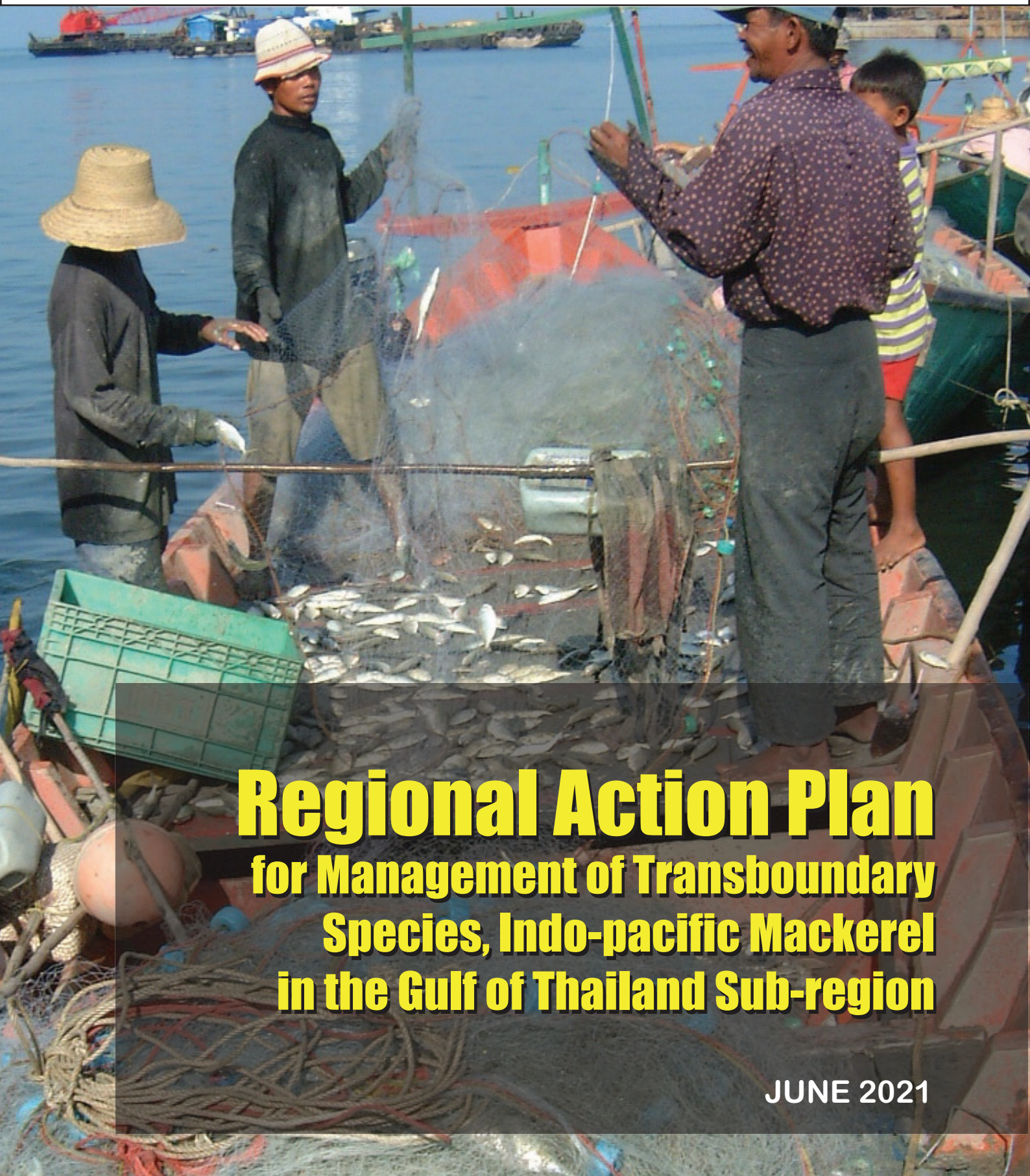




Establishment and Operation of a Regional System of Fisheries *Refugia*  
in the South China Sea and Gulf of Thailand



# **Regional Action Plan for Management of Transboundary Species, Indo-pacific Mackerel in the Gulf of Thailand Sub-region**

JUNE 2021

**Cover Graphic and Photo:**  
Somboon Siriraksophon

---

**Copies of the report can be downloaded from:**





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

**REGIONAL ACTION PLAN**

**FOR**

**MANAGEMENT OF TRANSBOUNDARY SPECIES,**

**INDO-PACIFIC MACKEREL (*Rastrelliger brachysoma*)**

**IN THE GULF OF THAILAND SUB-REGION**

**SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER**  
**TRAINING DEPARTMENT**

**JUNE 2021**

First published in Phrasamutchedi, Samut Prakan, Kingdom of Thailand in June 2021 by the Training Department of the Southeast Asian Fisheries Development Center

Copyright © 2021, SEAFDEC Training Department

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder provided acknowledgement of the source is made. SEAFDEC Training Department would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or for any other commercial purpose without prior permission in writing from the SEAFDEC Training Department.

