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REPORT OF THE EXPERT MEETING ON DEEP-SEA FISHING AND ITS IMPACT TO ECOSYSTEM

31 August - 2 September 2010

Bangkok, Thailand

1. The Expert Meeting on Deep-sea Fishing and Its Impact to Ecosystem was organized by the SEAFDEC Training Department in Thailand from 31 August to 2 September 2010 at Jasmine City Hotel, Bangkok, Thailand. The Workshop was attended by marine fisheries experts, fishing gear technologists and representatives from Brunei Darussalam, Indonesia, Japan, Malaysia, Myanmar, Philippines, Thailand, United state of American, and Vietnam as well as from the SEAFDEC Secretariat and the Training Department. The List of Participants appears as **Annex 1**.

I. OPENING OF THE MEETING

2. The Deputy Secretary-General of SEAFDEC, Mr. Kenji Matsumoto officially opened the meeting. He welcomed the participants and thanked them for their participation in the Meeting. He briefed that due to the depletion of the region's coastal resources, fishery policy makers in the Southeast Asian countries searching the new fishery resources in the deep-sea area. Japanese Trust Fund Program through the SEAFDEC, Training Department is supporting the activity to explore deep-sea resources in the Southeast Asian waters. He emphasized that the exploration is not only for searching new fishing ground but also to improve information of deep-sea Vulnerable Marine Ecosystem in the Southeast Asian waters to support proper fishery management in the future. He believe that the Expert Meeting could pave the way for exchanging knowledge and experience of the countries in the region on deep-sea fishery resources exploration in order to address the impacts of deep-sea fisheries to ecosystem. His opening speech appears as **Annex 2.**

II. INTRODUCTION

3. Project director, Dr. Worawit Wanchana of the SEAFDEC Training Department (SEAFDEC/TD) presented the participants on the background as well as on the rationale and objectives of the Workshop (**Annex 3**). He mentioned that the Expert Meeting on Deep-Sea Fishing and Its Impact to Ecosystem is the activity under project title: Deep-sea Fisheries Exploration in the Southeast Asian Waters which is program under ASEAN-SEAFDEC Strategic Partnership and FCG Mechanism with the support from Japanese Government. The Expert meeting was organized with the aim to provide knowledge and better understanding of deep-sea ecosystem, review and update regional/national initiatives related to deep-sea fishery resources exploration in the Southeast Asian Region and share experience on the study on impact of fishing on deep-sea ecosystem among the experts.

4. He also informed the meeting for the definition of deep-sea for the Deep-sea Fisheries Exploration in the Southeast Asian Waters project that was agreed during the Workshop on the Standard Operating Procedure (SOP) and Development of Sampling Gears for Deep-Sea Resources Exploration in May 2009 is considered regions deeper than 200 meter. The definition is also follow

the definition of deep-sea in the FAO/APFIC/SEAFDEC Workshop on Assessment and Management of the Offshore Resources of South and Southeast Asia in 2008.

5. The agenda which appears as **Annex 4** was adopted.

6. Summary activities of SEAFDEC on the deep-sea fisheries resources exploration in the Southeast Asian region project since 2008 were presented by Mrs. Panchan Laongmanee (**Annex 5**). She reviewed the meeting that the program consist of five activities including deep-sea fisheries resources survey by MV.SEAFDEC 2 and national research vessel, the study on impact of fishing to deep-sea ecosystem which start by this expert meeting, development/improvement of sampling gear and exploration methodology, human resource development (HRD) programs on deep-sea fisheries resources exploration and information publication.

7. The project partly supported the deep-sea fisheries resource survey in Brunei water and off shore of Sabah and Sarawak of Malaysia aboard M.V.SEAFDEC2 and at the continental slopes in the Lingayen Gulf aboard M/V DA-BFAR, Philippines. The standard operating procedure for the deep-sea fisheries resource and sampling gears design was discussed in the workshop in 2009. The HRD program had been conducted by the formal workshop such as in the Ship board Training on Deep-Sea Exploration on M/V DA-BFAR of the Philippine and the Training Workshop on Identification of Deep-Sea Fish at SEAFDEC/TD and through on-the job training during the deep-sea fisheries resource survey cruise. She also mentioned that the information dissemination of the project is mainly through project website at http://map.seafdec.org/deepsea/ . The soft copy of manual, report, species checklist and poster can be downloaded. More over the database of deep-sea fish in SEAFDEC collection can also access from this site.

8. During the discussion, participants suggested that the utilization of deep-sea resources is need scientific base management. There are a number of studied shown that stock sizes of deep-sea fish are small and most of them are slow growth rate. The project was organized in the proper time in order to encourage Member Countries to conduct exploration/research prior the utilization of deep-sea fisheries in the region. With the fact that deep-sea study require high budget, the cooperation of all countries in the region are needed to support/share data and information for proper management.

