
Southeast Asian Fisheries Development Center	Sweden Government	United Nations Environment Programme	Global Environment Facility

**Establishment and Operation of a Regional System of Fisheries *Refugia*  
in the South China Sea and Gulf of Thailand**

**Report**  
**Regional Consultative Meeting on Regional Action Plan for  
Management of Transboundary Species, *Rastrelliger brachysoma*  
in the Gulf of Thailand Sub-region**

Bay Beach Resort, Jomtien, Chonburi Province, Thailand  
12<sup>th</sup> – 13<sup>th</sup> September 2019



**SEAFDEC/UNEP/GEF/Fisheries Refugia**  
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## 1. INTRODUCTION

1) The Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrilliger brachysoma*) in the Gulf of Thailand (GOT) Sub-Region co-organized by the SEAFDEC-Sweden and SEAFDEC/UNEP/GEF Project on Establishment and Operation of Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand (Fishery Refugia) was convened in Chonburi Province, Thailand from 12-13 September 2019. The Meeting was attended by representatives from Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam, officers from SEAFDEC Secretariat and Training Department (TD), members of Regional Fisheries Policy Network (RFPN), expert from Sweden and Burapha University. The List of Participants appears in [Annex 1](#)

## 2. OPENING OF THE MEETING

2) The Secretary-General (SG) of SEAFDEC, Dr. Kom Silapajarn, welcomed all attendees and opened the Meeting. He highlighted the importance of managing the Indo-pacific mackerel (*R. brachysoma*) in the Southeast Asian region in order to achieve sustainability. He also mentioned that several management activities were already undertaken under the SEAFDEC-Sweden Project such as training courses on stock assessment and fish larvae identification. He added that in 2018, DNA study were conducted in Cambodia, Malaysia, Thailand and Viet Nam and results were already presented in the previous the Gulf of Thailand technical meeting on management of transboundary species: Indo-Pacific mackerel in December 2018. Moreover, he reiterated that best practices and action plan for management of this species should be further discussed to ensure that it is sustainably harvested. Finally, as Secretary-General (SG) of SEAFDEC for the last time, Dr. Kom declared the Meeting open. His Opening Remarks appears [in Annex 2.](#)

## 3. BACKGROUND, OBJECTIVE OF THE MEETING AND ADOPTION OF THE AGENDA

3) The Gulf of Thailand Sub-regional Coordinator, under SEAFDEC-Sweden Project, Ms. Saisunee Chaksuin gave a brief presentation on the background and objective of the Meeting based on the several activities and meeting relevant to Transboundary Species: Indo-Pacific mackerel or short mackerel (*Rastrilliger brachysoma*) in the Gulf of Thailand Sub-region from SEAFDEC-Sweden and Fisheries Refugia projects, She also present agenda of the Meeting prospectus which appears in [Annex 3.](#)

## 4. REVIEW THE PROGRESS ON THE MANAGEMENT OF TRANSBOUNDARY SPECIES: INDO-PACIFIC MACKERELS FOR GULF OF THAILAND SUB-REGION

### • SEAFDEC-SWEDEN PROJECT

4) The Policy and Program Coordinator in SEAFDEC, Dr. Worawit Wachana, presented about the progress of the sub-regional activities implementation in GOT countries: Indo-pacific mackerel. The presentation included the spawning area, migration pattern, life cycle of the Indo-Pacific mackerel. He mentioned that, based on the request from ASEAN countries, the SEAFDEC already conducted bilateral and sub-regional initiatives to prove that Indo-Pacific mackerel is a shared stock among countries. Moreover, he emphasized that SEAFDEC encourage countries to formulate policy framework to support long-term fisheries management and establish agreements on coordinated national measures for transboundary stock. His presentation appears in [Annex 4.](#)

### • SEAFDEC/UNEP/GEF FISHERIES REFUGIA PROJECT

5) The Project Director of the Fisheries Refugia Project, Dr. Somboon Siraksophon presented the projects under SEAFDEC-Sweden project and Japanese Trust Fund from 2002 to 2009 and the works done by MFRDMD relative to Indo-Pacific mackerel. He mentioned that the data gathered from these projects will be used in the brainstorming discussion to come up with the restoration of the fisheries through refugia system in the South China Sea (SCS) and GOT. He also clarified that the

Refugia project concept has already been adopted by ASEAN mechanism in 2008. The aim was to come up with a project that addresses challenges on the declining stocks. Moreover, he further informed the Meeting that it is expected, that 170,000 hectares refugia to protect larva, spawning as well as the critical habitat and the life circle of the species will be implemented at the end of the projects. The member countries have to set up the institution framework such as national refugia committee, national scientific and technical committee including Cites management board which will be very helpful to ensure implementation of the project. He also discussed that there were already 15 refugia sites established during the project and it is hoped that by 2020 or 2021, 15 refugia sites will be completed. His representation appears as [Annex 5](#).

## **5. REVIEW ON THE EXISTING SCIENTIFIC KNOWLEDGE OF INDO-PACIFIC MACKEREL**

### **• OCEANOGRAPHY IN THE GULF OF THAILAND**

6) The Assistant Professor of Burapha University, Dr Anukul Buranaprateepat, presented about the observation of water column condition, seasonal variation, thermocline in the GOT by SEAFDEC in 2014. He focused on the results of the study for water circulation and short mackerel distribution seasonally, life cycle of mackerel and population measurement. His presentation appears in [Annex 6](#).

7) The representative from Department of Fisheries, Thailand commented that data collection system gathered by SEAFDEC was very good. She mentioned that the water circulation and oceanographic system are quite useful particularly results in salinity and dissolved oxygen. She also inquired the occurrence of double thermocline in center part of Gulf of Thailand. The presenter clarified that more apparent thermocline occurred in summer time due to strong heat and event of water circulation.

8) The representative from the Indonesia commented that the presentation on the circulation of the short mackerel should also consider the acidity, as it may restrain the vertical movement of the current. In view of this, the presenter explained the similarity of this condition to hypoxia condition which may refract the waters and trigger a vertical movement. He also suggested that these kinds of studies should be considered more under a species study.

### **• STOCK/POPULATION, MAPPING AND HABITAT LINKAGES, FISHERIES STATUS AND EXISTING LEGAL/MEASURES**

9) In this session, Dr. Somboon guided the participants in brainstorming the steps of work and proposed roadmap for Indo-pacific mackerel in the Gulf of Thailand sub-region. The participants were encouraged to put more efforts on discussing the step of work and list of action to formulate the objectives and goal of the Indo-Pacific mackerel regional plan of action. In the step of work brainstorming, there were a proposed action for identifying the objectives, outcomes and goal and develop the roadmap. Those steps of works are based on review of knowledge gaps/issues and countries respond from the questionnaire which was given to the participants. Countries respond were summarized which consists of input from national and regional level. The input from countries were further modified and divided into seven components which are: Data Information, Understanding Fish Stock Status, Management Response, Awareness Building, Strengthen Regional Cooperation, Study the Environment Impact, and Enhance Capacity Building. List of revised issues based on the given components would be used in revising the list of action, objectives, goal and outcome of the regional action plan on Indo-pacific mackerel in the Gulf of Thailand sub-region. His presentation appears in [Annex 7A, B and C..](#)

## **6. DISCUSSION ON THE DRAFT OF THE GULF OF THAILAND SUB-REGIONAL ACTION PLAN FOR FISHERIES MANAGEMENT OF INDO-PACIFIC MACKEREL**

10) The participants of the meeting were divided into two groups to discuss the draft of Regional Action Plan for Fisheries Management of Indo-Pacific Mackerel in the Gulf of Thailand. The two groups discussed and identified list of action, objectives, goal and outcome on the dimensions: ecosystem,



social, economic, governance and climate change. The group 1 focused on the social, economic, governance dimension based on the components on data and information; understand the fish stock status and management responses. The group 2 focused on the ecosystem and climate change dimensions based on components on awareness building; strengthen regional cooperation; study the environment impact and enhance capacity building.

11) The participants came up with an agreement to be implemented in their respective departments. Moreover, the participants were able to identify objectives, outcomes and goal to draft the Regional Action Plan for fisheries management of Indo-Pacific Mackerel in the Gulf of Thailand sub-region. The results of the group discussions appear in [Annex 8](#)

## **7. PLENARY DISCUSSION ON THE FINALIZATION OF THE DRAFT RAP OF THE GULF OF THAILAND SUB-REGIONAL ACTION PLAN FOR FISHERIES MANAGEMENT OF INDO-PACIFIC MACKEREL**

12) Dr. Somboon presented the result of the group from the plenary discussion on knowledge gaps/issues, list of action, responsibility, objectives, goal and outcome under the five (5) dimensions ecosystem, social, economic, governance and climate change. The participants further discuss in plenary the formulation of objectives, responsibilities, main goal and outcome.

13) The Meeting achieved several decisions in formulating the main goal and outcomes for the regional plan of action of Indo-Pacific mackerel management in the Gulf of Thailand sub-region. It is intended as a guide in the sub-region for the Indo-Pacific mackerel management resources. The draft RAP of Indo-Pacific mackerel management in the Gulf of Thailand sub-region appears in [Annex 9](#).

## **8. CONCLUSION AND WAYS FORWARD**

14) The Meeting agreed on the holistic management approach on the Indo-Pacific mackerel in the Gulf of Thailand and not including the Indo-Pacific species stocks that maybe found in other countries. In this regard, the results from this holistic management can be used a template for future species management in other countries.

15) The Meeting also agreed in formulating preamble and introduction to give a background and explanation on the formulation of Regional Action Plan (RAP). This RAP is intended as a guide for the Indo-Pacific mackerel management resources in other countries.

16) The SEAFDEC-Sweden Project Manager, Ms. Pattaratjit Kaewnuratchadasorn, informed the Meeting that a policy should be formulated after the Regional Action Plan draft is convened. She also added that the initial draft is going to be presented in the forthcoming PCM and that the final draft shall be presented in Council Meeting and for approval in 2020.

## **9. CLOSING OF THE MEETING**

17) On behalf of Dr. Kom Sirapajarn, SEAFDEC Secretary-General, the Policy and Program Coordinator SEAFDEC Secretariat Dr. Worawit Wanchana expressed his gratitude to all the participants for their inputs during the two-day follow up Meeting on the Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-region. He also expressed his hope that the action plan for other resources in the region will also push through. He finally thanked the active participation of Dr. Somboon and support of Dr. Magnus and then declared the Meeting closed.

## ANNEX 1

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## ANNEX 2

### OPENING REMARKS

By Dr. Kom Silapajarn,  
Secretary-General of SEAFDEC

Distinguished delegates from Cambodia, Indonesia, Malaysia, Philippines, Thailand and Viet Nam,  
My colleagues from SEAFDEC, Ladies and Gentlemen

Good morning!

It is a great honor for me to be here with you and welcome you to the two-days “Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-region”, which is jointly organized by SEAFDEC-Sweden Project and SEAFDEC/UNEP/GEF/Fisheries Refugia Project.

Are there anyone who has never eat Indo-Pacific mackerel or short mackerel?

I believe that every know this species, Indo-Pacific mackerel or short mackerel or in scientific name called *Rastrelliger brachysoma* is one of most important commercially pelagic species found in the Southeast Asian region, covers the Gulf of Thailand includes Philippines and Indonesia. Over the years, you may have heard through media revealing the disappearance of this Indo-Pacific mackerel or the reduction of catch. In general, Indo-pacific mackerels are caught by various types of fishing gears in the GoT, with the major fishing gear was purse seine recorded the catch was caught 45% in 2008. However, the landings showed declining trends indicating that the mackerel stocks in the South China Sea and GoT are already overexploited.

Indo-pacific mackerels have been monitoring by countries and made effort to understand the stock status. Obviously, many countries have paid seriously attention to find the appropriate management measures, with the aim for the sustainable use of pelagic species.

Ladies and gentlemen,

Through the regional and sub-regional effort, the SEAFDEC-Sweden Project has been highlighted on the management of transboundary species that includes Indo-pacific mackerels at many consultative meetings both bi-lateral level and the Gulf of Thailand Sub-region. Several activities were also undertaken under the SEAFDEC-Sweden Project such as training courses on stock assessment, fish larvae identification, especially identify to Genus and Species level of Scombridae Family. In 2018, the Project supported the conduct of DNA study in Cambodia, Malaysia, Thailand and Viet Nam, where the results was revealed in the Technical Meeting on Management of Transboundary Species: Indo-Pacific Mackerel, which was held in December 2018.

Furthermore, the SEAFDEC/UNEP/GEF Project on Establishment and Operation of Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand, the transboundary areas for Indo-Pacific mackerel has been addressed particularly in the border between Thailand and Cambodia, and Cambodia and Viet Nam. The best practices and action plan for management of this transboundary species needed to be further discussed to ensure that the Indo-Pacific mackerel are sustainable harvested

Since good progresses have been made so far by both projects and other organizations, it is opportune time to look at the concrete results and make the steps to take further, as it is urgent needed for the countries to prepare and do appropriate actions. Therefore, this Meeting is being organized jointly by the SEAFDEC-Sweden Project and Fisheries Refugia Project, and brings your expertise and valuable

contributions as well as those inputs from the 2018 Technical Meeting and other technical inputs, to discuss and develop the regional action plan or roadmap for national and regional level to be carry further for fisheries management of Indo-Pacific mackerel in the Gulf of Thailand sub-region.

Ladies and gentlemen, I would like to inform you that this is the last year of the SEAFDEC-Sweden Project and it would also perhaps the last technical event of the Project. This is my last meeting to join you all here in the capacity of Sec-Gen of SEAFDEC too. I wish to express our deepest appreciation to the government of Sweden for providing the financial support to our Region, enabling SEAFDEC to support ASEAN Member States to carry out the several activities for all these years to achieve the UN Sustainable Development Goals.

I also would like to extend my sincere gratitude to the UNEP/GEF for the fund to implement the activities under the Fisheries Refugia Project and bring us all join here this joint effort to manage transboundary resources.

My big thanks to colleague from ASEAN countries for your support during my term of service I have learned a lot from you and without your close collaboration and constant hard working, many activities would not be accomplished.

Last but not least, on behalf of SEAFDEC, I hope this Meeting will result in success. Once again, I welcome all of you to Thailand and hope that you have a nice stay in Chonburi province. Lastly, it is an opportune time for me to declare the meeting open.

Thank you very much.

## ANNEX 3

### PROSPECTUS AND AGENDA

#### I. BACKGROUND

Mackerels (Family Scombridae) particularly the Indo-pacific mackerel also known as short mackerel (*Rastrelliger brachysoma*) are the most economically important small pelagic fishes in the Southeast Asian region contributing about 38% to the small pelagic fisheries production or 11% to the total capture fisheries production in 2010. Indonesia is the major contributor to the region's total mackerel production, the highest catch of mackerels was recorded in 2012 was at 3,757,030 metric tons (SEAFDEC, 2014).

Gulf of Thailand Subregion is one of the important fishing ground for *R. brachysoma* where the peak highest catch of mackerel in the Gulf of Thailand (GoT) area caught by purse seine and falling net was in 1996 at 328,955 MT while the lowest catch had 3 peaks, in 1999, 2005 and 2010 at 289,285 MT, 283,984 MT and 259,354.56 MT, respectively that never reached 300,000 MT as recorded in 1996.

In general, *R. brachysoma* are caught by various types of fishing gears in the GoT and the three major types recorded in 2008 are purse seines (45%), driftnets (31%), trawls (18%) and others (6%). The landings show declining trends indicating that the mackerel stocks in the South China Sea and GoT are already overexploited. For species composition of purse seine catch, Indian mackerels made up about 25% of the total catch while short mackerels account for only 2% (SEAFDEC, 2017).

The study conducted by Bidin and Kassim (2007) estimated that the average exploitation rates (E) for *R. kanagurta* is at 0.69 from 2002 to 2006 in four countries bordering the South China Sea. This higher E value was also recorded for *R. brachysoma* in a study done in Malaysia and Philippines with average exploitation rate of 0.66. It could be concluded that the mackerel resources in the South China Sea during the study period are already overexploited.

With the support from SEAFDEC-Sweden project, the issues of stock status and transboundary areas of *R. brachysoma* has been addressed at many consultative meetings under the bi-lateral dialogues between Thailand and Cambodia, Cambodia and Viet Nam, Thailand and Malaysia. In addition, at the Gulf of Thailand Sub-region, the member countries of the GoT namely Cambodia, Malaysia, Thailand and Viet Nam agreed to focus in the management of transboundary species especially *R. brachysoma*. Technical support on data collections and scientific research such as DNA study and analysis in collaboration with Research Institutes and University in Thailand have been facilitated since 2018 to identify stock structure of *R. brachysoma* and to support the information for management policy at national and sub-regional levels.

Under the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand (Fishery Refugia), the transboundary areas for *R. brachysoma* has been addressed particularly in the border between Thailand and Cambodia, and Cambodia and Viet Nam. The best practices and action plan for management of this transboundary species needed to be further discussed to ensure that the *R. brachysoma* are sustainable harvested.

Taking into accounts, the results from the Expert Group Meeting in December 2018 suggested to follow up and actions at national and regional level included carry out research necessary on *R. brachysoma*, monitoring (data collection), and control (specific measure and legislation) as well as linkage to Fisheries Refugia project requirements, SEAFDEC proposes the Technical Consultation Meeting for Drafting the Regional Action Plan for Fisheries Management of *R. brachysoma* in the GoT Sub-region. The Meeting hosts by SEAFDEC Sweden project in collaboration with the Fisheries Refugia project.

## II. OBJECTIVE

Brainstorm to draft the Regional Action Plan for fisheries management of *R. brachysoma* and its habitat in the Gulf of Thailand sub-region

## III. EXPECTED OUTPUT

Gulf of Thailand sub-regional Action Plan for fisheries management of *R. brachysoma*.

## IV. EXPECTED OUTCOME

Gulf of Thailand Sub-regional countries agreed and action on the *R. brachysoma* management plans beneficial to sustainability of fisheries resource and healthy of habitats as well as well-being of communities.

## V. MEETING DATE AND VENUE

Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: *R. brachysoma* in the Gulf of Thailand Sub-region will be held on 12-13 September 2019, in Pattaya city, Chonburi Province, Thailand

## VI. EXPECTED PARTICIPANTS

- 1) Representatives from the South China Sea and Gulf of Thailand Region: countries namely: Cambodia, Indonesia, Malaysia, Philippines, Thailand, Viet Nam
  - SEAFDEC-Sweden Project fund for
    - o a Focal Point or SEAFDEC National Focal point for the Gulf of Thailand Sub-region
    - o One representative form senior official who is responsible for data collection, monitoring and assessment of transboundary species stock focus on *R. brachysoma*
  - SEAFDEC/UNEP/GEF on Fisheries Refugia Project fund for:
    - o A Fisheries Refugia National Focal Point
    - o A Fisheries Refugia National Scientific and Technical Focal Point
- 2) Resource person from research/academic institutes and relevant Organization including SEAFDEC/UNEP/GEF Fisheries refugia Project, FAO/RAP, and etc.
- 3) Representatives from SEAFDEC Secretariat, and relevant SEAFDEC Departments

## ANNEX 4

# SEAFDEC SWEDEN PROJECT PROGRESS OF THE SUB-REGIONAL ACTIVITIES IMPLEMENTATION IN GOT COUNTRIES: INDO-PACIFIC MACKEREL

### Outline

- Activities implemented in GoT sub-region and major findings
- Plan for joint/collaborative management of Indo-Pacific Mackerel resources in the GoT sub-region



### Shared stock ?

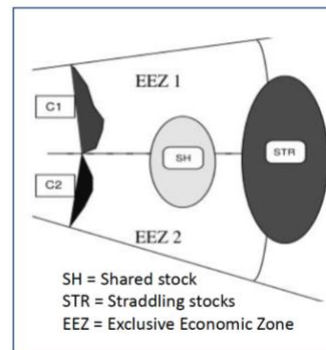


*Rastrelliger brachysoma*  
(Platoo)



### Shared Stocks ?

- **Transboundary stocks:** fish resources crossing the EEZ boundary of one coastal State into the EEZ (s) of one, or more, other coastal States
- **Highly migratory species:** the resources to be found both in coastal State EEZ and the adjacent high seas, consisting of the major tuna species
- **Straddling stocks:** all other species to be found both within the coastal State EEZ and the adjacent high seas
- **Discrete high seas fish stocks:** fish stocks to be found exclusively in the high seas



Ref.: FAO Code of Conduct for Responsible Fisheries, Article 7 (FAO, 2003b)

## Activities in GoT Sub-region

A series of bilateral and sub-regional initiatives/activities (research, consultation for information gathering and discussion, capacity building programs, etc.) in collaboration with GoT (CMTV) countries



*Rastrelliger brachysoma*  
(Platoo)

### Information gathering

- Status and trend: information gathering based on existing data
- DNA study on stock structure (research activities in CTV countries)

## Gulf of Thailand Sub-regional Initiatives on Transboundary Fish Stocks

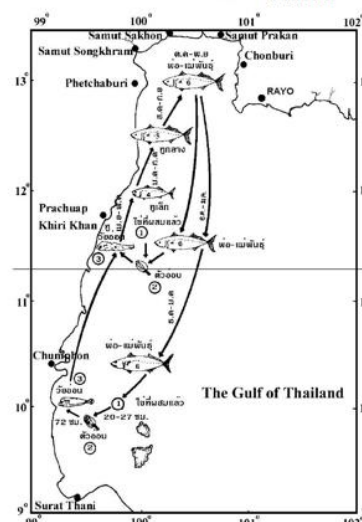
- Platoo was prioritized as economical important species for the GoT countries (Cambodia, Malaysia, Thailand, and Viet Nam)
- At the 5<sup>th</sup> Meeting of the GoT in 2015, SEAFDEC was suggested to:
  - Encourage GoT countries to formulate policies by including data collection activities in the national policy frameworks to support long-term fisheries management
  - Conduct sub-regional activities for better understand stock status and migratory pattern of Platoo which will be used as a basis for establishing agreements on coordinated national measures for transboundary stock.