SEAFDEC

Training Department

Southeast Asian Fisheries Development Center

Postal Address: P.O.Box 97, Phrasamutchedi, Samut Prakan, Kingdom of Thailand

Tel: (66) 2 425 6100

Fax: (66) 2 425 6110

<https://www.seafdec.or.th/home/>

#### DISCLAIMER:

The contents of this report do not necessarily reflect the views and policies of the Southeast Asian Fisheries Development Center, the United Nations Environment Programme, and the Global Environment Facility.

For citation purposes this document may be cited as:

SEAFDEC, 2021. Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-Region. Southeast Asian Fisheries Development Center, Training Department, Samutprakan, Thailand. 20p.



## Table of Contents

<b>CHAPTER-1: INTRODUCTION .....</b>	<b>4</b>
<b>CHAPTER 2: STOCK STATUS OF INDO-PACIFIC MACKEREL.....</b>	<b>5</b>
<b>CHAPTER 3: ISSUES, KNOWLEDGE GAPS, AND CHALLENGES.....</b>	<b>6</b>
<b>3.1) DATA AND INFORMATION .....</b>	<b>6</b>
<b>3.2) UNDERSTANDING THE STATUS OF FISH STOCK .....</b>	<b>6</b>
<b>3.3) MANAGEMENT RESPONSES.....</b>	<b>6</b>
<b>3.4) AWARENESS BUILDING.....</b>	<b>6</b>
<b>3.5) STRENGTHEN REGIONAL COOPERATION.....</b>	<b>6</b>
<b>3.6) STUDY THE ENVIRONMENT IMPACT.....</b>	<b>7</b>
<b>3.7) ENHANCE CAPACITY BUILDING .....</b>	<b>7</b>
<b>3.8) INFORM THE AGREED MANAGEMENT MEASURES.....</b>	<b>7</b>
<b>CHAPTER 4: REQUIRED REGIONAL COOPERATION FOR TRANSBOUNDARY MANAGEMENT .....</b>	<b>8</b>
<b>CHAPTER 5: PROVISIONS OF THE REGIONAL ACTION PLAN.....</b>	<b>9</b>
<b>5.1) THE GOAL OF REGIONAL ACTION PLAN .....</b>	<b>10</b>
<b>5.2) EXPECTED OUTCOMES.....</b>	<b>10</b>
<b>5.3) ACTIONS .....</b>	<b>11</b>
<b>A) GOVERNANCE DIMENSION .....</b>	<b>11</b>
<b>B) SOCIAL DIMENSION .....</b>	<b>13</b>
<b>C) ECONOMIC DIMENSION .....</b>	<b>14</b>
<b>D) ECOSYSTEM DIMENSION.....</b>	<b>15</b>
<b>E) CLIMATE CHANGE DIMENSION .....</b>	<b>18</b>
<b>REFERENCES:.....</b>	<b>20</b>

## CHAPTER-1: INTRODUCTION

Mackerels (Family Scombridae), particularly the Indo-Pacific mackerel (*Rastrelliger brachysoma*), also known as short mackerel, are among the most economically important small pelagic fishes in the Southeast Asian region, contributing to approximately 38% of the region's total small pelagic fisheries production or 11% of total capture fisheries production in 2010. Comparing mackerel species, in 2016, Indo-Pacific mackerel contributed to 78% of the total mackerel production with an average price of 1,492 USD/MT, decreasing from the production reported in 2015. (SEAFDEC, 2018).

On the production of Indo-Pacific mackerel by countries, Indonesia was the major catcher in the region, reporting the highest production at 283,106 MT in 2016, followed by the Philippines at 38,339 MT (SEAFDEC, 2018). As for Thailand, the mackerel production was not segregated by species, but the total production of all mackerel species was reported to be 81,017 MT in 2016. Nevertheless, the country's total mackerel production had drastically reduced from those of 194,845 MT in 2012. Like Thailand, the Philippines also reported declining trends in its Mackerel production through the period (SEAFDEC, 2018).

The Gulf of Thailand Sub-region (GoT) is one of the critical ecosystems for Indo-Pacific mackerel, where the peak of highest catch using purse seine and the falling net reported in 1996 at 328,955 MT; while the low catch appeared during three periods, in 1999, 2005 and 2010 at 289,285 MT, 283,984 MT, and 259,354.56 MT, respectively. Moreover, the catch has never reached 300,000 MT as recorded in 1996 (SEAFDEC, 2018).

In general, various types of fishing gears were used to harvest Indo-Pacific mackerel in the GoT; and the three significant types recorded in 2008 were purse seines (45%), driftnets (31%), trawls (18%). The landings show declining trends indicating that the Indo-Pacific mackerel stocks in the South China Sea and GoT were overexploited. For instance, in 2016, Thailand reported the catch production of Indo-Pacific mackerel by three main fishing gears, purse seine at 3,008 MT, trap at 691.6 MT, and trawl at 630.3 MT (SEAFDEC, 2018).