III. REVIEW REGIONAL/NATIONAL INITIATIVES RELATED TO DEEP-SEA FISHERIES RESOURCES EXPLORATION AND THE STUDY ON IMPACT OF FISHING TO DEEP-SEA ECOSYSTEM

3.1 Brunei Darussalam

9. Initiative activities of Brunei on deep-sea fisheries resources exploration was presented by Ms. Desimawati Haji Matali **(Annex 6)**. She explained fishing zonation of Brunei that the EEZ of Brunei Darussalam has been divided into four zones, namely: zone 1 from 0 to 3 nm; zone 2 from 3 to 20 nm; zone 3 from 20 to 45 nm; and zone 4 from 45 to 200 nm. The offshore area which covers about 75% of the country's territorial waters, is also in zone 4, and is largely rough with plenty of deep troughs > 3000 m depths. The area at 100-200 m depth is a very narrow strip (about 2 nm^2) and is 40 nm from the shoreline. The bottom is generally muddy on the western side and rocky on the eastern side. The continental slope creeps sharply from the 200 m depth up to about 3000 m depth of the sea floor towards the Palawan trough that ends in Brunei waters.

10. Deep water surveys have been carried out to assess recent status of demersal marine resources in the area covered in zone 3 and 4 and to achieve sustainable development of these resources through proper management using scientific data generated through the systematic surveys. Thus, Brunei Darussalam in collaboration with SEAFDEC was conducted deep-sea fisheries resources survey from 2008 to 2010 at depths deeper than 100 m of the country's EEZ using the M.V. SEAFDEC 2.

11. The results of the oceanographic survey revealed healthy and normal condition of the country's marine environment. Deep water otter board trawl and beam trawl were conducted with the CPUE from 0.63-1.53 mt/km^2 and 0.64 mt/km^2 respectively in year 2008. Species compositions were analyzed according to sampling depth. At 105-163 meter depth, catch compositions are similar to the coastal water trawl that is dominated by lizard fish and Threadfin breams while at depth range 215-374 meter, catch composition were different. The deep water haul dominated by siverbelly seaperch follow by lantern fish, beard fish and deep water shrimps (*Heterocapus* sp., *Plesionika* sp., *Parahempomades* sp. and *Metanephrops* sp.). The high composition of deep-sea shrimp shown potential resource for future utilization of Brunei water.

12. She also mention that Department of Fisheries (DOF) of Brunei collected a lot of data from the survey, however due to the limitation of staff and the lack of expertise in deep-sea resources, a lot of data still waiting for analysis. In September, DOF Brunei in collaboration with SEAFDEC will conduct deep-water demersal resource survey along the continental slope. The survey was planed to fulfill necessary data/information of the specific fishery resource and habitat for future sustainable development.

13. There is suggestion for the use of two fishing gear; beam trawl and otter board trawl. These two gears have difference merit. The catch ability of otter board trawl is higher than beam trawl while beam trawl able to operate in the rough sea bottom. Therefore, in order to compare CPUE and CPUA of these two fishing gear the catch efficiency coefficient is needed.

3.2 Indonesia

14. Considering that 2/3 of Indonesian region is covered by water, the country's deep-sea region is the waters beyond the jurisdiction line of 12 nm from the coastline, including the Indonesia EEZ and international seawaters > 200 m deep or beyond the continental shelf. Most of Indonesia deep-sea areas are located in Indian Ocean. Dr. Fayakun Satria report the meeting that deep-sea fishery resources surveys in Indonesia were conducted to locate the unexploited stocks of fishes and prawns in the waters of the outer continental shelf and slope, and identify the species with commercial potential and evaluate their species distribution **(Annex 7)**. The deep-sea resource survey was started since 1972 at South Java by Korea research vessel, Oh Dae san. Most of the deep-sea resource research and exploration both by Indonesia government and in cooperative with funded countries such as German, Japan, Norway and USA are conducted in the South of Indonesia. At west Sumatera in 1991, 2004, 2005 and 2008 , at South Java in 1975, 2003, 2004 and 2005, at South Sunda Lesser in 1979 and 1981, at Timore sea in 1992 and 1993 and at Tanimbar & South off Papua in 1991 and 1995. There are only two area, at Kei island that is in the middle east of Indonesia in 1991 and 1993 and recently in 2010 at the Northern of Indonesia call INDEX SATAL expedition which is Indonesia government conducted in collaboration with USA.

15. During 2008-2009, Indonesia conducted commercial fishing for deep-sea fish resources at North West Simeulue and West Banda Aceh by Japanese commercial fishing boat. F/V Koshin Maru operated 5 month in 2008 and F/V Fukoyoshi Maru, operate 4 month in 2009 then they stop due to the policy of Indonesia government that still not ready to manage deep-sea fisheries resource. However, many fishermen already started to utilize deep-sea fish resources. Currently there are local fishermen in Pelabuhan Ratu using gill net and in Banda using trawl to catch deep-sea fish with the ordinary fishing license.

16. He also explained detail result of the experiment to operate commercial deep-sea fishing in 2008-2009 in the view of impact of fishing on deep sea demersal resources to the deep ecosystem. There are 145 deep sea demersal fish species from 62 families. They are distributes in clumped pattern. The two survey area have difference characteristic, North West Simeulue is hilly while at the West Banda is dominance by big sea mouth that influence to the biodiversity and abundance of recourse. He found that at North West Simeulue, biodiversity is increasing with water depth but CPUA is decreasing with depth while at West Banda is in opposite trend. Plot of Size distribution of *Haplostethus rubellopterus* versus depth shown that size is increase with depth. The first maturity length of this species is at 33 cm which mostly distribute at 800-900 meter depth. Therefore it is high risk to utilize, since the fishing is usually at shallower than distribution of mature fish.