## Information Gathering

- Scientific name: *Rastrelliger brachysoma*
- Common name: short mackerel, Indo-Pacific mackerel
- Habitat: shallow waters of Southeast Asia
- Fishing gear: gillnet, purse seine, trawl



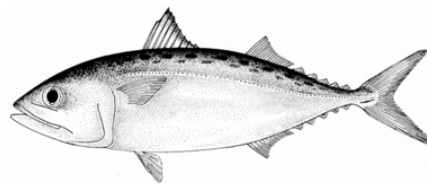
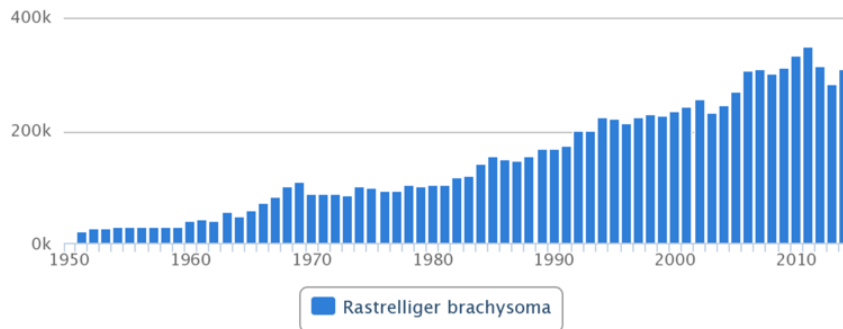
Platoo



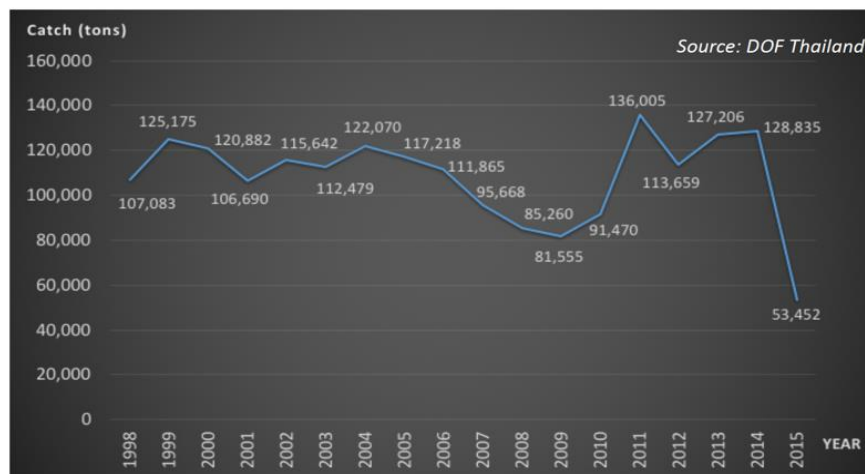


Global Capture Production for species (tonnes)

Source: FAO FishStat



Landing of Plattoo 1998-2015



Sub-regional Initiatives for Transboundary Fish Stocks in GoT

- Expert Group Meeting on Stock Status and Geographical Distribution of AIB Species in the GoT, Sep. 2016
- Technical Meeting on Planning for Development of Stock Study for AIB Species in the GoT, Feb. 2017
- Stock Study on Indo-Pacific Mackerel in GoT since late 2017
- Workshop on results from DNA study for IPM in GoT, Dec. 2018



## Stock Status (2017)

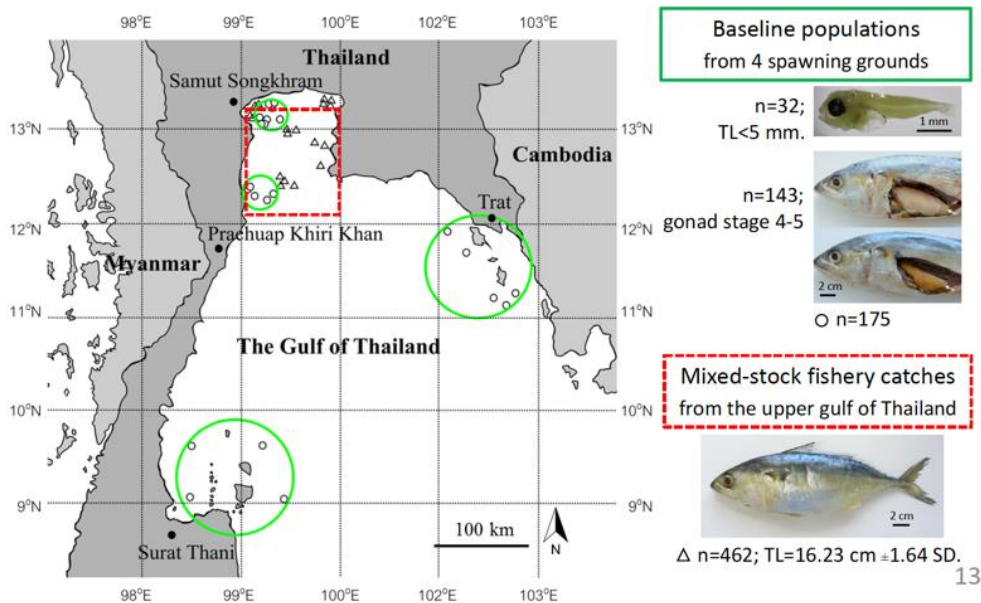
Species	Status		
	Decreasing	Stable	Increasing
Anchovy	Viet Nam	Thailand	Malaysia
Indo-Pacific Mackerel		← Malaysia Thailand	
Blue swimming crab	Thailand Viet Nam		



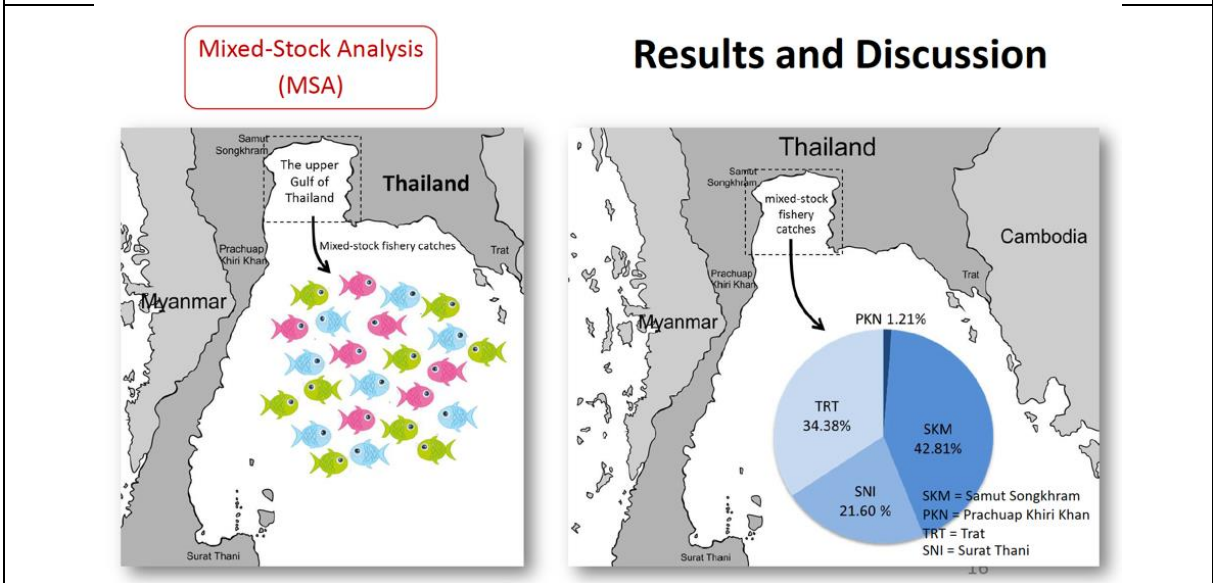
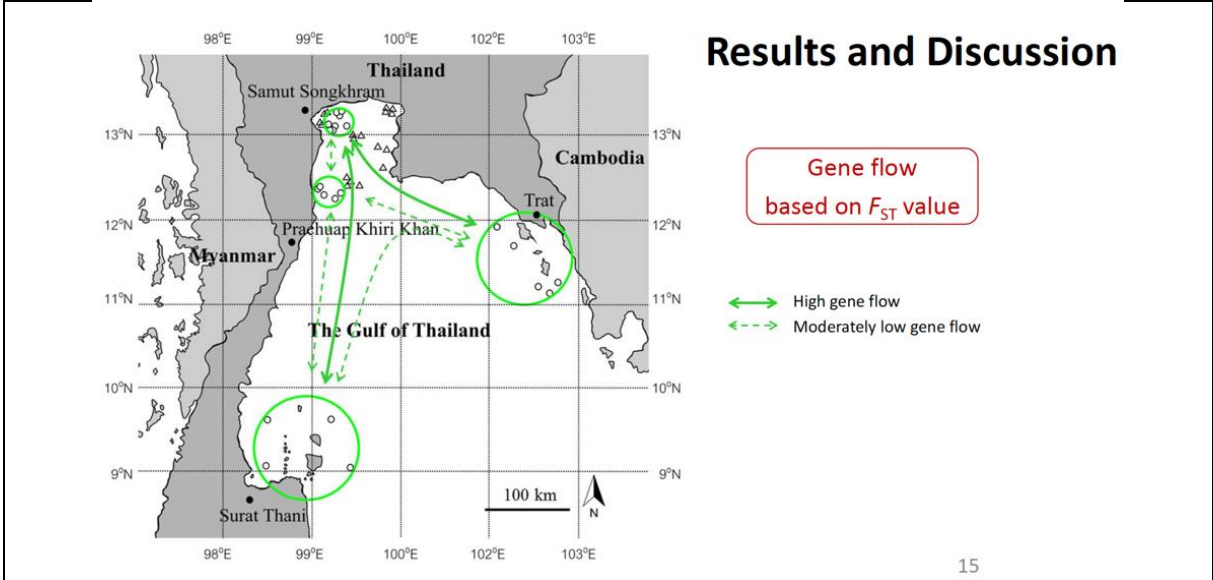
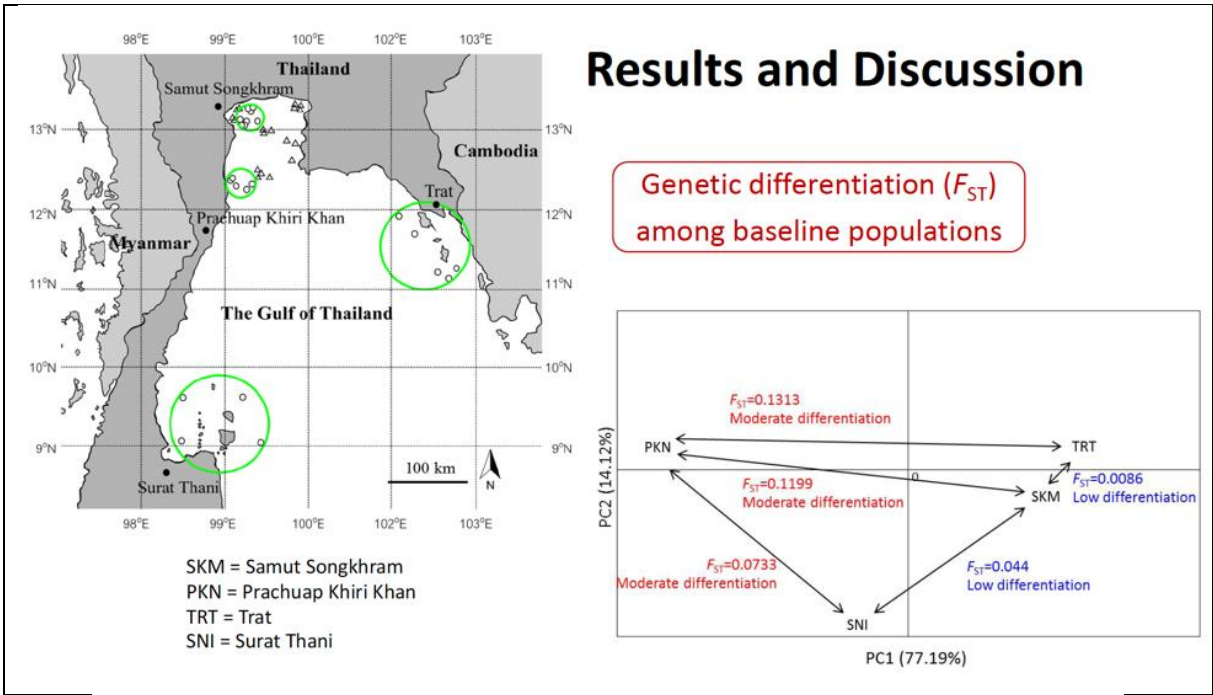
## DNA study on stock structure

- Population structure and genetic mixed-stock analysis (MSA) of short mackerel (*Rastrelliger brachysoma*)
- Identify major population contributing to fishery catches in the upper Gulf of Thailand

## Materials and Methods

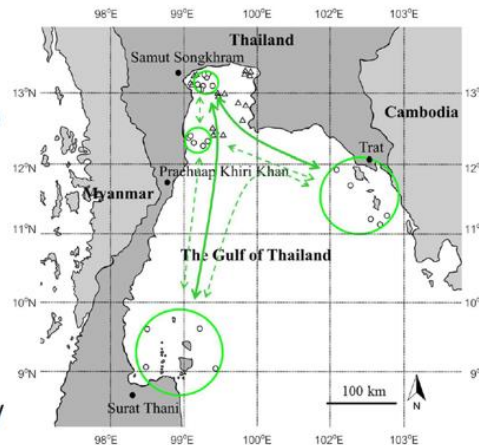






**Conclusion of MSA Study for Indo-Pacific Mackerel in GoT (Thai Waters)**

- Four populations are identified according to their spawning grounds.
- Samut Songkhram population is the major contributor to fishery catches in the upper gulf of Thailand.
- Trat and Surat Thani populations are the second and third large contributors and also provide gene flow to Samut Songkhram population.
- Prachuap Khiri Khan population is the smallest contributor and has low gene flow to others.
- These information is envision to assist sustainable fishery management in the upper gulf of Thailand.



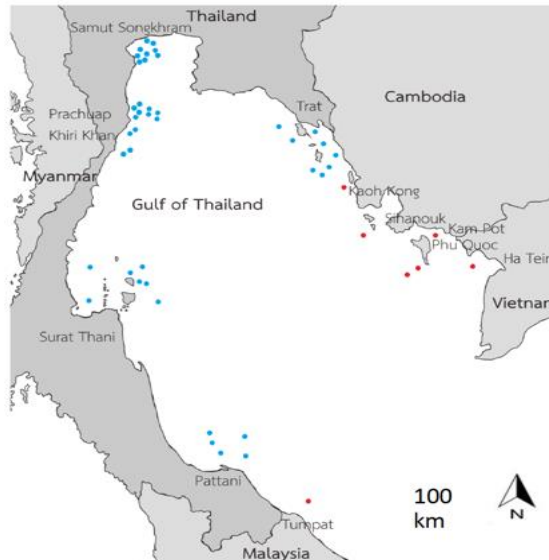
**Sample collection**

**Baseline populations**

Locations	o	n	N
Trat	59	30	89
Samut Songkhram	43	4	47
Prachuap Khiri Khan	59	30	89
Surat Thani	14	16	30
Pattani	27	21	48
Cambodia	-	50	50
Vietnam	-	50	50
Malaysia	-	33	33
	202	234	436

o = old samples (DOF project)  
n = new samples (SEAFDEC project)

Fig. 1 Map indicating sampling localities. Samples from neighboring countries and Thailand colored using red and blue dots, respectively.



**Genetic flowchart**

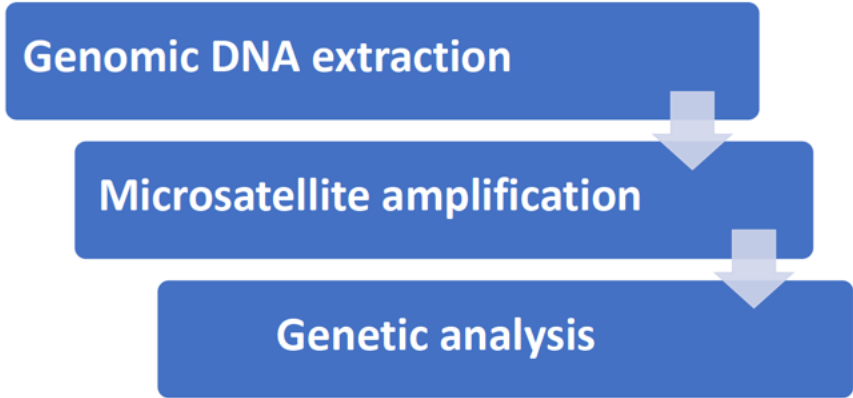


Fig. 2 Principle component analysis (PCA) representing genetic similarity and differentiation among the short mackerel populations from Thailand (TH) and Malaysia (MY).

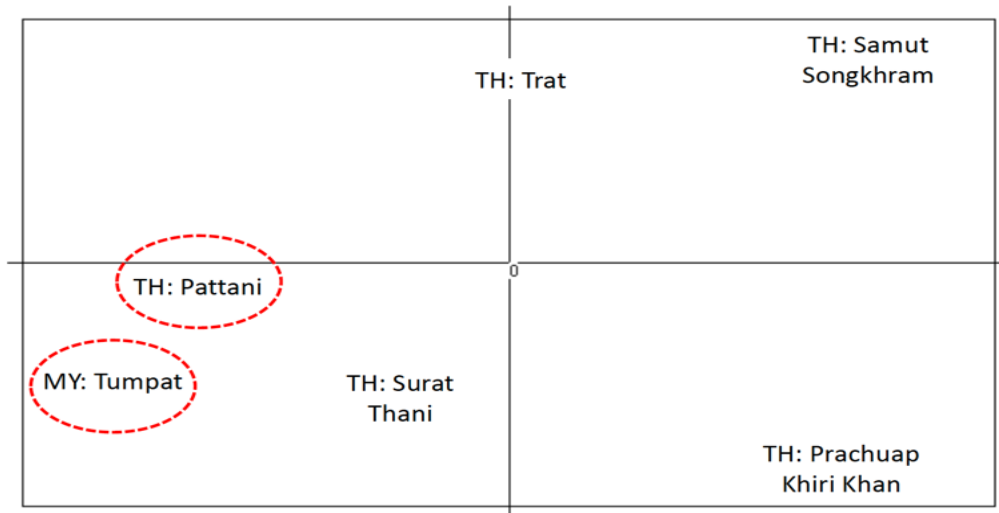


Fig. 3 Principle component analysis (PCA) representing genetic similarity and differentiation among the short mackerel populations from Cambodia (CM) and Vietnam (VN).