Short mackerel is considerable inexpensive but contains high protein, making the species popular for consumption in the Southeast Asia.

## CHAPTER 2: STOCK STATUS OF INDO-PACIFIC MACKEREL

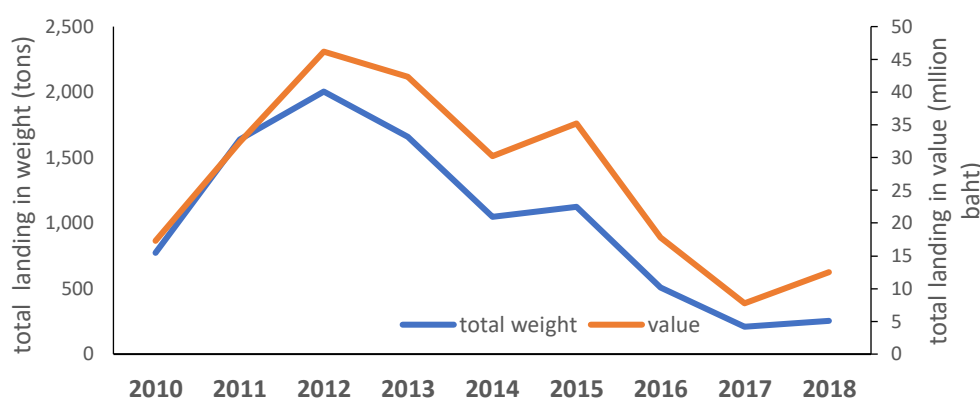
Indo-Pacific mackerel is considerably inexpensive but contains high protein, making the species popular for consumption in Southeast Asian countries such as Cambodia, Indonesia, Thailand, and Malaysia. However, with a drastic increase in the production of canned mackerels to replace the decreasing sardines, the catch of Indo-Pacific mackerel has recently been declining due to overfishing and unregulated fishing operations in several countries. Such a situation has become a significant concern by countries in the Southeast Asian region.

Several fish species, including mackerels, were reported to be in the overexploitation state in the Gulf of Thailand (Puthy, 2007). His study using the Schaefer and Fox models indicated that mackerel stocks are both biologically and economically overexploited. However, there were still opportunities to increase the mackerel stocks by reducing fishing efforts, allowing the stocks to recover.

Thailand also reported that the species was under an overexploitation state throughout the past years. The species also had to change population patterns, which could be due to the environmental impacts. Furthermore, the distribution of fish larvae could also be influenced by changes in phytoplankton, water current, and temperature (SEAFDEC, 2017).

In Indonesian waters, over-exploitation of marine fishery resources, including Indo-Pacific mackerel, has been highlighted in the Java Sea and other Indonesian waters. However, the recent population dynamic study by Zamroni, A.& Ernawati, T. (2019) showed that Indo-Pacific mackerels in Northern Coast Java of Indonesia water were still under fully exploitation state, and the recruitment process has not been disturbed. Although the species has yet to reach the heavy exploitation state, the suggestion was made that fishing efforts should be reduced, while fishing permits, such as the number of units, size of the fishing fleet, fishing gear dimensions, and fishing technology pressure, should also be controlled. Nevertheless, due to limited biological information of Indo-Pacific mackerel, genetic diversity study of the species, including in Java Island, was conducted (Indaryanto *et al.* 2015).

Meanwhile, the decline of Indo-Pacific mackerel due to changes in environmental condition and water quality, modification, and loss of critical habitats, has been documented in several countries and reported by the media.



Total weights and values of short mackerel landed in Trat fisheries refugia site (Munprasit *et.al.*2020)

## CHAPTER 3: ISSUES, KNOWLEDGE GAPS, AND CHALLENGES

The Scientific and Technical Committee for fisheries refugia project identifies the issues, knowledge gaps, and challenges for sustainable utilization of Indo-Pacific mackerel based on the reviews and inputs from six targeting Southeast Asian countries, namely Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam. In response to SEAFDEC questionnaires in September 2019, the issues, knowledge gaps, and challenges are categorized and summarized as follows:

### 3.1) DATA AND INFORMATION

- Insufficient information on the Indo-Pacific mackerel fishery characteristics
- Insufficient series catch and effort data, series of size data, biological data collection for population and abundance study
- No current information of migratory route, spawning ground, and season for a whole life cycle
- No regular monitor data collection on capture production.