17. During the survey, not only commercial fish that were caught, there are also low value species. From F/V Koshin Maru, about 32 % of total catch in average is by catch. He also tried to develop index value of importance from by catch many species was categories as a fragile for lost of biodiversity. The sea bottom habitat destruction was also observed during the survey, many black coral, sponge and etc are by catch of trawl operation near Simeulue Island. Therefore, in the future this area may prohibit for deep-sea demersal fishery.

18. From his opinion, future study on deep-sea fishing in Indonesia will emphasize on the impact of the practice of deep sea fishing of trawl and other gears as well as how to minimize the impact of the deep sea fishing practice to looking for the best practices of the deep sea fishing.

19. Biology of *Beryx splendens*, was discussed that the aggregation of this species during Dr. Fayakun survey are close to the slope area. In Japan, there are many *Beryx splendens* fishing ground along Pacific coast from Okinawa to Izu Island. Their spawning ground is at sea month. Their egg diameter is 1.5 mm, cover with pink color membrane and has large oil globule. Their egg and newly hatch larvae are planktonic that drifted at 20-50 meter water depth layer. If they cannot find any appropriate settlement area, they will keep pelagic mode. Therefore if we understand their biology, rotate fishing ground with suitable time period, the utilization of this fish can be sustained.

20. The utilization of deep-sea fish by local fishermen was also widely discussed. Dr. Fayakun added more information that local fisherman operates monofilament bottom gill net upto 300 m. at Indian ocean , near Pelabuhan Ratu , to catch *Hoplostethus* sp., *Nemipetus* sp. and etc. They send them fresh to Taiwan. Local fisherman also use handline targeted deep sea demersal fish especially, read snapper (*Etelis* sp.) at about 300 meter depth. Dr, Fayakun purpose the meeting that project should study for suitable fishing gear for local fisherman in Southeast Asian Region to utilize deep-sea demersal fish. There is suggestion to try to use bottom vertical longline which its catch efficiency is better than gill net while impact to deep sea ecosystem is less than.

21. During discussion, the studies of size distribution and length at first maturity were suggested to include in future studies to support deep sea fisheries resource management.

3.3 Malaysia

22. Representative from Malaysia, Head of Deep-Sea Fisheries Development Section, Mr. Hj Sufian bin Sulaiman reported the meeting that total area of the coastline of Malaysia is 4,900 km and approximately 47,000 km^2 sq nautical mile of maritime area, of which the EEZ declaration expanded to 162,000 sq **(Annex 8)**. nautical miles. Deep-sea fisheries contributed to 311,715 and 293,532 metric tones of the national fisheries production in 2008 and 2009, respectively as the demand of fish product number of licensed vessel of deep-sea fishing is gradually increase from 601 vessels in 2001 to 1,242 vessels in 2009.

23. The exploration of deep-sea fishing in Malaysia had been conducted since the declaration of EEZ area in the year 1980. Deep-sea definition of Department of Fisheries, Malaysia is at beyond 30 nautical miles to Malaysia Exclusive Economic Zone (EEZ) which will use fishing both that bigger than 70 GRT (Gross Registered Tonnage). In 1987, Malaysia and Thailand started joint venture deep-sea fishing that was launched by both Prime Minister on 17 September at Kuantan Port, Pahang. After termination of the joint venture, Malaysia focused on training local fishermen to enter in deep-sea fisheries and developed Tok Bali (Kelantan), Batu Mauang (Penang), and Tanjung Maris (Sarawak) to be hub of fisheries deep-sea industries. Government has strategic to promote deep-sea industry base on Ecosystem Based Management Approach. Currently, Vessel Monitoring System (VMS) was applied to monitor fishing activities and resource.

24. He also mention that recently, Malaysia in cooperation with SEAFDEC had conduced deep-sea fisheries resources survey at offshore of Sabah and Sarawak in August 2010 using M.V. SEAFDEC 2. Result of the survey will be used to manage our deep sea resource.

3.4 Myanmar

25. Status and potential of deep-sea fishery resources in Myanmar was presented by Mr. Myint Pe **(Annex 9)**. At this moment, Myanmar didn't have deep-sea fishing. The coastline of the Union of Myanmar which is about 3000 km, forms several large estuaries, delta system and numerous offshore islands, and is rich in aquatic resources. The country's continental shelf covers 230,000 km^2.

26. In 1982, the extensive deep sea survey was conducted by R.V. Dr. Fridjof Nansen under the UNDP/FAO project in order to estimate the marine fish biomass in the EEZ of Myanmar as well as in the continental shelf. As a result, it was estimated that MSY of pelagic and demersal fish is 0.5 metric ton and 0.3-0.5 metric ton, respectively. In October 1982, Myanmar use local research vessel, the 24.25 m stern trawler ,no.413 to operate shrimp trawl net (head line 18.5 fathoms) and fish trawl net (head line 16.7 fathoms) at deep-sea water (230-500 meter depth) of Thaninthary coast. Catch composition are dominance by three deep-sea fish species, *Peristedon weberi*, *Chlorophathalmus* sp. and *Palinurichtus pringiei* more over, deep-sea lobster ,*Puerulus sewelli* and deep-sea shrimp , *Heterocarpus woodmasoni* and *Parapandalus spinipes* were also found. The deep-sea shrimp and lobster survey was again conducted in 1990 by Russian research vessel, F.V. Poyarkovo at Taninthary coastal area, average catch rate of deep-sea lobster, shrimp and fish are 46.6, 6.5 and 191.7 kg/hr, respectively.