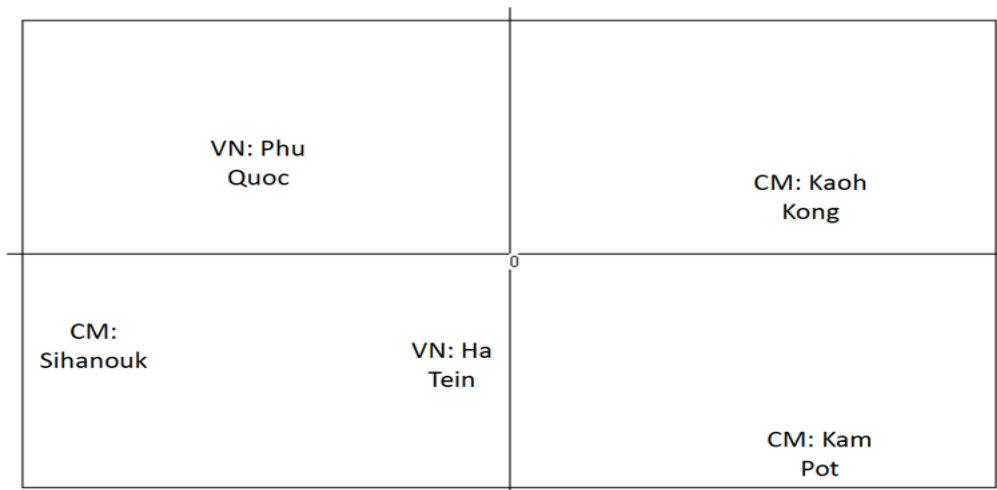


Fig. 4 Principle component analysis (PCA) representing genetic similarity and differentiation among the short mackerel populations from Thailand (TH), Cambodia (CM) and Vietnam (VN).

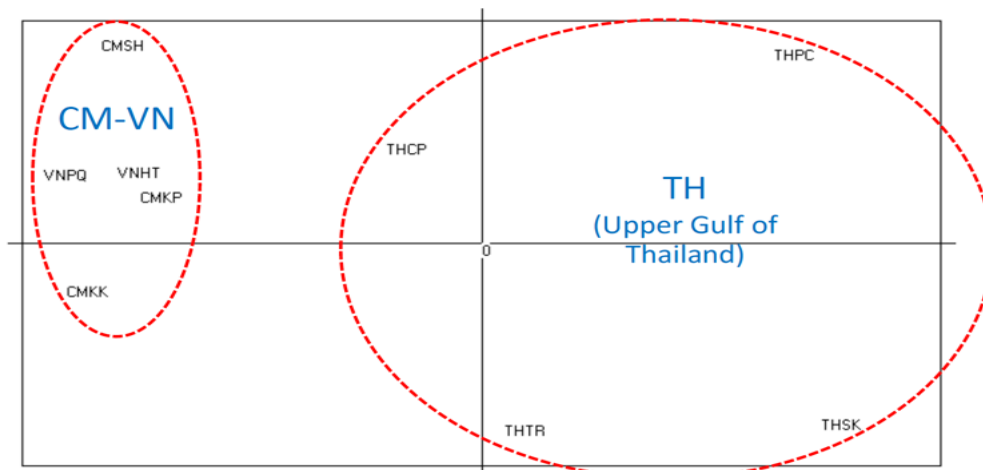


Fig. 5 Principle component analysis (PCA) representing genetic similarity and differentiation among the short mackerel populations from all four countries (TH, CM, VN and MY).

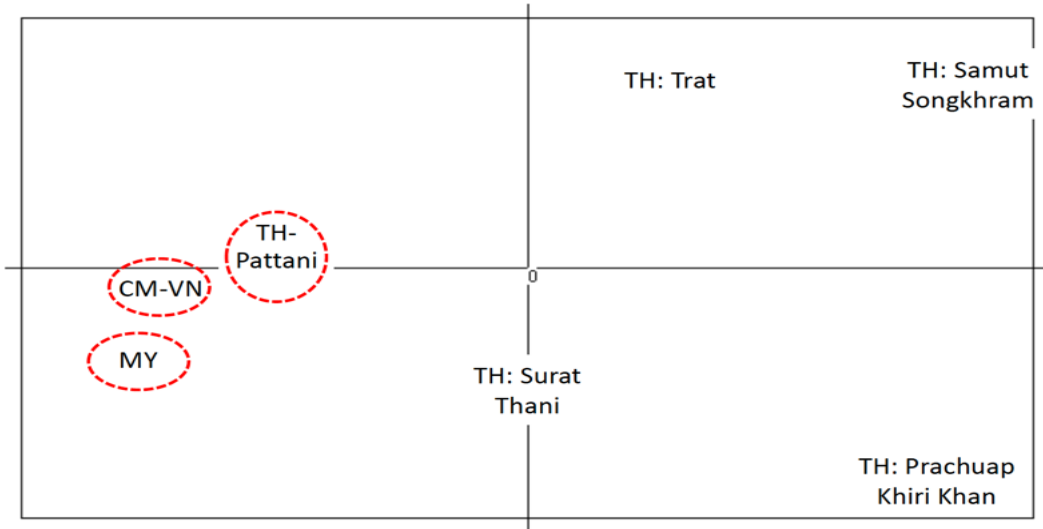


Fig. 6 Map indicating sampling localities with grouping based on PCA result.

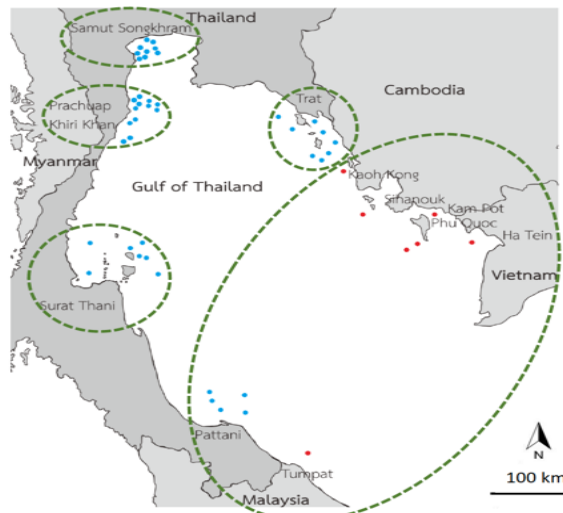
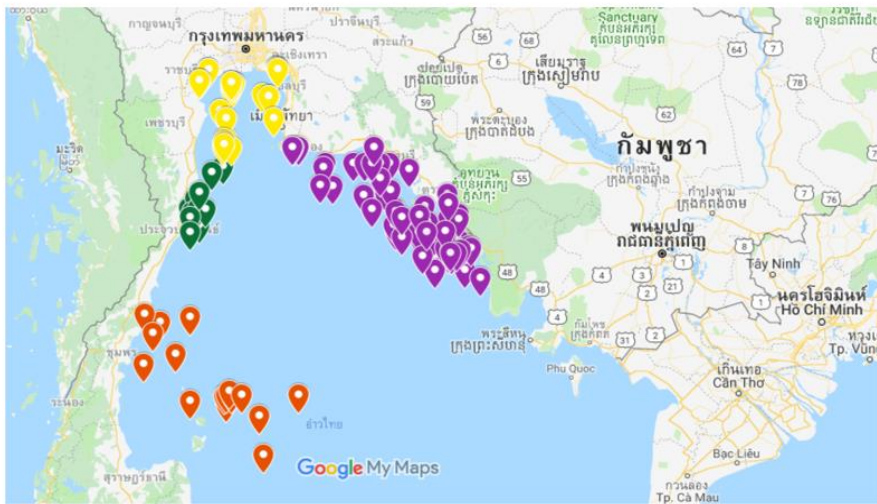
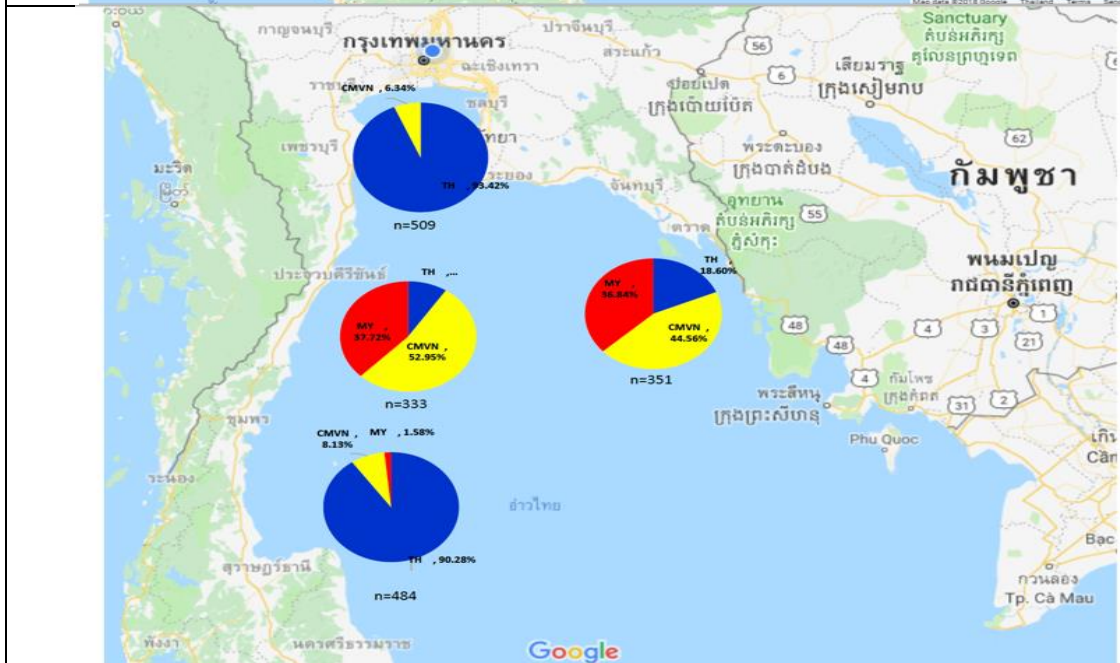
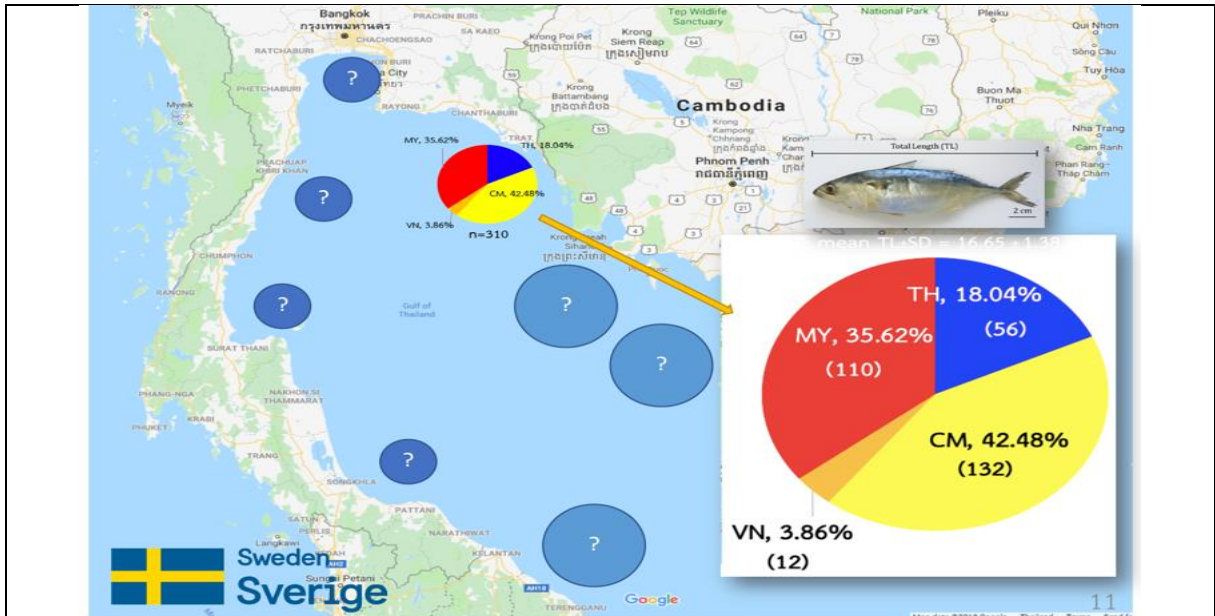


Fig. 7 Map of the Gulf of Thailand represents catching sites of the short mackerel (DOF samples; year 2014; n=1677; mean TL±SD = 16.97 ± 1.53 cm) used for mixed-stock analysis (MSA). The areas covered Lat: 09° 11' to 13° 21' N Long: 99° 24' E to 102° 58'.







## Joint Management Plan

Possible Areas of Cooperation in GoT countries on Platoon Management

- National management measures for transboundary species to be developed and agreed upon the results from the sub-regional collaborative research/activities
- MCS Network Establishment: agree and implement workplan of activities

## Plans, Methodologies, Outputs, and Outcomes...

Activities	Outputs	Outcomes
<b>Short-term plan</b>		
1. Conduct Genetic Mixed-Stock Analysis (2018, completed)		
<u>Step 1</u> : Identify major fishing ground information by countries	Inputs for designing the genetic study on AIB species	Fishing ground mapping for AIB species in GoT
<u>Step 2</u> : Conduct baseline population studies	Determination of number of AIB stocks in GoT	National and joint management plans for AIB species in GoT
<u>Step 3</u> : Conduct MSA	Determination of amount of contribution from other stocks in particular to area of study	National and joint management plans for AIB species in GoT

## Plans, Methodologies, Outputs, and Outcomes...

Activities	Outputs	Outcomes
<b>Short-term plan (continued)</b>		
2. Improved Data Collection on AIB Species Using Existing SOP		
<u>Step 1</u> : Name the enumerators for each landing site and study area	Enumerator designated for landing sites in study areas	Harmonized regional data in GoT countries
<u>Step 2</u> : Train the designated enumerators	Enhanced knowledge on biological and environmental data	Improve capacity of enumerators from GoT countries for being trainers in the future
<u>Step 3</u> : Data collection and analysis	Updated information and data on biological and environmental aspects	National and sub-regional management plans for AIB species in GoT
<u>Step 4</u> : Convene meeting to discuss and validate data	Validated data for understanding stocks of AIB species in GoT	National and sub-regional management plans for AIB species in GoT

## Plans, Methodologies, Outputs, and Outcomes...

Activities	Outputs	Outcomes
<b>Medium and long-term plan</b>		
1. Monitoring change in catch and landing		
Periodic catch and landing survey (depending on the countries)	Updated information on stock status/condition	Effectiveness of the management plans
2. Discussion on development of a joint/collaborative plan/actions		
GoT meeting (s)		

## Level of the Development for Joint Management Plans for the Shared Stocks

- **Primary Level:** cooperation on research program/activity
- **Secondary Level:** the establishment of agreements of coordinated national fisheries management measures



## Conclusion

- A set of information can be used for future joint actions plan development
- Technical capacities (together with SOP, etc.) are already in place
- GoT initiatives on IPB in primary level → development of the joint/collaborative actions/management plan ?
- Future action (s) ?





## ANNEX 5

### LINKING THE SCIENCE AND MANAGEMENT INTERFACE FOR SUSTAINABLE USE OF SHORT MACKEREL IN THE GULF OF THAILAND

SOMBOON SIRIRAKSOPHON  
Fisheries Refugia Project Director  
somboon@seafdec.org

#### I. INTRODUCTION

Early effort by the Government to manage the coastal resources generally involved decision-making at high levels and rarely involved participation of the communities as well as the science-based approaches. Consequently, strategies failed to minimize degradation of coastal resources and to improve the condition of those living in poverty. From these lessons, empowering of coastal communities to enable them to manage their own resources is gradually recognized by the government. Linking the science-based information to fisheries management for sustainable use is also needed. This paper provides some baseline and scientific information on one of the considered major fisheries resources in the coastal areas of Gulf of Thailand, the short mackerel. Base on the

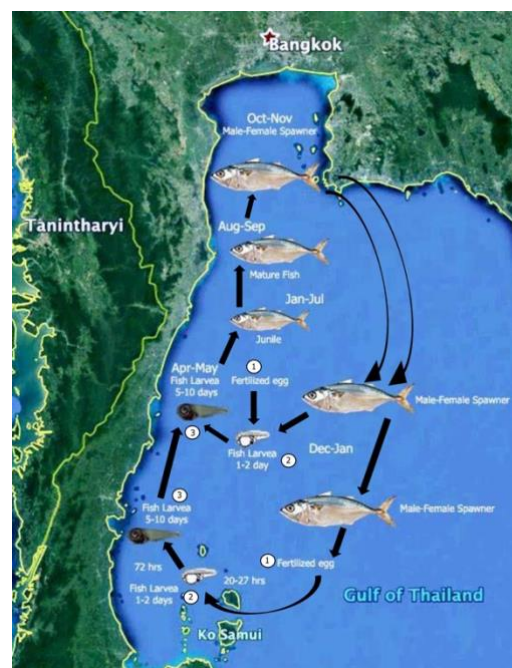
Short mackerel, *Rastrelliger brachysoma*, an epi-pelagic fish, is considered an important fishery resource of the Gulf of Thailand. In 2009, the population of Short mackerel dramatically decreased as compared with previous years (2005- 2008) (Department of Fisheries, 2009). The distributions of short mackerel are influenced by environmental factors such as monsoon season and current movements (MFRDMD, 2010). Short mackerel in the Gulf of Thailand is potentially exposed to a large number of pollutants, especially heavy metals (e.g., cadmium, iron, mercury, and lead) and petroleum hydrocarbons in sediment and water, which potentially play a role in the diminishing fish populations (Cheevaporn & Menasveta, 2003; Wattayakorn, 2012).

#### II. REQUIRED SCIENCE-BASED INFORMATION

The realistic approach to the sustainable utilization of fisheries resources is to integrate all knowledges not only on science but also local based information as well as applying the baseline information and ocean forecasting system that affects to the fisheries resources of short mackerel. Developing of any area-based approach fisheries management measures for short mackerel, therefore it is needed to understand the key important issues as follows:

##### A. Life cycle history

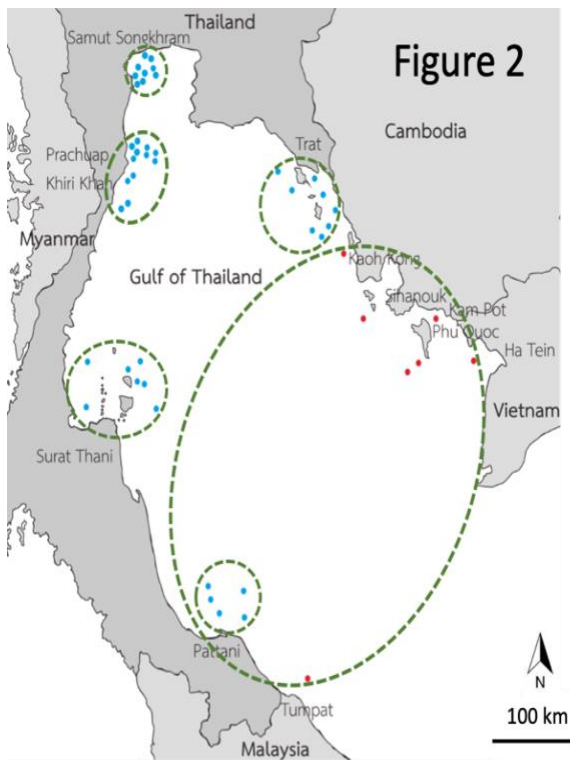
In the Gulf of Thailand, particularly the west and north coast, the Life cycle of the Indo-Pacific mackerel in the Gulf of Thailand (Boonprakob, 1974) were discovered as shown in Fig. 1. This spatially and geographically defined of spawning grounds, nursery grounds and their migration route are very important information for the management. However, lack of life cycle history in the eastern part of the Gulf of Thailand, in the coastal areas of Cambodia and South Viet Nam induce the low effectiveness of fisheries management for short mackerel by those countries.