### 3.2) UNDERSTANDING THE STATUS OF FISH STOCK

- Lack of knowledge on stock structure (need on DNA study)
- Insufficient stock status of *R brachysoma* (distribution and abundance)
- Insufficient information on Population dynamics (Growth parameters, mortalities, and relationship to other regional stock)
- No Actual effort to exploit the resources
- Trans-boundary distributions
- Lack of knowledge on how to assess multi-fishing gears to harvest

### 3.3) MANAGEMENT RESPONSES

- No Fisheries Management Plan
- No information on existing and effectiveness of regulations
- No co-management schemes/arrangements
- No transboundary management mechanism/plan
- No information on Effects/Loss to IUU fishing
- No reliable database or software for Assessment
- No Traceability system using an electronic logbook
- support the Sustainable management concept, Co-management, and EAFM

### 3.4) AWARENESS BUILDING

- Educate people and student in fisheries communities
- Distribute brochures or any media to promote fisheries management
- Raise awareness of both small-scale fishers and commercial fishers
- Sharing of the findings to both policy management level and fishermen
- develop consultation among researchers, managers, and stakeholders (EAFM)
- to support the Sustainable management concept, Co-management, and EAFM

### 3.5) STRENGTHEN REGIONAL COOPERATION

- Standardization on data collection for regional stock assessment
- Data sharing



- Lack of management body
- Develop the transboundary management mechanism/plan

### 3.6) STUDY THE ENVIRONMENT IMPACT

- Temporary disappear of short mackerel in the Gulf of Thailand
- impact of climate change to fish migration route

### 3.7) ENHANCE CAPACITY BUILDING

- Strengthen knowledge on research works as follows:
  - Species identification of small size (juvenile) and larval fishes
  - otolith (to know the age of fish)
  - Data collection at landing sites: catch and biological data
  - Data analysis
  - Stock Assessment and modeling for stock assessment
  - Harvest Strategy
- Fishing gear technology
- Fisheries manager
  - Translating scientific advice into management measures and actions
  - Understand various fisheries management tools and used them in the actual implementation

### 3.8) INFORM THE AGREED MANAGEMENT MEASURES

- Relavant stakeholders including fishers, fishing industry, local community, etc.)
- Ensure its compliance.



Technical Training on Biological Studies of Indo-Pacific Mackerel on 12-14 February 2019 in Koh Kong Province, Cambodia

## CHAPTER 4: REQUIRED REGIONAL COOPERATION FOR TRANSBOUNDARY MANAGEMENT

Since 1953, Thailand undertook several management actions for Indo-Pacific mackerel stock. From 1953 to 2015, 13 Notifications were released concerning the closure of fishing areas in the Gulf of Thailand to conserve the spawning grounds and nursery stages of aquatic resources (Saikliang 2016). Thailand also undertook several studies to enhance knowledge on migration patterns of Indo-Pacific mackerel within the country's EEZ in the Gulf of Thailand. The country's efforts for effective fisheries management for Indo-Pacific mackerel have continued up to the present.

Although the information on migration patterns of Indo-Pacific mackerel within the country's EEZ in the Gulf of Thailand sub-region is already available for almost 30 years, however, the recent result from genetic analysis of Indo-Pacific mackerel using the individual assignment and mixed-stock analysis shows the contradictory migratory behavior of the species between the stock in the inner Gulf of Thailand and the stock in the eastern part of the Gulf of Thailand (Kongseng et al., 2020). Additionally, the population from Pattani Province may also migrate across the eastern Gulf of Thailand through the southern part of Viet Nam and Cambodia waters. Such results indicated that Indo-Pacific mackerel is transboundary species, and joint management cooperation at the regional or sub-regional levels among countries that harvested Indo-Pacific mackerel is necessary for sustainable management.



Regional Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species, Indo-pacific Mackerel was held at Bay Beach Resort, Jomtien, Chonburi Province, Thailand (12th – 13th September 2019).

## CHAPTER 5: PROVISIONS OF THE REGIONAL ACTION PLAN

There are a number of international instruments aiming at conservation and management of marine resources, e.g., the 1982 United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Fish Stock Agreement (UNFSA), and the UN Sustainable Development Goal (SDG) 14. These instruments also support initiatives in combating illegal fishing towards sustainable use of seas and marine resources and enhancing the environmental, economic, and social well-being of coastal fishers and communities. At the regional level, the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted by the ASEAN-SEAFDEC Member Countries in 2001 and 2011 also specified the importance of establishing and implementing effective fisheries management through ecosystems approach by integrating habitat and fisheries resources and increasing social and economic benefit to all stakeholders and applying knowledge/science-based development and management of fisheries.

It recognizes the need to strengthen cooperative efforts among countries toward sustainable utilization of the marine resources, particularly the Indo-Pacific mackerel, a critical transboundary resource in the Gulf of Thailand. SEAFDEC with the funding support from the Government of Sweden through the SEAFDEC-Sweden Project on “Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia” and 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 (Fisheries Refugia)” therefore facilitated discussion among the Gulf of Thailand countries to develop the Regional Action Plan (RAP) for Management of Indo-Pacific mackerel. The RAP contains five Sections, namely:

Section 1: Introduction

Section 2: Stock Status of Indo-Pacific mackerel

Section 3: Issues, Knowledge Gaps, and Challenges

Section 4: Required Regional Cooperation for Management of Transboundary Species

Section 5: Provisions of the RAP including goal, outcomes, objectives, and actions.