27. Myanmar also works with SEAFDEC to conduct fisheries resource survey. Result of the joint research survey on pelagic fisheries resources survey had conducted in Andaman sea by Myanmar, Thailand, Indonesia and SEAFDEC where depth of water beyond 700 meters and the Collaborative Marine Fishery Resources Survey in Myanmar Water by scientist from Myanmar and SEAFDEC in 2007 indicated that Swordfish (*Xiphias gladius*), Yellowfin Tuna (*Thunnus albacares*), Striped marlin (*Tetrapturus audax*) and Sailfish (*Istiophorus platypus*) that commercially important species are rich in Myanmar water. Currently, there are only foreign fishing vessels operate offshore fisheries in Myanmar water.

28. Mr. Myint Pe emphasized that major constrain to develop offshore and deep-sea fisheries in Myanmar is the lack of appropriate fishing technology, fishing gear and fishing vessel. Good cooperation with international/regional organization such as ASEAN, BIMSTEC, FAO, SEAFDEC and etc are opportunity of Myanmar to obtain technologies, knowledge and experience to utilize and manage fisheries resource. Moreover, Myanmar also welcome for investment and joint venture program from foreign to develop new fisheries in Myanmar.

29. Following suggestion of Mr. Myint Pe that due to the huge destruction of the deep-sea bottom trawl, this region should not allowed the deep-sea bottom trawl fishery. The meeting responded that deep sea trawl is necessary for fishery resource survey. However, size of trawl was suggested to reduce in order to decrease effect to deep-sea ecosystem. Currently SEAFDEC try to develop less destructive fishing gear such as deep sea trap and will try to use bottom gill net following experience of Indonesia fisherman.

3.5 Philippines

30. Representative from the Philippine, Mr. Rafael Ramiscal, report the meeting that the Philippines surrounding by deep-sea water **(Annex 10)**. However, the deep-sea resource is largely unknown. Philippine has a long history of deep-sea explorations since the 18th and 19th century by the foreign expedition; Samarang, 1843 to 1846; Novara, 1857 to 1859; Challenger, 1874 to 1875. About 18 deep-sea explorations and resources surveys were conducted in Philippine waters. Lately, surveys of the deep-water benthic fauna in the Philippine waters were conducted and dubbed as Aurora 2007 and Lumiwan 2008.

31. During the AURORA 2007 and LUMIWAN 2008, the survey aboard M.V. DA-BFAR used three main sampling gears: bottom trawl, deep-sea beam trawl, and deep-sea trap. Results indicated that most abundance of fish and crustacean was observed at 400-600 meter depth. The catch composition is related to water depth. The results also confirmed the prevalence of pandalid shrimp species (*Heterocarpus woodmasoni, H. hayashi, H. dorsalis*) in deep sea areas (400-600m) and that their distribution beyond 1000 m may be limited. The pandalid shrimp could therefore be considered as the most promising resource for developing into deep-sea based fisheries. However, in order to protect the vulnerability of such resource from over-exploitation, an in-depth feasibility study and stock assessment should be conducted before offering the fishery resource to the fishermen.

32. Results from AURORA 2007 and LUMIWAN 2008 encourage Philippine to implement pilot deep-sea shrimp trap fishery by modified the sampling gears (e.g. deep-sea trap, beam trawl, and otter trawl) to improve efficiency and decrease impact to the ecosystem. The study on cost and

benefit of the deep-sea shrimp trap fishery will be conducted as well. Currently pandalid shrimp has limited market in some area of Mindanoa with the limited quantity. Formulating of a management plan/policy on deep-sea fisheries is also aim of the deep-sea project of the Philippine. Deep-sea shrimp fisheries targeted on pandalid shrimp is still active in Kagoshima province of Japan using small boat (400-600 meter). Catch is sold with high prize in supermarket.

33. More over Mr. Rafael informed the meeting that Philippine will conduct deep-sea fisheries resources survey in October to November 2010. The modified of sampling gear (scale down bottom trawl) to improve the efficiency will be tested.

3.6 Thailand

34. Mr. Weera Pokapunt, Representative from Thailand reported the meeting that deep-sea area of Thailand is only in Andaman Sea **(Annex 11)**. In the recent years, Thailand had conducted a demersal resources survey in Andaman Sea during 2006 to 2007 at water depth less than 200m using BVL and deep-sea traps. The major fish species caught were snappers, groupers, sharks, lobsters, etc. However, in the last decade, two major explorations at the deep areas with the sea depth between 200 and 550m were conducted by R/V No.2 of DOF Thailand (1975-1976) and R/V Dr. Fridtjof Nansen (1980) with the jointed program with FAO and NORAD in Andaman Sea.

35. Catch from the survey in 1975-1976 by R/V No.2 using otter board trawl net compose with 69 species of deep-sea fish and 13 species of deep-sea shrimp and lobster. The survey was conducted to explore new fisheries resource that can be alternative fishing ground for Thai fisherman that was hinder to fishing in Bay of Bengal. Result from the survey suggested that potential resources for deep-sea fishery in Andaman Sea are deep-sea shrimp and lobster. However, the improvement on catch ability of fishing gear is needed. Moreover, he also recommends SEAFDEC and Member Countries to conduct joint survey in the deep water area both in the Andaman Sea and South China Sea.