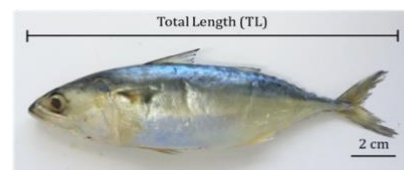
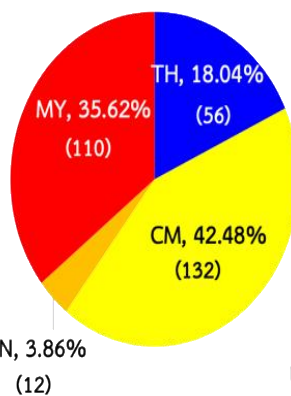
B. Fishery Biological Consideration

As living populations or communities, aquatic living resources are capable of on-going renewal through the processes of growth in size and mass of individuals and additions to the population or community through reproduction (leading to what in fisheries is often called ‘recruitment’). In a population at equilibrium, the additive processes of growth and reproduction on average equal the loss process of total mortality. For sustainable fisheries on short mackerel, it is required a total population is maintained above a certain abundance or biomass, but also that the age structure of the population is maintained in a state in which it is able to maintain the level of reproduction, and hence recruitment, necessary to replenish the losses through mortality. But in fact, due to the declining of short mackerel stock due to fishing over a long period on selected portions of a stock, for example large individuals or individuals spawning at a specific time or locality within a wider spawning season or range, can reduce the frequency of the particular genetic characteristics giving rise to that feature or behavior. This has the effect of reducing the overall genetic diversity of the stock in principle. With reduced genetic diversity, the production potential of the population can be adversely affected, and it may also become less resilient to environmental variability and change. It is therefore needed to understand the overall

genetic diversity of short mackerel in the Gulf of Thailand. By these reasons, SEAFDEC supported by the Sweden Government conducted the survey in collaboration with coastal countries in the Gulf of Thailand namely Cambodia, Malaysia, Thailand and Viet Nam (SEAFDEC, 2018). The results of genetic analysis of 436 short mackerel samples from the coastal areas as shown in Figure 2 indicate that: 1) Population differentiation is found in the Gulf of Thailand; 2) Thailand populations are genetically different to each other in moderate level; 3) Cambodia, Vietnam, Malaysia and Pattani (Thailand) populations are genetically different to each other in low level.



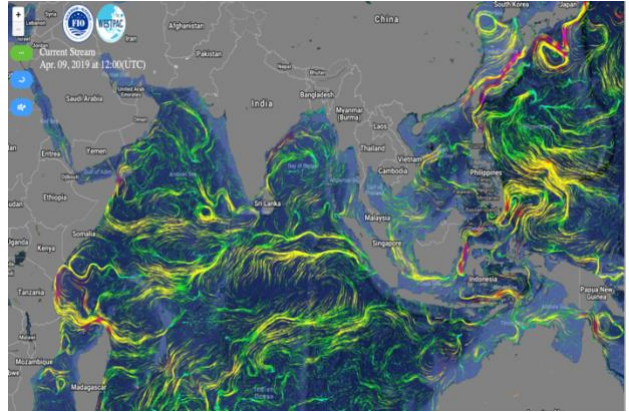
In addition, make use these genetic results focused in the Trat province where located nearby Cambodia border as shown in Figure 3, indicates that the short mackerel harvested off Trat province consisted of 42.48% from Cambodia, 35.63% from Malaysia and 3.86% from Viet Nam, while only 18% from Thai waters.



n=310; mean TL±SD = 16.65 ± 1.38 cm

### C. Ocean forecasting system

Taking in to consideration that distributions of short mackerel are influenced by environmental factors such as monsoon season and current movements as well as potentially exposed to the pollutants, especially heavy metals and petroleum hydrocarbons in sediment and water, therefore the ocean data and forecasting system is an important tool to support in monitoring its affects to aquatic marine animal. Regarding this, it is necessary to acknowledge to the SEAGOOS project under the IOC/WESTPAC that developed the ocean modelling to understand the flow of current, sea temperature, wave, wind, and salinity (SEAFDEC, 2019). This information is useful to facilitate the effectiveness. It is expected in very near future the improved modelling will include more higher resolution of the image as well as include runoff of nutrients, pollutants, etc.



### III. LINKING THE SCIENCE AND MANAGEMENT

Integration of overall information as above mentioned to management of short mackerel in the Gulf of Thailand is aligned with the regional initiatives through the GEF Funded, UNEP implemented and SEAFDEC executed project on “Establishment and Operation of a Regional Fisheries Refugia in the South China Sea and Gulf of Thailand” which is one of the component under the implementation of the Strategic Action Programme for the South China Sea.

Area-based approaches to fisheries management in the western Gulf of Thailand have applied over the last decade to safeguard spawning stock and larvae of the short mackerel. The measures designed against the backdrop of high fishing pressure and increasing demand for the region’s seafood products (see refugia areas A and B depicted in Figure 5) have enabled resource managers, scientists, fisherfolk and communities to develop experience working together in safeguarding critical fish stock and life-cycle linkages.

This has involved the application of targeted management measures aimed at significant reductions in fishing effort and use of inappropriate fishing gear and practices for 90 days in area A (15 Feb-15 May) and 30 days area B (16 May – 14 June) to safeguard fish in spawning condition and fish larvae, respectively (Saikliang, 2016). The large size of these management has been the source of some tension between government and larger-scale operators, with discussions largely having focused on the need for area-based measures to reflect more fully the known migratory routes, ocean circulation patterns and primary production in the Gulf.





Accordingly, the fisheries refugia concept was recently applied to the establishment of nursery refugia in the upper Gulf of Thailand aimed at boosting year class strength of new recruits to the fishery. This has been achieved via application of targeted measures, combined with revised and strengthened regulations and enforcement, in refugia area C (60 days from 15 Jun – 15 Aug) and refugia areas D (60 days from 1 Aug – 30 Sep) aimed at targeted and incidental capture of larval and juvenile fish. This staged and combined application of refugia areas in a northerly, clockwise direction from the western to the upper central Gulf to protect fish at critical life-cycle stages including spawning, larval, and juvenile to pre-recruit has shown to bring about significant improvements in landings and food security for small-scale operators.

Department of Fisheries, Thailand reports an almost 10-fold increase in landings from 2,470 tons prior to the expansion of the network to 28,670 tons include the operational management of areas C and D. This success points to possible strengthened resilience of stocks of Indo-Pacific associated with the ongoing establishment and planned management of fisheries refugia sites for this species in the transboundary area of Trat, Thailand and Koh Kong, Cambodia which are located to the east of the present managed areas. Recent surveys show these areas to be critical areas for juvenile and young adult Indo-Pacific mackerel.

#### IV. CONCLUSIONS

Many countries in the coastal areas of the Gulf of Thailand effort to manage their fisheries resources and short mackerel, however, individually works for development of their fisheries management maybe not enough to safe and ensure fish stock for sustainable utilization. As short mackerel is a shared fish stock, it is therefore required clear scientific information such as migration patterns, spawning areas, as well as genetic study of its population. Between Thailand and Cambodia particular in Trat Province of Thailand and Koh Kong Province of Cambodia, it is necessary to find on how migration of short mackerel in these transboundary areas. In addition, the short mackerel between Cambodia and Southern Viet Nam needed to be identified as well to support the management of their stock for sustainable utilization by those countries.

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- 4) Pirochana Saikliang (2014). Development of Fisheries Refugia through Closed Seasons and Areas in the Gulf of Thailand, *J. Mar. Biol. Ass. India*, 56 (1), 70-76.
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- 6) SEAFDEC, 2019. Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand, Report of the Second Meeting of the Regional Scientific and Technical Committee (RSTC2) in Kampot Province, Cambodia on 21th – 23th May 2019. Southeast Asian Fisheries Development Center, Training Department, Samutprakarn, Thailand; 179 p.
- 7) Wattayakorn, K. (2012). Petroleum pollution in the Gulf of Thailand: A historical review. *Estuarine and Coastal Marine Science*, 35, 234–245.

INTRODUCTION OF FISHERIES REFUGIA PROJECT



**SEAFDEC/UNEP/GEF Project  
on Establishment and  
Operation of A Regional  
System of Fisheries Refugia in  
SCS & GoT**

**Restoring Fisheries through  
Refugia Systems in the South  
China Sea and Gulf of Thailand**

  
CAMBODIA

  
INDONESIA

  
MALAYSIA

  
PHILIPPINES

  
THAILAND

  
VIET NAM

**14 LIFE BELOW WATER**








**ASEAN-SEAFDEC  
COOPERATION**





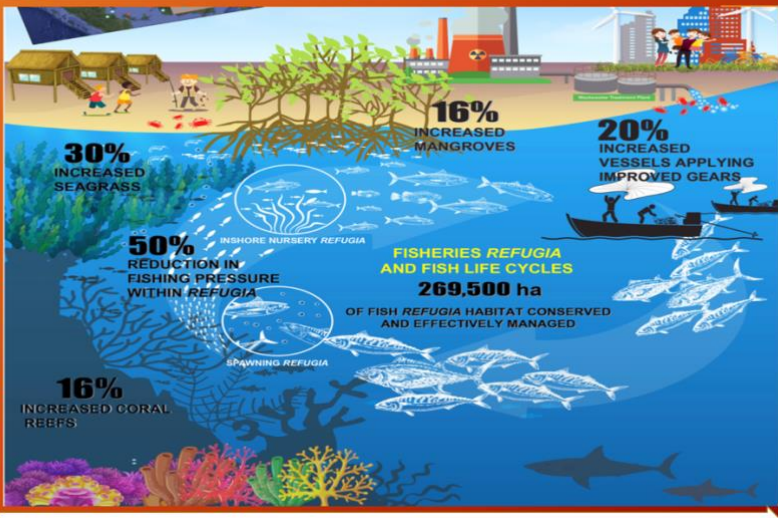
**SAP FOR THE SCS**

**Improved integration of fisheries management and habitat conservation**



**FISH STOCKS**

- Under-exploited: 16%
- Accidentally exploited: 23%
- Over-exploited: 44%
- Depleted: 16%



**HEALTHY ECOSYSTEM**

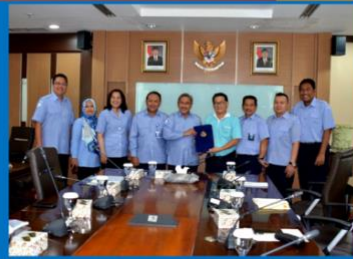
**Present**



Progress of SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries Refugia in the SCS and GoT (since 2017)

**1) Signed Letter of Agreement (LOA) :**

- ✓ Cambodia (in January 2017);
- ✓ Philippines (in March 2017);
- ✓ Thailand (in March 2017);
- ✓ Malaysia (in June 2017);
- ✓ Viet Nam (on 3<sup>rd</sup> May 2019)
- ✓ Indonesia ( on 13<sup>th</sup> June 2019)



**2) Agreed TORs for Establishment of Nat' & Reg' Institutions**

- ✓ National Fisheries Refugia Committee (NFRC) + Regional PSC
- ✓ National Scientific and Technical Committee (NSTC) + Regional STC
- ✓ Site-based Management Boards (SBMB)

**3). intensive series of consultations** on the boundaries of fisheries *refugia* to identify key threats to fisheries *refugia* sites and initiate discussion about possible management;

**4). improvement of the management of critical habitats** for fish stocks of transboundary significance:

- ❖ compile and update information and data on the distribution of habitats, known spawning areas, locations of refugia, MPAs, fisheries management areas, and critical habitats for endangered species;
- ❖ Develop the national and regional datasets,

**5). information management and dissemination** in support of national and regional-level implementation of the fisheries *refugia* concept

**6). national cooperation and coordination** for integrated fish stock and critical habitat management were enhanced



Meeting with TWG chaired by the Governor of Kep



**7) Selected 15 Priority Fisheries Refugia Sites in 6 Countries**

**15 Priority Fisheries Refugia Sites**

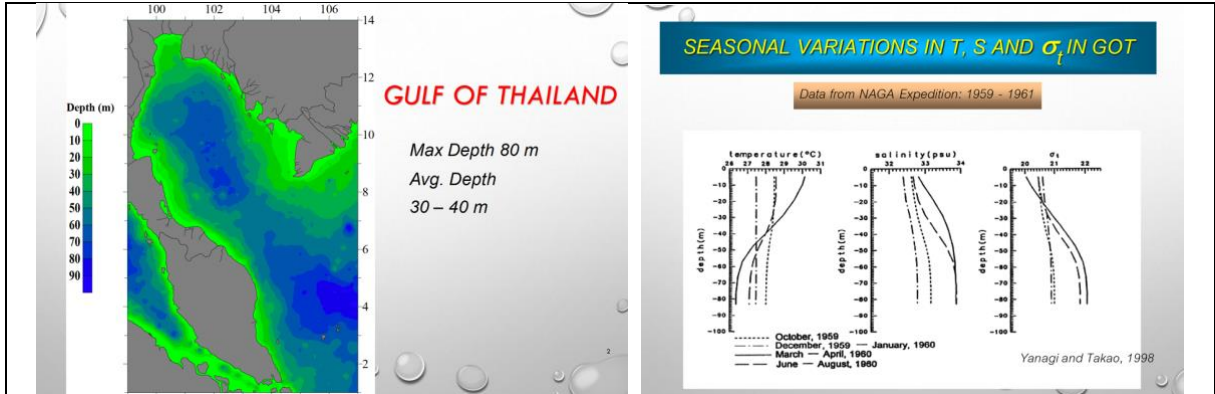








## ANNEX 6 OCEANOGRAPHIC CONDITIONS AND FISHERY RESOURCES IN THE GULF OF THAILAND



### Yanagi et al. (2001)

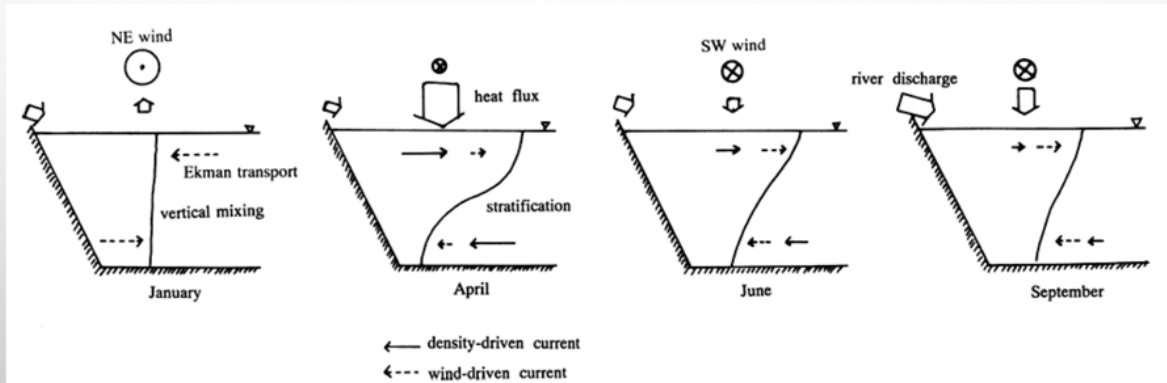
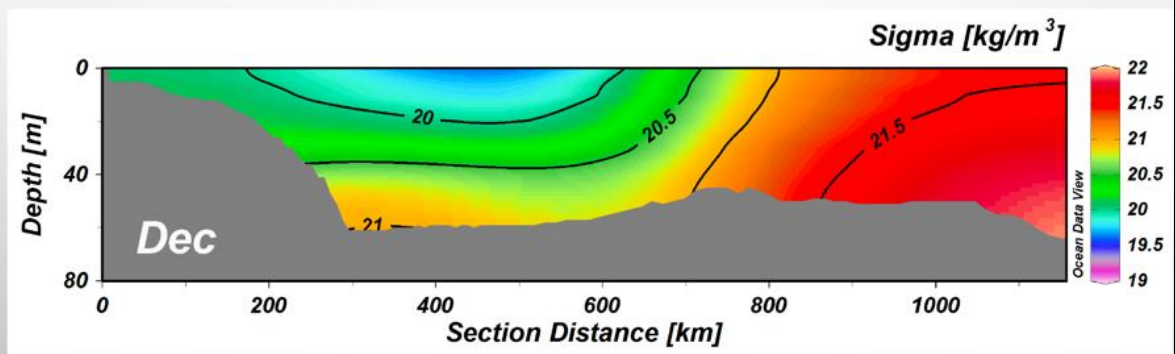


Fig. 12. Schematic representation of seasonal variations in wind, heat flux through the sea surface, river discharge, stratification, density-driven current and wind-driven current in the Gulf of Thailand.

## VARIATIONS IN SCS WATER INTRUSION



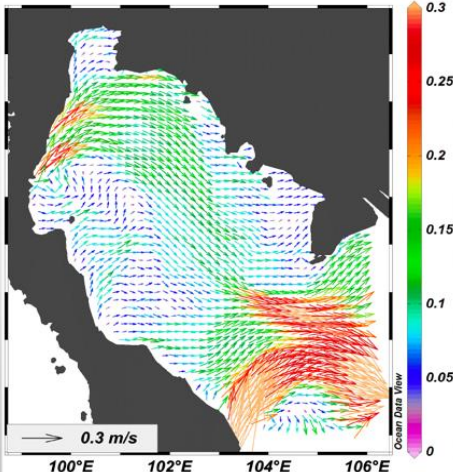
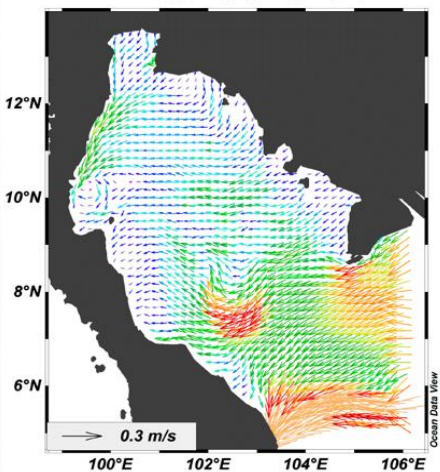
## SEASONAL SURFACE CIRCULATIONS

December

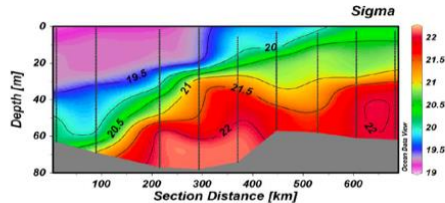
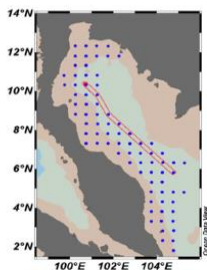
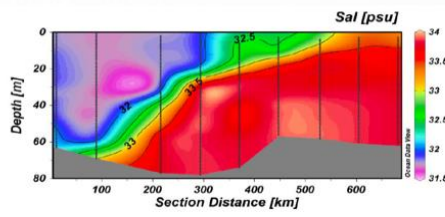
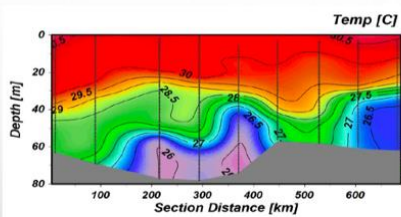
July

Mag [m/s] @ Depth [m]=first

Mag [m/s] @ Depth [m]=first

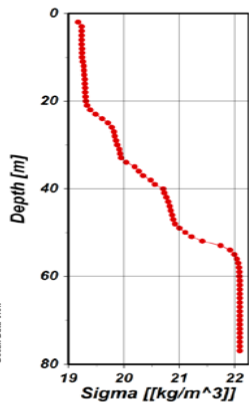
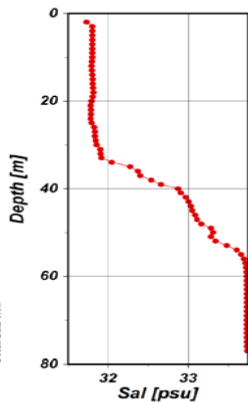
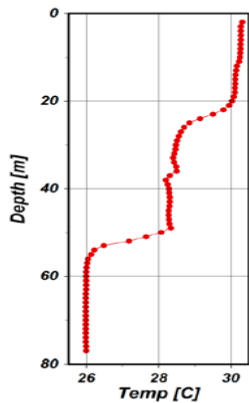
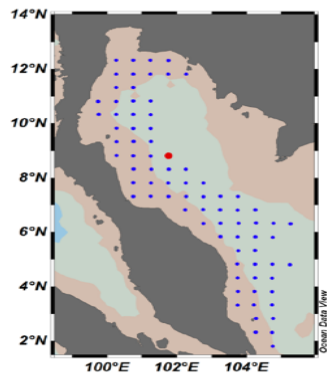