The Provisions of RAP were categorized into five dimensions, which are: 1) Governance; 2) Social; 3) Economic, 4) Ecosystem; and 5) Climate Change. These five dimensions were aligned with the concept of the Ecosystem Approach to Fisheries Management (EAFM).

This RAP for Management of Indo-Pacific mackerel is a non-legal binding document meant to serve as a foundation to identify practices and processes that support the implementation of the relevant ASEAN-SEAFDEC Resolution and Plan of Action. It marks an evolutionary step towards a concerted regional approach to support countries’ efforts to manage the transboundary fish stock in the Gulf of Thailand.



### 5.1) THE GOAL OF REGIONAL ACTION PLAN

The Regional Action Plan is intended to serve as a guide for concerned countries in implementing actions to achieve the goal of

**“Sustainable Indo-Pacific mackerel fisheries in the Gulf of Thailand sub-region through science-based management for the shared benefit to the other ASEAN Member States by 2030”**

### 5.2) EXPECTED OUTCOMES

- 1) Healthy Indo-Pacific mackerel resources through the implementation of fishery management plan of the Gulf of Thailand.
- 2) Accurate and comprehensive information on Indo-Pacific mackerel of the Gulf of Thailand.
- 3) Model for development of management plan for Indo-Pacific mackerel that could be applicable to other sub-regions.





## 5.3) ACTIONS

### A) GOVERNANCE DIMENSION

#### Overall Objective:

Regional/sub-regional fisheries management mechanism is in place building upon national regulations and management scheme.

#### Specific Objectives

- A1. Fisheries management mechanism developed and approved (including fisheries management plan and arrangement, the effect of regulation)
- A2. The data management system is enhanced and considered regional/sub-regional standardization data management system in place.
- A3. The standard for assessing fishing effort large, medium and small-scale fishery agreed.
- A4. Understandings on national law and management schemes within the sub-regional are communicated and applied.
- A5. Impact of unregulated and unreported fishing assessed.
- A6. Catch documentation system applied as a tool to improve traceability of the short mackerel fishery.

Knowledge Gaps/Issues	Actions	Ref.	Responsibility
Insufficient catch and landing data	Develop the SOP/technical guidance for data collection (including catch data, biological data)	A2	<ul style="list-style-type: none"> <li>• SEAFDEC</li> <li>• University</li> <li>• Government agency</li> <li>• Fishery research institute</li> </ul>
	To further develop catch documentation	A2	
	Harmonization/standardized on data collection and develop database system	A2	
Insufficient biological data collection	Conduct capacity building program for data collection to enumerator and scientist, researchers	A3	<ul style="list-style-type: none"> <li>• SEAFDEC</li> <li>• University</li> <li>• Government agency</li> <li>• Fishery research institute</li> </ul>
	Conduct time series data collection with standardized method	A3	
Insufficient Fishing effort (include commercial and small scale)	Link to the catch documentation include commercial and small-scale fishery (as available)	A4	<ul style="list-style-type: none"> <li>• Government and Private sector</li> </ul>
	Regular monitor data collection on fishing effort capture production (include commercial and small scale)	A4	
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	A1	<ul style="list-style-type: none"> <li>• SEAFDEC</li> <li>• University</li> <li>• Government agency</li> <li>• Fishery research institute</li> <li>• All stakeholder (fishers, others)</li> </ul>
	Initiative on development of harvesting strategy		

	Establish regional cooperation on monitoring, control and surveillance	A1	<ul style="list-style-type: none"> <li>Existing national MCS partners/network</li> </ul>
	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>	A1	<ul style="list-style-type: none"> <li>SEAFDEC</li> <li>University</li> <li>Government agency</li> <li>Fishery research institute</li> <li>All stakeholder</li> </ul>
	Promote stakeholder consultation among researchers, managers and stakeholders using EAFM	A1	<ul style="list-style-type: none"> <li>SEAFDEC</li> <li>University</li> <li>Government agency</li> <li>Fishery research institute</li> <li>All stakeholder</li> <li>International organizations (FAO, NOAA, etc)</li> </ul>
	Conduct habitat conservation and rehabilitation and conduct stock enhancement programs	A1	<ul style="list-style-type: none"> <li>SEAFDEC</li> <li>University</li> <li>Government agency</li> <li>Fishery research institute</li> <li>All stakeholder</li> </ul>
Understanding national law and regulations	Comparative review of national law and regulations, (including local wisdom)	A5	<ul style="list-style-type: none"> <li>Government and resource person</li> </ul>
	Disseminate knowledge and information on the conservation and management of Indo-pacific mackerel to fisheries communities and students	A5	<ul style="list-style-type: none"> <li>Government</li> <li>Other stakeholders</li> </ul>
Flexibility of regulation to respond to science advise	Encourage periodic evaluation of policy and regulation	A1	<ul style="list-style-type: none"> <li>Government</li> </ul>
Management schemes/arrangements including transboundary aspects.	Develop management schemes/arrangements at sub-regional area including transboundary aspects	A1	<ul style="list-style-type: none"> <li>SEAFDEC</li> <li>University</li> <li>Government agency</li> <li>Fishery research institute</li> <li>All stakeholders</li> </ul>
	Support establishment of regional cooperation/management mechanism (non-legal binding and scientific advisory committee)	A1	
Illegal, Unregulated and Unreported Fishing	Assessing the impact of Illegal, Unregulated and Unreported Fishing	A6	<ul style="list-style-type: none"> <li>Government and resource person</li> </ul>
	Strengthen the Monitoring, Control and Surveillance network against the illegal fishing (none legal binding)	A6	<ul style="list-style-type: none"> <li>Inter-agencies coordination</li> </ul>
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.	A6	<ul style="list-style-type: none"> <li>Government and resource person</li> </ul>