36. More over Mr. Aussanee add that Department of Fisheries had continuously conducted survey at 150-400 meter depth using bottom vertical longline. He suggests to concern researcher to review that result which may be able to suggest more information of deep-sea fisheries resource in Andaman Sea.

3.7 Vietnam

37. A review on the living marine resources in the deep sea of Vietnam was presented by Ms. Nguyen Thuy Duong **(Annex 12)**. She reported that for management purposes, the marine waters of Vietnam have been divided into five areas, namely: Tonkin Gulf, Central, Southeast, Southwest and Offshore waters. The deep-sea water is located mostly in the central and offshore. Intensive fishery resources survey using the bottom longline, bottom vertical longline, otter trawl, trap and pot been conducted during 1978-1988 by Viet-Xo Joint surveys at 4,412 stations in total and 1996-2005 by ALMRV surveys at 1,312 stations in the deep area. And more than one thousand survey stations in total with 154 stations in the deep-sea were conducted during 1996-2005. In 2005-2007, MOFI in collaboration with SEAFDEC conducted two survey cruises at 32 stations on the continental shelf of Vietnam.

38. The results of the resources survey in Vietnamese waters showed catch belonging to 656 species from 195 families, while those of CPUE from the bottom vertical longline indicated the

different of CPUE distribution by monsoon season. While the CPUE from the bottom trawl was high along the continental slopes.

39. Vietnam still needs further studies on resource assessment of its deep-sea waters, deep-sea species identification, deep-sea ecology, and gear improvement/development for deep sea fisheries as well as technology transfer in collaboration with SEAFDEC.

40. Mr. Bundit Choksaguan of SEAFDEC/TD recommended the meeting to seeking for the exiting mapping on topographic survey in the continental slope (>200m) may help to identified the deep-sea area and assign the survey station.

3.8 Japan

41. Dr. Yoshinobu Konishi, former researcher of the Seikai National Fisheries Research Institute in Nagasaki, Japan presented the Japanese seamount bottom trawl fishery and the trial research on its impact to the ecosystem under "the Regional Framework of High Sea Bottom Fisheries in the Western North Pacific" that members are Japan, South Korea, Russia and USA **(Annex 13)**. The framework missions are to sustainable management of the resources and conservation of vulnerable ecosystems (pursuant to the FAO International Guidelines). The review of Japanese high sea bottom fisheries in the Western North Pacific, data analysis, and method on the information collection of the fishery resources and identification of the vulnerable ecosystem in the fishing ground and impact were presented.

42. The Japanese high sea bottom fisheries in the Western North Pacific use bottom trawl and bottom gill net targeted Splendid Alfonsin (*Beryx splendens*) and North Pacific Armorhead (*Pseudopentaceros wheeleri*). These fisheries were developed since more than 50 years ago. Number of vessel is little frustrated; there are 10, 4 and 7 vessels in 1992, 2002 and 2007, respectively.

43. Current status of targeted fisheries resources was analyzed base on commercial catch and effort and estimated biomass by Japanese research trawler using production model for Alfosin and comparison between commercial catch data and estimated biomass for Armorhead. Result show that Alfonsin is already overfished, while Armorhead resources are exhausted suggested to manage the fisheries by freezing number of fishing vessel, shiefing fishing ground to the Japaness EEZ, reducing fishing capacity, close fishing ground in November and December for 20% reduction of fishing pressure from the average in 1997-2006 and 10-30% limit of increasing fishing pressure in the next year after occurrence of dominant cohort.

44. The identification of vulnerable Marine Ecosystem (VME) in the fishing grounds and impact of fishing to VMEs were study by sea bed topography survey, remotely operated vehicle (ROV) survey, drop camera system (DCS) survey and data of coral fishery by Japanese fishing boats. Four orders of coral that are the element of potential VMEs were observed. However, the low densities at two areas are complicatedly categorized as VME.

45. Dr. Konishi suggested that the deep-sea bottom fisheries resources exploration and the study on its impact in the EEZs of Southeast Asian Countries should conduct at the shelf-break area (100-200m) and continental slope area (200-500m) where underexploited. At the shelf-break, he suggested to investigate abundance and biological factors of commercially important fishes using the suitable sampling/fishing gear. The life-history factor of fish that were caught in this area

is necessary to integrated analysis with data that obtain from shallower water due to their distribution/habitat is usually change by age. The development of commercially bottom fisheries should be target to large fishing boats that presently operated in the coastal area for reduction of fishing pressure to coastal fisheries resources. It is necessary to monitor catch and effort of that commercial fishing boat to mange the resources.

46. Furthermore, at the continental-slope area (200-500m), the implementation of the research surveys to obtain the information on distribution and abundance of commercially important fish, topographic survey and mapping of the potential fishing ground for each gears type, detection of the vulnerable marine ecosystem using ROV and species composition of fish larvae and juveniles should be conducted. In concurrently, the development and improvement of sampling/fishing for reduction of impact to VME should also be carried out.

47. In conclusion, Dr. Konishi recommended that there is a promising on deep-sea fishery resources at the shelf break area of Southeast Asian Countries, the deep-sea shrimp fishery in the Philippines waters and deep-sea demersal fish by hand line and bottom gill net at the continental slopes of Indonesia. The meeting suggested that it is necessary to have the scientific-based plan prior the introduction of all deep-sea fisheries. Moreover, the monitoring of fishing practices in those area compare to the coastal area should be conducted.