## DOUBLE THERMOCLINE



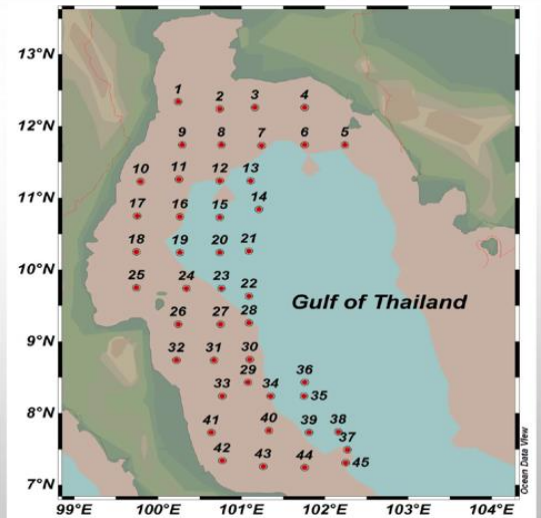
SEAFDEC DATA  
24 Apr - 17 May 1996

## DOUBLE THERMOCLINE

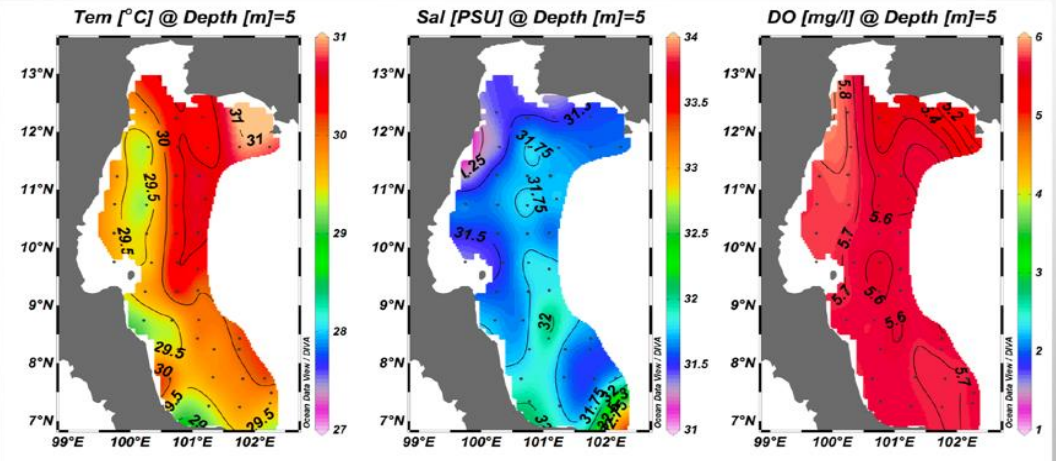


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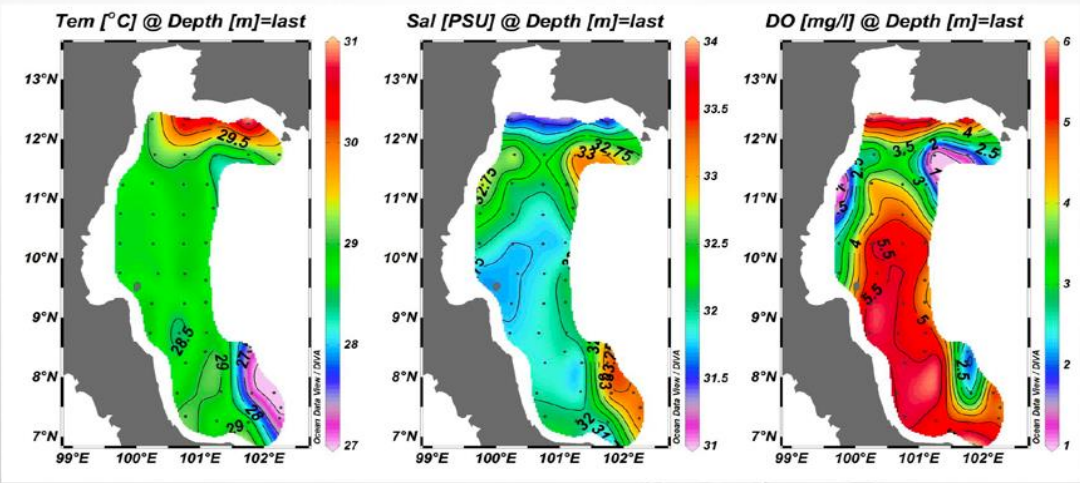
**SEAFDEC OBSERVATION  
14 MARCH –  
12 APRIL 2013**



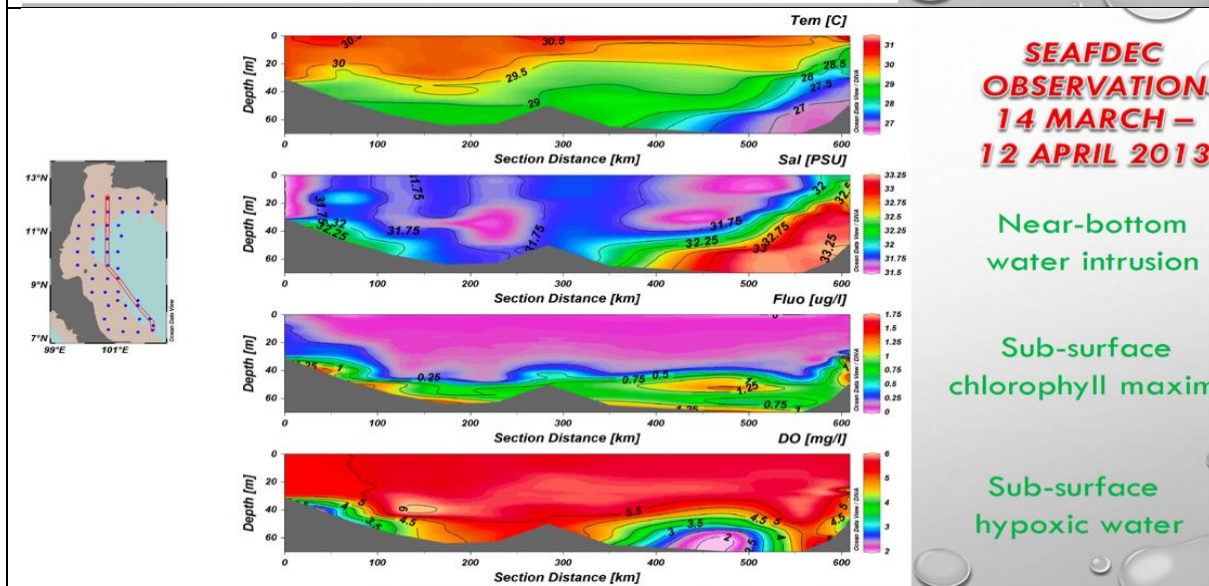
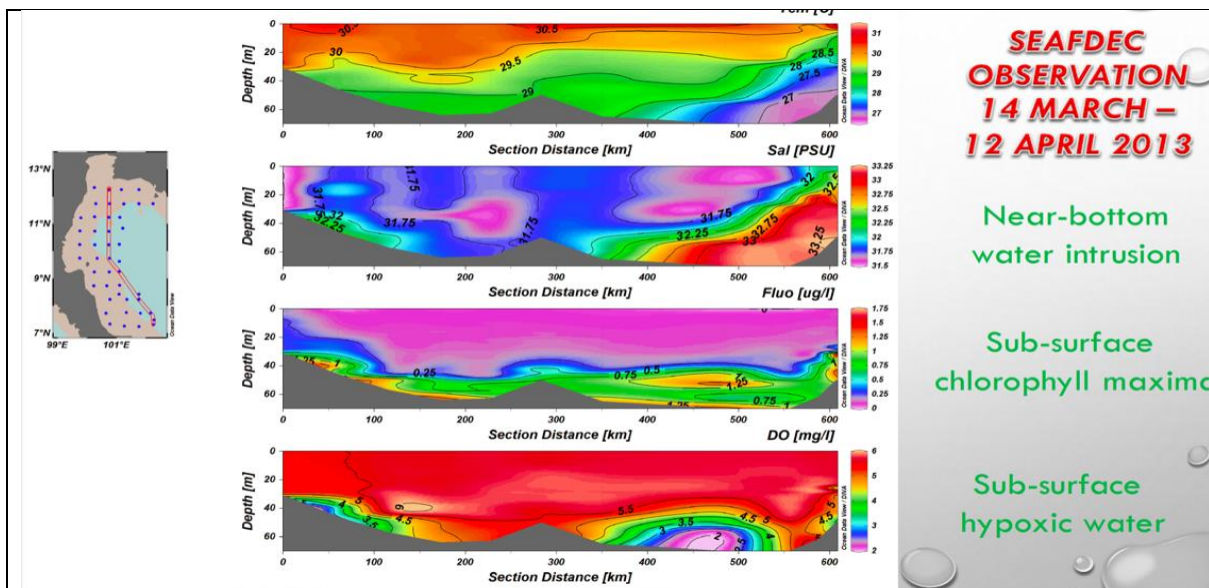
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14 MARCH – 12 APRIL 2013**



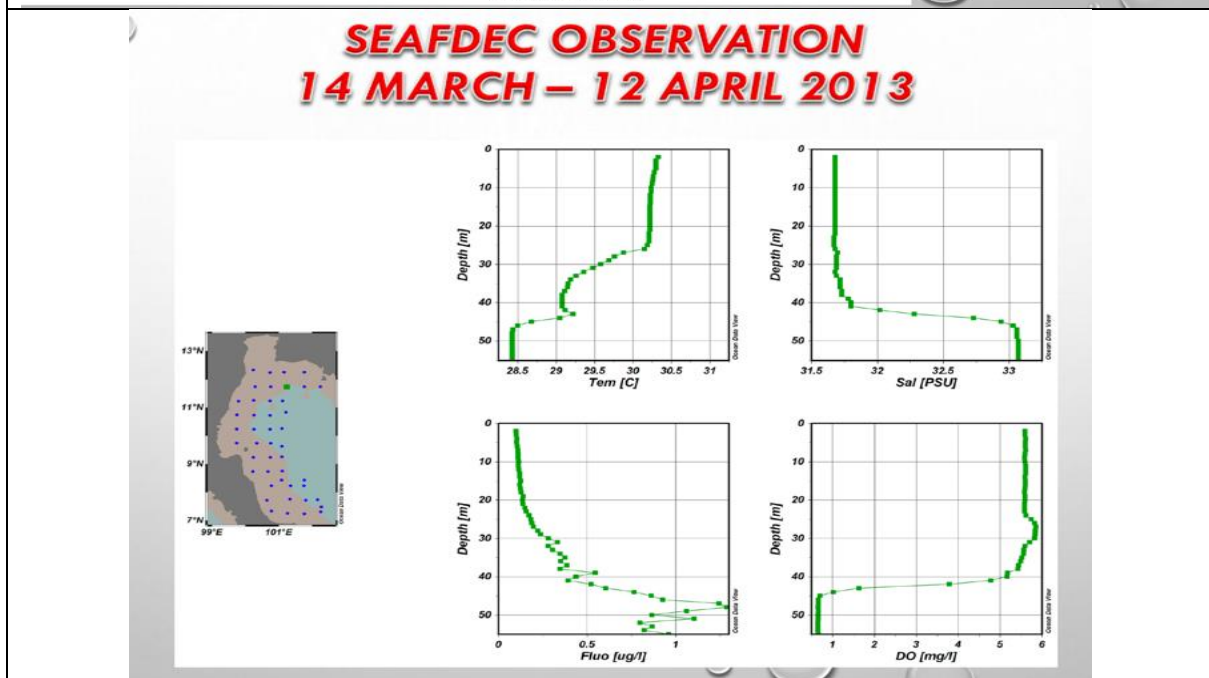
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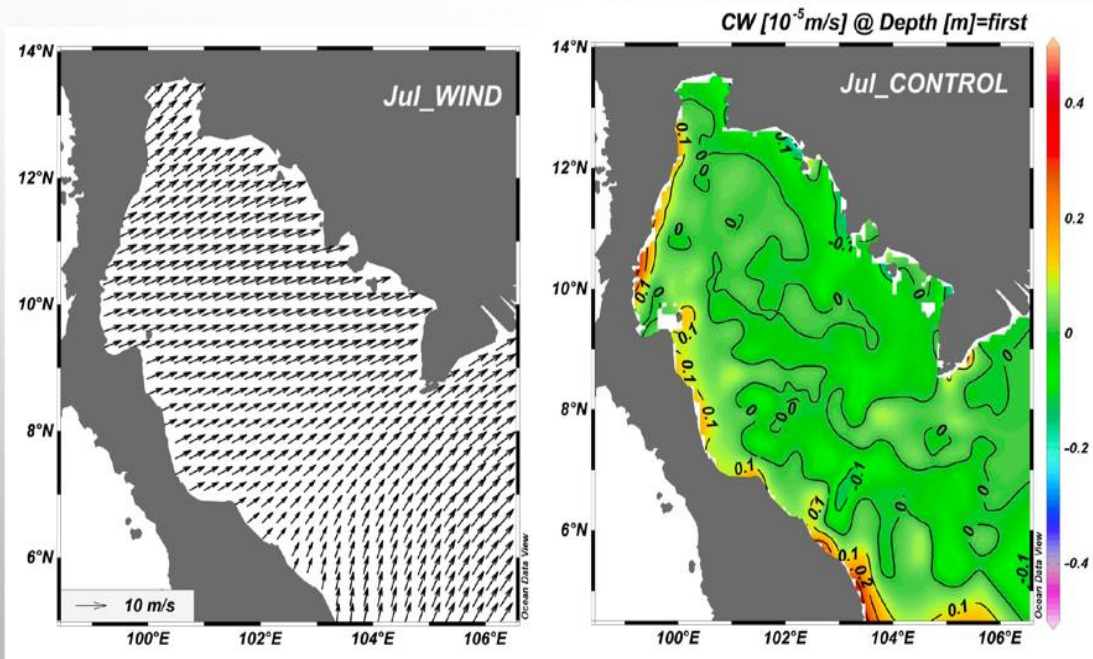


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14 MARCH - 12 APRIL 2013**

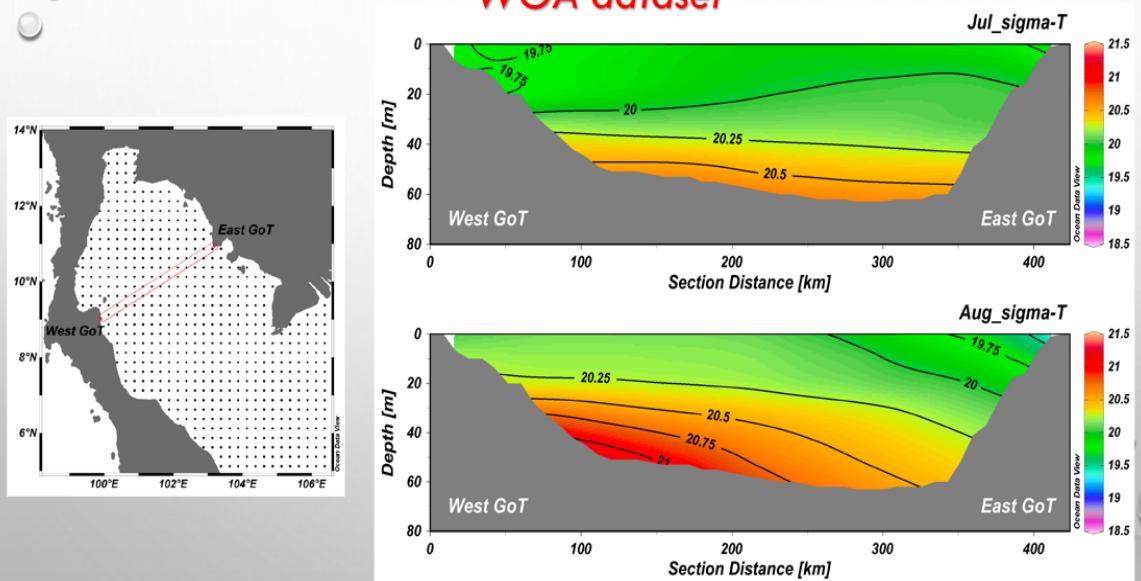


# Coastal upwelling in GoT

## Coastal upwelling along the west coast based on POM

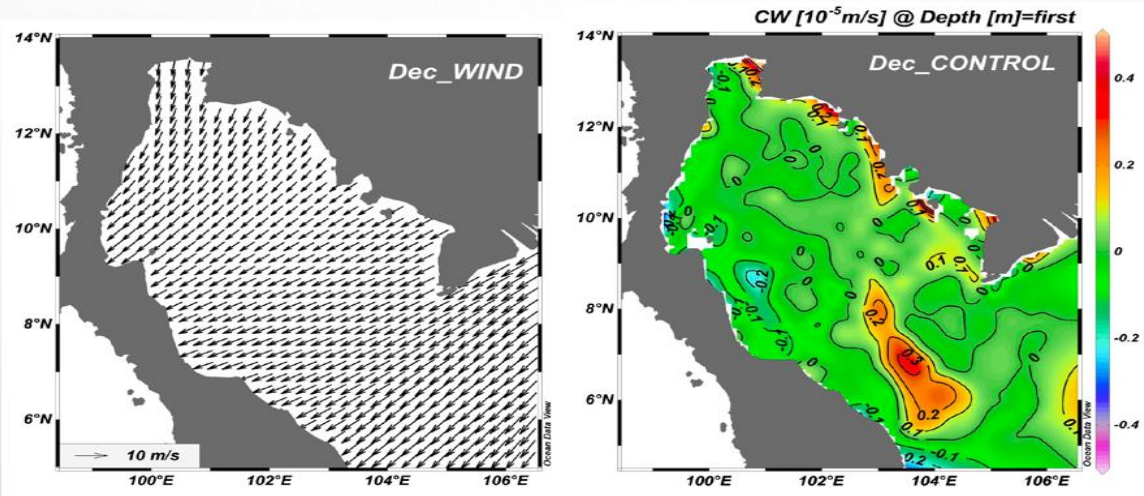


## Coastal upwelling along the west coast WOA dataset

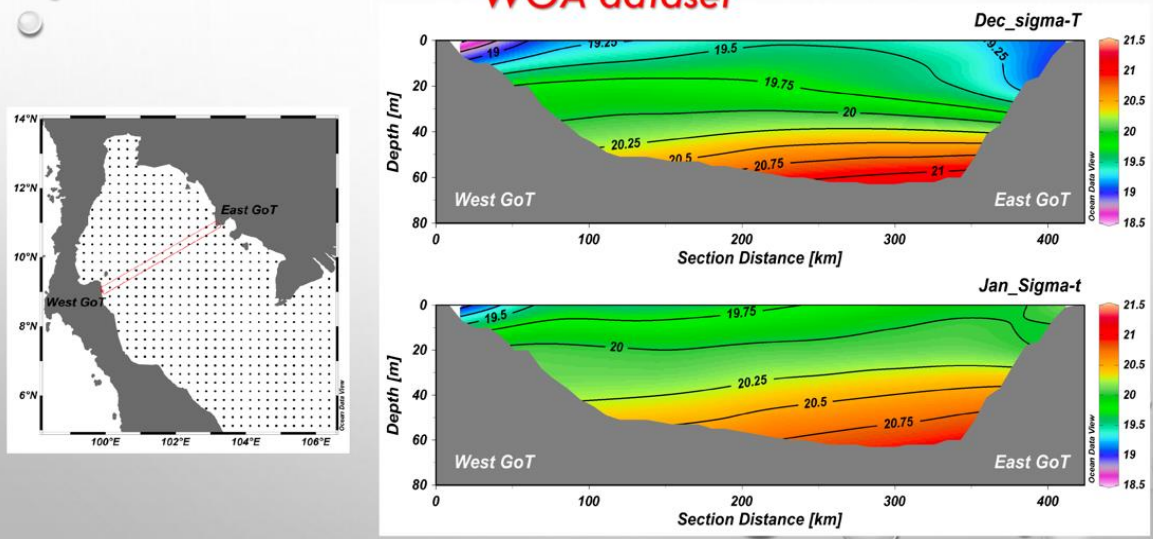




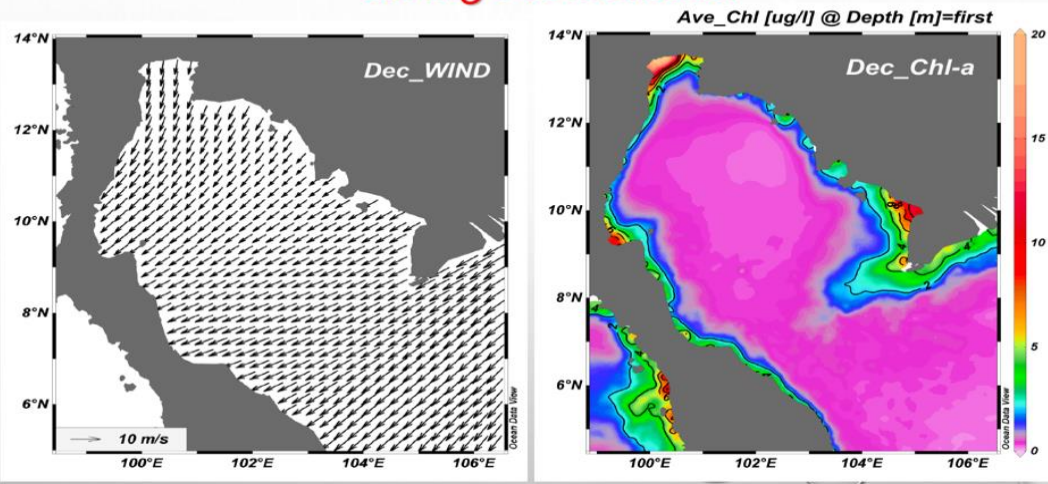
### Coastal upwelling along the east coast based on POM