## B) SOCIAL DIMENSION

### Overall Objective:

Social responsibility and involvement in fisheries management achieved

### Specific Objectives:

- B1. Understanding the social condition of people involving in the fishery at the local and national level.
- B2. Increase participation and involvement of stakeholders at various levels.
- B3. Resolve conflict on land and resource use
- B4. Build awareness and capacity at all level.

Knowledge Gaps/Issues	Actions	Ref.	Responsibility
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)	B1	<ul style="list-style-type: none"> <li>Government</li> <li>University</li> </ul>
Traditional fishing (indigenous knowledge and social responsibility)	Improve and disseminate the best practice to other (indigenous people)	B1	<ul style="list-style-type: none"> <li>Government</li> </ul>
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	B2	<ul style="list-style-type: none"> <li>Government</li> <li>University</li> </ul>
People engagement in policy making (fisherfolk organization, academy, private sector,	Promote Public Private Partnership	B2	<ul style="list-style-type: none"> <li>Government</li> </ul>
	Promote multi stakeholder engagement in policy making	B2	<ul style="list-style-type: none"> <li>Government and relevant stakeholder</li> </ul>
Social structure (community small scale and large scale, gender, migrant labor, and fisher)	Encourage gender equality based on understanding of social structure in community	B2	<ul style="list-style-type: none"> <li>Government and relevant stakeholder</li> </ul>
Conflict on land and resource use	Promote stakeholder consultation	B3	<ul style="list-style-type: none"> <li>Government and relevant stakeholder</li> </ul>
	Promote marine spatial planning and coastal zone management	B3	<ul style="list-style-type: none"> <li>Government</li> <li>Resource person</li> <li>Relevant stakeholder</li> </ul>
Awareness Raising	Distribute brochures or any media (e.g. digital media) to promote fisheries management and regulations)	B4	<ul style="list-style-type: none"> <li>SEAFDEC</li> <li>Government</li> <li>Relevant stakeholder</li> </ul>
	Capacity building and experts exchange		
	Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures		

## C) ECONOMIC DIMENSION

### Overall Objective:

Equal distribution of economic benefit, economic return, and employment opportunities

### Specific Objectives:

- C1. Ensure the national government and private sector commitment for long-term funding and support.
- C2. Understanding the structure and ownership of assets within the fishing industry (large, medium, and small scale).
- C3. Maximized economic benefit return for management response and reduced unequal distribution.

Knowledge Gaps/Issues	Actions	Ref.	Responsibility
Funding	To ensure the national government commitment for long-term funding and support	C1	<ul style="list-style-type: none"> <li>• Government</li> <li>• Private sector</li> <li>• Funding agency/donor</li> </ul>
	Explore various potential donor	C1	
	Promote capital access through micro finance scheme	C1	
	Promote corporate social responsibility	C1	
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	C2	<ul style="list-style-type: none"> <li>• Government</li> <li>• Resource person</li> </ul>
Benefit and economic return and unequal distribution	Assess benefit and economic return throughout the value chain	C3	<ul style="list-style-type: none"> <li>• Government</li> <li>• Resource person</li> </ul>
Increase of cost (fuel and other inputs)	To ensure the fuel and other input exist for local fishermen	C3	<ul style="list-style-type: none"> <li>• Government</li> </ul>
Fisheries employment revenue	To create the alternative work	C3	<ul style="list-style-type: none"> <li>• Government</li> <li>• Private Sector</li> <li>• Relevant stakeholder</li> </ul>
	Require the contract among people engage in fishing		



## D) ECOSYSTEM DIMENSION

### Overall Objective:

Maintain a healthy ecosystem for the wellbeing of short mackerel resources

### Specific Objectives:

D1. Understand current status and improve the knowledge of short mackerel resources for scientific-based management