48. During the discussion, Dr. Satria was added information to the meeting that in the tropical area especially in Indonesia waters, the deep-sea resources may have highly biodiversity but only few species that high abundance and could be permissible to utilize. Most of the fishing ground those related to the sea mount, each sea mounts have different characteristic and normally one sea mount dominated by one or two species. During the survey in Indonesian waters not all the deep-sea area have quite good resources and normally there are sharing resources with the sea mount pinnacle. There were only few hot spot fishing grounds were identified and the INDEX-SATAL survey also demonstrated the same promising. In the Southeast Asian waters not quite high abundant of the deep-sea fisheries resources to exploited.

IV SHARING OF EXPERIENCES AND INFORMATION RELATED TO DEEP-SEA FISHERIES RESOURCES EXPLORATIONAND THE STUDY ON IMPACT OF FISHING TO DEEP-SEA ECOSYSTEM

4.1 International initiatives related to deep-sea ecosystem and international guidelines for the management of deep-sea fisheries in the high seas

49. The international initiatives related to study on impact of fishing to deep-sea ecosystem and international guidelines for the management of deep-sea fisheries in the high seas were presented by Dr. Somboon Siriraksophon, Policy and Program Coordinator of SEAFDEC/Secretariat **(Annex 14)**. Due to the significant impacts of deep-sea fisheries to the vulnerability of deep-sea resources, the Vulnerable Marine Ecosystem (VMEs) was requested to protect during the 27th FAO COFI in the year 2007.

50. The development of the international guideline had been process through the expert and technical consultation on deep-sea fisheries in the high sea during 2006-2008 and submitted to the 28th FAO COFI in 2009. The objective of developing the guidelines is to provided tools and guidance on their application to facilitate and encourage the efforts of Regional Fisheries

Management Organizations (RFMOs) and states towards sustainable use of marine living resources, also preventing of significant adverse impacts to vulnerable marine ecosystems (VMEs) and the protection of marine biodiversity.

51. In conclusion, Dr. Somboon suggested to careful study on the draft guidelines and takes part in the finalization of the guideline for a proper planning for Southeast Asian countries. The guidelines has voluntary nature but developed based on a number of several international binding instrument. There are various views on the how the deep-sea fisheries issues are handled. The advantage points of the guideline could be used as a tool to implement on the deep-sea fisheries in the high sea or EEZ. The proper management plans should be conducted before allowing new or continuation of deep-sea fisheries may be constraint to many developing countries.

52. Furthermore, Dr. Somboon informed the meeting that SEAFDEC has cooperation with National Fisheries University (NFU) to conduct fisheries resources survey in the Southeast Asian Waters from 2006 to 2013 by M.V. Tenyo Maru and Koyo Maru. The objectives were to enhance the human resources capacity on fisheries resources survey methodology and transferred technology from NFU to participants aboard.

53. Moreover, the meeting was requested to consider on the future cooperation on the deep-sea fishery resources survey using the M.V. SEAFDEC and M.V. SEAFDEC 2, and facilities available (e.g. sampling gears, oceanographic equipments). The possible cooperation was proposed on the sub-areas survey such as the Andaman Sea area that could be conducted the joint survey among the territorial countries; review all deep-sea surveys in the region to identify the potential resources; and development on the regional proposal through consultation with relative member countries and seeking fund support from the donors.

4.2 INDEX-SATAL: A US and Indonesia Partnership to explore Indonesia's Sea

54. An Indonesia and US Partnership in Exploring the Deep-Sea of Sangihe Talaud (INDEX-SATAL) was presented by Dr. Fayakun Satria (Annex 15). The survey was conducted at the North of Manado, Sulawesi from 24 June to 7 August 2010 aboard research vessel "Okeanos" and "Baruna Jaya IV". The deep-sea demersal trawl was operated aboard Baruna Jaya IV in two sea depth substrata ranging from 300m to 500m and 500m to 1,000m. The improvement on understanding of undersea ecosystem particularly those associated with submarine volcanoes and hydrothermal vents and first time ROV was operated in Sangihe Talaud region including the area within Coral Triangle Region.

55. The results from the "Okeanos" survey were produced more than 100 hour of video and 100,000 photographs which captured using a robotic vehicle and piped to shore in real time by satellite and high-speed internet. There are several seamounts identified (some are active volcano) was successfully mapping during the survey. The trawl survey of "Baruna Jaya IV" able to identify fishes from 32 families, crustacean 10 families, and cephalopod 5 families including their type of habitat.

4.3 Mesoelagic fish research- current trends and future directions

56. The mesopelagic fish research-current trends and future directions presented by Dr. Andrey Suntsov, Ichthyologist from Pacific Island Fisheries Science Center (NOAA), Hawaii **(Annex 16)**. In

outlining the pelagic environment represent the largest ecosystem on earth and mesopelagic are the most extensive ecosystem and considering as a potential resources considered from the study of Gjoseater and Kawaguchi (1980) on the estimation on biomass of mesopelagic in the world ocean to be about 1 billion tones. The most important biological features of the mesopelagic fishes are the diurnal vertical migration and also formed the deep-sea scattering layer (DSL) and the bioluminescent capabilities.