### Coastal upwelling along the east coast WOA dataset

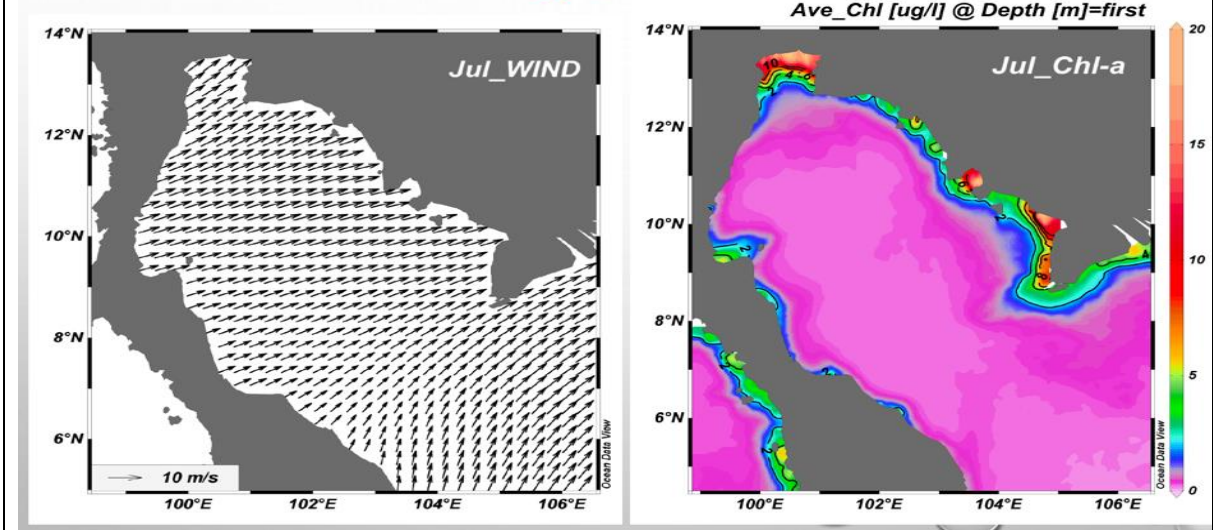


### Wind field and MODIS Chl-a during NE monsoon

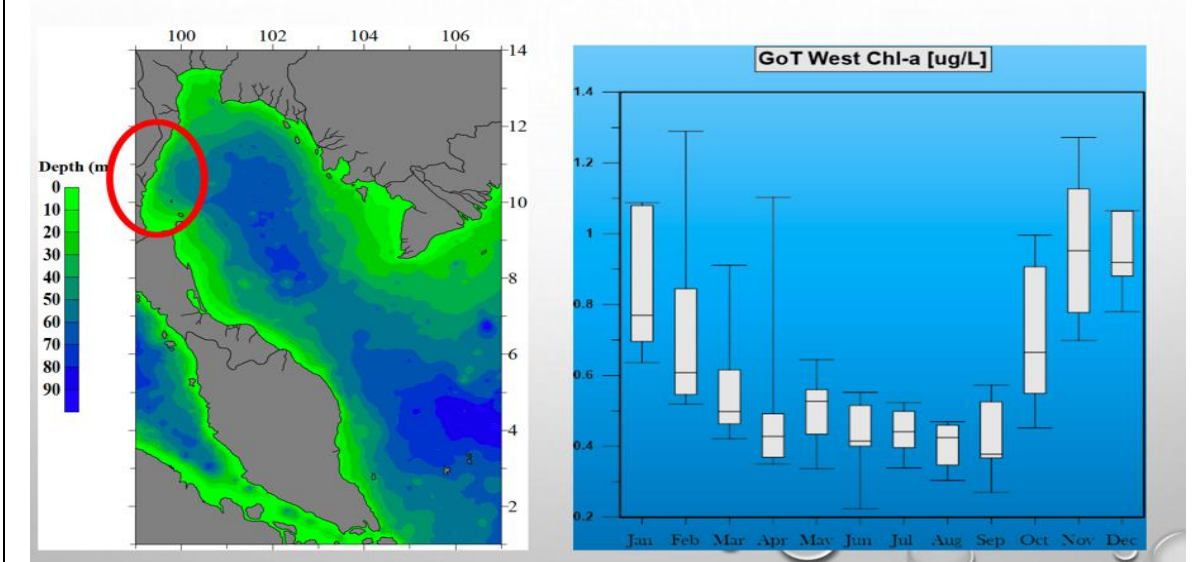




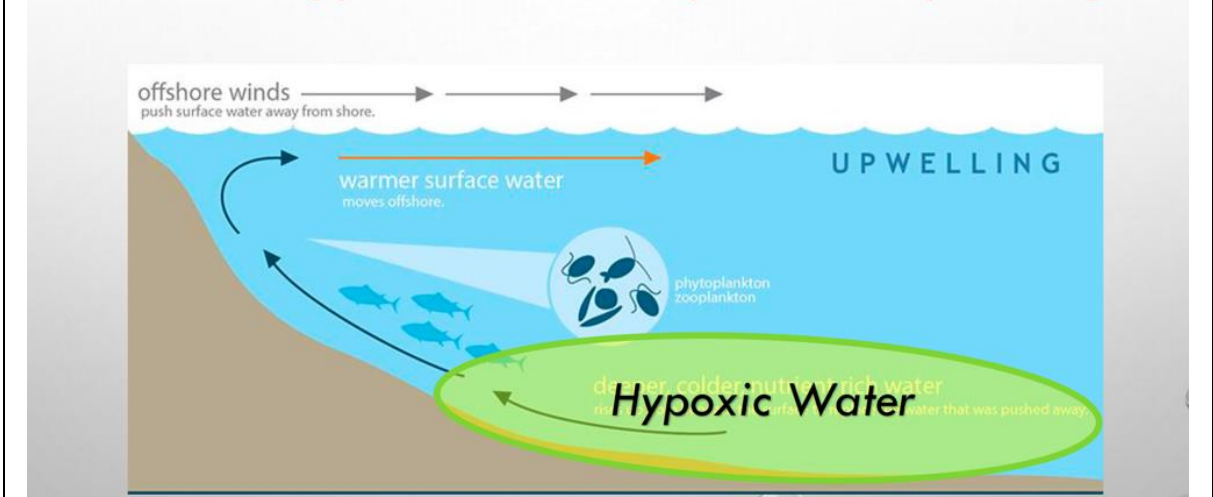
## Wind field and MODIS Chl-a during SW monsoon

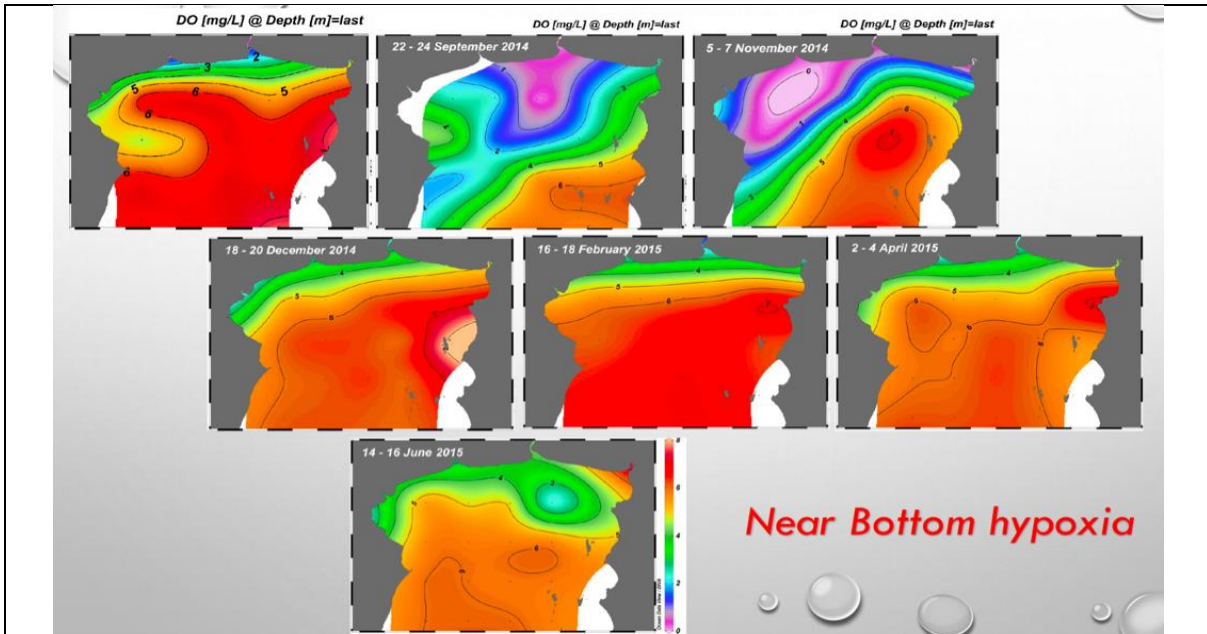


## MODIS Chl-a variations in the west coast

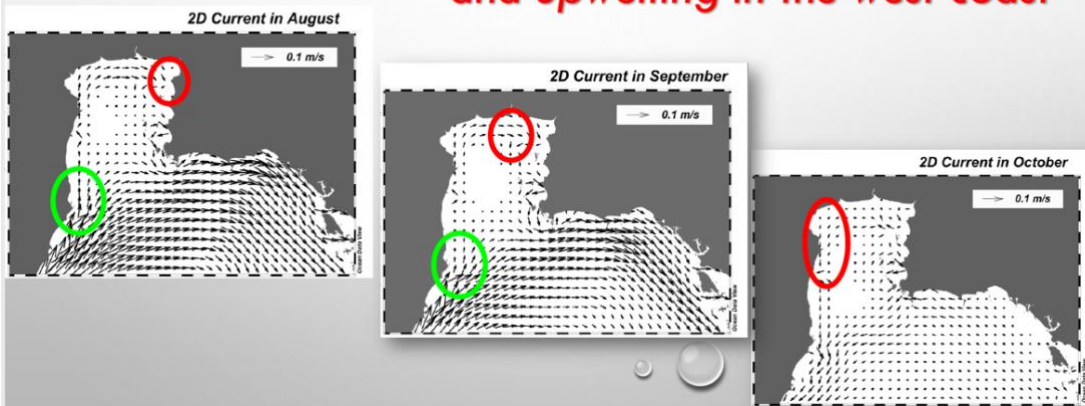


## Nearshore hypoxia induced by coastal upwelling ?

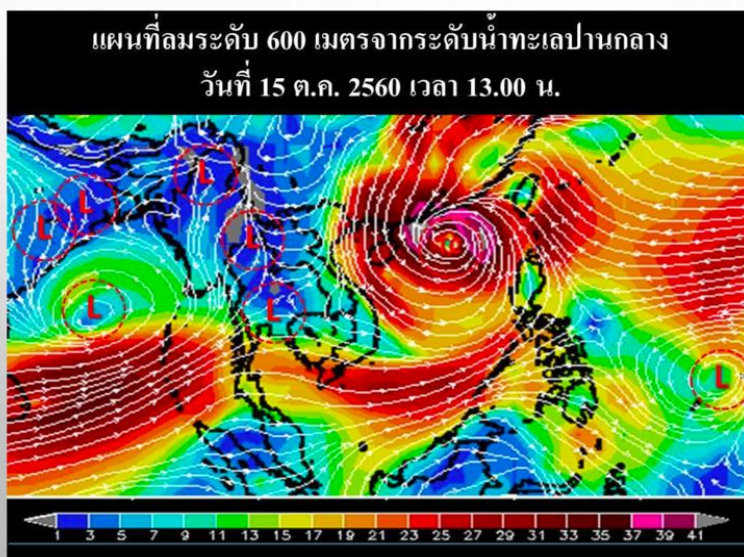




**The movement of hypoxic water mass and upwelling in the west coast**



**Wind streamline  
600 m above MSL on Oct 15, 2017**



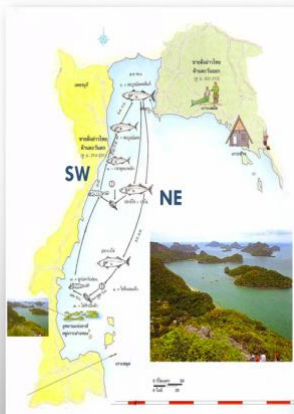




## CIRCULATION AND SHORT MACKEREL DISTRIBUTION<sup>1</sup>

<sup>1</sup>The survey results from Department of Fisheries

**Life cycle of the short mackerel**



### WHAT CONTROL THE DISTRIBUTION OF MACKEREL IN GOT?

- The spawning grounds: More than one? Where?
- Do we understand the life cycle clearly?
- Do they distribute or migrate with water circulation?
- Are oceanographic conditions important? Water column conditions? Upwelling?



## ANNEX 7 (A)

### EXISTING SCIENTIFIC KNOWLEDGE OF *R. Brachysoma (Indo-pacific Mackerel/short mackerel)*

#### I. INTRODUCTION

This paper is developed based on the inputs from 6 relevant countries on the transboundary species of *Rastrelliger Brachysoma* in the Gulf of Thailand and the South China sea sub-region. The objective of this paper is to provide the existing scientific and local knowledge and information to manager for consideration and decision on the development of the Regional Action Plan for management of this transboundary species in the sub-regions.

#### II. GENERAL INFORMATION AND CHARACTERISTICS

The Short Mackerel is a species of mackerel in the family Scombridae. It is known by some other names such as Shortbodied Mackerel, Maquereau Trapu (French), Caballa Rechoncha (Spanish), *Rastrelliger brachysoma* (scientific name) and Pla thu (Thai). It is mainly found in the shallow waters of Southeast Asia and Melanesia. And the fish is of major importance in the fisheries industry. This species is pelagic and oceanodromous and is found in estuarine habitats with slightly reduced salinities and in areas where surface temperature range between 20–30°C. It forms schools of equally sized individuals, and feeds chiefly on microzooplankton with a high phytoplankton component.

Catches of the Short Mackerel are generally either recorded as *Rastrelliger spp.* or combined with *R. kanagurta*. This fish species is the most important commercial species of mackerel in the Philippines. It is caught throughout the year with native purse seines and fish corrals in Manila Bay. In addition, This species is also importance in Thailand, Cambodia, Indonesia, Malaysia and Viet Nam. The Short Mackerel is generally sold at market at low prices. But it is a very good source of protein. And it is popular as food in it's native area.



Conservation Status

The Short Mackerel has a very deep body. It is generally of silver color, with somewhat pointed snout. Their dorsal fin is yellowish with black edge, the pectoral and pelvic fins are dusky and other fins are yellowish.



Their head is about equal to or less than their body depth. Average body length of the Short Mackerel is around 20 cm, with a maximum length of 34.5 cm. Length at 50% maturity ranges from 15–18 cm fork length (FL) (Sudjastani 1974, Isa 1986, Pairoh 1987), and has an estimated longevity of at least two years (Tandog-Edralin 1988, Isa 1986, Pairoh 1987).

### III. STOCK/POPULATION

#### CAMBODIA:

In 2018, the total catch of mackerels is 2, 984 ton in Cambodia. There are four stocks of *R. Brachysoma* in the Gulf of Thailand, i.e. Eastern, Upper, Central and Lower stocks. The genetic analysis results focused in the Trat province in Thailand where border to Cambodia showed that *R. Brachysoma* harvested off Trat province consisted of 42.48% from Cambodia, 35.63% from Malaysia and 3.86% from Viet Nam, and 18% from Thai waters.

#### INDONESIA:

Based on Marine Affairs and Fisheries Ministerial Decree No. 50 Year 2017, there is an estimation stock potency for small pelagic fish (does not specifically mentioned for *R. Brachysoma*) in Malacca Strait and Andaman Sea (those waters are grouped in Fisheries Management Zone [FMZ] 572) as amount as 99.865 tons with allowable catch 79.892 tons, and utilization rate 0.83 (categorized as fully-exploited). Suman et al, 2018, in Jurnal Kebijakan Perikanan Indonesia, mentioned that the fish stock for all species in FMZ 571 as amount as 425.444 tons in 2016.

#### MALAYSIA:

Population from Tumpat, was genetically close to the mackerel from Pattani according to the close geographical distance between the sampling localities (2018).

#### PHILIPPINES:

The Indo-pacific mackerel registered a total production of 31.17 thousand metric tons in 2018. It was 12.25 percent short of its 2017 performance of 35.52 thousand metric tons.

TABLE 2 Volume of Fisheries Production by Species: Philippines, 2016 - 2018

Species	Volume of Production (metric tons)			Percent Change		% Point
	2016	2017	2018	2017/2016	2018/2017	Contribution
<b>Fisheries</b>	<b>4,355,792.42</b>	<b>4,312,089.51</b>	<b>4,351,892.60</b>	<b>(1.00)</b>	<b>0.92</b>	<b>0.92</b>
Milkfish	402,655.07	416,363.17	400,118.78	3.40	(3.90)	(0.38)
Tilapia	300,722.50	310,974.80	321,076.58	3.41	3.25	0.23
Tiger prawn	49,254.50	46,157.00	44,884.45	(6.29)	(2.76)	(0.03)
Roundscad (Galunggong)	211,776.50	183,077.67	168,148.04	(13.55)	(8.15)	(0.35)
Skipjack (Gulyasan)	220,108.99	247,593.66	258,316.72	12.49	4.33	0.25
Yellowfin tuna (Tambakol/Bariles)	103,037.15	106,920.07	94,183.45	3.77	(11.91)	(0.29)
Seaweed	1,404,519.23	1,415,320.79	1,478,300.85	0.77	4.45	1.46
Frigate tuna (Tulingan)	133,886.39	122,074.67	111,755.82	(8.82)	(8.45)	(0.24)
Indian sardines (Tamban)	280,472.75	241,477.37	257,634.84	(13.90)	6.69	0.37
Big-eyed scad (Matangbaka)	112,826.16	109,203.03	110,724.31	(3.21)	1.39	0.04
Indian mackerel (Alumahan)	63,320.00	60,071.23	55,705.17	(5.13)	(7.27)	(0.10)
Squid (Pusit)	52,118.54	49,898.73	47,031.16	(4.26)	(5.75)	(0.07)
Mudcrab	17,845.72	18,997.85	21,678.67	6.46	14.11	0.06
Threadfin bream (Bisugo)	39,682.28	39,598.35	36,507.14	(0.21)	(7.81)	(0.07)
Fimbriated sardines (Tunsoy)	76,585.73	79,421.79	88,270.48	3.70	11.14	0.20
Anchovies (Dilis)	55,760.61	50,174.37	48,734.48	(10.02)	(2.87)	(0.03)
Indo-pacific mackerel (Hasa-hasa)	38,338.79	35,518.34	31,167.97	(7.36)	(12.25)	(0.10)
Blue crab (Alimasag)	28,616.74	31,327.61	33,963.01	9.47	8.41	0.06
Eastern little tuna (Bonito)	36,918.06	37,090.00	36,562.73	0.47	(1.42)	(0.01)
Grouper (Lapu-lapu)	17,881.70	17,482.65	17,798.63	(2.23)	1.81	0.01

Reference: Fisheries Situation Report January to December 2018 ISSN 2012-0400

#### THAILAND:

- **2016** > MSY =96,455 Tonnes at fishing effort 78,680 days
- Actual fishing status point =24,328 Tonnes at fishing effort 237,679 days
- **Fishing effort over = 66.90%**
- **2017** > MSY =123,515 Tonnes at fishing effort 58,906 days
- Actual fishing status point =12,310 Tonnes at fishing effort 208,079 days
- **Fishing effort over = 71.74%**



**VIET NAM:**

In the south western of Viet Nam, the length at first maturity for female, *R. Brachysoma* was 152,3 mm while for male was 163,2 mm. Normal length ranged from 160mm - 200mm. Sex ratio between male and female in stock is 1:1.4

**IV. FISHERIES STATUS****CAMBODIA:**

In Cambodia, the catch of mackerels had increased from 1,000 ton to 4650 ton from 1990 to 2006. In Sihanouk Province of Cambodia, there are two high catch peaks, i.e. first one in January and February; and second peak in July, September, and October. The Indo Pacific Mackerel catch composition was 86% of the total pelagic catch based on data in 2003-2004. In Kampot Province, the high peak catch is in May, June, July and September. The catch composition was 63% of the total pelagic catch in 2004. Mackerel is not only sold on the domestic market but is also exported to neighboring country both fresh and processed.

