Mae Rumphueng, Muang District, Rayong Province, with the cooperation of Department of Fisheries and Southeast Asian Fisheries Development Center (SEAFDEC) conducted a two-year project on the "Introduction of Set-Net Fishing to Develop Sustainable Coastal Fisheries Management in Southeast Asia: Case Study in Thailand". The project was launched in April 2003. After the set net fishing gear was installed in the coastal area of Mae Rumphueng, later on the first fishing operation was implemented on 16 October 2003. To have the effectiveness of administration and management of the set net fisheries to be in order and fair, therefore, it should be ordered the rule and regulation of the set net fisher's group as follow:

Section 1: This regulation shall be: Regulations of administration and management the set net fisher's group"

Section 2: This regulation shall take effect from the announced date. Any rules, regulations, announcements and orders which effected in the past and conflict with this regulation, shall the committee members of the set net fisher's group use this regulation instead.

ARTICLE 1

Section 3: Location

The location of the Mae Rumpheung set net fisher group is Taphong Sub-District, Maung District, Rayong Province.

Section 4: Definition of the regulation

- 4.1 "Set Net" means a kind of stationary fishing gear which composed of rope and net, using for trapping aquatic animals in the marine or any coastal area;
- 4.2 "Administration and Management Committee" means the committee that take responsibility administration and management of set net activities;
- 4.3 "Member" means member who registered in the set net fisher's group.

Section 5: The objectives of the set net fisher's group shall be:

- 5.1 To conduct the set net fisheries project in proper manners;
- 5.2 To promote local fishermen to obtain effectively knowledge and skills in the administration and management of a fisher's group works;
- 5.3 To promote and develop systematically the administration and management of fisher's group;
- 5.4 To be a community-based organization which transfer fishing technology to practices;
- 5.5 To be an example of fisher' group which has fisheries cooperative administrative and management system.

Section 6: Sources of initial funding or properties

- 6.1 Some of set net fishing gear was given by Southeast Asian Fisheries Development Center (SEAFDEC) and Siam Brother Co. Ltd. The member may conduct net sewing and net installation in the sea with supervision and instruction through training by officers and expert on fishing gear;
- 6.2 Some spare part of fishing gear can be used for repairing and maintaining purposes in the beginning by using material from construction and installation;
- 6.3 Fishing boat is a property of the group which shall be taken care of it;
- 6.4 Fishing efforts (manpower) is shall be under administration and management of the group for having most benefits and sufficient remuneration;
- 6.5 There is no cost for new member at the initial stage. However, after the completion of set net installation, new member may request to pay for registration.
- 6.6 Incomes of set net fisher's group
 - From selling catches which hauling from the set net
 - Registration fee
 - Any interests or profits generated by set net fisheries
 - Supporting funds from other organizations
 - Monies or properties may be received without any commitment conditions

ARTICLE 2 **MEMBERSHIP**

Section: Qualification of member

The set net fisher's group shall have two categories of membership: **REGULAR MEMBER** and **HONORARY MEMBER**.

- 7.1 **REGULAR MEMBER** has qualification as follow:
 - 7.1.1 Any fisherman who fish along the coastal area of
 - 7.1.2 Any person who are interested to engage in responsible fisheries for sustainability;
 - 7.1.3 Any person who voted and approved by the committee to be a member;
 - 7.1.4 Patient, sacrificial and for the sake of group beneficiary.

Section 8: Application

- 8.1 Submit the application form to the committee;
- 8.2 Anyone who qualify with accordance to **Section 7**;
- 8.3 The committee will consider and accept any person to be a member reasonably.

Section 9: Termination of membership

The membership shall be terminated by the following causes

- 9.1 Dead;
- 9.2 Resignation with approved by the committee;
- 9.3 At the Annual General meeting (AGM), more than a simple majority vote of attended member shall be required;
- 9.4 Intend to violate the regulation of the group or behave opponent to the group or do not support or cooperate to the group. In acting upon the cases as mentioned, more than a half of the committee vote shall be required.
- 9.5 Lack of any qualification under **Section 7** by these regulation.

Section 10: Resignation of the membership

- 10.1 Member who has no debt or commitment with the group, can resign from the membership by submit the resignation form to the committee for approval and it will be effective on the approval date;
- 10.2 The committee will consider discontinuation and calculate a dividend payment, a share, or any benefits that member may receive from the group. The amount of money will return to the resigned member when those lists are approved by the committee.

ARTICLE 3 **REGISTRATION FEE**

Section 11: Registration fee

- 11.1 "Registration fee" means money that member pay the group when apply to be a member of the group for expenses of implementation;
- 11.2 New member shall pay 30 Baht for the registration fee when the committee considers and approves with accordance to **Section 9**. It has to be paid within 3 days after receiving a notice from the committee;
- 11.3 The group shall not refund the registration fee to members for any reasons.

ARTICLE 4 **MEETING**

Section 12: Annual General Meeting

The Annual General Meeting of the set net fisher's group shall be held for regular members at least 1 time a year, within the period of 15 days from the date of the termination of the Administrative and Management Committee. The annual meeting is a forum for the election of new committee. It is an opportunity for members to receive copies of a group' account and review fiscal information for the past year.

Section 13: Extraordinary meeting

- 13.1 Besides the annual general meeting (AGM) in accordance with **Section 12** of this regulation, other meetings shall be called Extraordinary meeting. The committee may call for extraordinary meetings at any time it deems appropriate, or when there is a current issues that needs to finalize a resolution or agreement from the meeting;
- 13.2 Besides **Section 13.1**, the committee may call for extraordinary General Meeting (EGM) when there is a request by members representing not less than the number of one-fifth of the total issued members. However, the reason for requesting a meeting must be specified in such written request. The committee shall hold a meeting within 15 days from the date of request by members.

Section 14: Quorum

- 14.1 The meeting of members of the set net fisher's group may by called by no fewer that half of total members;
- 14.2 Member may grant power to a proxy by certify in a statement in a supplement proxy letter to attend and vote at the meeting, but, a proxy may grant only one power;
- 14.3 Any meetings, number of members attending at the meeting is not complete a quorum; the meeting may be called again within 15 days from the first call of

meeting. The following meeting if is not AGM, when number of members is not less than one-third of total members, it can be a quorum.

Section 15: Voting

In voting, one member carries 1 vote. In the case of a tied vote, the Chairman shall have the casting vote. The judgment is the majority vote.

ARTICLE 5

ADMINISTRATION AND MANAGEMENT OF A SET NET FISHER'S GROUP

Section 16:

The qualification of a person having the right to be the Administrative and Management of Set Net Fisher's Group committee shall and shall not as following:

- 16.1 Be a member of small scale fisheries group in the prospective area;
- 16.2 Attaining adulthood at the age of 20 years old;
- 16.3 Behave in proper manner under the religious, responsible, sacrificial and participate in the community activities, not involve the gambling and drugs, believe in the democratic regime;
- 16.4 Never been sentenced to imprisonment according to a final judgment, except for an offence committed by negligence or a petty offence;
- 16.5 Not being dismissed or removed from the government office, the Independent Organs established under the Constitution of the Kingdom of Thailand, State enterprise Agencies, due to being honest, cheating or causing serious damages to the government, organizations, or agencies belonging.

Section 17: Number of the committee members

Members may consider and select the suitable person who has knowledge and skill to become the committee member under the democratic regime, not fewer 8 people but not more than 10.

Section 18: Composition of the committee

- 18.1 A committee of the set net fisher's group is composed of Chairman, Vice Chairman, Coordinator, Assistance Coordinator, Trustee, Assistant Trustee, Finance and Accounting, and Assistant F&A;
- 18.2 The set net fisher's group may have 2 advisors: 1 staff of EMDEC and 1 staff of Fisheries Provincial office.

Section 19: Term of office

- 19.1 The committee members shall take office for one year term starting from July to June of every year;
- 19.2 Before the termination of committee, at the Annual General Meeting (AGM) shall be held an election of a new committee in order to continue the work from the old committee;
- 19.3 In case of any committee member remove from the position for any reasons, the committee shall be selected candidate to be a member of the committee to replace the old member who removes from the position within 30 days;
- 19.4 Member who retires by rotation may be selected for the next termination according to the majority vote of membership at the AGM before the termination of office.

Section 20: Powers and Duties of the committee

General power and responsibilities of the committee shall be:

- 20.1 To administer and manage the set net implementation, to supervise and direct the affairs and activities of the cooperation, allocate the benefit to the working team, operational committee and maintenance plan preparation of the following year and serving public benefit to small-scale fisheries's groups;
- 20.2 To make rules and regulations regarding the administration and management the group;
- 20.3 To make a membership roster;
- 20.4 To appoint or call for a meeting at such time and place as determined by said committee. Special meetings may be called upon the requests of at least one-fifth of total members. However, the request must be specified in such written request. The committee shall hold a meeting within 15 days from the date of request by members.
- 20.5 To make and maintain a balance in an account, to allocate the interest earned, all expenses that occurred from the group's incomes;
- 20.6 To conduct other duties in accordance with approved by position in the committee **Section 16**.

Section 21: Termination of office

- 21.1 Retiring by rotation;
- 21.2 Death;
- 21.3 Resignation;
- 21.4 Expulsion by the committee, more than a two-thirds vote of the committee shall be required;
- 21.5 Expulsion at the General meeting, more than a two-thirds vote of the committee shall be required;
- 21.6 Disqualification with accordance to **No.16**.

Section 22: Quorum

- 22.1 Committee meetings shall be held when a half number of committee members are present;
- 22.2 In the absence/ or unable to serve the office of the Chairman and if there is a Vice Chairman, the Vice Chairman shall act as Chairman. If there is no Vice Chairman or he can not execute his duty, one of committee members may be elected as a chairman.

Section 23: Voting

- 23.1 In voting, one committee member carries one vote. In normal circumstance, a simple majority vote of committee members attending. In case of a tied vote, the Chairman shall have the casting vote;
- 23.2 Any committee member having a private interest in any issues to be voted on, is not eligible to attend the meeting.

Section 24: Duties of committee members

- 24.1 Chairman of the committee shall:
 - Be a chairman of a meeting;
 - Control the implementation;
 - Have authority to sign documents;

- Implement any issues upon the committee are assigned under the regulations.
- 24.2 Vice Chairman of the committee shall:
- Perform duties of Chairman if the Chairman is absent;
 - Record the minutes of all meetings and report of the implementation;
 - Supervise all group's documentations, records, accounting;
 - Perform duties as assigned by the committee.
- 24.3 Coordinator of the committee shall:
- Conduct correspondence within/and outside the group;
 - Send notices of the meeting to member concerned as well as perform public relations;
 - Provide the catch distribution;
 - Coordinate the project;
 - Perform such duties as assigned by the committee.
- 24.4 Assistant Coordinator shall:
- Perform such duties with the section;
 - Perform duties of the section when other unable to serve the office;
 - Conduct such other duties as assigned by the section.
- 24.5 Trustee shall:
- Prepare man power (fishermen team) by rotation to operate the set net;
 - Record fishing logbook;
 - Check the market prize;
 - Provide other benefits occurred by the set net.
- 24.6 Assistant Trustee shall assist the performance of Trustee and act as Trustee when he are unable to serve the office.
- 24.7 Finance and accounting shall:
- Be the custodian of all monies of the group;
 - Deposit-withdraw all monies of the group in bank account;
 - Conduct the Incomes-Expenses account;
 - Handle the allocation of finance and divide the profit.

24.8 Assistant Finance and Accounting shall assist Finance and accounting conducting responsibility for the section and perform such duties when Finance and Accounting is unable to serve the duties.

ARTICLE 6

THE APPROPRIATION OF ANNUAL NET PROFIT

Section 25: The appropriation of annual net profit

At the end of fishing season in each year, the committee shall calculate and summarize the operational results of the year within 1 month after keeping the set net fishing gear from fishing ground. When there have net profits, the committee shall allocate the divided payment to member as follow:

- 25.1 40 % of the net profit may reserve for investment budget and maintenance for following year;
- 25.2 55% of the net profit may use as the remuneration for the year to the committee members and operational group;
- 25.3 5% of the net profit may use for Welfare and public benefit of fishery's groups joins in the set net activities.

ARTICLE 7
ACCOUNTING AND AUDITING

Section 26: Accounting

- 26.1 Finance and accounting shall conduct monthly an incomes-expenses account of the group during the year, by deposit all monies of the group and incomes to the bank account. Withdrawal request has to be signed by 2 in 3 committee members who are: Chairman, Vice Chairman, and Treasurer;
- 26.2 Calculate and pay monthly the remuneration to the committee members to be in line with a monthly Incomes-Expenses account.

A TRANSITORY PROVISION

Section 27: All announcements, orders, and rules and regulations shall take effect at the approval date of these regulations until the changes or cancellation of these regulations.

Section 28: The committee members shall follow these regulations

Approved on

.....
The Chairman of Mae Rumpheung Set-Net Fisher group

By Aussanee Munprasit
Translation by Ms. Pattarajit Kaewnurachadasorn



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