57. As regards the development of sampling gears, Dr. Andrey was sharing the experience on comparing of the catch composition of micronekton among three types of sampling gears (Cobb Trawl, IKMT, and Rectangular Frame Trawl). Different types of gears were collected different type of organism and the composition of catches between day time and night time also significantly difference. The cobb trawl was mostly captured large animal and high diversity compared to those IKMT and Rectangular Frame Trawl. IKMT was got more individuals in term of abundance than other sampling gears while the species richness was similar between the Rectangular Frame Trawl and IKMT. Due to large number of mesopelagic fishes were collected Dr. Andrey was also interested in deep-sea fish monoliths as it could provide the information on age, growth, and identified species by the shape of otoliths.

58. The information from the micronekton research in the northern California Current during the year 2004-2006 and the midwater fish research in Southern California current during 2008 was presented to the meeting. Studies of mid-trophic level organisms were conducted as the mesopelagic fishes are very important in the oceanic food web. The mesopelagic fishes presented in the intermediate Trophic level and consume lot of zooplankton, but in the same time they formed the important food for the pelagic fishes such as tuna, oceanic squid and Baleen whales. However the trophic ecology of many mesopelagic species still not very well known. Recently, the biomass of micronekton around Guam was estimated during the R/V Oscar Elton Sette cruise earlier this year (2010).

59. Regarding to the improvement of information on mid-water fish research in Southeast Asian waters, Dr. Andrey emphasized the need for obtained the recent data on mesopelagic species in the region. As the Southeast Asian region holds the richness shallow water biodiversity but the deep pelagic waters remain unexploited. The deep pelagic habitat is likely to host very high biodiversity as well as the SEA region is holding four different large marine ecosystems (LMEs) and approaching to study on the oceanic marine environment. Dr. Andrey highlighted on the importance of midwater fishes that they're formed a prey for commercial species and also competitors for the same prey. The midwater fishes also influencing general community structure and enhance stability of the ecosystem. Over the continental slope, the midwater fishes also found near shore as distinct mesopelagic boundary community linking between nearshore and oceanic ecosystems.

60. In conclusion, Dr. Andrey suggested the need to testing different types of midwater gear; estimates of midwater fish diversity; community oriented studies; taxonomic training to develop the local expert on the particular species; developing on database; and communicates results through scientific papers.

61. During the discussion, the meeting was emphasized that further studies on deep scattering layer in the Southeast Asian waters should be considered. However, the economic return incase of to harvest the micronekton resources and impact of utilization on those mesopelagic species as

fish meal materials should also be taken into considered, as well as the stock estimation and mesopelagic larval origin particularly lantern fishes. Moreover, the HRD program to young scientist to study on deep-sea fishes and/or mesopelagic fish taxonomy should also be considered.

V. REGIONAL PLAN ON THE DEEP-SEA FISHERIES RESOURCE EXPLORATION

5.1 Standard Operating Procedure (SOP) for deep-sea fisheries resources exploration

62. The 2nd draft of SOP was finalized after the "Regional Workshop on the Standard Operating Procedure and Development/ Improvement of Sampling Gears for the Deep-Sea Resource Exploration" organized by the SEAFDEC Training Department in Thailand from 26 to 28 May 2009 was presented to the meeting by Dr. Natinee Sukramongkol **(Annex 17)**. The details on scope of the terms according to 'deep-sea' were defined, the sampling gears standardized, the indicators for deep-sea resources survey, and operating procedure was given as information to the meeting.

63. During the discussion, it was noted that the objective of the draft of SOP was developed for the member countries to refer to as practical tools to support the deep-sea exploration in the Southeast Asian waters. The meeting was agreed to input all comments and report of this expert meeting as an appendix of the SOP draft and finalized before circulated as soon as possible to all workshop participants for further comments and finalized.

5.2 Key topic for the study on impact of fishing to deep-sea ecosystem

64. The list of ecosystem concern and scientific challenges for the study on impact of fishing to ecosystem was presented to the meeting by Mrs. Penchan Laongmanee **(Annex 18)**. The presentation is aimed to brief participant prior the brainstorming session. As regards the scientific challenge of deep-sea fisheries from FAO fisheries report no. 838 and report and documentation of the expert consultation on deep-sea fisheries in the high sea and so on, Mrs. Penchan suggested the methods and parameters to study on the impact of fishing to ecosystem such as habitat and biodiversity impact assessment and method including the benthic organism studies.

65. As regards enhancement of human resource capacity and encourage member countries on the initiation of deep-sea resources exploration, the training workshop on research methodologies for study on impact of fishing on deep-sea ecosystem is going to conducted during 16-20 October 2010 in Brunei Darussalam. Mrs. Penchan briefed on the training program activities which consisting of lecture and shipboard training on topographic survey, deep-sea sampling and catches sorting, primary species identification, and underwater VDO camera operating. Aim of the training workshop on is to advice practical work for the study on impact of fishing to deep-sea ecosystem to participants. Furthermore, the deep-sea sampling gears for using at the training workshop including beam trawl, otter trawl and deep-sea trap were presented to the meeting by SEAFDEC fishing gear technologist, Mr. Sayan Promjinda.

66. Mr. Bundit Choksaguan informed the meeting during discussion that another SEAFDEC program of activities under the Responsible Fishing Technologies & Practices Project (Fishing in Harmony with the Nature) with the support of Japanese Trust Fund is the Reduction of the Impacts of Fishing on Coastal and Marine Environment in Southeast Asian Water (IFCOME). Therefore the deep-sea exploration project can work in parallel with IFCOME to reduce impact of fishing to environment.