**INDONESIA:**

Suwarso et al, 2010 reported that small pelagic fish is a dominant catch fish species in South China Sea (in between Riau Archipelagoes waters and Kalimantan) with a vital decreasing rate of catch per years. Suwarso et al, 2015, BAWAL journal Vol. 7, reported that there is a shift of changing in catching areas due to decreased catch volume per years in Northern Java Sea, Indonesia. Most of the FMZs in Indonesia are in fully exploited and over-exploited status on small pelagic catch. The most critical condition is on FMZ 571 (Malacca Strait and Andaman Sea)

**MALAYSIA:**

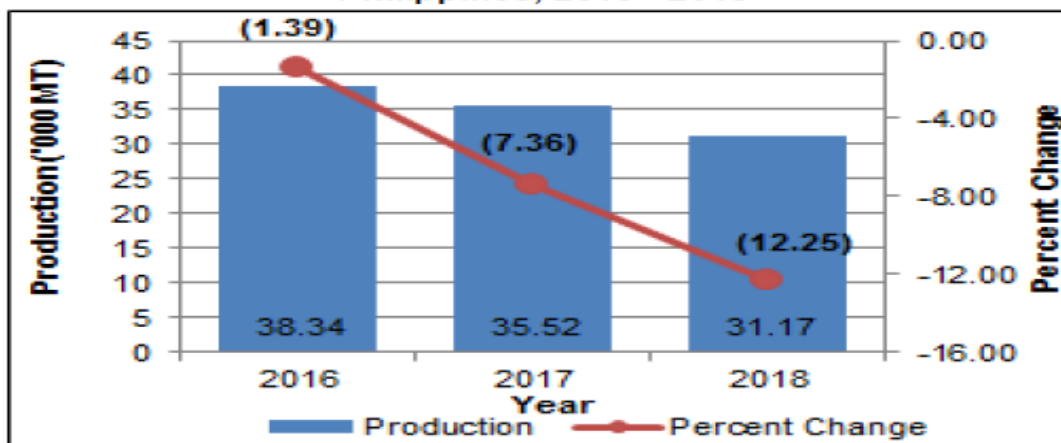
- During 2009-2015, the highest quantities of mackerel were recorded in Zone A in Kelantan and Pahang, and Zone B in Terengganu and East Johor (2016).
- small pelagic species in the east coast of Peninsular Malaysian waters are still under-exploited and sustainable which includes the Indo-Pacific mackerel (2016)
- Stable for Sustainable harvest level in the east coast of Peninsular Malaysian waters.
- The main gears used are gill nets/drift nets and purse seines and their catch is landed in the States of Kelantan, Terengganu, Pahang, and East Johor. During 2009-2015, the highest quantities of mackerel were recorded in Zone A in Kelantan and Pahang, and Zone B in Terengganu and East Johor.

State	Total Catch (MT)	Average MT/Y	Gear types (% of catch)	% of species catch according to fishing zone for 7 years (2009-2015) A (0-5 nm), B (5-12 nm), C (12-30 nm) and C2 (>30 nm)
Kelantan	941.87	134.55	Gill/drift net (7.3%) Trawler (25%) Handline (2%)	A= 74.70 B=6.62 C= 10.81 C2=7.87
Terengganu	262.15	37.45	Purse seine (44%) Trawler (36%) Gill/drift net(18%) Handline (2%)	A= 20.55 B=71.51 C= 3.37 C2=4.57
Pahang	4336.03	619.43	Gill/drift net(90%) Trawler (6%) Purse seine (3%) Others (1%)	A= 90.79 B=2.99 C= 2.13 C2=4.09
East Johor	114.99	16.41	Trawler (78%) Gill/drift net(21%) Purse seine (1%)	A= 20.67 B=44.89 C= 33.86 C2=0.58

**PHILIPPINES:**

Volume of catch continuously went down for the past three years. From a 7.36 percent drop in 2017, a higher decrease of 12.25 percent was observed in 2018. Of the total catch in 2018, 65.85 percent were unloaded in municipal fish landing centers and the rest in commercial fish landing centers. The volume of catch of indo-pacific mackerel was almost equally distributed quarterly. However, the volume was relatively higher during second and fourth quarters which represented 27.20 and 26.53 percent of the total output in 2018, respectively. Drop in production was observed in all quarters of 2018. Double digit increments of 13.51 and 17.29 percent during the second and third quarters sealed the low output in 2018, respectively.

**FIGURE 21 Volume of Indo-pacific Mackerel Production Philippines, 2016 - 2018**



Reference: Fisheries Situation Report January to December 2018 ISSN 2012-0400

**THAILAND:**

3 Main fishing gears: Purse seine 75%, Indo Pacific Mackerel encircling gill net 19 %, Indo Pacific Mackerel gill net 3%, and Other < 1%. Total catch of Indo Pacific Mackerel is decreasing trend during 2015 – 2018.

**VIET NAM:**

In the southwest monsoon (from May to October), the total biomass estimated at 264 thousand tons, and the total allowable catch (TAC) 106 thousand tons (Nghia *et al.*, 2007. RIMF). In addition, In the northeast monsoon (from November to April the following year), the mackerel species biomass about 169 thousand tons and TAC: 87 thousand tons (Nghia *et al.*, 2007. RIMF).

## V. MAPPING AND HABITAT LINKAGES, SPAWNING, NURSERY GROUNDS

**CAMBODIA:**

- The major fishing areas of mackerel in Cambodia including Koh Rong, Koh Thas, Koh Roeusey, Koh Takiev, Koh Thmey, Koh Ses and other small islands archipelago and in Kampong Som bay inshore and offshore such as Koh Rong Sanlem, Koh Tang, Koh Pring and Koh Poulowai archipelagoes. During rainy season, this species is caught in inshore area such as near Koh Daekol, Koh Pours, Koh Thas, in front of Thmorsor and Stoeung Hav areas in Preah Sihanouk province by trawlers and caught by gillnets, push nets and small trawlers which operating near shore in Kampot and Kep provinces.
- Cambodia's offshore waters are considered as important spawning and nursing grounds for regional stocks of Indo Pacific mackerel. The spawning of this species may occur throughout the year with peaks of spawning from February to May. Males were slightly more abundant

than females. The processors of steamed mackerel fish in Preah Sihanouk province observe that during Jan-Apr the steamed fish always break its belly because egg is bigger and this period is not good for this processing.

#### INDONESIA:

- The distribution of the species in Indonesia is largely concentrated in coastal waters of Kalimantan, West Sumatra, Java Sea, Malacca Strait, South-east Sulawesi (District Muna - Buton) and Arafura Sea (dunia-perairan.com).
- Based on Suwarso et al, 2015, Jurnal Kebijakan Perikanan Indonesia, the spawning season for the species is estimated on October to November in Northern Java Sea.
- Jannati et al, 2016, <https://repository.ipb.ac.id/handle/123456789/86212> mentioned that spawning season of the species in Sunda Strait is estimated on April as a start, and August as the peak.

#### MALAYSIA:

Require the element for resource mapping for management; comprising for spawning ground, nursing ground and fishing ground and identification of egg and larvae hotspots.

#### PHILIPPINES:

- Known Critical Spawning and Nursery Areas for Significant Fish Species in the Philippines: Short mackerel (*Rastrelliger brachysoma*)
  1. Lingayen Gulf 16°12'42" – 120°08'17"
  2. Batangas Coast 13°39'N – 120°44'E
- Species of transboundary significance and their recorded occurrences in waters of the South China Sea side of the Philippines: Short mackerel (*Rastrelliger brachysoma*)\*
  1. Bauang,
  2. La Union;
  3. Manila Bay;
  4. Calapan, Mindoro

\*Reference: Barut, Noel. NATIONAL REPORT on The Fish Stocks and Habitats of Regional, Global, and Transboundary Significance in the South China Sea PHILIPPINES. National Fisheries Research and Development Institute. Department of Agriculture. 940 Kayumanggi Press Building, Quezon Avenue, Quezon City 1103, Philippines

- Key spawning areas (ichthyoplankton) in South China Sea\*\* are:
  - (a) Malampaya Sound;
  - (b) the western portion of Lingayen Gulf;
  - (c) Mindoro Strait; and
  - (d) Northern Palawan including the Calamianes Islands.

It is also believed that Scarborough Shoal and the Kalayaan Island Group are major sources of propagules for the country's archipelagic waters and fishing grounds, although comparable information (e.g. ichthyoplankton) for use in undertaking a more definitive examination are lacking.

\*\*Reference: <https://fisheries-refugia.org/philippines-background/93-refugia-country-activities/philippines/background-philippines/161-known-areas-philippines>

- Locations on the South China Sea Coast of the Philippines that important pelagic species utilize for spawning (compiled by Mr. Noel Barut, Fisheries Focal Point for the Philippines)

Country	Geographical Location	Important Pelagic Species that Utilise the Area for Spawning	Fishing Gears and Practices Used in the Area	Existing Fisheries Management Measures in the Area
Philippines	Busuanga, Coron, Cullion and Tayaty Palawan; along South China Sea	Sharks, rays, garfish, hemiramphus, mackerels, scads, belonidae, salmon, fusiliers, sardines, milkfish, garfish, herrings, penaeid shrimps, rabbitfish, mullet, anchovies, carangidae families, scombroids; hawksbill & green sea turtle; bottlenose & irrawady dolphin, sea cow		Marine reserve Marine park
Philippines	Mabini and San Juan, Batangas; South China Sea	Anchovy, jacks, mackerels, tunas, dogtooth and yellowfin tuna, rays, remora, sailfish, flying fish, halfbeak, herring, sardines, salmon, golden trevally, barracuda, fusiliers		Marine reserve Marine park
Philippines	Bolinao and Anda, Pangasinan; along South China Sea	Anchovies, herrings, sardines, salmon, tuna, rays, sharks, sailfish, fusiliers, barracuda		Marine reserve Marine park

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#### THAILAND:

- The populations are genetically different to each other in moderate level.
- Mixed Stock Analysis (MSA) , Samut Songkhram 42.81%, Trat 34.38%, Surat Thani 21.60%, Prachuap Khiri Khan 1.21%
- The life cycle; Distribution - along the coastal, less than 50 m. depth. Spawning season – all year and Spawning grounds – the middle of the GoT (off Prachuap KiriKhan, Chumphon and Surat Thani provinces.
- Gravid fish move from the inner Gulf to spawn in the middle Gulf.
- Fertilized eggs float in areas of 20-30 m. in depth.
- Juveniles move to the inner Gulf.

#### VIET NAM:

- XXXX

## VI. EXISTING LEGAL/MANAGEMENT MEASURES

#### CAMBODIA:

- Mackerels catching is banned from 15 January to 31 March of each year according to Fisheries Law of Cambodia

#### INDONESIA:

- Law No. 31 Year 2004 on Fisheries, a law in governing the fisheries sector within its all aspects.
- Marine Affairs and Fisheries Ministerial Regulation No. 18 Year 2014 for Fisheries Management Zone governs the management of the fisheries zone in Indonesia.
- Marine Affairs and Fisheries Ministerial Decree No. 50 Year 2017 for allowable catch and rate of utilization to all commercially recognized species (not specifically mentioned the species - *Rastrelliger Brachysoma*).
- Trade Ministerial Regulation No. 66 Year 2018 on Fisheries Import Requirements governs the arrangement on importing fish and its product (not specifically mentioned the species).
- No specific regulation under Ministerial decree or regulation on the species.

**MALAYSIA:**

- Prohibiting the use of some commercial gears during the closed season and protecting the nursery ground by enforcement.
- While management measures are in place for local mackerel stock, there is none for the transboundary stocks as much information is still needed to confirm.

**PHILIPPINES:**

- DA-DILG JAO Order No. 2, s. 2014 - Establishing a closed season for the conservation of small pelagic in Davao Gulf.
- FAO No. 167 – Establishing of closed season for the conservation of sardines, herrings and mackerels in the Visayan Sea.
- Reference: <https://www.bfar.da.gov.ph/LAW>

**THAILAND:**

- Closed season
- Closed area
- During 15Feb-15May to conserve gravid fish and juveniles in the Gulf of Thailand.
- Control Fishing licenses, Fishing zone, and Gear restriction

**VIET NAM:**

- Indo-Pacific mackerel together with continued links to existing cooperation transboundary species among Gulf of Thailand countries.
- Existing data/information in support of improved understanding of stock status as well as to provide the basis for appropriate fisheries management measures (focus on fishing effort regulation).
- Fisheries Laws (2003)
- Strategy and Master Plan for Sustainable Fisheries Development to 2020 approved by the Government (2013).
- NPOA of IUU and Fishing Capacity Management are being drafted.
- Viet Nam became a Cooperating Non-Member of WCPFC since 2009 and thus legal and policy arrangements have also being reviewed in the light of WCPFC's requirements.
- UNCLOS ratified by Vietnamese Government in 1994 is used as basis for fisheries management arrangements.
- Member of RPOA



ANNEX 8 (B)

The Inputs from Countries and Research Institutions As of 10 September 2019

No.	Questions	THAILAND	CAMBODIA	MALAYSIA	PHILIPPINES	SEAFDEC/IFRDM
1	To achieve a <i>sustainably management of Rastrelliger brachysoma resources in national EEZ and at Sub-regions (GoT/SCS)</i> , what are the issues/knowledge gaps/scientific questions/priority areas should be addressed based on your opinion/expertise and country requirements.	<p><b>National level:</b></p> <ul style="list-style-type: none"> <li>• small size identification</li> <li>• study on otolith (to know age of fish)</li> <li>• DNA study</li> <li>• restudy on migratory route, spawning ground (to recheck)</li> </ul>	<p><b>National level:</b></p> <ul style="list-style-type: none"> <li>• Conduct study to collect both data capture production and biology</li> <li>• Regular monitor data collection on capture production</li> </ul>	<p><b>National level:</b></p> <ul style="list-style-type: none"> <li>• Stock status of <i>R brachysoma</i> in SCS</li> <li>• Genetic assessment <i>R brachysoma</i> in SCS</li> <li>• Spawning season on <i>R brachysoma</i> in SCS</li> <li>• Malaysia is in the process of fisheries resource management through Fisheries Management Plan.</li> </ul>	<p><b>National level:</b></p> <ol style="list-style-type: none"> <li>1. Stock status (Distributions and Abundance)</li> <li>2. Population dynamics (Growth parameters, mortalities and relationship to other regional stock)</li> <li>3. Effects/Loss to IUUF (esp. poaching)</li> <li>4. Review on effectiveness of regulations</li> </ol>	<p><b>National level:</b></p> <ul style="list-style-type: none"> <li>• Stock status</li> <li>• Actual effort to exploit the resources</li> <li>• Spawning grounds</li> </ul>
2	Please elaborate on the roles of the four cross-cutting themes in addressing these science questions to <b>support the future actions on RAP if any.</b> a. <i>Capacity building and technology transfer</i>	<p><b>Sub-regional level:</b></p> <ul style="list-style-type: none"> <li>• data collection needs to standardize (before combine the data)</li> <li>• stock assessment for transboundary species</li> <li>• study on migratory route, spawning ground</li> </ul> <p>■ DNA</p> <p>■ Otolith</p> <p>■ Data collection (make the same standard in each country)</p> <p>■ Stock assessment for transboundary species</p>	<p><b>Sub-regional level:</b></p> <ul style="list-style-type: none"> <li>• Continues transboundary management mechanism</li> </ul>	<p><b>Sub-regional level:</b></p> <ul style="list-style-type: none"> <li>• Insufficient biology and landing data collection</li> </ul>	<p><b>Sub-regional level:</b></p> <ol style="list-style-type: none"> <li>1. Transboundary distributions/migration patterns (<i>spawning, etc</i>)</li> <li>2. Population dynamics</li> <li>3. Review of existing regulations</li> <li>4. Population structure (regional)</li> </ol>	<p><b>Sub-regional level:</b></p> <ul style="list-style-type: none"> <li>• Stock structure (shared or not)</li> <li>• Multi gear to harvest</li> <li>• Data sharing</li> <li>• Migratory species</li> <li>• Regional stock status</li> <li>• Lack of management body</li> </ul>
		<p>■ Provide knowledge on identification of species, biology and analysis</p>	<p>• To strengthen capacity building on fish stock identification, stock assessment, genetic study, fishing gear technology, database-software.</p> <p>• Traceability system using technology-</p>	<p>• Improved capacities among countries (i.e. stock assessment, data collection, enforcement, etc) will harmonize management strategies and measures for the stock.</p>	<p>• Data collation</p> <p>• Data Analyses</p> <p>• Modeling</p>	

					logbook			
	<i>b. Potential Partnerships (at country, Regional and international)</i>	<ul style="list-style-type: none"> <li>• University</li> <li>• Scientist among regional country</li> <li>• SEAFDEC</li> </ul>	<ul style="list-style-type: none"> <li>▪ Cooperation at regional level</li> </ul>		<ul style="list-style-type: none"> <li>• Collaboration among AMS/regional action bodies (GEF, IOTC), universities.</li> </ul>	<p>The partnership may develop co-management schemes/arrangements.</p>	<ul style="list-style-type: none"> <li>• Local university</li> <li>• FRI</li> <li>• Hokkaido University</li> <li>..</li> </ul>	
	<i>c. Access to information, data and knowledge (such as satellite data, regional production data/statistic, ocean data simulation, etc)</i>	<ul style="list-style-type: none"> <li>▪ Regional fisheries statistic data (SEAFDEC)</li> <li>▪ Water quality data from Pollution Control Department</li> </ul>	<ul style="list-style-type: none"> <li>▪ N/a</li> </ul>	<ul style="list-style-type: none"> <li>• To share/develop existing database (e.g. trawl base).</li> </ul>	<ol style="list-style-type: none"> <li>1. This will improve management of the transboundary stock by access to data which will be useful in the collective assessment in the region.</li> <li>2. This will also result to a more realistic/reliable</li> </ol>		<ul style="list-style-type: none"> <li>•</li> </ul>	
	<i>a. Communication and awareness raising</i>	<ul style="list-style-type: none"> <li>• Educate people and student in fisheries communities</li> <li>• Distribute brochures or any media to promote of fisheries management</li> <li>• Raise awareness of both small-scale fishers and commercial fishers</li> </ul>	<ul style="list-style-type: none"> <li>▪ Result of the study will be provided to both policy management level and fisherman.</li> </ul>	<ul style="list-style-type: none"> <li>• To develop consultation among researchers, managers and stakeholders (EAFM).</li> </ul>	<ul style="list-style-type: none"> <li>• <u>This activities</u> will improve participation among all stakeholders on responsible practices</li> </ul>	<ul style="list-style-type: none"> <li>• Sustainable management concept</li> <li>• Co-management</li> <li>• EAFM</li> </ul>		

ANNEX 9 (C)  
SUMMARY ON ISSUES AND GAPS

No.	Questions	INPUTS FROM CAM, MY, TH, PH, MFRDMD
1	<p>To achieve a <u>sustainably management of <i>Rastrelliger brachysoma</i> resources in national EEZ and at Sub-regions (GoT/SCS)</u>, what are the issues/knowledge gaps/scientific questions/priority areas should be addressed based on your opinion/expertise and country requirements.</p>	<p><b>National level:</b></p> <ul style="list-style-type: none"> <li>• Insufficient data on population and abundance</li> <li>• small size (juvenile) identification</li> <li>• study on otolith (to know age of fish)</li> <li>• DNA study</li> <li>• restudy on migratory route, spawning ground (to recheck)</li> <li>• conduct study to collect both data capture production and biology</li> <li>• Regular monitor data collection on capture production</li> <li>• Stock status of <i>R brachysoma</i> (distribution and abundance)</li> <li>• Population dynamics (Growth parameters, mortalities and relationship to other regional stock)</li> <li>• Spawning grounds and season on <i>R brachysoma</i> in SCS</li> <li>• Fisheries Management Plan</li> <li>• Effects/Loss to IUUF (esp. poaching)</li> <li>• Review on existing and effectiveness of regulations</li> <li>• Actual effort to exploit the resources</li> <li>• develop co-management schemes/arrangements.</li> <li>• Climate change impacts to fisheries</li> </ul> <p><b>Sub-regional level:</b></p> <ul style="list-style-type: none"> <li>• data collection needs to standardize (before combine the data)</li> <li>• stock assessment for transboundary species</li> <li>• Population dynamics</li> <li>• Stock structure</li> <li>• study on migratory route, spawning ground</li> <li>• Transboundary distributions</li> <li>• transboundary management mechanism/plan</li> <li>• Insufficient biology and landing data collection</li> <li>• Data sharing</li> <li>• Lack of management body</li> <li>• <b>Multi gear to harvest</b></li> </ul>
2	<p>Please elaborate on the roles of the four cross-cutting themes in addressing these science questions to <b>support the future actions on RAP if any</b></p>	<ul style="list-style-type: none"> <li>▪ DNA study</li> <li>▪ Otolith</li> <li>▪ Data collection (make the same standard in each country)</li> <li>▪ Data analysis</li> <li>▪ Stock assessment for transboundary species</li> <li>▪ Modeling for stock assessment</li> <li>▪ knowledge on identification of species, biology and analysis</li> <li>▪ fishing gear technology,</li> </ul>