D2. Understand various habitats of short mackerel throughout its life cycle

Knowledge Gaps/Issues	Actions	Ref.	Responsibility
Migratory route	Update, further define and confirm the migratory route at national, sub-regional or regional area	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• National Research Institutions,</li> <li>• Regional Institutions</li> </ul>
	Conduct tagging program, e-DNA, DNA	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions</li> </ul>
Spawning and nursery grounds (including dispersion and distribution of fish larvae)	Conduct comprehensive larvae survey (e.g. ichthyoplankton)	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions</li> </ul>
	Study on critical habitats	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> </ul>
Seasonal changes	Conduct comprehensive larvae survey (e.g. ichthyoplankton)	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
	Conduct reproductive biology study	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
Physical and chemical oceanographic conditions and ocean circulation	Conduct oceanography survey	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
	Develop oceanographic modelling	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> </ul>

			<ul style="list-style-type: none"> <li>• Research Institutions, IOC/WESTPAC</li> </ul>
	Conduct satellite imagery (GIS, remote sensing) analysis	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions</li> </ul>
Stock structure	Conduct DNA study, otolith, tagging, etc.	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
Stock status at national and regional of <i>R. brachysoma</i> (distribution and abundance)	Conduct stock assessment at national, sub-regional or regional level	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
	Share data, information and findings from scientific research to relevant stakeholders	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
	Standardized data collection for regional stock assessment	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
	Develop modeling for stock assessment	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC,</li> <li>• FAO</li> </ul>
Species Identification	Provide capacity building on species identification of small size (juvenile) and larval fishes	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
Status and Trends	Investigate the trend of short mackerel catch at national, sub-regional levels	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
Population dynamics (Growth parameters, mortalities etc.	Conduct survey on fisheries biology	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions</li> </ul>
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	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>

	Enhance Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)	D2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC</li> </ul>
Stock assessment and distributions for transboundary species	Enhance the cooperation for information sharing among the bordering countries	D1	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• SEAFDEC</li> </ul>
Capacity building and experts exchange	Training, workshop, conference and experts exchange	D1,2	<ul style="list-style-type: none"> <li>• Fisheries Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, FAO, UNEP-GEF</li> </ul>

## E) CLIMATE CHANGE DIMENSION

### Overall Objective:

Adaptive management based on understanding the impact of climate change and disaster

### Specific Objectives:

- E1. adaptive management measures **in place** in response to the impact of climate change and disaster on short mackerel fisheries and habitats
- E2. mitigation and precautionary measures **adopted** to compensate for the effects of climate change

Knowledge Gaps/Issues	Actions	Ref.	Responsibility
Impact of climate change to fish migration route	Assess the impact of climate change/disaster/anthropogenic activities to fish migration route, habitat and behavior	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
	Study effect of environmental changes on the migratory pattern and spawning patterns based on climate change	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
	Share information from the findings of scientific research to both fisheries managers and fishers	E2	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
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	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
	Study on the critical habitats (spawning and grounds)	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> </ul>



			<ul style="list-style-type: none"> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
	Study effect of environmental changes on the migratory pattern and spawning patterns	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
	Data sharing (assign focal person to share information)	E1	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>
Capacity building and experts exchange	Training, workshop, conference and experts exchange on CC impacts	E1 E2	<ul style="list-style-type: none"> <li>• Fisheries and Environmental Agencies,</li> <li>• Research Institutions,</li> <li>• SEAFDEC, UNEP-GEF, UNDP, FAO</li> </ul>

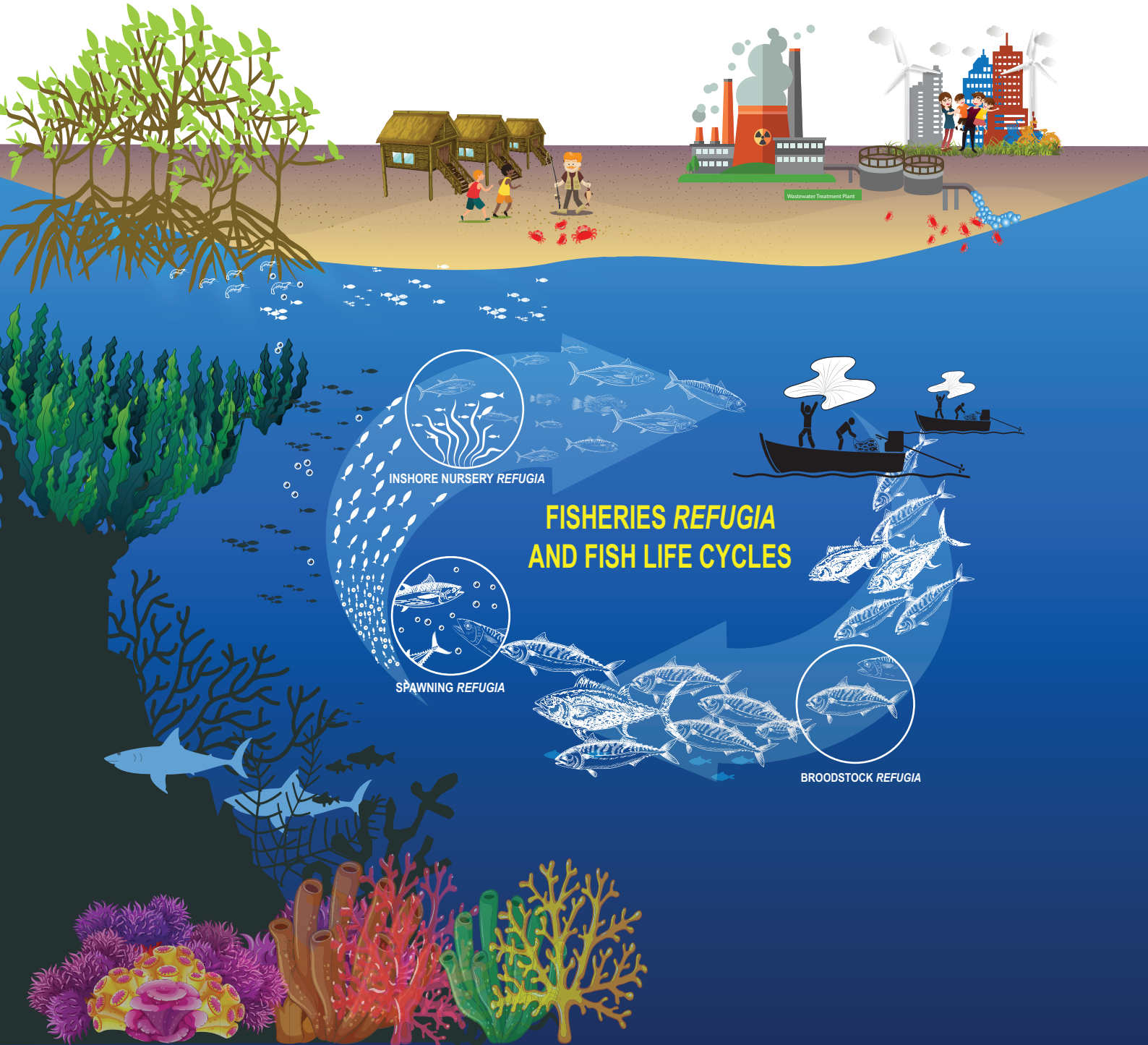
## REFERENCES:

1. Em Puthy (2007). Final Report of the Fisheries Training Programme: Policy and Planing, the United Nations University, Iceland. <http://www.unuftp.is/static/fellows/document/puthy07prf.pdf>
2. Indaryanto et al. (2015). Genetic variation of short body mackerel, *Rastrelliger brachysoma* of Java Island, Indonesia based on mtDNA control region sequences AACL Bioflux, 2015, Volume 8, Issue 5. <http://www.bioflux.com.ro/aac>
3. Kongseng, S., Phoonsawat, R.s Swatdipong, A., (2020). Individual assignment and mixed-stock analysis of short mackerel (*Rastrelliger brachysoma*) in the Inner and Eastern Gulf of Thailand: Contrast migratory behavior among the fishery stocks. Fish. Res. 221, 1-9. <https://doi.org/10.1016/j.fishres.2019.105372>
4. SEAFDEC (2017). Report of the Experts Group Meeting on Stock Status and Geographical Distribution of Anchovy, Indo-Pacific mackerel and Blue Swimming Crab (AIB), in the Gulf of Thailand, Bangkok, Thailand, 22-23 September 2016, Southeast Asian Fisheries Development Center. 69 pp.
5. SEAFDEC (2018). Fishery Statistical Bulletin of Southeast Asia 2016. Southeast Asian Fisheries Development Center.143 pp.
6. Zamroni, A.& Ernawati, T. (2019). Population Dynamic and Spawning Potential of Short Mackerel (*Rastrelliger brachysoma* Bleeker, 1851) in the Northern Coast of Java. 1-9. <http://ejournal-balitbang.kkp.go.id/index.php.ifri>
7. Munprasit R., Nootmorn P., Loychuen K. (2020). Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand, Technical Report of Fisheries Refugia Profile for Thailand: Trat. Southeast Asian Fisheries Development Center, Training Department, Samut Prakan, Thailand; FR/REP/TH25, 37 p.





# The Establishment and Operation of A Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand is a part of Strategic Action Programme for the South China Sea



## OUR KEY PARTNERS



FIA  
CAMBODIA



MMAF  
INDONESIA



DOF  
MALAYSIA



NFRDI  
PHILIPPINES



DOF  
THAILAND



D-FISH  
VIET NAM