VI. Other matters

67. Additional presentation on the deep-sea fisheries resources survey: experience in the Andaman Sea during 1975-1999 was presented by Mr. Aussanee **(Annex 19)**. He listed six major survey and training cruises by M.V. Paknam of SEAFDEC and R.V. Fisheries Research No.II of Department of Fisheries. The results suggested that fishing ground of deep-sea shrimp in Andaman Sea is at 300-400 meter depth, appropriate area for bottom trawl is at 350-400 meter depth and bottom vertical longline may be proper fishing gear to catch deep-sea fish in Andaman Sea in term of catch efficiency and less investment.

VII CONCLUSION AND RECOMMENDATIONS

68. Considering that most of Southeast Asian Countries recently implement deep-sea fishery resource survey targeting high value fish using trawl. Even through, few studies/survey had been conducted, survey result show potential deep-sea fishery in SEA waters. However, most of fishers in SEA waters are local and small-scale, not familiar with offshore (deep-sea) fisheries (fishing gear, operation, post-harvest technology, etc.). Member Countries show intention to apply Ecosystem Fisheries Management approach into the national management plan for utilization of deep-sea resources. Due to the high cost of deep-sea survey, the activities need the support from MCs, donors, etc.

69. Base on the discussion, the meeting suggested a series of bullet as follow:

- Development of various guidelines on how to develop deep-sea fisheries (not only the sampling gear and methodologies)
- Resource assessment should be analyzed together with oceanographic information and environment assessment
- Results of biomass by different sampling gear will come out different – suggest to study comparison beam trawl and otter-board trawl for the stock assessment
- Minimize the impact of deep-sea fishing to avoid the lost of bio-diversity.
- Minimize the impact from fishing on deep-sea bottom ecosystem, non-trawl fishing gear can be used (e.g. handline, gillnet, etc.)
- Implement pilot deep-sea shrimp trap fishery
- Modify current trap design to improve efficiency
- Use smaller otter and beam trawl net for sampling/assessment
- Formulation of a management plan or national policy on deep-sea fisheries
- Inventory of the deep-sea fish found in SEA waters
- Analyze the life history factor by using method similar to those for the coastal area
- Mapping of area survey
- Detection of VMEs (corals, sponges, etc) by using ROV or DSC

70. In conclusion, there are two groups of suggestion for the follow up activities of exploration on deep-sea fisheries resource in Southeast Asian program from the meeting. In term of policy, the meeting suggested the formulation of national management plan for (small-scale) deep-sea fisheries that may start through a pilot project. For the scientific point of view, the meeting suggested follow up action include; having a to review the results from the survey (biomass estimation), developing regional guideline for deep-sea fishery development, developing regional identification guide for deep-sea fish, reviewing all results from the previous survey conducted in

the region, capacity building program for scientist in the regional on deep-sea study (taxonomy, survey and analysis methodology, etc.), explore new area , continue improve sampling gear and socio-economic study focus on the market demand and value of the deep-sea resources. More over, the meeting also suggested establishing regional collaborative program for further seeking funding support.

71. In order to review the results from the previous deep-sea resources survey, the format of the data input for reviewing should be develop among the Member Countries and propose to RAC meeting in next February 2011.

72. Considering the needs to the study topics on the study on impact of fisheries to the deep-sea ecosystem in the Southeast Asian waters, the follow up action and initiative/program in regional and national level were proposed: (1) supporting of SEAFDEC on the deep-sea resources survey at the national level; (2) technical support on fish taxonomic should be provide to the Member Countries; (3) particular species on specific habitat such as fish assemblage, fish community should be study for the future survey; (4) introducing and improving the sampling gear's design and technique e.g. mid-water trawl, mesopelagic sampling gear, gill net, bottom vertical longline ; (5) building resource person capacity on the fishing gear technology ; (6) focusing on the high-value deep-sea species (e.g. pandalid shrimp, lobster, alfonsino, deep scattering layer); (7) preservation technique on the deep-sea specimens should be included at the coming workshop in Brunei Darussalam during 16-18 October 2010; (8) Study on the vulnerable marine ecosystem; (9) Using private sector fishing boat for specimens sampling (e.g. fishing boat rental, private company's vessel); (10) encouraging the young scientists working on the particular research; (11) Alternative HRD capacity/building by learning from the expert and/or experience on the major resources survey (e.g. Koyo-Maru research vessel practical survey in South China Sea area since 2007).

VIII CLOSING OF THE REGIONAL WORKSHOP

73. The SEAFDEC Deputy Secretary-General and Trust Fund Program Manager thanked the participants for their active participation during the Expert Meeting on Deep-Sea Fishing and Its Impact to Ecosystem. The meeting has served as useful avenue to share/exchange and update the progress of deep-sea resources exploration project in the region on the study of impact to ecosystem. He also commended the participant realization of their respective activities on deep-sea fisheries resources exploration depends on participant willingness and intention to apply from this meeting. On SEAFDEC part will make effort to provide to the participants with the necessary support to ensure the success and sustainability of this important collaborative effort in the near future. After assuring the meeting that SEAFDEC would find ways and means to initiate the implementation of the regional Plan of Action on Deep-Sea Resources Exploration as endorsed during the meeting, he declared the meeting closed. His Closing Remarks appears as **Annex 20**.