	<p><i>A. Capacity building and technology transfer</i></p>	<ul style="list-style-type: none"> <li>▪ database- software.</li> <li>▪ Traceability system using technology-logbook</li> </ul> <p><b>Role of partnership:</b></p> <ul style="list-style-type: none"> <li>▪ Improved capacities among countries (i.e. stock assessment, data collection, enforcement, etc) will harmonize management strategies and measures for the stock.</li> </ul>
	<p><i>B. Potential Partnerships (at country, Regional and international)</i></p>	<ul style="list-style-type: none"> <li>• University</li> <li>• Scientist among regional country</li> <li>• SEAFDEC</li> <li>• AMS</li> <li>• Regional Action bodies: GEF, IOTC</li> <li>• Hokkaido University</li> <li>• National Fisheries Research Institutions</li> </ul> <p><b>Role of partnership:</b></p> <ul style="list-style-type: none"> <li>• This will improve management of the transboundary stock by access to data which will be useful in the collective assessment in the region.</li> <li>• This will also result to a more realistic/reliable</li> </ul>
	<p><i>C. Access to information, data and knowledge</i> (such as satellite data, regional production data/statistic, ocean data simulation, etc)</p>	<ul style="list-style-type: none"> <li>▪ Regional fisheries statistic data (SEAFDEC)</li> <li>▪ Water quality data from Pollution Control Department</li> <li>▪ Trawl base</li> <li>▪ Ocean Forecasting system (e.g. IOC/WESTPAC, SEAGOOS, etc.</li> </ul> <p><b>Role of partnership</b></p> <ul style="list-style-type: none"> <li>▪ This activity will improve participation among all stakeholders on responsible practices</li> </ul>
	<p><i>D. Communication and awareness raising</i></p>	<ul style="list-style-type: none"> <li>• Educate people and student in fisheries communities</li> <li>• Distribute brochures or any media to promote of fisheries management</li> <li>• Raise awareness of both small-scale fishers and commercial fishers</li> <li>• Sharing of the findings to both policy management level and fishermen</li> <li>• develop consultation among researchers, managers and stakeholders (EAFM)</li> <li>• support the Sustainable management concept, Co-management, and EAFM.</li> </ul>





## ANNEX 10

## BRAINSTROMING SESSION

*R. Brachysoma (Indo-pacific Mackerel/short mackerel)*

## IDENTIFY ACTIONS BASED ON ISSUES/KNOWLEDGE GAPS

Knowledge Gaps/Issues	Actions
<b>1. ECOSYSTEM DIMENSION</b>	
Migratory route	To further define and confirm the migratory route at national, sub-regional or regional area (E) Conduct tagging program, e-DNA, DNA (E)
Spawning and nursery grounds (including dispersion and distribution of fish larvae)	Conduct the comprehensive larvae survey (e.g ichthyoplankton (E)
Seasonal changes	Conduct the comprehensive larvae survey (e.g ichthyoplankton (E) Conduct the reproductive biology (E)
Ocean circulation	Work with a potential partner (E) Develop Oceanographic modelling
Physical and chemical water parameter	Conduct oceanography survey (E)
Stock structure	Conduct DNA study, Otolith, tagging, etc)
Stock status at national and regional of R brachysoma (distribution and abundance)	Conduct stock assessment at national, sub-regional or regional level Share information from the findings of scientific research to both fisheries managers and fishers Capacity building and experts exchange Standardized data collection for regional stock assessment Develop modeling for stock assessment
Species Identification	Provide capacity building on species identification of small size (juvenile) and larval fishes
Status and Trends	Investigate the trend of short mackerel catch at national, sub-regional levels
Population dynamics (Growth parameters, mortalities etc.	Conduct survey on fisheries biology
Impact of fishing effort on stock structure (Multi-fishing gears to harvest)	Conduct study on impact of fishing effort on stock structure (Multi-fishing gears to harvest) to improve the fishery management Enhance Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)
Stock assessment and distributions for transboundary species	Enhance the cooperation for information sharing among the bordering countries
Sensitivity of species on environment change (pollution, climate change, etc.)	Conduct study on sensitivity of species on environment change (pollution, climate change, etc) to support the management response Study on the critical habitats (spawning and grounds) Study effect of environmental changes on the migratory pattern and spawning patterns Data sharing (assign focal person to share information)
<b>2. SOCIAL DIMENSION</b>	

Social and economic at local and national level	Conduct a baseline survey based on available information on social and economic at local and national level (S)
Traditional fishing (indigenous knowledge and social responsibility)	Improve and disseminate the best practice to other (indigenous people)
People engagement in fishery activity (include small scale fishery and large scale/commercial fishery, processing)	Conduct stakeholder analysis for understanding the important and influence of stakeholder in various level
People engagement in policy making (fisherfolk organization, academy, private sector,	Promote Public Private Partnership
	Promote multi stakeholder engagement in policy making
Social structure (community small scale and large scale, gender, migrant labor, and fisher)	Encourage gender equality based on understanding of social structure in community
Conflict on land and resource use	Promote stakeholder consultation
	Promote marine spatial planning and coastal zone management
Awareness	Distribute brochures or any media (e.g. digital media) to promote fisheries management and regulations
	Capacity building and experts exchange
	Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)
<b>3. ECONOMIC DIMENSION</b>	
Funding	To ensure the national government commitment for long-term funding and support
	Explore various potential donor
	Promote capital access through micro finance scheme
	Promote corporate social responsibility
Structure and ownership of asset within the fishing industry (large and small scale)	Review structure and ownership of asset within the fishing industry (large and small scale) for management responses
Benefit and economic return and unequal distribution	Assess benefit and economic return throughout the value chain
Increase of cost (fuel and other inputs)	To ensure the fuel and other input exist for local fishermen
Fisheries employment revenue	To create the alternative work
	Require the contract among people engage in fishing
<b>4. GOVERNANCE DIMENSION</b>	
Insufficient catch and landing data	Develop the SOP/technical guidance for data collection (including catch data, biological data, (G)
	To further develop catch documentation- <del>(G)</del>
	Harmonization/ <del>standardized</del> on data collection and develop database system (G)
Insufficient biological data collection	Conduct capacity building program for data collection to enumerator and scientist, researchers (G)
	Conduct time series data collection with standardized method (G)
Fishing effort (include commercial and small scale)	Link to the catch documentation include commercial and small-scale fishery (as available) (G)
	Regular monitor data collection on fishing effort capture production (include commercial and small scale) (G)
Fisheries Management Mechanism (including fisheries management plan	Develop fisheries management plan for short mackerel at national and sub-regional level

and arrangement, the effective of regulation)	Establish regional cooperation on monitoring, control and surveillance
	Raise awareness of both small-scale fishers and commercial-scale fishers <ul style="list-style-type: none"> <li>○ Policy and regulations</li> <li>○ Management measures</li> <li>○ Sustainable utilization</li> </ul>
	Promote stakeholder consultation among researchers, managers and stakeholders using EAFM
Understanding national law and regulations	Comparative review of national law and regulations
	Disseminate knowledge and information on the conservation and management of Indo-pacific mackerel to fisheries communities and students
Flexibility of regulation to respond to science advise	Encourage periodic evaluation of policy and regulation
Management schemes/arrangements including transboundary aspects.	Develop management schemes/arrangements at sub-regional area including transboundary aspects
	Support establishment of regional cooperation/management mechanism (non-legal binding and scientific advisory committee)
Unregulated and Unreported Fishing	Assessing the impact of Unregulated and Unreported Fishing
	Defining the illegal fishing
Traceability system for fish and fishery product (using electronic logbook, etc)	Develop the catch documentation that suitable for traceability system e.g. electronic logbook, etc
<b>5. CLIMATE CHANGE DIMENSION</b>	
IMPACT of climate change to fish migration route	Assess the impact of climate change/disaster/anthropogenic activities to fish migration route, habitat and behavior (5)
	Share information from the findings of scientific research to both fisheries managers and fishers (1,4,5)
	Study effect of environmental changes on the migratory pattern and spawning patterns (1,5)





## ANNEX 11

Regional Action Plan for Management of *Rastrelliger brachysoma*  
in Gulf of Thailand Sub-region**GOAL (proposed)**

1. Sustainable Indo-pacific mackerel fisheries in the Gulf of Thailand sub-region through holistic management approach by 2030

**OUTCOME**

1. Sustainability of short mackerel resources through the implementation of fishery management plan
2. Accurate and comprehensive information for short mackerel make available and use for management responses
3. Well-being of people engaged in short mackerel fishery sustained

The template for the development of management plan for short mackerel applicable for other small pelagic species

<b>1) GOVERNANCE DIMENSION</b>	<p><b>Overall Objective:</b> Regional/sub regional fisheries management mechanism are in place building upon from national regulation and management scheme</p> <p><b>Specific Objectives</b></p> <ol style="list-style-type: none"> <li>1) Fisheries Management Mechanism developed and approved (including fisheries management plan and arrangement, the effective of regulation)</li> <li>2) Data management system are enhanced and considered regional/sub-regional standardization data management system in place</li> <li>3) Standard for assessing fishing effort large, medium and small-scale fishery agreed</li> <li>4) Understandings on national law and management schemes within the sub-regional are communicated and applied</li> <li>5) Impact of unregulated and unreported fishing assessed</li> <li>6) Catch documentation system applied as a tool to improve traceability of the short mackerel fishery</li> </ol>		
Knowledge Gaps/Issues	Actions	Sp.Obj	Responsibility
Insufficient catch and landing data	Develop the SOP/technical guidance for data collection (including catch data, biological data)	2	SEAFDEC University Government agency
	To further develop catch documentation	2	
	Harmonization/standardized on data collection and develop database system	2	Fishery research institute
Insufficient biological data collection	Conduct capacity building program for data collection to enumerator and scientist, researchers	3	SEAFDEC University Government agency Fishery research institute
	Conduct time series data collection with standardized method	3	

Fishing effort (include commercial and small scale)	Link to the catch documentation include commercial and small-scale fishery (as available)	4	Government and Private sector
	Regular monitor data collection on fishing effort capture production (include commercial and small scale)	4	
Fisheries Management Mechanism (including fisheries management plan and arrangement, the effective of regulation)	Develop fisheries management plan for short mackerel at national and sub-regional level	1	SEAFDEC University Government agency Fishery research institute All stakeholder (fishers, others)
	Establish regional cooperation on monitoring, control and surveillance	1	Existing national MCS partners/network
	Raise awareness of both small-scale fishers and commercial-scale fishers <ul style="list-style-type: none"> <li>○ Policy and regulations</li> <li>○ Management measures</li> <li>○ Sustainable utilization</li> <li>○ Involvement the participation, considering gender sensitivity</li> </ul>	1	SEAFDEC University Government agency Fishery research institute All stakeholder
	Promote stakeholder consultation among researchers, managers and stakeholders using EAFM	1	SEAFDEC University Government agency Fishery research institute All stakeholder International organizations (FAO, NOAA, etc)
	Conduct habitat rehabilitation and stock enhancement programs	1	SEAFDEC University Government agency Fishery research institute All stakeholder
Understanding national law and regulations	Comparative review of national law and regulations	5	Government and resource person
	Disseminate knowledge and information on the conservation and management of Indo-pacific mackerel to fisheries communities and students	5	Government Other stakeholders
Flexibility of regulation to respond to science advise	Encourage periodic evaluation of policy and regulation	1	Government
Management schemes/arrangements	Develop management schemes/arrangements at sub-regional area including transboundary aspects	1	SEAFDEC University

including transboundary aspects.	Support establishment of regional cooperation/management mechanism (non-legal binding and scientific advisory committee)	1	Government agency Fishery research institute All stakeholder
Illegal, Unregulated and Unreported Fishing	Assessing the impact of Illegal, Unregulated and Unreported Fishing	6	Government and resource person
	Strengthen the Monitoring, Control and Surveillance network against the illegal fishing (none legal binding)	6	Inter-agencies coordination
Traceability system for fish and fishery product (using electronic logbook, etc)	Develop the catch documentation that suitable for traceability system e.g. electronic logbook, etc	7	Government and resource person

<b>2. SOCIAL DIMENSION</b>	<b>Overall Objective:</b> social responsibility and involvement in fisheries management achieved <b>Specific Objectives</b> 1) Understanding the social condition of people involving in fishery at local and national level. 2) Increase participation and involvement of stakeholder in various level. 3) Resolve conflict on land and resource use 4) Build awareness and capacity in all level .....		
	<b>Knowledge Gaps/Issues</b>	<b>Actions</b>	<b>Sp.Obj</b> <b>Responsibility</b>
Social and economic at local and national level	Conduct a baseline survey based on available information on social and economic at local and national level (S)	1	Government University
Traditional fishing (indigenous knowledge and social responsibility)	Improve and disseminate the best practice to other (indigenous people)	1	Government
People engagement in fishery activity (include small scale fishery and large scale/commercial fishery, processing)	Conduct stakeholder analysis for understanding the important and influence of stakeholder in various level	2	Government University
People engagement in policy making (fisherfolk organization, academy, private sector,	Promote Public Private Partnership	2	Government
	Promote multi stakeholder engagement in policy making	2	Government and relevant stakeholder
Social structure (community small scale and large scale, gender, migrant labor, and fisher)	Encourage gender equality based on understanding of social structure in community	2	Government and relevant stakeholder
Conflict on land and resource use	Promote stakeholder consultation	3	Government and relevant stakeholder
	Promote marine spatial planning and coastal zone management	3	Government Resource person

			Relevant stakeholder
Awareness	Distribute brochures or any media (e.g. digital media) to promote fisheries management and regulations	4	SEAFDEC Government Relevant stakeholder
	Capacity building and experts exchange	4	
	Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)	4	

<b>3. ECONOMIC DIMENSION</b>	<p><b>Overall Objective:</b> equal distribution of economic benefit, economic return and employment opportunities</p> <p><b>Specific Objectives:</b></p> <ol style="list-style-type: none"> <li>1) Ensure the national government and private sector commitment for long-term funding and support.</li> <li>2) Understanding the structure and ownership of asset within fishing industry (large, medium and small scale).</li> <li>3) Maximized economic benefit return for management response and reduced unequal distribution.</li> </ol> <p>.....</p>		
	<b>Knowledge Gaps/Issues</b>	<b>Actions</b>	<b>Sp.Obj</b>
Funding	To ensure the national government commitment for long-term funding and support	1	Government Private sector Funding agency/donor
	Explore various potential donor	1	
	Promote capital access through micro finance scheme	1	
	Promote corporate social responsibility	1	
Structure and ownership of asset within the fishing industry (large and small scale)	Review structure and ownership of asset within the fishing industry (large, medium and small scale) for management responses	2	Government Resource person
Benefit and economic return and unequal distribution	Assess benefit and economic return throughout the value chain	3	Government Resource person
Increase of cost (fuel and other inputs)	To ensure the fuel and other input exist for local fishermen	3	Government
Fisheries employment revenue	To create the alternative work	3	Government Private Sector Relevant stakeholder
	Require the contract among people engage in fishing	3	

<b>4. ECOSYSTEM DIMENSION</b>	<p><b>Overall Objective</b> Maintain healthy ecosystem for the wellbeing of short mackerel resources</p> <p><b>Objectives</b></p>
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	<p>1) Understand current status and improve the knowledge of short mackerel resources for scientific based management</p> <p>2) Understand various habitats of short mackerel throughout its life cycle</p>		
Knowledge Gaps/Issues	Actions	Sp.Obj	Responsibility
1.1 Migratory route	Update, further define and confirm the migratory route at national, sub-regional or regional area	2	Fisheries Agencies, National Research Institutions, Regional Institutions
	Conduct tagging program, e-DNA, DNA	1	Fisheries Agencies, Research Institutions
1.2 Spawning and nursery grounds (including dispersion and distribution of fish larvae)	Conduct comprehensive larvae survey (e.g ichthyoplankton)	1	Fisheries Agencies, Research Institutions
	Study on critical habitats	2	Fisheries Agencies, Research Institutions,
1.3 Seasonal changes	Conduct comprehensive larvae survey (e.g ichthyoplankton)	1	Fisheries Agencies, Research Institutions, SEAFDEC
	Conduct reproductive biology study	1	Fisheries Agencies, Research Institutions, SEAFDEC
1.4 Physical and chemical oceanographic conditions and ocean circulation	Conduct oceanography survey	2	Fisheries Agencies, Research Institutions, SEAFDEC
	Develop oceanographic modelling	2	Fisheries Agencies, Research Institutions, IOC/WESTPAC
	Conduct satellite imagery (GIS, remote sensing) analysis	2	Fisheries Agencies, Research Institutions
1.5 Stock structure	Conduct DNA study, otolith, tagging, etc.	1	Fisheries Agencies, Research Institutions,



			SEAFDEC
1.6 Stock status at national and regional of <i>R. brachysoma</i> (distribution and abundance)	Conduct stock assessment at national, sub-regional or regional level	1	Fisheries Agencies, Research Institutions, SEAFDEC
	Share data, information and findings from scientific research to relevant stakeholders	1	Fisheries Agencies, Research Institutions, SEAFDEC
	Standardized data collection for regional stock assessment	1	Fisheries Agencies, Research Institutions, SEAFDEC
	Develop modeling for stock assessment	1	Fisheries Agencies, Research Institutions, SEAFDEC, FAO
1.7 Species Identification	Provide capacity building on species identification of small size (juvenile) and larval fishes	1	Fisheries Agencies, Research Institutions, SEAFDEC
1.8 Status and Trends	Investigate the trend of short mackerel catch at national, sub-regional levels	1	Fisheries Agencies, Research Institutions, SEAFDEC
1.9 Population dynamics (Growth parameters, mortalities etc.	Conduct survey on fisheries biology	1	Fisheries Agencies, Research Institutions
1.10 Impact of fishing effort on stock structure (Multi-fishing gears to harvest)	Conduct study on impact of fishing effort on stock structure (Multi-fishing gears to harvest) to improve the fishery management	1	Fisheries Agencies, Research Institutions, SEAFDEC
	Enhance Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)	2	Fisheries Agencies, Research Institutions, SEAFDEC
1.11 Stock assessment and distributions for transboundary species	Enhance the cooperation for information sharing among the bordering countries	1	Fisheries Agencies, SEAFDEC
1.12 Capacity building and experts exchange	Training, workshop, conference and experts exchange	1,2	Fisheries Agencies, Research Institutions,

			SEAFDEC, FAO, UNEP-GEF
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<b>5. CLIMATE CHANGE</b>	<b>Overall objective:</b> <b>Adaptive management based on understanding the impact of climate change and disaster</b>		
	<b>Objectives:</b> 1) adaptive management measures <b>in place</b> in response to the impact of climate change and disaster to short mackerel fisheries and habitats 2) mitigation and precautionary measures <b>adopted</b> to compensate the effects of climate change		
Knowledge Gaps/Issues	Actions	Sp.Obj	Responsibility
5.1 IMPACT of climate change to fish migration route	Assess the impact of climate change/disaster/anthropogenic activities to fish migration route, habitat and behavior	1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Study effect of environmental changes on the migratory pattern and spawning patterns based on climate change	1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Share information from the findings of scientific research to both fisheries managers and fishers	2	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
5.2 Sensitivity of species on critical habitats and environment impact to ecosystem (pollution, climate change, etc)	Conduct study on sensitivity of species on environment change (pollution, climate change, etc) to support the management response	1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Study on the critical habitats (spawning and grounds)	1	Fisheries and Environmental Agencies,

			Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Study effect of environmental changes on the migratory pattern and spawning patterns	1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Data sharing (assign focal person to share information)	1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
5.3 Capacity building and experts exchange	Training, workshop, conference and experts exchange on CC impacts	1,2	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO