Southeast Asian Fisheries Development Center | United Nations Environment | Global Environment Facility

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

REPORT

The 3rd Regional Scientific and Technical Committee Meeting

Classic Hoang Long Hotel, Hai Phong City, Viet Nam

5th – 7th February 2020

SEAFDEC/UNEP/GEF/Fisheries *Refugia*
JUNE 2020

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SEAFDEC/UNEP/GEF
Project Co-ordinating Unit
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://fisheries-refugia.org

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ADOPTED REPORT OF THE MEETING

AGENDA 1: OPENING OF THE MEETING

1.1. WELCOME AND OPENING ADDRESS

1.1.1. WELCOME ADDRESS BY CURRENT CHAIRPERSON (2019)

1. Mr. Valeriano M. Borja, Chairperson of the Regional Scientific and Technical Committee for 2019, welcomed all participants. He was grateful for the participants ' presence despite Coronavirus pandemic, while he expressed his gratitude to the Government of Vietnam, the Directorate of Fisheries (D-Fish). He sincerely wished that the meeting would carry out successfully.

1.1.2. OPENING ADDRESS BY PROJECT DIRECTOR

2. Dr. Somboon Siriraksophon, Project Director, expressed his gratitude to Mr. Le. Tran Nguyen Hung, Deputy Director of Conservation and Aquatic Resources Development, Directorate of Fisheries (D-Fish) for his support for hosting the 3rd Meeting of the Regional Scientific and Technical Committee. He welcomed all participants to Hai Phong City, Viet Nam, one of the fisheries refugia sites. He thanked all Committee and Regional experts who joined the meeting even though they were aware of the epidemic of Coronavirus, not only in Southeast Asia but around the world. Accordingly, he suggested all participants take care of themselves during the stay in Hai Phong City. He believed that all participants stay safe and enjoy the stay mentioned above.

3. He also informed the Committee the meeting objectives were to update all progress works having done by all partners and the SEAFDEC PCU. He then encouraged all Committee and regional experts to participate in the discussion actively. The good results of this meeting would reflex the Mid-term Evaluation at the end of 2020.

4. He also expressed his most profound appreciation for UNEP and SEAFDEC/Training Department for supports and sincere wish for a successful meeting. He then declared the meeting open at 09:00 am.

1.2 INTRODUCTION OF MEMBERS

5. Mr. Valeriano M. Borja, the current Chairperson, noted that there were some new members of the RSTC and invited the participants to introduce themselves to the meeting. The list of participants attached as ANNEX 1 to the report.

AGENDA 2: ORGANISATION OF THE MEETING

2.1 DESIGNATION OF OFFICERS FOR 2020

6. Dr. Somboon Siriraksophon informed the Committee on the Rules of Procedure for the election of the Chairperson, vice-chairperson, and rapporteur from amongst the members to serve their duties for one year, as mentioned in the TORs for RSTC adopted at the first meeting of the Project Steering Committee held in December 2018. The rules stated further that officers should be eligible for re-election no more than once in the same year. Mr. Valerianno M.Borja from the Philippines, Dr. Ngurah

N. Wiadnyana from Indonesia, and Mr. Richard Rumpet from Malaysia who had served as a Chairperson, a Vice-Chairperson and an official Rapporteur respectively, during 2019, are, therefore, all eligible for re-election in 2020.

7. The current Chairperson, Mr. Borja, invited the Committee to nominate the new Chairperson, Vice-Chairperson and Rapporteur for the RSTC3 2020. The results were 1) Ms. Praulai Nootmorn, 2) Mr. Nguyen Thanh Binh, and 3) Sallehudin bin Jamon were nominated and elected as the Chairperson, the Vice-Chairperson and the Rapporteur respectively, during 2020.

8. A new Chairperson, Ms. Praulai Nootmorn, gave her first speech before the meeting started.

2.2 DOCUMENTATION AVAILABLE TO THE MEETING

9. Dr. Somboon Siriraksophon introduced the documentation available to the meeting by referring to document SEAFDEC/UNEP/GEF/FR-RSTC.3 INF.4. He informed the Committee that most of the documents had been circulated one week in advance of the meeting and were uploaded to the project web site (https://fisheries-refugia.org/3rd-rstc-meeting/3rd-rstc-doc) as shown in ANNEX 2. More papers waited to be the inputs during the meeting would be uploaded after the meeting.

2.3 ORGANISATION OF WORK

10. Mr. Somboon Siriraksophon briefed the participants on the administrative arrangements for the conduct of the meeting and the organization of work as appears in the SEAFDEC/UNEP/GEF/FR-RSTC.3_INF.1 and SEAFDEC/UNEP/GEF/FR-RSTC.3 INF.2a-b, respectively.

AGENDA 3: ADOPTION OF THE MEETING AGENDA

11. The Chairperson, Ms. Praulai Nootmorn invited the Project Coordinating Unit, Dr. Somboon Siriraksophon, to introduce the Provisional Agenda appeared as SEAFDEC/UNEP/GEF/FR-RSTC.3 INF.2b and asked members to propose any amendments or additional items for further consideration by the Committee.

12. Dr. Somboon Siriraksophon added that the country might have decided earlier which target species selected alignment with the establishment of fisheries refugia. Therefore, the PCU expected the meeting could update and finalize the list and location of species and tentative refugia sites through the consultation and involvement of relevant stakeholders to support the development of fisheries refugia profile of each target species.

13. He also pointed out the meeting results should reflex the preparation for the Mid-term Evaluation, which is expected by the end of 2020.

14. The meeting adopted the agenda and timetable without amendments as ANNEX 3.

AGENDA 4: REPORT OF THE PROJECT DIRECTOR ON WORK PROGRESS

15. Dr. Somboon Siriraksophon presented the progress of regional activities during the past six months until the end of 2019, implemented by SEAFDEC PCU in cooperation with all country partners. The report appeared in ANNEX 4.

16. He introduced preparatory works and the four regional meeting organizations which took place in May, September, and November 2019. He informed the updates on the Fisheries Refugia Websites: status of country's implementation and technical reports, meeting materials, country profiles, and preparation for GIS mapping on the web site.

17. He highlighted the work progresses on the establishment of Fisheries Refugia by country and the development of Regional Guidelines on indicators for the management of fisheries refugia and Regional Action plan for Sustainable Fisheries Management of Transboundary Species: Indo-Pacific Mackerel.

18. He congratulated Viet Nam for the Ministry of Agriculture and Rural Department (MARD) had approved the yearly project budget plan in October 2019. Besides, he noted that the NFRC and NTSC had the first meeting in January 2020 to give direction and instruction to implementing agency to prepare the project detailed budget plan to get MARD approval and promote the project implementation in 2020 onward. He then encouraged the National Lead Agency for Viet Nam to start implementing the project as soon as possible due to less than two years for implementation of the project.

19. Dr. Somboon Siriraksophon summarized the list of relevant stakeholders, e.g., national institutions, local government, inter-agency, fisher organization, private sectors, NGO, and others who involved in the project activities in each country as appeared in the working paper. Regarding this, he then requested all countries to confirm the lists and logos, so PCU could finalize and prepare for the Mid-term evaluation.

20. He reported the percentages of work completion implementing by the country and the PCU in the past two years. He highlighted that Cambodia's work was outstanding, and he stressed that the presentation of this indicator was meant to encourage the country to continue its ongoing projects. He also informed the meeting that this issue would be analyzed and addressed again with the budget spent and outputs, at the 4th Meeting of the Regional Scientific and Technical Committee scheduled in 2020.

21. Referring to the changing of Committee due to retiring, he informed the meeting that Malaysia nominated new focal points not only for National Scientific and Technical Focal Point (NSTFP) but also National Focal Point (NFP). Moreover, Indonesia will soon nominate a new NFP, Dr. Aulia Riza Farhan, S.T., M.Sc., to replace Dr. Joni Haryadi D., M.Sc. The PCU will wait for the official nomination letter.

22. Mr. Valeriano M. Borja suggested that the participants should update their ongoing work completion since there must have been many activities done in the prior period.

AGENDA 5: PRESENTATIONS BY THE NATIONAL SCIENTIFIC AND TECHNICAL COMMITTEE ON THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF 31 DEC. 2019

5.1 CAMBODIA

23. Mr. Leng Sy Vann presented the status of the project implementation at selected three fisheries refugia sites in Koh Kong, Kampot, and Kep Provinces. In his presentation, the management and coordination structure, including national and provincial institutions. At the national level, it is the Technical Working Group on Fisheries chaired by Director General of Fisheries Administration and some Sub-Group on Fisheries are under the Technical Working Group on Fisheries chaired by one of

Deputy Director General of Fisheries Administration, and which fisheries *refugia* is in the one of Sub-Group on Fisheries naming Sub-Group on Conservation and Economic. At the provincial level, it is the Provincial Management Committee chaired by Provincial Governor and the Technical Working Group for site-level is under the Provincial Management Committee chaired by Provincial Deputy Governor. The management mechanisms have been built in order to coordinate and operate marine fisheries management as well as fisheries *refugia* sites in Cambodia. Besides, the policy and legal basis for the development of Fisheries Refugia are the key concerns. Also, the concept of fisheries refugia had integrated into national fisheries policy and legal basis, including the law of Fisheries, National Plan for Action, a 10-year strategy for fisheries conservation to ensure fisheries management effectively as appears in ANNEX 5.

24. He also reported that in 2019 the Minister of the Ministry of Agriculture, Forestry, and Fisheries officially promulgated the Indo-pacific Mackerel Fisheries Refugia in Koh Kong Province on 16 September 2019 and a 5-year management plan for marine fisheries management area (MFMA) for blue swimming crab in Kep Province. was approved and signed officially by Director General of Fisheries Administration and Kep Governor on 3 February 2020.

25. With regards to fisheries management measures, he mentioned that there are two Committee for management of fisheries refugia have been established at the provincial level in KEP: 1) Management Committee chaired by Provincial Governor and 2) Technical Working Group chaired by Provincial Deputy Governor. For Koh Kong Province, Provincial Governor will approve the management committee for Indo-pacific mackerel refugia in the 1st Quarter of 2020.

26. Mr. Leng Sy Vann also informed the meeting that FiA collaborated with Fisheries Administration Cantonment (FiAC) to patrol and crack down illegal fishing in the MFMA and Fisheries Refugia Sites. Besides, they conducted the protocol of closed fishing season of blue swimming crab in KEP Province through awareness building and local media such as posters dissemination and distribution to fishers, community fisheries, and local authority.

27. For the biological and geographic information of each fisheries refugia presented here, the SEAFDEC/PCU will keep the records of discussions in the Fishery Profile Session appears in the agenda 6.

28. Mr. Weerasak Yingyuad pointed out that some committee structures involving in the national fisheries refugia project. However, he observed that some committee structures were only from the Fisheries Administration. He, therefore, suggested to include academic institutions who could look over the work of the existing agencies. In reply, Mr. Leng Sy Vann explained that the educational institutions were under the research section, not the management section. Also, the project asked many inter-agencies/institutions to join the Committee, such as Provincial Police, NGOs, Provincial Line Departments, Military Police, Maritime Police Department, Local Authorities, and Private Sector to cooperate with the management.

5.2 MALAYSIA

29. Mr. Sallehudin bin Jamon presented the country progress of two Refugia sites in Malaysia: 1) Spiny Lobster (*Panulirus polyphagus*) Refugia in Tanjung Lemen, east Johor and 2) Tiger Prawn (*Penaeus monodon*) Refugia in Kuala Baram, Sarawak as appears in ANNEX 6.

30. For spiny lobster, the *Panulirus polyphagus is dominant species* in Tanjung Lemen, east Johor, the main activities in 2019 were 1) Collection of lobster landing data from fisherman jetties; 2) 195 fishing hauls of spiny Lobster surveys by commercial trawlers via observer onboard program; 3) Socio-

economic studies of fishing communities; 4) conducting the EAFM workshop for proposed lobster refugia sites and management measures.

31. The results from observer onboard program show the distribution and abundance of spiny lobster, particularly *Panulirus polyphagus,* which recommends the 1400 km^2 or equivalent to 140,000 Hectares for spiny lobster fisheries refugia area for further consideration by relevant stakeholders and government.

32. He also informed the meeting on the results of socio-economic surveys of fishers covering eight fishing villages in Pahang and Johor States during 2018-2019, revealed that 88.25 % of 165 respondents agreed with the establishment of refugia as proposed by Department of Fisheries of Malaysia (DoF). And 66.7% of respondents agree not to conduct fishing operations targeting spiny lobster during its breeding season. A 98.5% agreed that DoF should discuss with fishers about the demarcation area and management measures for the establishment of refugia before any action. Additionally, the result of the survey showed that 72% of the respondents were well aware of the refugia concept.

33. He added that the Refugia team conducted the Workshop on Ecosystem Approach Fisheries Management (EAFM) in the Air Papan Resort, Mersing, Johor State during the 4th quarter of 2019. Thirty-six fishers participated, learned, and shared information on how to manage the refugia for spiny lobster in the proposed tentative refugia site.

34. He also introduced the budgetary allotment for the fisheries refugia project in 2019.

35. For the Tiger Prawn refugia in Kuala Baram, Sarawak, Mr. Sallehudin presented the main activities in 2019 were: 1) collection of adult tiger prawn in Batu 1 (landing site) and Krokop market; 2) juvenile tiger prawn survey at three main rivers as nursery areas; 3) adult tiger prawn survey at sea by trawl-net; 4) establishment of a Refugia gallery for tiger prawn at Fisheries District Office, Miri, Sarawak; and 5) socio-economic assessment based on the survey in 2016.

36. The results from 22 operations by trawl surveying for adult tiger prawn show the distribution and abundance of adult tiger prawn that are useful for identifying the demarcation area for tiger prawn Refugia, which is estimated about 295 nm^2 (equivalent to 76,400 Hectares). Besides, he shows the density of juvenile appeared at three rivers, namely 1) Pasu river, 2) Lutong river, and 3) Sibuti river.

37. Based on the 2016 socio-economic survey of tiger prawn refugia by UiTM-JPLS, the results show 89 % of the total 231 respondents did not know the fisheries refugia for tiger prawn.

38. In the discussions, Dr. Nopporn Manajit pointed out the life cycle map for spiny lobsters, which references to 1996 encyclopedia, may make confusion to people who interested. In this regard, Dr. Somboon Siriraksophon suggested to Malaysia redrawing the life cycle map for spiny lobster per the actual geographic features of east Johor, where the larvae, juvenile, and adult stages of spiny lobster migrated.

39. Dr. Somboon Siriraksophon also pointed out the importance of understanding the negative impact of existing fishing gears and practices on larval, juvenile, and spawn lobsters. This knowledge will support the decision on management measures for the establishment of fisheries refugia and protecting each critical stage in the life cycle of lobster.

40. The meeting also noted that DOF Malaysia has successfully produced awareness campaign media such as documentary video via broadcasting TV on the importance of fisheries refugia that helped boost understanding among local people. In this connection, Dr. Somboon Siriraksophon requested for sharing of such video but should include the English subtitle to promote on the Regional Refugia Website.

5.3 PHILIPPINES

41. Mr. Valeriano M. Borja presented the country's accomplishment report of 2019, including the meetings, workshops, and training held in three fisheries refugia sites, namely: Bolinao, Pangasinan: Masinloc, Zambales; and Coron, Palawan as appears in ANNEX 7.

42. The accomplishments in 2019 are as follows:

a) Finalized the recommended members and provisional TORs for the Fisheries Refugia Site Management in Coron, and Masinloc;
b) Agreed target species for Coron Fisheries Refugia, *Lutjanus argentimaculatus* (mangrove red-snapper);
c) Agreed target species for Masinloc Fisheries Refugia, tentatively, *Sardinella fimbriata* (sardine), *Pterocaesio tesellata* (one-stripe fusilier), and *Auxis thazard* (frigate tuna).
d) Consolidated threats and issues to fisheries refugia sites in the Municipality of Coron, Masinloc, and Bolinao;
e) Adopted the Executive Orders for establishing the Refugia Site Management Committee in Masinloc Municipality and Bolinao Municipality;
f) Identified the boundaries of the proposed refugia site for at-sea mapping;
g) Consulted with stakeholders in 3 Refugia sites for the terms and agreements on protocols and practices for the development of National Guidelines for the establishment of fisheries refugia for the Philippines;
h) Established the Refugia Center at BFAR Provincial Fisheries Office in Masinloc, Zambales;
i) The Chairman of the Bolinao RSMC, Hon. Alfonso Celeste provided a room in the Tourism Office of the municipality to serve as the *Refugia* Center in the site;
j) Enhanced capacity building for three Refugia sites on drafting of the management plan for fisheries refugia sites through the Essential EAFM concept;
k) Involved in the celebration of the 50^{th} Fish Conservation Week by providing the short IEC lecture to Coron School of Fisheries as well as distributed the IEC materials.

43. He added the future activities as follows: 1) reproductive biology sampling of identified priority fishes at three sites in July 2020, 2) quarterly Ichthyoplankton survey, 3) the conduct of at-sea mapping of actual fisheries refugia at three locations, 4) presentation of national guidelines on procedures for formal designation and management of fisheries refugia to the NFARMC, and 5) IEC campaign in the coastal villages in 3 fisheries refugia sites. Lastly, he introduced the budgetary allotment for the fisheries refugia project from 2017-2020.

44. Dr. Somboon Siriraksophon expressed his gratitude for the Philippines on the drafting of the national guideline for the management of fisheries refugia as it was one of the critical outputs for the fishing refugia's establishment.

45. Mr. Weerasak Yingyuad supported and acknowledged the activities that have been implemented by NFRDI, particularly the importance of applying Essential EAFM training to all stakeholders for the development of the fisheries management plan for each refugia site. He implied

that the capacity building on EAFM, help relevant stakeholders to thoroughly understand the logical processes for effective management of fisheries refugia.

46. About Mr. Borja's presentation, the meeting discussed the case of some refugia sites are within the Marine Protected Areas (MPAs) as "No Take Zone." He suggested during the meeting that the fisheries refugia can be within the MPAs because the species inside MPAs is already well protected by the law.

47. The meeting also discussed the issues facing conflict with other agencies for the establishment of fisheries refugia. In this regard, Dr. Somboon Siriraksophon pointed out the proposed fisheries refugia concept is to integrate fisheries and habitat management in which all relevant stakeholders should involve not only fisheries but environmental agencies in the processes.

48. Mr. Borja mentioned that in the operations of the establishment of fisheries refugia, the NFRDI usually consulted several stakeholders and Sectors who are involve in coastal management such as provincial sectors, local sectors, federal sectors, etc. He also informed the meeting the involved stakeholders acknowledge the usefulness of fisheries refugia concept but not for sanctuary and MPAs.

5.4 THAILAND

49. Ms. Praulai Nootmorn presented the fisheries refugia areas in Trat and Surat Thani provinces where targeted species are the Indo-Pacific Mackerel and Blue Swimming Crab, respectively, as appears in ANNEX 8.

50. She also presented the activities in the past few years: a preliminary survey on fisheries resources and fishing communities in Samui Island, Chang Strait in Trat Province, Stakeholders Consultation in Surat Thani Province. Also, the regular meeting with the Department of Fisheries was held once in three months.

51. She also summarized the activity for in-cash co-finance during the past years to support the establishment of fisheries refugia as follows:

a) Investigation on the life cycle of Indo-Pacific Mackerel in the Gulf of Thailand;
b) Conducted surveys on fisheries resources for assessment of the Maximum Sustainable Yield (MSY), Catch per Unit Effort (CPUE), and stock assessment in the Gulf of Thailand;
c) Conducted fisheries biology, socio-economics, and ecosystems in connection to the existing Fishery Improvement Program (FIP) for blue swimming crab at Ban Don Bay, Surat Thani Province.

5.5 INDONESIA

52. Dr. Ngurah Nyoman Wiadnyana updated the country's progress of activities since the project has implemented in the 3rd quarter of 2019. He shows 80% of the activities related to the reviewed works for existing fisheries and coastal habitats information and data to support the comprehensive policy in the establishment of fisheries refugia. The rest 20% of activities were the strengthened cross-sectoral coordination in the establishment and operation of fisheries refugia.

53. He also presented the 2020 work plan would be organized accordingly to the component. His presentation is as appears in ANNEX 9.

54. Dr. Somboon addressed that, in comparison with the activities done in 2019, the fisheries refugia profiles could be finalized by the end of 2020 through the stakeholder consultations.

5.6 VIET NAM

55. Mr. Nguyen Thanh Binh presented overall project budget plan approved by Ministry of Agricultural and Rural Department (MARD) in October 2019 including the establishment of the National Project Steering Committee and National Scientific and Technical Committee after signing of the LOI between SEAFDEC and the Directorate of Fisheries (D-Fish) in May 2019. His presentation appears as ANNEX 10.

56. He informed the meeting on tentative three priority Refugia sites as 1) at Bach Long Vy Refugia Site in Hai Phong for small pelagic species and reef fish; 2) at Hon Cau Refugia Site in Binh Thuan targeting for Scombridae and Bivalve mollusks; and 3) at Phu Quoc refugia site in Kien Giang targeting anchovies, Indo-pacific mackerel, and blue swimming crab. He also especially added that the Blue Swimming Crab had already been managed under the Fisheries Improvement Program (FIP) by the cooperation with private companies and WWF.

57. The meeting also noted the existing data and information in countries for small pelagic fisheries that remained unidentified. And suggested to the Committee for Viet Nam the review of existing data.

AGENDA 6: FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES:

58. Dr. Somboon Siriraksophon updated the meeting on 15 priority refugia sites proposed by six country partners, as appears in Table 1 (as of February 2020), and more details on mapping appear in ANNEX 11.

Country	Refugia Site	Priority species	Remark
CAMBODIA	Kep	Blue swimming crab (*Portunus pelagicus*)	
	Kampot	Oranges spotted grouper (*Epinephelus coioides)*	
	Koh Kong	Indo-pacific mackerel, (*Rastrelliger brachysoma*)	
INDONESIA	Bangka-Belitung	Mitre squid (*Uroteuthis chinesis*)	
	West Kalimantan	Shrimp (*Fenneropenaeus spp.*)	Indian white shrimp, banana shrimp ??
MALAYSIA	Tanjung Leman, Johor	Spiny lobster (*Panulirus polyphagus)*	*other Panulirus spp.:* *P. versicolor* *P. ornatus* *P. Homarus ;* and *P. longipes*
	Miri, Sarawak	Tiger prawn (*Penaeus monodon*)	
PHILIPPINES	Bolinao, Pangasinan	Gloden-spotted rabbitfish (*Siganus punctatus*)	

	Masinloc, Zambales	Frigate Tuna (*Auxis thazard*)	
	Coron, Palawan	Mangrove Jack (*Lutjanus argentimaculatus*)	
THAILAND	Trat	Short, Indo-pacific mackerel, (*Rastrelliger brachysoma*)	
	Surat Thani	Blue swimming crab (*Portunus pelagicus*)	
VIET NAM	Bech Long Vi Island, Haiphong	• Small pelagic species Reef fish	will be confirmed later
	Hon Cau Island, Binh Thuan	• Scombridae Bivalve mollusks	
	Phu Quoc Island, Kien Giang	• Anchovy species, Short mackerel	

59. He also refers to the Fisheries Refugia Profile template that all country partners have to provide the input as one of the national outputs for mid-term evaluation in 2020.

60. The progress fisheries refugia profiles implemented by country partners are as follows:

6.1 CAMBODIA Fisheries Refugia Profile

61. Mr. Leng Sy Vann introduced the refugia profile of three sites with references to the provided template. The detailed information of the refugia profile appears in ANNEX 12.

62. He also added some results from the baseline survey of the Indo-pacific mackerel in Koh Kong, which elaborated on the data collection process and provided scientific findings to support the establishment and management of mackerel fisheries in Koh Kong province. The result of the monthly distribution of three target species showed the length at first maturity stages, and particularly the calculated gonadosomatic index (GSI) for males and females of Indo-pacific mackerel. Regarding this, Mr. Leng Sy Vann stressed that the mean GSI of male short mackerel specifically increased from 2.43 to 3.49 during October to November 2019.

63. He also pointed out that difficulties were collecting the fish and larvae during, especially in June and July 2019. The assumption that the fish might have migrated to the Thai border. In this regard, Ms. Praulai Nootmorn pointed out that the calculated GSI found in Cambodia is the quite low value when comparing with the GSI in the Thai waters in the Gulf of Thailand. Regarding this, Mr. Leng Sy Vann expressed that it is dependent on using the formulation of GSI calculation. In his case, he used the formulation of GSI calculation (gonad weight*100/body weight). Besides, Dr. Kornravee Aiemsomboon suggested that the fish collection could be checked and compared with landing catch in bordering countries such as in Trat provinces of Thailand and in Viet Nam to confirm the fish distribution and status in June and July 2019. Furthermore, she suggested that the data should be separated monthly. The length and body weight can not guarantee mature development, whereas the GSI is more reliable.

64. The species identification for short mackerel was one of the challenges facing by the project in Cambodia. Accordingly, Mr. Leng Sy Vann mentioned that the species identification of collected larval fishes could be at the genus level for mackerel groups. Besides, Dr. Kornravee Aiemsomboon, Chula Longkorn University of Thailand, has supported the DNA study for species identification, and presently it is in the initial process after received the samples and data from Cambodia. In this regard, Mr. Sukchai Arnupapboon informed Cambodia that the SEAFDEC/TD could help with taxonomy work at the species level.

65. Dr. Somboon Siriraksophon suggested that considering the short mackerel as transboundary species, the more accurate data, as well as the standardized data collection, are necessary for those countries involved. He, therefore, suggests the need for collaborative works between Cambodia (Koh Kong Refugia sites) and Thailand (Trat Refugia Site). He informed the meeting that the Project Coordinating Unit would provide a platform of exchanging and sharing the knowledge between relevant countries and institutions to clarify and examine the links for a better understanding of the fish stock status and best solutions for sustainable fisheries management in the future.

6.2 INDONESIA Fisheries Refugia Profile

66. Dr. Ngurah Nyoman Wiadnyana presented the draft profiles of fisheries refugia in West Kalimantan for shrimps (*Fennerropenaeus spp*.) and Bangka-Belitung for mitre squid (*Uroteuthis chinensis*) based on the reviewed works from existing data and information. In his presentation, the importance of target species based on economic importance in fisheries sectors, he also elaborated type of fishing gears in quantity, the number of fishers involved, social economy and institutions existed, as well as the critical habitat for juvenile shrimps. The details of his presentation appear in ANNEX 13.

67. Dr. Ngurah Nyoman Wiadnyana also informed the meeting on existing conservation areas, marine protected areas, and conservation areas of fisheries established in Belitung Regency, Bangka Regency, etc. Particularly the conservation area of fishing in the Bangka Regency, where the habitats of squid are protected. Regarding this, Dr. Somboon Siriraksophon asked how Indonesia is going to link the conservation area to the Fisheries Refugia establishment? In response to this, Dr. Ngurah Nyoman Wiadnyana replied that they would need further scientific data and seasonal data collection and mapping as squids are economically significant, and the use of fishing gears managed under the concept of fisheries refugia.

68. Mr. Nguyen Thanh Binh asked what does Indonesia expects to establish fisheries refugia, since many conservation areas exist. In reply, Dr. Ngurah Nyoman Wiadnyana assumes that the government can control the fishing gears since there were so many being operated at the moment and due to declining of squid stock in the areas. In this connection, Mr. Nguyen Thanh Binh suggested that the refugia should be closed for years to track the growth of squids. But somehow the government may face other problems on illegal fishing during the closing period.

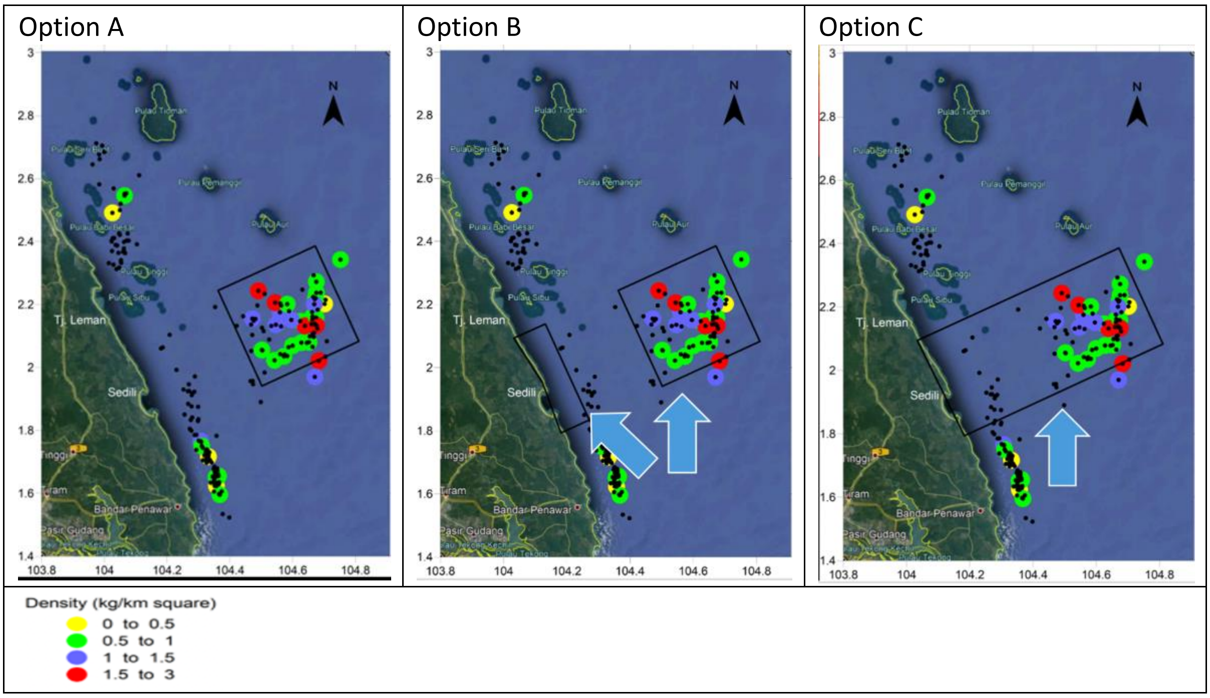
69. Mr. Weerasak Yingyuad suggested that the Fisheries Refugia concept can apply to all marine species. However, it needs involvement from stakeholders. Identifying threats in every stage of the lifecycle, and later accurately identify the resolution and management actions are the key activities. In conjunction with the required actions mentioned in component 1.4 of the project document, the Monitoring Control and Surveillance (MCS) are one of the outputs.

6.3 MALAYSIA Fisheries Refugia Profile

70. Mr. Jamil Bin Musel, alternate national scientific and technical Committee for Malaysia, presented the draft profile of fisheries refugia in Malaysia. The profile included population, socio-economic, number and types of fishing vessels operated in the refugia area, the role of fisheries refugia for sustainable fisheries, number of fishing communities, priority species information including biology, life cycle, mating behavior, stock size and assessment, and GIS mapping. His presentation appears as in ANNEX 14.

71. For mud spiny lobster (*Panulirus polyphagus*), he explained the life cycle and migration pattern, which is a significant finding when compared with other biological data. He informed the meeting that the size at first maturity stage based on the Gonadosomatic index and mapping data are essential information to support the decision for area-based management when establishing the refugia for mud spiny lobster.

72. He also informed the meeting on proposed three options for candidate fisheries refugia of mud spiny lobster which will be further consulted with all relevant stakeholders as follows:



73. For the Tiger Prawn (*Penaeus monodon*) Refugia in Kuala Baram, the critical habitat linkages in their life cycles are the coral reef offshore of Sibuti National Marine Park and Mangrove in Kuala Baram area.

74. Ms. Praulai Nootmorn asked whether Malaysia would select only one target species of the spiny lobsters or include other spiny lobsters. In response to madame chair, Mr. Jamil Bin Musel, in their studies, mentioned that DOF/MY might cover the studies for four species of lobster to help improve the information of mud spiny lobster as dominant species in the same areas. He also informed that in the studies, all caught, including spiny lobsters, were collected using commercial trawlers. The scientists calculated the density of caught by the swipe area of the bottom trawl.

75. Mr. Nguyen Thanh Binh added that the exploitation rate in 2017 based on the surveys was impressed (0.2-0.9 year^{-1}) when compared with other results such as biomass (26.3 metric ton), landing weight (2-113 metric ton), and MSY (8-62 metric ton). Mr. Jamil Bin Musel replied that the

rate was a result of the seasonal fishing activities. However, the new survey would be conducted again to guarantee the accurate results of the exploitation rate for spiny lobsters.

76. Dr. Somboon Siriraksophon suggests that the establishment of refugia for mud spiny lobster as a dominant species of the coastal area of Tanjung Leman should focus on protecting of gravid (egg-bearing) lobsters and juvenile lobsters because of threats from some commercial fishing gears. Identification of the period and location that lobster bearing eggs are needed. Protection of lobster larvae by the establishment of refugia may not needs if no threats from fishing gear and practices to the larvae. It is therefore required mapping data that integrated other information to help the final decision on the establishment and proposed management measures in the refugia.

6.4 PHILIPPINES Fisheries Refugia Profile

77. Mr. Valerianno M. Borja presented the progress works on baseline surveys for fish landing data and larval fish survey in 2019 in three sites: 1) Bolinao, Pangasinan; 2) Masinloc Zambales; and 3) Coron, Palawan as appears in ANNEX 15.

78. At Bolinao, He found the different species composition of larval fishes in 8 sampling points along the Bolinao Bay in each quarter of 2019. There were existing measures such as total banning in catching "*padas*" juvenile rabbit fishes in Bolinao; Closed season during spawning season for the 4th, 5^{th,} and 6th days after new moon for few days consequently only; and Banning of fine-meshed gears catching rabbit fishes.

79. At Masinloc, he showed the results of distribution and abundance as well as the species composition of larval fishes from quarterly fish larvae and egg surveys in 2019 in 6 samplings stations of the Masinloc Bay. The results indicated Scombridae larval fishes less than 12% in each quarter, but there was no species identification at the genus and species levels.

80. The landing data of Frigate Tuna (*Auxis thazard)* as a target species represented in the Masinloc, Zambales, showed the quantity of landing in 2019 was 7.62 metric tons or about 3.2% of the total landing of 239.37 metric ton.

81. At Coron, the target species for this refugia site is mangrove jack snapper (*Lutjanus argentimaculatus).* Mr. Borja reported the filed works on fish data samplings from two selected landing sites: 1) Tagumpay, and 2) Public market. From the presentation, bottom set longline, and fish corral is the main fishing gears for catching demersal fishes as well as the Lutjanidae family. Nevertheless, the meeting noted that mangrove jack as target species in Coron was missing in the landing report.

82. The results of fish eggs and larval fish surveys from 7 sampling points around the Coron Bay in each quarter of 2019 presented in family levels.

83. After the presentation, several comments, and clarification raised by the Committee as follows:

a. For frigate tuna refugia in Masinloc, Dr. Somboon Siriraksophon pointed out the needs of biological data such as length-frequency found in the whole year in comparison with the quantity of catch. Besides, the distribution of Frigate tuna outside Zambales territory to make sure that Masinloc is the best ground for refugia. Also, based on the larval fish survey, there are unclear on the larval fish of frigate tuna in the studied areas. However, either the frigate spawn in this area or not, if there was no fishing gear impact on the larval fishes, so it is no need management measures for fishing gears in this area. Accordingly, the country can focus on the protection of young or juvenile frigate tuna in this area;

b. For the mangrove jack in Coron, the meeting noted the crucial habitats located in the Marine Protected Area (MPA). Regarding this, Mr. Nguyen Thanh Binh pointed out that the establishment of refugia covering the MPA is possible if the country wanted to add protocols/measures which aimed to improve fisheries resources and habitats. However, the state should avoid any overlapping efforts;
c. Mr. Weerasak Yingyuad said that the definition of MPA, which consists of five categories, NO TAKE ZONE in common, is used to protect the coastal habitat. Still, it would impact fishers since they cannot fish. But the concept of Fisheries Refugia is about the linkage of critical habitat and fishery resources, for example, coral reef area in Koh Chang/Thailand, mangrove area in Koh Kong/Cambodia, seagrass area in Bolinao/Philippines, etc.; and
d. In general, identification of target species at the genus and species levels are still the main problems by the technical lead agency due to lack of resource person. This matter is not only faced by the Philippines but also in other participating countries, in response to this PCU will seek assistance from SEAFDEC Training Department to conduct a training course on larval fish identification to those countries funded by the project.

6.5 THAILAND Fisheries Refugia Profile

84. Mr. Kampon Loychuen presented fisheries refugia profiles in Trat Province for Indo-Pacific mackerel and in Surat Thani Province for blue swimming crab. In his presentation included geographic characteristics of the studies areas, numbers of Commercial Fishing Vessels, fishing community/institutions, existing management measures, as appears in ANNEX 16

85. At Trat province, fisheries Refugia studied site covers 6,400km^{2,} including mangrove 162.5km^2, seagrass 10.2km^2, coral reef 28.4km^2, and artificial reef 118km^2. He presented several types of fishing gear catch Indo-Pacific mackerel and the species compositions of each fishing gear operated off Trat Province. The local fishing community organization includes 28 groups of coastal fisheries, seven groups of offshore fishing, seven groups of fish processing, and five groups on aquaculture. He also informed on the existing fisheries management measures in Trat, which are related to the prohibitions of fishing gears and methods in the coastal areas, 15 fishing grounds, and four aquatic sanctuaries.

86. Comparisons between the interview data in 2017, 2018, and 2019 and the existed records in 2014 and 2016 showed the occurrences and size distribution of Indo-Pacific mackerel off Trat provinces. Based on the survey data by research vessels also showed the distributions of larval fish, adult, mature, and fully mature Indo-Pacific mackerel in the studied areas off Trat Province, and the results identified a peak spawning period of Indo-Pacific mackerel in January – February in 2018. Accordingly, the Department of Fisheries Thailand proposed a tentative fisheries refugia of Indo-Pacific mackerel for further consultation with relevant stakeholders.

87. Mr. Weerasak Yingyuad stated that the occurrences showed the local knowledge from fishers presented scientifically. He described Ban Haad Lek is at the border with Cambodia; therefore, from September to December, the juvenile fish could be found. Around the Koh Kong area could also found juveniles during this period as well. He suggested Cambodia conduct the same data collection. However, the data should be crosschecked with accurate information and also with local knowledge from acknowledged fishers.

88. Dr. Somboon Siriraksophon suggested checking compositions of trash fishes from trawl net to see how the distribution of juvenile Indo-Pacific mackerel caught by trawl net.

89. Mr. Sallehudin bin Jamon asked about purse seines associated with luring light. Some of the proposed areas, if any effect of lights, in Malaysia, the small fish, they would be blind because of brightness. He questioned if there was any research on the impact of the lights on the fish.

90. After a discussion on Indo-Pacific mackerel refugia, Mr. Kampon Loychuen continued his presentation on Blue Swimming Crab Refugia in Surat Thani province. The size of the blue swimming crab was significantly reduced from 14cm of the carapace length in 1987, reduced to 8cm in 2007.

91. He informed the meeting on the life cycle, the fecundity, catch compositions by type of fishing gears targeting the blue swimming crab, and distribution and size of the crab in the studied areas in relation to the ecosystem and environmental parameters, e.g., salinity, suspended solids, etc.

92. With regards to the small size of the mature crab, Ms. Praulai Nootmorn added that the blue swimming crab, fully matured, its size was tiny even though the healthy ecosystem for blue swimming crabs such as seaweed, seagrass. In this connection, Mr. Sallehudin bin Jamon asked if there was any regulation for mesh size? He also suggested that If putting more fishing pressure, and the mature size would be smaller.

93. Mr. Ngurah Nyoman Wiadnyana shared that in Indonesia, there are many types of Blue Swimming Crab. The size of the crab does not change much. The crab spawns all year round.

94. Mr. Weerasak Yingyuad added that the blue swimming crab, the juvenile habit in the seagrass, then went out and were threatened by the fishing activities. The diagram should combine both threats and life cycles, and it would be more specific to come up with the management action.

95. Ms. Praulai Nootmorn mentioned the best practices and methods for increasing the resource and spawner protection by releasing the gravid crab back to the sea. Thailand is promoting these best practices with engagement and voluntary supports from trawlers.

AGENDA 7: DATA AND INFORMATION NEEDS TO SUPPORT ACTIVITIES

7.1 FISHERIES STATISTIC FOR EACH TARGET SPECIES: STATUS AND TRENDS AT COUNTRY LEVEL (FROM 1995 TILL PRESENT) AND BIOLOGICAL PARAMETERS

96. Dr. Somboon Siriraksophon presented the factsheet on target species compiled from several sources published by FAO, FishBase, etc. to support the partners on drafting Fisheries Refugia Profile for each species. The factsheet consisted of taxonomy, geographic areas, biological information, and other information such as stock, fisheries, threats, etc. as appears in ANNEX 17-27 as follows:

- Factsheet of Rabbit fish (*Siganus fuscescen*); ANNEX17
- Factsheet of Banana prawn (*Fenneropenaeus merguiensis*) ANNEX18
- Factsheet of Blue swimming crab (*Portunus pelagicus*) ANNEX19
- Factsheet of Frigate tuna (*Auxis thazard*) ANNEX20
- Factsheet of Goldspotted spinefoot (*Siganus punctatus*) ANNEX21
- Factsheet of Mangrove red snapper (*Lutjanus argentimaculatus*) ANNEX22
- Factsheet of Mitre squid (*Uroteuthis chinesis*) ANNEX23
- Factsheet of Mud spiny lobster (*Panulirus polyphagus*) ANNEX24
- Factsheet of Orange spotted grouper (*Epinephelus coioides*) ANNEX25
- Factsheet of Indo-Pacific macekerel or Short mackerel (*Rastrelliger brachysoma*) ANNEX26
- Factsheet of Tiger prawn (*Penaeus monodon*) ANNEX27

97. He also requested all partners to consider and provide the existing data and information based on scientific research conducted at national and sub-regional levels, which supported the effective management of fisheries refugia in the long term. The suggested contents of Fisheries Refugia Profiles also require fisheries statistic data, particularly fisheries production. So, the cooperation from member countries to provide statistical data of the target species is crucial.

98. Mr. Weerasak Yingyuad pointed out that, according to the project outputs as appeared in Component 1.1, the end target was agreement among stakeholders' intervention for all refugia sites, which requires all 15 Fisheries Refugia profiles.

99. PCU developed factsheet for each species is aimed to support the country and to update the findings from project implementation for publicity.

100. Dr.Somboon Siriraksophon suggested that all six countries should work together to support each other and come up with strategy not only at national but also at regional levels.

101. The Chairperson asked the member countries should share the data from their local waters for regional assessment.

102. Dr. Somboon encouraged all member countries to insert their workplan for 2020. The PCU is considering to upload such as statistical data to the refugia website. The regional database includes members' activities and GSI mapping. The PCU will ally with member countries for long term objectives.

7.2 REGIONAL WEBSITES/ DATABASE/ PROJECT REPOSITORY

103. Dr. Somboon Siriraksophon updated the Regional website based on the online demonstration via URL: https://fisheries-refugia.org. He highlighted the updated webpage for the Regional Meetings during the past year, such as RSTC2, PSC2, Regional Meeting for Indicators, and Regional Meetings for Drafting of Regional Plan of Action for Indo-pacific mackerel, etc. where all working papers and reports were published and uploaded onto the website.

104. He also informed that the PCU uploaded the Technical Report and Papers submitted in 2017 to the end of December 2019 on the website.

105. For the way forwards, the PCU would further develop database and mapping related to fisheries refugia sites to improve the website. Accordingly, the Committee took note and support the plan.

AGENDA 8: OTHER BUSINESS

8.1 REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPECIES: INDO-PACIFIC MACKEREL

106. Dr. Somboon Siriraksophon informed the meeting on the status of the Regional Action Plan for Management of Transboundary Species: Indo-pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-Region. Due to the need to improve fish stock and enhance knowledge gaps for effective management, as mentioned in ANNEX 28. the PCU drafted the Regional Action Plan through a series of Technical Consultation Meetings. The Meeting included scientists from various institutions, experts, and managers on fishery policy from six countries, who agreed on the urgent requirement of

cooperation for sustainable utilization of Indo-pacific mackerel. He pointed out the importance of the RAP as a guide to all concerned countries to achieve the goal of “Sustainable Indo-Pacific mackerel fisheries in the Gulf of Thailand sub-region through science-based management.”

107. He also considered the Regional Action Plan as a supplementary guide to the ASEAN-SEAFDEC Resolution and the Plan of Action towards 2030. He requested all partners to coordinate internally with the higher official level on the endorsement and adoption at the forthcoming SEAFDEC Council Meeting in April 2020, and later by ASEAN through its mechanism. He then encouraged the Committee to coordinate with the SEAFDEC council director in the respective country for support and endorsement at SEAFDEC as well as the ASEAN forum.

8.2 REGIONAL GUIDELINES ON INDICATORS FOR MANAGEMENT OF FISHERIES REFUGIA

108. Dr. Somboon Siriraksophon presented the draft guidelines on Indicators for Management of Fisheries Refugia that addressed at the 1st Regional Meeting held on 9-11 September 2019 at A-One The Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand as appears in ANNEX29. The guidelines aimed to support partners on the effective management of fisheries refugia established during the project implementation and to ensure that after project-end, the country would continue and increase the number of fisheries refugia in their country based on the agreed indicators.

109. He also requested all Committee and regional experts of the RSTC3 to suggest appropriate methodology and references for further finalization of the guide by the forthcoming PSC3 meeting in 2020.

110. Regarding this, the Chairperson suggested the PCU to circulate the template of the indicators' list to each country for inputs in particular methodology needs. She also added that the criteria should be first made then the methodology follows.

8.3 1ST REVISION OF THE CONCEPT NOTE FOR SSFA ON “IMPROVING HEALTHY OCEAN ECOSYSTEMS THROUGH BEST PRACTICES AND FISHING GEAR INNOVATIONS.”

111. Dr. Somboon Siriraksophon, on behalf of the UNEP, funded, SEAFDEC executed Project for drafting the Concept Note to reflex the need for improving ocean ecosystems, which affected by fishing activities. The 1st Draft of the concept note on **IMPROVING HEALTHY OCEAN ECOSYSTEMS THROUGH BEST PRACTICES IN TRAWL FISHERIES** was addressed at the RSTC2 and PSC2 in May and November of 2019, respectively.

112. The meeting noted the changing title of the Concept Note to be “**Improving Healthy Ocean Ecosystems through Best Practices and Fishing Gear Innovations**” (ANNEX 30). Due to some participating countries banned trawl fisheries, that is the main reason to propose a broad scope of the project not to focus only on trawl fisheries. He cited that the Concept Note was drafted based on the gap analysis from more than 150 published research papers.

113. He summarized the needs for this proposal in Southeast Asia because fisheries sectors are essential, which contributes to economic and social betterment. In 2015, the world's top marine fisheries production was in the region. Lack of effective fisheries management in the past created in huge quantity numbers of fishing vessels and destructive fishing gears results in the damage in fish stocks. The environmental damage caused by fishing activities, traditional trawlers, and other harmful fishing activities is still active. They directly damage the seabed habitats, the spread of marine plastic, debris from abandoned nets, occurrences of microplastics, as well as the increased emission of CO_2.

114. He requested all partners to consider and provide suggestions to the revised note for finalization of the Concept Note and further development of the full proposal in an attempt to meet the requirement of the DONORs such as Green Climate Funds (GCF), Global Environment Facilities (GEF). The necessary fund was approximately $50 Million for 5 Years implementation. He also mentioned that, in the case of GCF, the relevant countries of the project had to coordinate with National Designated Authority (NDA) and had to seek “No Objection Letter” for the Project Preparation Facility (PPF).

115. Mr. Nguyen Thanh Binh suggested that Trawl Fisheries are practiced over SEA, not just within the South China Sea. The impact of the trawl fisheries, which are the most used fishing gear and ground damages a lot. Therefore, the habitats, nursery, and spawning grounds that locate nearshore should be concerned overall. But when offshore, the debate around the South China Sea is still going on. Dr. Somboon Siriraksophon explained the need for building new habitats or shelters not only in the nearshore but should cover the offshore areas. Recently, many projects have developed for the nearshore area, such as artificial reefs.

116. The Chairperson stated that the proposal should not focus only on trawl fishing but cover other fishing that impacts on the ecosystem. She also pointed out the issues in overlapped areas to avoid political problems in the South China Sea.

117. Mr. Jamil bin Musel added that this is the challenge for Indonesia since it is about trawls. The bottom trawls are still considered the most operated tools in the industry. This proposal can help us find another option for best practice. Because in Malaysia waters, the stock is left than 10%, the government agreed to eliminate the bottom trawls.

118. In this connection, Dr. Somboon Siriraksophon added that the project could subsidize the innovation of improved trawls or fishing gear development. The point is the offshore resources can be applied to many methods to grow in numbers, so it may be an opportunity for this project to develop innovative/friendly fishing gear for the region.

119. Mr. Weerasak Yingyuad stated that this project is not about offshore resource enhancement but also covers the study of best fishing practices and innovative technology to reduce the impact assessment from destructive fishing gear/practices.

120. Besides, Dr. Somboon Siriraksophon informed the six countries that reference to the agreed Concept Note, in the process of fund seeking from GCF, the participating countries need to develop their proposal relies on the concept notes. Also, SEAFDEC welcomes individual consultation for further discussion for the development of the full project documents.

121. Mr. Nguyen Thanh Binh pointed out the sustainable fisheries development requires regional actions, e.g., the seabed or bottom trawls, which are illegal in some parts in Southeast Asia. His concerns are the scope of the project, and engagement of the private sectors, industrial sectors, maritime sectors for controversial face discussion.

122. Mr. Nguyen Thanh Binh also suggested that, in some areas, there are historical issues between Cambodia, Viet Nam, so they need the bilateral arrangement. Not for the establishment of MPA, but some kind of baseline cooperation so they don’t want to touch upon the international conflicts. Some parts of member countries still hold issues with China’s terrestrials.

123. The discussion also includes the definition of "off-shore" that could be anywhere the trawls operated.

124. After deliberation on the concept note, Dr. Somboon Siriraksophon informed the Committee that this concept note would address at the forthcoming SEAFDEC Council Meeting in May 2020 for their support and endorsement. Taking into consideration, it needs further steps of development for a full project document and submits to UNEP for reviews and approval.

8.4 PROJECT MID-TERM EVALUATION

125. Dr. Somboon Siriraksophon informed the Committee on the proposed Mid-term evaluation by external evaluator under the purview of UNEP and SEAFDEC/PCU at the end of 2020. In this connection, the PCU would further compile all progress and outputs from the NFP and NSTFP via e-mail communication and virtual meeting.

8.5 OTHER MATTER

126. In the next meeting, the member countries may need to present past achievements—the first week of November.

127. The PCU supported Mr. Binh that the national budget also granted for training and stakeholder consultation at the site level not only for local management boards but also for the project staff from the central office or national lead agency.

AGENDA 9: ADOPTION OF THE REPORT OF THE MEETING

128. As agreed, the rapporteur would circulate the draft report to all participants for suggestions and finalization via e-mail communication. The Committee adopted the amended report .

AGENDA 10: DATE AND PLACE OF THE 4TH REGIONAL SCIENTIFIC & TECHNICAL COMMITTEE MEETING

129. The Committee from 6 countries were requested to propose the date and place of the next meeting. After deliberation, Indonesia offers to host the 4th RSTC in September 2020 in Bangka Belitung Islands

AGENDA 11: CLOSURE OF THE MEETING

130. The Chairperson expressed her gratitude to all participants for their cooperation during the past week, and she stated that she was looking forward to meeting every member country again at the next RSTC meeting. She granted all participants her best wishes.

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ANNEX 1
LIST OF PARTICIPANTS (DRAFT AS OF 27JAN2020)

CAMBODIA

Leng Sy Vann (Mr.) Deputy Director	Department of Fisheries Conservation Fisheries Administration (FiA) #186, Preah Norodom Blvd. Chamcarmon, P.O. Box: 582 Phnom Penh CAMBODIA Tel: +855 17 446373 E-mail: lengsyvann@gmail.com

INDONESIA

Ngurah Nyoman Wiadnyana (Prof., Dr.) Senior Researcher	Ministry of Marine Affairs and Fisheries (MMAF) Pusat Riset Perikanan, Badan Riset dan Sumber Daya Manusia Kelautan dan Perikanan, Kementerian, Kelautan dan Perikanana, Gedung BRSDM II Lantai 2, Jl. Pasir Putih II, Ancol Timur, Jakarta 14430 REPUBLIC OF INDONESIA Tel: +62 812 1106 119 E-mail: ngurahwiadnyana14@gmail.com
Joni Haryadi (Dr.) Head of Research Institute of Fish Resource Enhancement	Directorate General of Marine and Fisheries Research and Human Resource Development Ministry of Marine Affairs and Fisheries (MMAF), Jl. Cilalawi No. 1 Jatiluhur, Jatimekar, Kec. Jatiluhur, Purwakarta 41152 REPUBLIC OF INDONESIA Tel: +62 821 2247 2337 E-mail: joniharyadi@yahoo.com
M Riza Farhan (Dr.)	Directorate General of Marine and Fisheries Research and Human Resource Development Ministry of Marine Affairs and Fisheries (MMAF), Jl. Cilalawi No. 1 Jatiluhur, Jatimekar, Kec. Jatiluhur, Purwakarta 41152 REPUBLIC OF INDONESIA E-mail: riza.farhan@gmail.com , nc.indonesia@gmail.com

MALAYSIA

Sallehudin bin Jamon (Mr.) Senior Research Officer	Fisheries Research Institute (FRI) Kg. Acheh, 32000 Setiawan, Perak. Tel: +605-6912093 E-Mail: Sallehudin_jamon@dof.gov.my
Jamil bin Musel (Mr.) Senior Research Officer	Fisheries Research Institute (FRI) Bintawa, 32000 Setiawan, Perak. Tel: +6082-334177 E-Mail: jamilmusel@dof.gov.my

PHILIPPINES

Valerianno M.Borja (Mr.) Aquaculturist II	National Fisheries Research and Development Institute (NFRDI) Corporate 101 Bldg., 101 Mother Ignacia, Quezon City, PHILIPPINES Tel: +63 9204033997 E-mail: valborja1029@gmail.com

VIET NAM

Nguyen Thanh Binh (Mr.)	Directorate of Fisheries (D-Fish) 10 Nguyen Cong Hoan Street Ba Dinh District, Hanoi VIET NAM Tel: +84 24 3771 2652 Fax: +84 24 3724 5120 E-mail: ntbinh@mard.gov.vn

THAILAND

Kumpon Loychuen (Mr.) Director	Eastern Gulf Fisheries Research and Development Center Department of Fisheries 2, Moo 2, Tambon Phe, Amphoe Mueang Rayong, Rayong, 21160 THAILAND Tel: +66 98 262 2274 E-mail: loychuenk@gmail.com
Praulai Nootmorn (Ms.) Senior Expert in Marine Fisheries	Department of Fisheries Kaset Klang, Phaholyotin Rd., Chatuchak Bangkok 10900, THAILAND Tel: +66 2 5620543 Fax: +66 2 5620543 E-mail: nootmorn@yahoo.com

REGIONAL EXPERT

Kornrawee Aiemsomboon (Dr.) Assistant Professor	Department of Marine Science, Faculty of Science, Chulalongkorn University, Phayathai Road, Patumwan, Bangkok 10330, Thailand Tel: +66 83 941 6551 E-mail: kornrawee.a@gmail.com
Nopporn Manajit (Dr.)	SEAFDEC Training Department P.O. Box 97 Phrasamutchedi Samut Prakan 10290, Thailand Tel: +66 24256100 ext. 162 Fax: +66 24256110 to 11 E-mail: nopporn@seafdec.org

SEAFDEC TRANING DEPARTMENT (TD)

Sukchai Arnupapboon (Mr.)	SEAFDEC Training Department P.O. Box 97 Phrasamutchedi Samut Prakan 10290, Thailand Tel: +66 24256100 ext. 143 Fax: +66 24256110 to 11 E-mail: sukchai@seafdec.org

PROJECT COORDINATING UNIT

Somboon Siriraksophon (Dr.) Project Director of Fisheries Refugia project	SEAFDEC Training Department P.O. Box 97 Phrasamutchedi Samut Prakan 10290, Thailand Tel: +66 81 900 3361 E-mail: somboon@seafdec.org
Weerasak Yingyuad (Mr.) Technical Coordinator of Fisheries Refugia Project/ Fishing Gear Technologist	SEAFDEC Training Department Tel: +66 86 970 3657 E-mail: weerasak@seafdec.org
Nathacha Sornvaree (Mrs.) Administrative Officer	SEAFDEC Training Department Tel: + 66 81 451 4925 E-Mail: natha@seafdec.org
Nuttaya Phaisantawechok (Ms.) Technical Officer	SEAFDEC Training Department Tel: + 66 83 278 2333 E-Mail: nuttaya.phaisan@gmail.com
Supakalang Ubping (Ms.) Technical Officer	SEAFDEC Training Department Tel: + 66 88 696 3639 E-Mail: supakalang@gmail.com

RAPPORTUER

Phanthanit Intharajak (Ms.)	19/4 PK Villa Sukhothai1 Alley, Sukhothai Road Suan Chitlada, Dust, Bangkok 10300, Thailand Tel: 66(0) 2 889 070 E-Mail: pplintharajak@gmail.com

ANNEX 2
LIST OF DOCUMENTS

DISCUSSION DOCUMENTS	
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.1	REPORT OF THE PROJECT DIRECTOR ON PROGRESS WORKS
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2a	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF DECEMBER 2019: CAMBODIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2b	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF DECEMBER 2019: INDONESIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2c	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF DECEMBER 2019: MALAYSIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2d	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF DECEMBER 2019: PHILIPPINES
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2e	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF DECEMBER 2019: THAILAND
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.2f	THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL AS OF DECEMBER 2019: VIET NAM
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: OVERVIEW BY PCU
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3a	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: CAMBODIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3b	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: INDONESIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3c	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: MALAYSIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3d	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: PHILIPPINES
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3e	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: THAILAND
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.3f	FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: VIET NAM
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1	DATA AND INFORMATION NEEDS TO SUPPORT ACTIVITIES: 1) **FISHERIES STATISTIC FOR EACH TARGET SPECIES: STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETE**RS: OVERVIEW BY PCU
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1a	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: ANCHOVY
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1b	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: BLUE SWIMMING CRAB
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1c	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: FRIGATE TUNA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1d	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: FUSILLER FISH
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1e	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: GROUPER

SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1f	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: MUD CRAB
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1g	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: RABBIT FISH
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1h	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: PENAEID SHRIMPS
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1i	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: INDO-PACIFIC MACKEREL
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1j	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: SPINY LOBSTER
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.1k	STATUS AND TRENDS AT COUNTRY LEVEL AND BIOLOGICAL PARAMETERS: SMALL PELAGIC FISH
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.4.2	REGIONAL WEBSITES/DATABASE/REPOSITORY
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.5.1	REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPEC IES: INDO-PACIFIC MACKEREL
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.5.2	REGIONAL GUIDELINES ON INDICATORS FOR MANAGEMENT OF FISHERIES REFUGIA
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.5.3	IMPROVING HEALTHY OCEAN ECOSYSTEMS THROUGH BEST PRACTICES IN TRAWL FISHERIES (REVISED 1)
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.5.4	PROJECT MID TERM EVALUATION
SEAFDEC/UNEP/GEF/FR-RSTC.3 WP.6	**ADOPTED REPORT OF THE RSTC3 MEETING**

INFORMATION DOCUMENTS	
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.1	INFORMATION NOTES
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.2a	PROVISIONAL PROSPECTUS
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.2b	PROVISIONAL AGENDA AND TIMETABLE
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.2c	ANNOTATED AGENDA
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.3	LIST OF PARTICIPANTS
SEAFDEC/UNEP/GEF/FR-RSTC.2 INF.4	LIST OF DOCUMENTS

ANNEX 3
PROVISIONAL AGENDA

DAY 1: WEDNESDAY 5TH, FEBRUARY 2020	
08:15-08:45	**REGISTRATION**
08:45-09:00	**AGENDA 1: OPENING OF THE MEETING** 1.1 WELCOME AND OPENING ADDRESS 1.1.1 WECOME ADDRESS BY CURRENT CHAIRPERSON (2019) 1.1.2 OPENING ADDRESS BY REPRESENTATIVE FROM D-FISH 1.2 INTRODUCTION OF MEMBERS
09:00-09:20	**AGENDA 2: ORGANISATION OF THE MEETING** 2.1 ELECTION OF OFFICERS FOR 2019 2.2 DOCUMENTATION AVAILABLE TO THE MEETING 2.3 ORGANISATION OF WORK
09:20-09:30	**AGENDA 3: ADOPTION OF THE MEETING AGENDA**
09:30-10:00	**AGENDA 4: REPORT OF THE PROJECT DIRECTOR ON PROGRESS WORKS**
10:00-10:30	**BREAK NETWORKING AND GROUP PHOTOGRAPH**
10:30-12:00	**AGENDA 5: PRESENTATIONS BY THE NATIONAL SCIENTIFIC AND TECHNICAL COMMITTEE ON THE PROGRESS WORK OF THE PROJECT ACTIVITIES AT THE NATIONAL LEVEL AS OF 31 DEC. 2019** 5.1 CAMBODIA 5.2 MALAYSIA 5.3 PHILIPPINES 5.4 THAILAND 5.5 INDONESIA 5.6 VIET NAM
12:00-13:30	**LUNCH BREAK**
13:30-15:00	**AGENDA 6: FISHERIES REFUGIA PROFILES FOR 15 PRIORITY REFUGIA SITES: (USE TEMPLATE AS AGREED)** 6.1 CAMBODIA: 3 SITES 6.2 INDONESIA: 2 SITES 6.3 MALAYSIA: 2 SITES 6.4 PHILIPPINES: 3 SITES 6.5 THAILAND: 2 SITES 6.6 VIET NAM: 3 SITES

15:00-15:30	**BREAK NETWORKING**
15:30-16:30	**AGENDA 6: CONTINUED**
DAY 2: THURSDAY 6TH, FEBRUARY 2020	
08:45-10:00	**AGENDA 7: DATA AND INFORMATION NEEDS TO SUPPORT ACTIVITIES** 7.1 FISHERIES STATISTIC FOR EACH TARGET SPECIES: STATUS AND TRENDS AT COUNTRY LEVEL (FROM 1995 TILL PRESENT) AND BIOLOGICAL PARAMETERS a) ANCHOVY: VIET NAM b) BLUE SWIMMING CRAB: CAMBODIA, THAILAND c) FRIGATE TUNA: PHILIPPINES, VIET NAM d) FUSILLER FISH: PHILIPPINES
10:00-10:30	**BREAK NET WORKING**
10:30-12:00	**AGENDA 7: CONTINUED** e) GROUPER: CAMBODIA f) MUD CRAB: PHILIPPINES g) RABBIT FISH: PHILIPPINES h) PENAEID SHRIMPS (PLEASE IDENTIFY): INDONESIA
12:00-13:30	**LUNCH BREAK**
13:30-15:00	**AGENDA 7: CONTINUED** i) SHORT MACKEREL: CAMBODIA, THAILAND, VIET NAM j) SPINY LOBSTER: MALAYSIA k) SMALL PELAGIC FISH (PLEASE IDENTIFY): INDONESIA
15:00-15:30	**BREAK NET WORKING**
15:30-16:30	**AGENDA 7: CONTINUED** 7.2 REGIONAL WEBSITES/ DATABASE/ PROJECT REPOSITORY 7.3 OTHERS
DAY 3: FRIDAY 7ND, FEBRUARY 2020	
08:45-10:00	**AGENDA 8: OTHER BUSINESS** 8.1 REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPEC IES: INDO-PACIFIC MACKEREL 8.2 REGIONAL GUIDELINES ON INDICATORS FOR MANAGEMENT OF FISHERIES REFUGIA
10:00-10:30	**BREAK NET WORKING**
10:30-11:45	**CONTINUED AGENDA 8: OTHER BUSINESS** 8.3 IMPROVING HEALTHY OCEAN ECOSYSTEMS THROUGH BEST PRACTICES IN TRAWL FISHERIES (REVISED 1) 8.4 PROJECT MID TERM EVALUATION 8.5 OTHER MATTER

11:45-12:00	**AGENDA 9: ADOPTION OF THE REPORT OF THE MEETING**
12:00-12:10	**AGENDA 10: DATE AND PLACE OF THE 4TH REGIONAL SCIENTIFIC & TECHNICAL COMMITTEE MEETING**
12:10-12:20	**AGENDA 11: CLOSURE OF THE MEETING**
12:20-13:30	**LUNCH BREAK**
14:30-17:30	LEAVE CLASSIC HOANG LONG HOTEL, HAI PHONG FOR HONOI AND STAY OVERNIGHT AT HANOI L'HERITAGE CNTRE HOTEL AND SPA*

*REMARK: Except for presentative from Cambodia who have direct flight from Hai Phong to Ho Chi Minh

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ANNEX 4
PROGRESS WORKS

Executive Summary

This summary highlights the Progress Works from the past half years implementations (as of 30 December 2019) by all participating countries and the SEAFDEC/PCU. The progress work of each activities are identified in percentage to understand the status of works in each country and the PCU. Noted that for Viet Nam, the Ministry of Agriculture and Rural Department (MARD) approved the yearly project budget plan in October 2019. The NFRC and NTSC had first meeting in January 2020 to give direction and instruction to implementing agency to prepare the project detailed budget plan to get MARD approval and promote the project implementation in 2020 onward.

ACTIONS BY THE RSTC3:

- ❖ Take notes, consideration and suggestion to the PCU on the Highlight of Progress Report for finalization.

PROGRESS WORK
DURING A PERIOD OF JUNE TO DECEMBER 2019

1. STATUS OF ESTABLISHMENT OF FISHERIES REFUGIA BY COUNTRY: are as follows:

a. **Cambodia**,

i. there are 3 priority fisheries refugia sites located in three Provinces along the coastal area of Cambodian sea.

1. **Kep Province**: for blue swimming crab (*Portunus pelagicus*)
2. **Kampot Province**: for juvenile grouper (*Epinephelus spp.)*.; and
3. **Koh Kong Province**: for short mackerel (*Rastrelliger brachysoma*);

ii. Main activities in this quarters are continued monthly baseline surveys for fish-larvae of short mackerel and scientific data to support the preparation of the Action Plan for implementation of the Fisheries refugia in Koh Kong Province. In addition, FiA established Technical working group for management of marine fisheries resources and conservation area in Koh Kong,

iii. At Kep Fisheries Refugia, FiA conducted the Provincial Management Committee Meeting to approve the 5 Years Action Plan for Marine Fisheries Management Area or fisheries Refugia for Blue Swimming Crab.

b. **Indonesia,**

i. 2 tentative priority fisheries refugia sites are located in 2 Provinces.

1. **Pulau Kecil in Bangka-Belitung Province**: for pelagic species: squid, and
2. **Bengkayang in West Kalimantan Province**: for penaeid shrimp.

ii. Since signing of the LOA between SEAFDEC and MMAF in June 2019, the AMFRHR as a National Lead Agency have conducted a series of preparatory Meetings on fisheries refugia profiles for two selected sites including the Inception workshop for implementation of the project. All meeting reported are compiled to guide for the 2020 stakeholder consultations at the selected sites.

c. **Malaysia**,

i. there are 2 priority fisheries refugia sites located in east coast of Peninsular Malaysia and in Sarawak State of Malaysia as follows:

1. **Tanjung Leman, Johor**: for spiny lobsters (*Panulirus polyphagus as a main species) and other Panulirus spp. such as P. versicolor*, *P. ornatus*, *P. homarus* and *P. longipes*) refugia; and
2. **Miri, Sarawak**: for tiger prawn (*Penaeus monodon*) refugia

ii. Department of Malaysia as a National Lead Agency of the project renovated the Refugia Information Center (RIC) established in late 2017 through the cooperation with private sector for spiny lobsters and local government for tiger prawn at Tanjung Leman Pier, Johor and Miri, Sarawak State of Malaysia, respectively.

iii. DOF/MY also continued the Lobster resources survey on-board Trawler and tiger prawn survey in Pasu River and Lutong River with aims to find the scientific evidence for establishment of the Refugia in the selected areas.

iv. For better understanding on the management in long term on Fisheries Refugia, DOF/MY conducted the capacity building and workshop for stakeholder at Mersing through the introduction of EAFM (Ecosystem Based Fisheries Management). In addition, the capacity to national officers to better understand the status of Fisheries Refugia project was made by sending relevant officers to attend the Project Steering Committee Meeting organized by SEAFDEC/PCU and hosted by DOF/MY in MIRI, Sarawak Malaysia.

d. **Philippines**,
   i. There are 3 priority fisheries refugia sites as follows:
      1. **Bolinao, Pangasinan**: for Rabbitfish (*Siganus spp*.) refugia in seagrass bed off Bolinao;
      2. **Masinloc, Zambales**: for juveniles of Frigate tuna (*Auxis thazard*) refugia; and
      3. **Coron, Palawan**: for fusilier fish refugia in coral reef area, and mud crab refugia in mangrove area.
   ii. NFRDi as a National Lead Agency of the Project for Philippines continued the Icthyo-plankton survey in Masinloc site, and conducted the Three Stakeholder Consultation Meeting for Reviewing the Draft Guidelines on procedures for formal designation of fisheries refugia in three sites: Msinloc, Bolinao, and Coron.
   iii. To build the capacity of local institutions at Fisheries Refugia Site in Coron, the Training workshop on Essential ecosystem approach to fisheries management (EAFM) was conducted in Coron City, Palawan Province. It is very useful for the local officers to understand on development of the management plan which apply to fisheries refugia management. This Training workshop will expand to other refugia sites in 2020;
   iv. The Project Year-end assessment for 2019 and 2020 workplan were conducted in IBA, Zambales, where the relevant officers attended.

e. **Thailand**,
   i. there are 2 priority fisheries refugia sites as follows:
      1. **Trat Province**: for short mackerel (*Rastrelliger brachysoma*) as a transboundary species with Koh Kong Province of Cambodia; and
      2. **Surat Thani Province**: for blue swimming crab (*Portunus pelagicus*)
   ii. DOF/TH as a National Lead Agency of the Project for Thailand conducted the Sixth Meeting of Thailand National Fisheries Refugia Committee, and the Second Meeting of Thailand National Scientific and Technical Committee with aims to update the achievements and way forwards on the demarcation of fisheries refugia areas for Indo-Pacific Mackerel in Trat and Blue Swimming Crab in Suratthani Provinces.
   iii. Encourage the Thai Trawlers to voluntary releasing the lived blue swimming crab into the sea in which it is believed that the best way to conserve and enhance the Blue Swimming Crab in the Gulf of Thailand.

f. **Viet Nam**,
   i. There are 3 Tentative refugia sites located in the North, Central and South of Viet Nam as follows:
      1. **Bech Long Vi Island, Haiphong Province**: for small pelagic fishes
      2. **Hon Cau Island, Binh Thuan Province**: for Frigate tuna (as a tentative species)
      3. **Phu Quoc Island, Kien Giang Province**: for anchovy species and short mackerel (*Rastrelliger brachysoma*) refugia as 2nd priority;
   ii. After signing the Letter of Intent in May 2019, long internal processes to get approval for the workplan and setting committee by the Government. The results during a period from June to December 2019 are as follows:
      1. Ministry of Agriculture and Rural Department (MARD) approved the yearly project budget plan in October 2019.
      2. Directorate of Fisheries (DFISH) as a National Lead Agency of the project assigned the National Fisheries Refugia Committee (National Project Steering Committee) with 11 members headed by DDG Nguyen Quang Hung and National Technical and Scientific Committee with 7 members

headed by a Deputy Director for Conservation and Aquatic Resource Development in November 2019

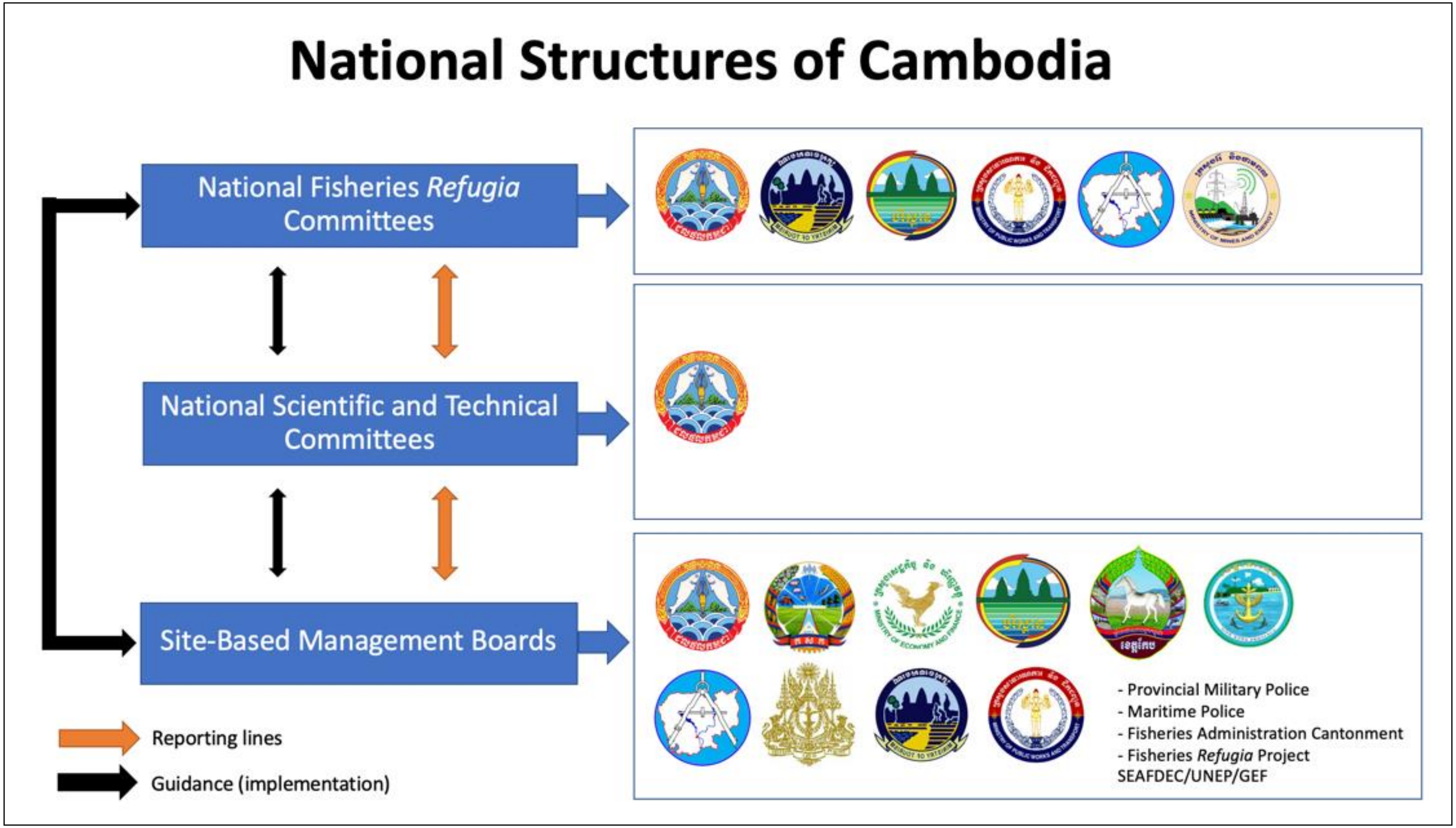
3. The NFRC and NTSC had first meeting in January 2020 to give direction and instruction to implementing agency to prepare the project detailed budget plan to get MARD approval and promote the project implementation in 2020 onward.
4. DFISH has been submitting the ODA registration to the Ministry of Finance as Vietnamese financial regulation.

2. PROJECT MANAGEMENT BY PCU

a. Finalized and Published the Meeting Reports, Regional Action Plan, etc:
    i. Report of the Regional Meeting on Indicators for Fisheries Refugia Management and Discussion on Project Follow-up held at A-one The Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand from 9th – 11th September 2019;
    ii. Report of the Regional Consultative Meeting on Regional Action Plan for Management of Transboundary Species, *Rastrelliger brachysoma* in the Gulf of Thailand Sub-region, held at Bay Beach Resort, Jomtien, Chonburi Province, Thailand 12th – 13th September 2019;
    iii. Regional Action Plan for management of transboundary species: Indo-pacific mackerel (*Rastrelliger brachysoma*) in the gulf of thailand sub-region (for endorsement by SEAFDEC and ASEAN
b. Preparatory work for organizing the Regular Meeting as follows:
    i. the 2nd Meeting of the Project Steering Committee Meeting held on 5th-6th November 2019 in MIRI, Sarawak, Malaysia:
    ii. the 3rd Meeting of the Regional Scientific and Technical Committee to be held on 5-7 February 2020 in Hai Phong, Viet Nam in cooperation with D-FISH
c. Organizing the 2nd Meeting of the Project Steering Committee Meeting held on 5th-6th November 2019 in MIRI, Sarawak, Malaysia
d. Updated the status of Partner's Implementation on establishment of Fisheries Refugia and Updated the Fisheries Refugia Websites;
e. Technical Support to participating Countries:
    i. Cambodia:
        1. Analysis of the genetic of Indo-Pacific Mackerel from Koh Kong Province by the Project Partners (Chula Longkorn University)
        2. Consultation for workplan on the impact of fishing gear to the Fisheries refugia site in KEP province, Cambodia
    ii. Philippines: Support the capacity building to local institutions and local government on applying EAFM for better management of fisheries refugia in Coron site;
    iii. Thailand: Support the stakeholder consultation for demarcation of the areas for fisheries refugia of Indo-pacific Mackerel in Trat Province.
f. Reporting the Progress of Fisheries Refugia as well as the Regional Action Plan for Management of Transboundary Species: Indo-pacific Mackerel in the Gulf of Thailand Region at the SEAFDEC and ASEAN Forums.

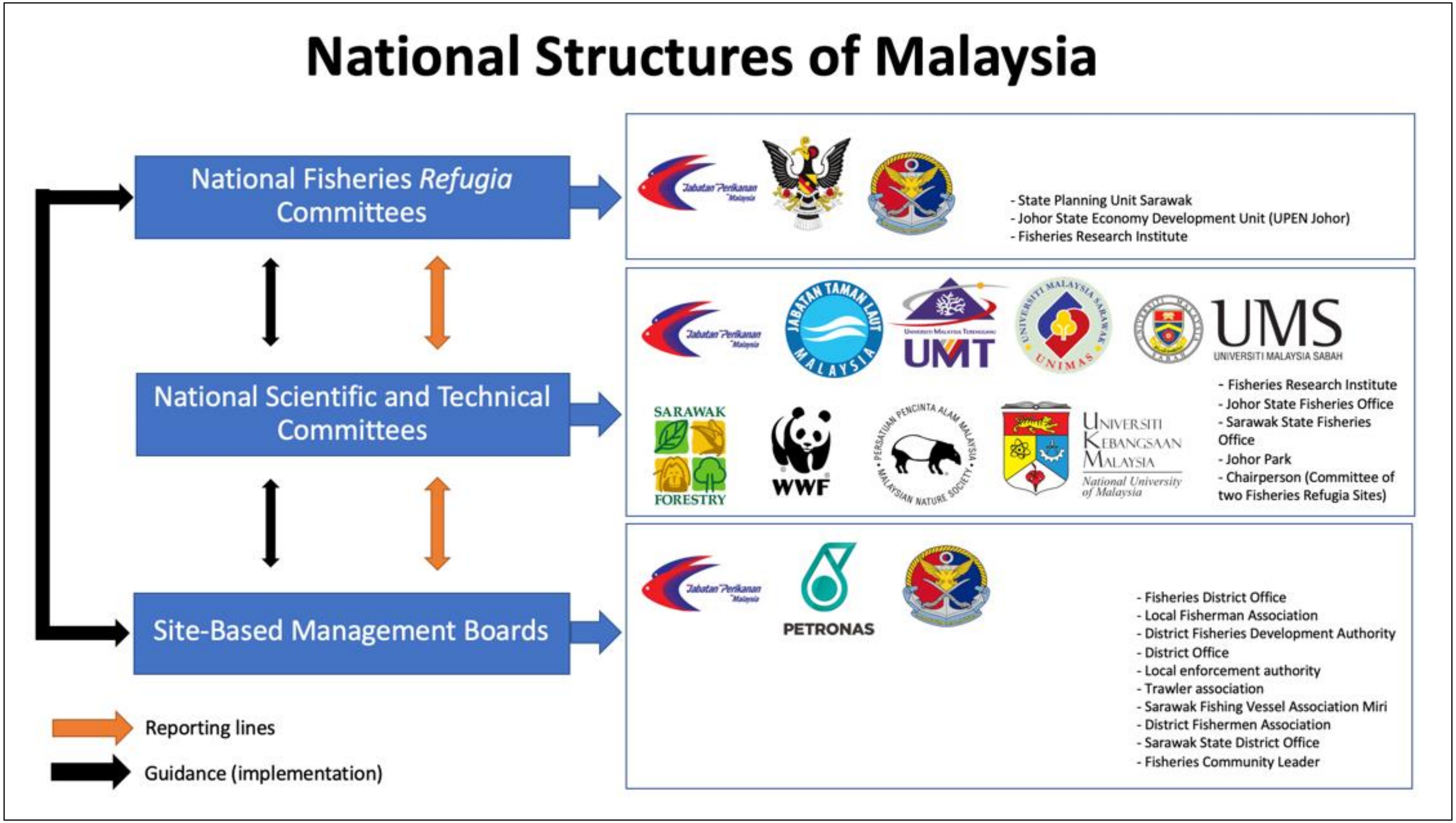
3. NATIONAL INSTITUTION STRUCTURES (DRAFT):

4. 3.1) CAMBODIA

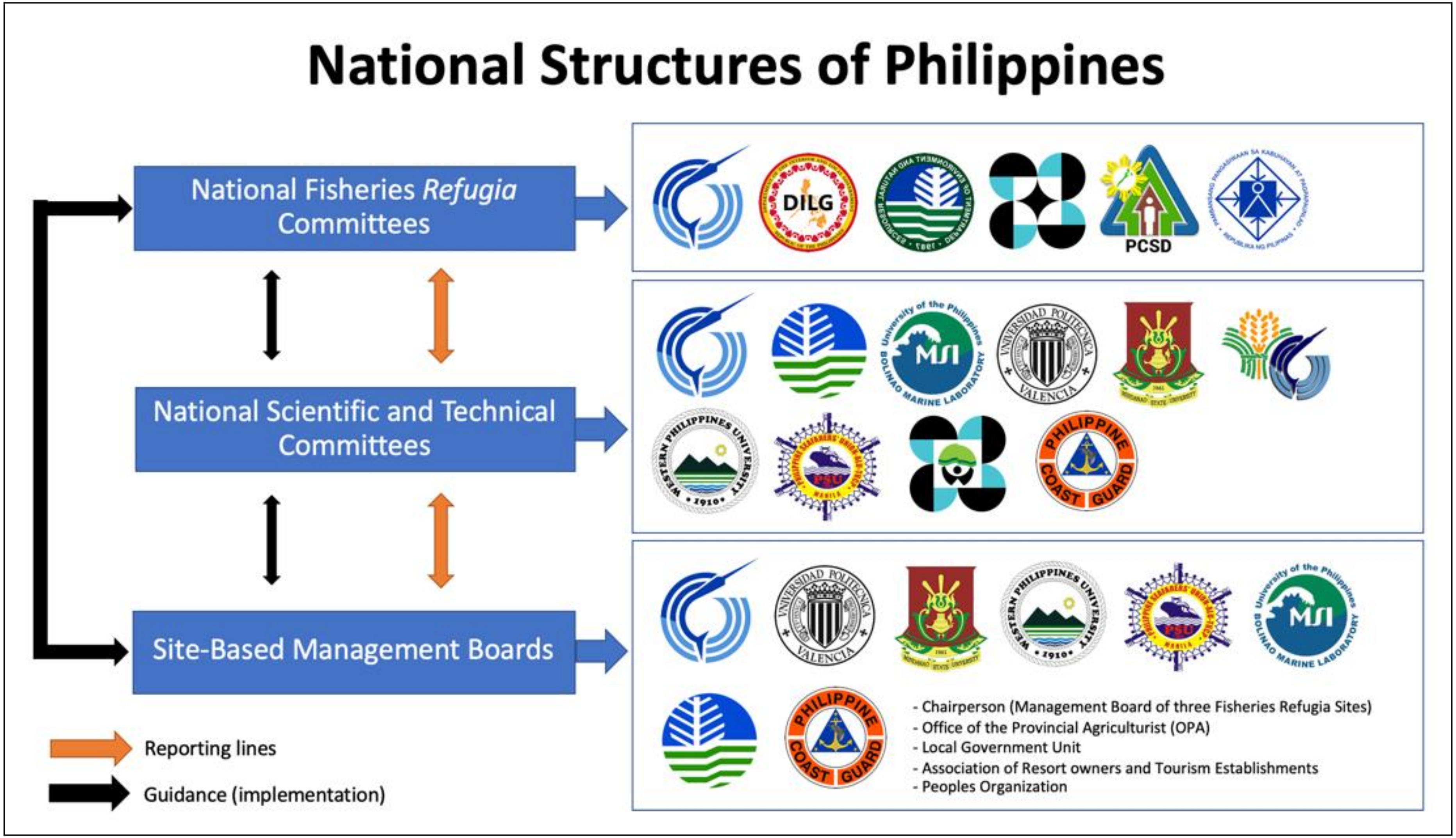


5. 3.2) INDONESIA

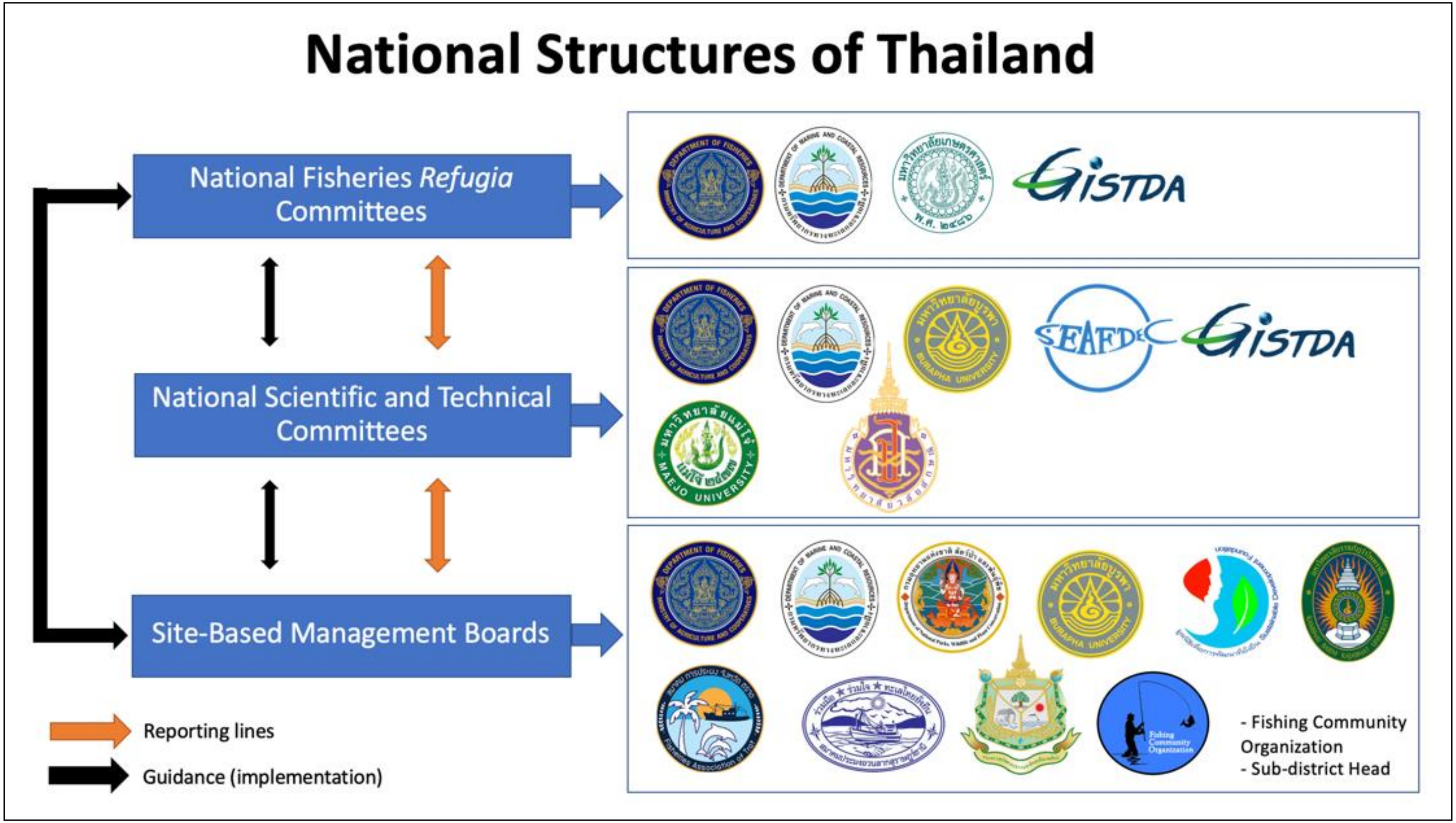
6. 3.3) MALAYSIA



7. 3.4) PHILIPPINES



8. 3.5) THAILAND



9. 3.6) VIET NAM (WILL BE UPDATED)

10. PROJECT IMPLEMENTATION PROGRESS IN PERCENTAGE BY COUNTRY AND PCU AS OF 30 DEC. 2019

Outputs	CAMBODIA	INDONESIA	MALAYSIA	PHILIPPINE	THAILAND	VIET NAM	PCU
Component 1 - Identification and management of fisheries and critical habitat linkages at priority fisheries refugia in the South China Sea							
Activity 1.1: Developing fisheries and coastal habitat information and data collection programmes for 14 priority fisheries refugia sites	50%	70.25 %	50%	50%	50%		N/A
Activity 1.2: Facilitating agreement among stakeholders on the boundaries of fisheries refugia at 14 priority fisheries refugia sites	70%	0 %	40%	25%	50%		N/A
Activity 1.3: Developing Community-Based Management Plans for 14 priority fisheries refugia sites	30%	0 %	20%	25%	50%		N/A
Activity 1.4: Establishing operational management for 14 priority fisheries refugia sites	40%	0 %	10%	25%	30%		N/A
Activity 1.5: Strengthening civil society and community organization participation in the management of 14 fisheries refugia sites	40%	0 %	0%	10%	20%		N/A
Component 2 - Improving the management of critical habitats for fish stocks of transboundary significance via national actions to strengthen the enabling environment and knoweldge-base for fisheries refugia management							
Activity 2.1: Enhancing policy guidance for improved management of the effects of fishing on critical habitats in the 6 participating countries	80%	0 %	10%	2.5%	30%		N/A
Activity 2.2: Defining the policy and legal basis for formal designation and establishment of fisheries refugia in the 6 participating countries	70%	0 %	10%	0%	30%		N/A
Activity 2.3: Development of national guidelines on the establishment and operation of fisheries refugia and reflected in an updated regional refugia action plan	70%	0 %	10%	45%	20%		N/A

Activity 2.4: Reforming national and regional policy, legal and planning frameworks for demarcating boundaries and managing refugia	50%	0 %	10%	2.5%	20%		N/A
Activity 2.5: Enhancing access to information relating to status and trends in fish stocks and their habitats in waters of the SCS marine basin	0%	0 %	50%	60%	10%		N/A
Activity 2.6: Improved national and regional-level management and sharing of information and data on fish early life history in the waters of the SCS	60%	0 %	10%	40%	10%		N/A
Activity 2.7: Enhancing access to information relating to the locations and status of coastal habitats and management areas in the SCS	20%	0 %	0%	0%	30%		N/A
Activity 2.8: Strengthening the information base for the planning, monitoring and evaluation of management at priority fisheries refugia sites	40%	0 %	10%	0%	10%		N/A
Activity 2.9: Improving basin-wide understanding of linkages between ocean circulation patterns, nutrient/chlorophyll concentrations, and sources and sinks of fish larvae in the South China Sea	N/A	N/A	N/A	N/A	N/A	N/A	50%
Activity 2.10: Regionally and locally appropriate best practices generated to address the effects of trawl and push net fishing on seagrass habitat, and the capture of juveniles, pre-recruits and fish in spawning condition	N/A	N/A	N/A	N/A	N/A	N/A	20%
Component 3 - Information Management and Dissemination in support of national-level implementation of the fisheries refugia concept							
Activity 3.1: Enhancing uptake of best practices in integrating fisheries management and	50%	0 %	10%	0%	10%		N/A

biodiversity conservation in the 6 participating countries							
Activity 3.2: Improving community acceptance of area-based approaches to marine management in the 6 participating countries	70%	0 %	30%	0%	20%		N/A
Activity 3.3: Knowledge generated and experiences from establishing and operating fisheries refugia captured and shared nationally, regionally, and globally	40%	0 %	10%	0%	10%		N/A
Activity 3.4: Information and Education Campaigns for small-scale fisherfolk on the links between fisheries, habitats and biodiversity coordinated regionally through a Regional Education and Awareness Centre	N/A	N/A	N/A	N/A	N/A	N/A	50%
Activity 3.5: Standardised methods for collection and analysis of information and data for use in assessing impacts of refugia and design appropriate indicators for the longer-term operation of the regional system of fisheries refugia	N/A	N/A	N/A	N/A	N/A	N/A	75%
Component 4 - National and Regional coordination for integrated fish stock and critical habitat management							
Activity 4.1: Strengthened cross-sectoral coordination in the establishment and operation of fisheries refugia in the participating countries	50%	18.88 %	100%	28%	50%		N/A
Activity 4.2: Harnessing national scientific and technical expertise and knowledge to inform policy, legal and institutional reforms for fisheries refugia	60%	0%	100%	12%	50%		N/A
Activity 4.3: Catalyzing local community action via establishment and operation of site-	40%	0%	10%	40%	50%		N/A

based management boards at 14 priority refugia sites							
Activity 4.4: Regional cooperation in the integration of scientific knowledge and research outputs with management and policy making	N/A	N/A	N/A	N/A	N/A	N/A	50%
Activity 4.5: Regional cooperation in the establishment and operation of a regional system of fisheries refugia	N/A	N/A	N/A	N/A	N/A	N/A	50%
Activity 4.6: Effective coordination of regional and national-level activities and reporting requirements of UNEP and GEF satisfied	N/A	N/A	N/A	N/A	N/A	N/A	60%

ANNEX 5

National Progress Report in Cambodia

ESTABLSIHMENT AND OPERATION OF A REGIONAL SYSTEM OF FISHERIES REFUGIA IN THE SOUTH CHINA SEA AND GULF OF THAILAND

LENG SY VANN
Deputy Director of Department of Fisheries Conservation,
Fisheries Administration of Cambodia and
National Scientific and Technical Focal Point

Supported by Fisheries *Refugia* SEAFDEC/UNEP/GEF

05-07 February 2020

Classic Hoang Long Hotel, Hai Phong, Vietnam

Content of Presentation

1. Project Sites for Fisheries Refugia in Cambodia
2. Project Management and Coordination Structure
3. Policy and Legal Basic for the Development of Fisheries Refugia
4. Management and Operation of Fisheries Refugia
5. Baseline Survey of Short Mackerel in Koh Kong

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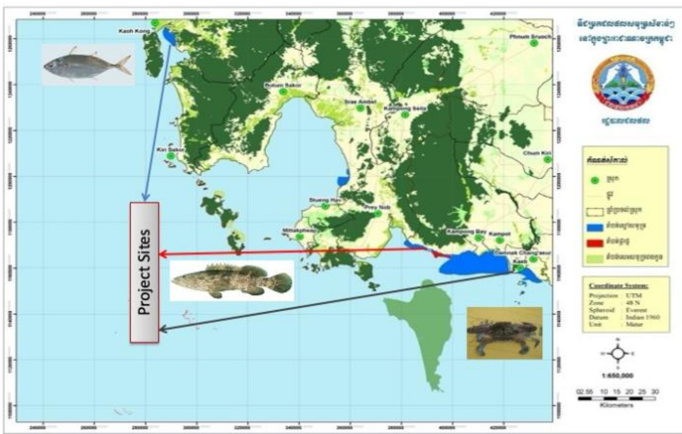
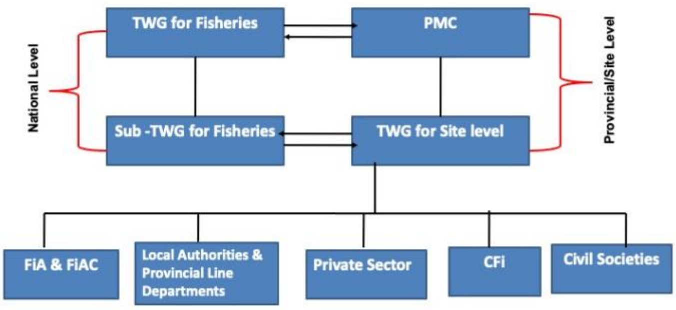
1. PROJECT SITES



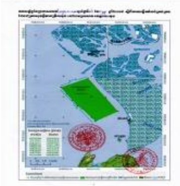
2. MANAGEMENT AND COORDINATION STRUCTURE



At national level it, Technical Working Group (TWG) for Fisheries is chaired by Director General of FiA. Fisheries Refugia in sub-group of socio economic and conversation chaired by DDG of FiA .
At provincial level, Provincial Management Committee (PMC) is chaired by Provincial Governor. Technical Working Group for Site chaired by Provincial Deputy Governor.

3. Policy and Legal Basic for the Development of Fisheries Refugia

- ✓ The concept of fisheries *refugia* has been integrated into national fisheries policy and legal basic including the Law of Fisheries, National Plan for Action, Plan on Combating IUU Fishing, 10 year strategy plan for fisheries conservation, and 5 year management plan for fisheries conservation, to ensure fisheries refugia management effectively.
- ✓ Blue swimming crab Fisheries Refugia in Kep is officially promulgated by the Minister of MAFF on 12 April 2018 , which is the total area of 417ha.
- ✓ Mackerel Fisheries Refugia is officially promulgated by the Minister of MAFF on 16 September 2019, which is the total area of 1283ha.
- ✓ Fisheries Refugia sites in Kampot province is not created officially yet due to overlapping some parts of project target and development areas. it is still discussing and consulting with provincial administration to address that issue.



4. Management and Operation of Fisheries Refugia

- Two management committee for blue swimming fisheries refugia in Kep established naming Provincial Management Committee for BWC for FR chaired Provincial Governor and TWG for BSC for FR chaired by Provincial Deputy Governor

- Planed to set up one management committee in Koh Kong named as TWG for Management of Mackerel FR at Peam Krasob

-FiA collaborating with MCC to deploy160 concrete boxes in Marine Fisheries Management Area and Blue swimming Crab Fisheries Refugia

Continued

✓Preparing 5 year management plan for marine fisheries management area and blue swimming crab in Cambodia language approved by Director General of FiA and Kep Governor

✓FiA collaborating with FiAC to install 15 mooring buoys at the boundary of fisheries refugia area

✓Patrolling illegal fishing at MFMA and Fisheries Refugia site.

Continued

Disseminating and distributing posters to fishermen, community fisheries, and local authorities

Broadcasting closed fishing season of blue swimming crab by local media system

5. BASELINE SURVEY OF SHORT MACKEREL (*Rastrelliger brachysoma*) IN KOH KONG

1. PURPOSE

To provide scientific data to support the establishment and management of mackerel fisheries *refugia* in Koh Kong province

2. METHODOLOGY

There are several methods to be conducted such as

- Collecting fish sampling from local market, landing site, and fishing ground
- Operating fish to check its gonad development
- Collecting its DNA
- Harvesting sampling of fish larvae using bongo net with the size of less 500micron

Collecting fish sample at local market in Koh Kong

Collecting DNA

Collecting sample of fish larvae

Operating fish to check its gonad

3. RESULTS

Table1: Monthly distribution of short mackerel by sex

Month/Year	Male		Female	
	N=	%	N=	%
Feb-19	21	25.61	61	74.39
Mar-19	58	67.44	28	32.56
Apr-19	12	13.79	75	86.21
May-19	22	34.38	42	65.63
Aug-19	34	44.74	42	55.26
Sep-19	40	54.79	33	45.21
Oct-19	45	48.39	48	51.61
Nov-19	42	47.73	46	52.27
Dec-19	61	66.30	31	33.70
Jan-20	57	58.76	40	41.24
Total	392	46.78	446	53.22

Table 1 showed 838 fish sampling were collected from local market, fishing ground, and landing site, 54.18% (446 fish individual) is female and 45.82% (392 fish individual) is male.

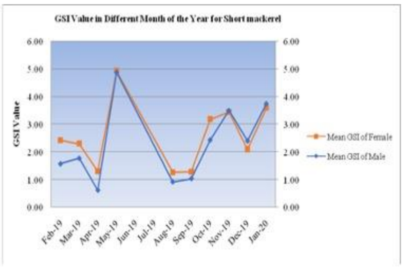
Table 2: Monthly distribution of mean total length and body weight of short mackerel by sex

Month/Year	Male		Female	
	TL(cm)	BW(g)	TL(cm)	BW(g)
Feb-19	17.09	58.15	17.70	67.89
Mar-19	16.69	53.87	17.03	58.7
Apr-19	16.09	49.94	16.25	52.24
May-19	16.64	50.54	17.59	57.8
Aug-19	15.76	41.07	16.33	44.92
Sep-19	16.93	50.53	16.23	44.63
Oct-19	16.83	55.05	17.18	58.01
Nov-19	16.92	53.67	17.50	60.73
Dec-19	16.84	57.18	17.32	61.96
Jan-20	17.15	61.65	17.54	66.57

Table 2 showed the total length of male fish increase from 15.76 cm in August to 17.15 in January meanwhile its body weight also increase from 41.07 in August to 61.65 cm in January. Total length of female increase from 16.33 cm in August to 17.79 cm in February meanwhile its body weight of female also increase from 44.92 in August to 67.89cm in February .

Table3: gonad somatic index value of male and female

Month/Year	Mean GSI of Male	Mean GSI of Female
Feb-19	1.57	2.42
Mar-19	1.77	2.30
Apr-19	0.62	1.30
May-19	4.87	4.92
Aug-19	0.92	1.27
Sep-19	1.04	1.29
Oct-19	2.43	3.18
Nov-19	3.49	3.44
Dec-19	2.40	2.10
Jan-20	3.74	3.59



Mean GSI value of short mackerel for male was estimated monthly from 0.92 in August to 1.04 in September in Figure 6, indicating immaturity period, after which the GSI value gradually increase from 2.43 in October to 3.49 in November, indicating the peak period of maturity. There is gradually decline in GSI value (2.40) in December, indicating the onset of spawning. GSI value (3.74) gradually increases in January, indicating pre-spawning period in January. There is abruptly decrease in GSI value from 3.74 in January to 1.77 in March, indicating the spawning period from February to March. There is abruptly decline in GSI value from 1.77 in March to 0.62 in April, indicating post spawning in April. There is abruptly increase from 0.62 in April to 4.87 in May, indicating pre-spawning period in May.

Mean GSI value of short mackerel for female was estimated monthly from 1.27 in August to 1.29 in September in Figure 6, indicating the preparatory period from August to September. There is abrupt increase in GSI value from 1.29 in September to 3.44 in November, indicating pre-spawning from October to November. But there is a gradual decrease in GSI value from 3.44 in October to 2.10 in December, indicating spawning period in December. GSI value gradually increases from 2.10 in December to 3.59 in January, indicating pre-spawning period in January. There is gradual decrease in GSI value from 3.59 in January to 2.30 in March, indicating spawning period from February to March. After that GSI value abruptly decline from 2.30 in March to 1.30 in April, indicating post spawning period in April. GSI value abruptly increases from 1.30 in April to 4.92 in May, indicating pre- spawning period in May.

Table 4: Monthly identification of specie composition by families and by station

Family	Station1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Total
Aploactinidae			4					3	**7**
Apogonidae			2		1			1	**4**
Bothidae			1		2				**3**
Bregmacerotidae					2				**2**
Carangidae					6			3	**9**
Clupeidae	1			2		1	1		**5**
Engraulidae	1	5					3	4	**13**
Ephippidae		3							**3**
Epinephelinae					2				**2**
Gobiidae	1	4			26		5	2	**38**
Lactariidae			1						**1**
Mullidae			1				1	1	**3**
Scombridae	2	30	27	3	4		4	2	**72**

Table 4 showed that 13 families were harvested with 8 stations from March to December 2019. 72 fish individual of Scombridae in 7 sstaions. 30 fish individual of Scombridae was collected in station 2, following is staion 3 (27 fish individual), and staion 5 and station 7 (4 each fish individual) . Staion1, Station 4, and Station 8 catching 2 fish individual, 3 fish individual, and 2 2 fish individual, respectively.

Figure 2: Percentage of specie composition by families and station

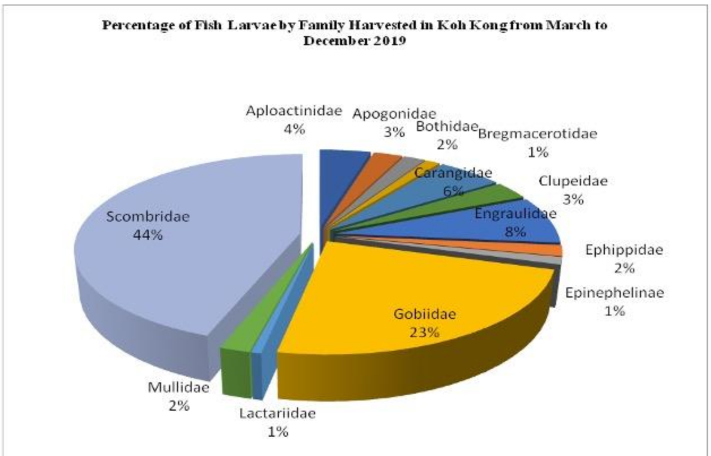
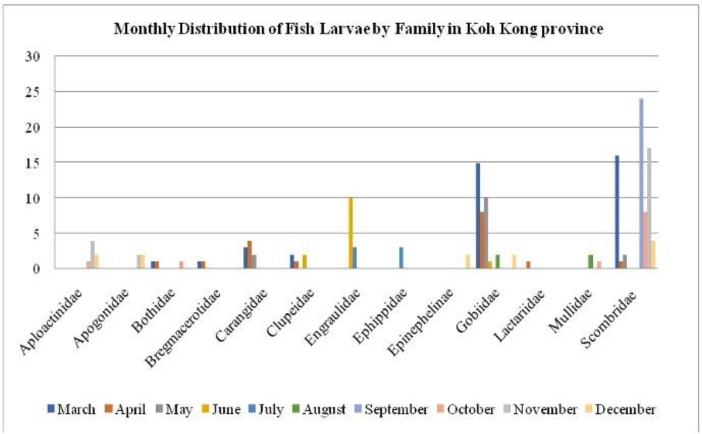


Figure 1 showed that 44% is Scobridae, following is Gobiidae (23%), and Carangidae (6%). However less percentage harvested, including Lactariidae (1%), Bregmacerotidae (1%), and Epinephelinae (1%).

Table 5: Distribution of fish composition by family and month

Family	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Aploactinidae								1	4	2	**7**
Apogonidae									2	2	**4**
Bothidae	1	1						1			**3**
Bregmacerotidae	1	1									**2**
Carangidae	3	4	2								**9**
Clupeidae	2	1		2							**5**
Engraulidae				10	3						**13**
Ephippidae					3						**3**
Epinephelinae										2	**2**
Gobiidae	15	8	10	1		2				2	**38**
Lactariidae		1									**1**
Mullidae						2		1			**3**
Scombridae	16	1	2				24	8	17	4	**72**

Table 5 showed that Scombridae can catch in March, April, May, September, October, November, and December, exception for the month of June, July, and August. In particular, 24 fish individual of Scombridae was collected in September, following November (17 fish individual), and March (16 fish individual), October (8 fish individual), December (4 fish individual), April (1 fish individual), and May (2 fish individual), respectively.



ANNEX 6

SEAFDEC/UN ENVIRONMENT/GEF Fisheries Refugia Project Progress Report By Department of Fisheries Malaysia

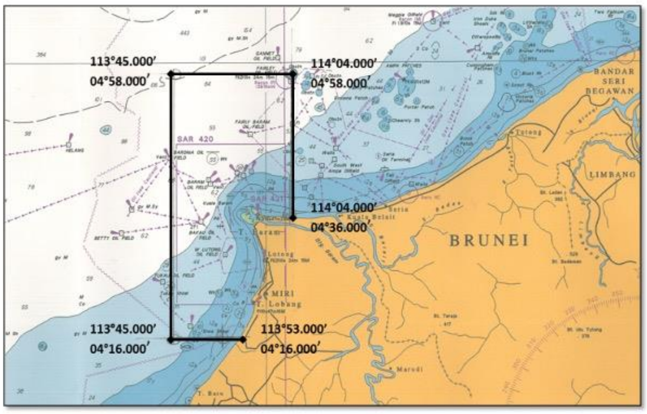
The 3rd Regional Scientific and Technical Committee Meeting for the SEAFDEC/UN Environment/GEF Project on Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand, 5 – 7 February 2020, Hai Phong City, Viet Nam

Refugia Sites in Malaysia

1. Tanjung Leman, Johor – Lobster (*Panulirus* spp.)
2. Kuala Baram, Sarawak – Tiger Prawn (*P. monodon*)

Lobster Area at South Pahang-East Johor

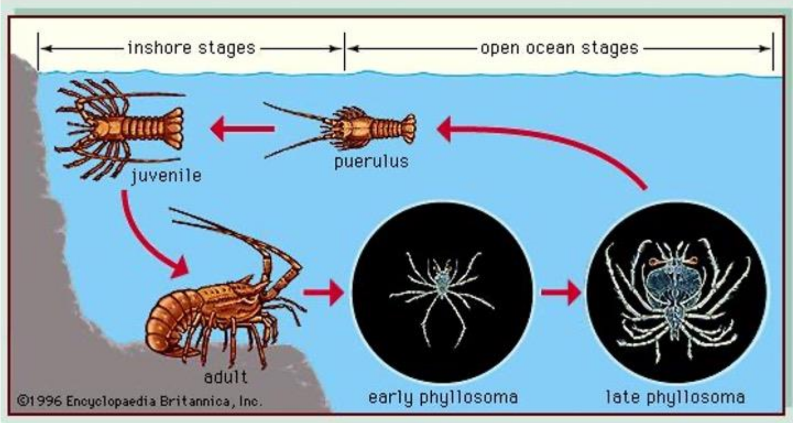
Proposed Tiger Prawn Refugia at Kuala Baram, Miri, Sarawak



2. Work Progress 2019

Lobster Research in South Pahang-East Johor

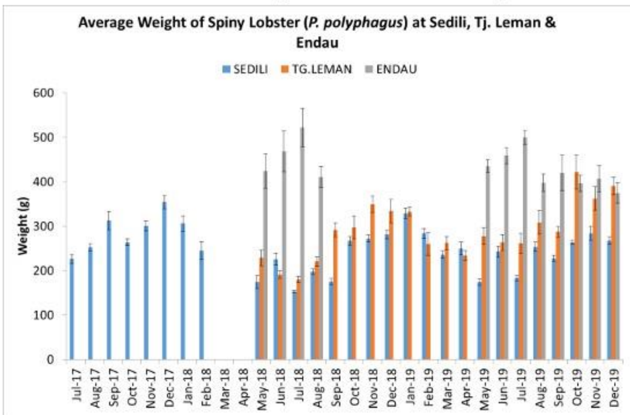
Spiny Lobster Life Cycle



Lobster Refugia Activities (2019)

1. Collection of lobster landing data from fisherman jetties
2. Lobster surveys (OBB) at sea
3. Socio-economic surveys of fishermen
4. EAFM workshop (11-13 Nov 19)

Lobster Landing Study At East Johor (2017 – 2019)



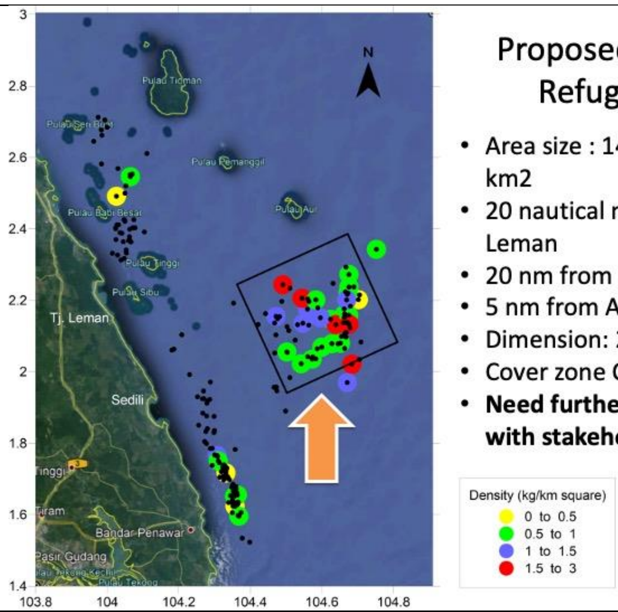
Average weight at Sedili: 250g, Tj. Leman:287g, Endau 434g

Lobster surveys (Observer-On-Board) at sea (Sept – Nov 2019)

No.	Date	Bot Reg.	Results
1.	2-15 Sept	JHF 5222T	35 hauls, 3 lobsters
2.	8-16 Oct	PAF 4623	20 hauls, 2 lobsters
3.	9-19 Oct	JHF 3388T	34 hauls, 12 lobsters
4.	16-30 Oct	JHF 5222T	38 hauls, 4 lobsters
5.	21-30 Oct	JHF 3388T	41 hauls, 27 lobsters
6.	22 Oct-2 Nov	JHF 1255T	27 hauls, 1 lobster
		Total	**195 hauls, 49 lobsters**

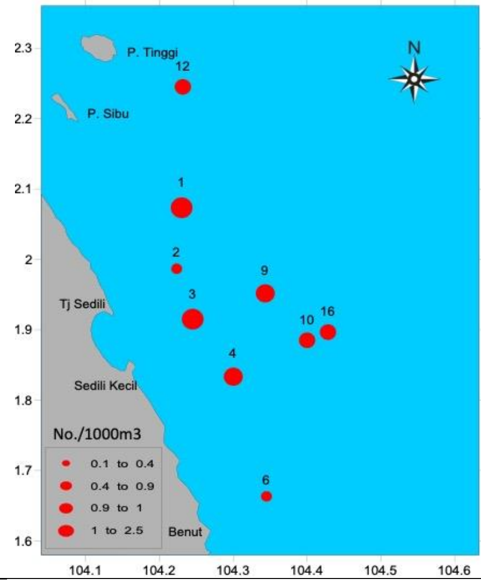
Lobster resource surveys at sea

Ave wgt= 598 g (190-1300g)
Ave carapace (CL) = 9.3 cm (3.1-13.2cm)



Proposed Lobster Refugia Site

- Area size : 140,023 Ha / 1400 km2
- 20 nautical miles from Tj. Leman
- 20 nm from Sedili
- 5 nm from Aur Island
- Dimension: 20x20 nm
- Cover zone C
- **Need further discussions with stakeholders**



Distribution and Density of Phyllosoma (larvae) in East Johor (Aug 2017)

Density (ind./1000m^3) of *Panulirus* spp. dan in 2017 survey.

Socio-economic surveys of fishermen

- 17 – 19 Sept 2019
- Tioman Island
- Survey team from FRI Batu Maung (Lead Ms. Norhanida Daud)
- Survey location targeting fishermen villages in Tioman Island

Socio-economic surveys of fishermen

- A baseline socio-economic survey of fishers covering eight fishing areas in Pahang-Johor was undertaken during 2018-2019 period.

State	District	Fishing base	Freq.	%
Pahang	Rompin	Kuala Rompin	14	8.5
		Rompin Lama	5	3.0
		Endau	5	3.0
		Pulau Tioman	27	16.4
Johore	Kota Tinggi	Tanjung Sedili	16	9.7
		Sedili Besar	19	11.5
		Sedili Kecil	21	12.7
		Sungai Musoh	38	23.0
	Mersing	Tanjung Leman	20	12.1
		Total	*165*	*100.0*

Socio-economic surveys of fishermen

- 88.2% of respondents **agreed** with the establishment of refugia as proposed by DoF.
- 66.7% of respondents **agreed** not to conduct fishing operation of lobster during its breeding season after the establishment of refugia.
- 95.8% of respondents **agreed** that the Department of Fisheries should discuss with the fishers and fishers 'community regarding the proposal of the establishment of lobster refugia in the beginning.

Socio-economic surveys of fishermen

Respondents understood the concept of refugia 72% (Yes) 27% (No)

Level of Awareness (Unit : %) # of Respondents : 165	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed
Respondent agrees with the proposal to establish the lobster refugia	29.4	58.8	0.0	7.91	3.9
Tanjung Leman is a suitable site for lobster refugia	60.6	21.8	2.4	10.3	4.8
Lobsters catching operations should be stopped during their breeding season	39.4	27.3	4.8	11.5	17.0
Respondent agrees to jointly-maintain the refugia once after it was established	28.5	27.9	9.7	15.2	18.7
Refugia site shoud be gazetted as prohibited areas for all fishing operations	29.7	32.1	5.5	9.7	23.0
DoF should consult with the fishers before proposing the establishment of refugia for lobster	66.7	29.1	2.4	1.8	0.0

Socio-Economic Survey - Lobster

EAFM Refugia workshop

- Target about 36 fishermen
- Participants from Pahang and East Johor
- Air Papan Resort, Mersing, Johor
- 11 -13 Nov 2019

Planned Activities 2020

- Phyllosoma (larvae) study at suggested refugia site (August & Oct 2020)
- Lobster landing data collection (Jan – June 2020)

TIGER PRAWN RESEARCH AT KUALA BARAM, MIRI, SARAWAK

Tiger Prawn (*Penaeus monodon*) Refugia in Kuala Baram, Sarawak

Tiger Prawn Refugia Activities (2019)

1. Collection of adult tiger prawn in Batu 1 (landing site) and market (Krokop market, Miri)
2. Juvenile tiger prawn survey at three main rivers (nursery area)
3. Tiger prawn survey (adult) at sea
4. Refugia gallery at Fisheries District Office, Miri, Sarawak.

Tiger prawn (adult) surveys (24 – 26 August 2019)

Station	Coordinate	Results (*P.monodon*)	Others
1.	N 04 41.099 E 113 55.131 (K.Lutong)	13 tails, 5 F, 8 M	Waters depth : 10.2 metres Water temperature :30.5° C Salinity : 34.3 ppt Dissolved oxygen : 3.5 ppm pH : 7.9
2.	N 04 38.340 E 113 53.764(K.Lutong)	29 tails, 13 F, 16 M	Waters depth : 10.2 metres Water temperature :30.4° C Salinity : 34.8 ppt Dissolved oxygen : 4.6 ppm pH : 7.5
3.	N 04 36.115 E 113 53.575(K.Lutong)	53 tails, 26 F, 27 M	Waters depth : 10.5 metres Water temperature :29.9 °C Salinity : 34.7 ppt Dissolved oxygen : 4.9 ppm pH : 7.5

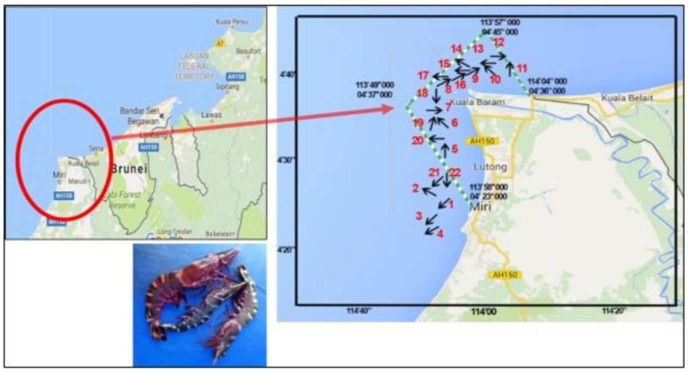
Tiger prawn (adult) surveys (24 – 26 August 2019)

Station	Coordinates	Results (*P.monodon*)	Others
4.	N 04 36.926 E 114 02.159 (K.Baram)	5 tails, 2 male, 3 female	Waters depth : 10.6 metres Water temperature :30.2° C Salinity : 32.4 ppt Dissolved oxygen : 5.2 ppm pH : 7.9
5.	N 04 43.721 E 113 59.171(K.Baram)	4 tails, 3 male, 1 female	Waters depth : 10.4 metres Water temperature :30.4° C Salinity : 32.8 ppt Dissolved oxygen : 3.9 ppm pH : 7.6

Tiger prawn (adult) resource surveys at sea (Kuala Baram)

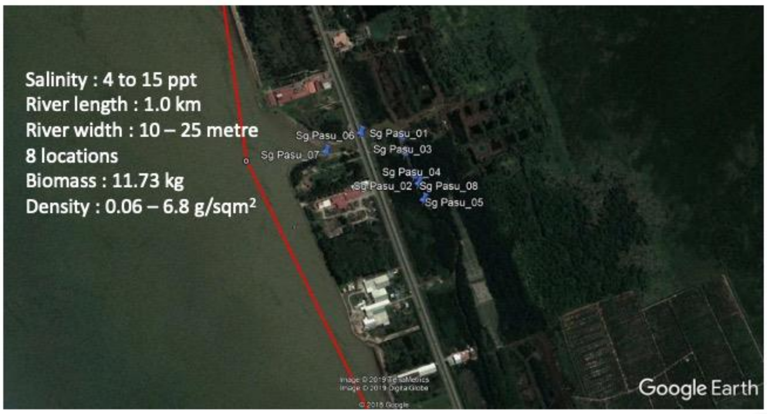
Tiger prawn (adult) resource surveys at sea (Kuala Lutong)

Proposed Tiger Prawn Refugia Site (Adult)-295 NM^2

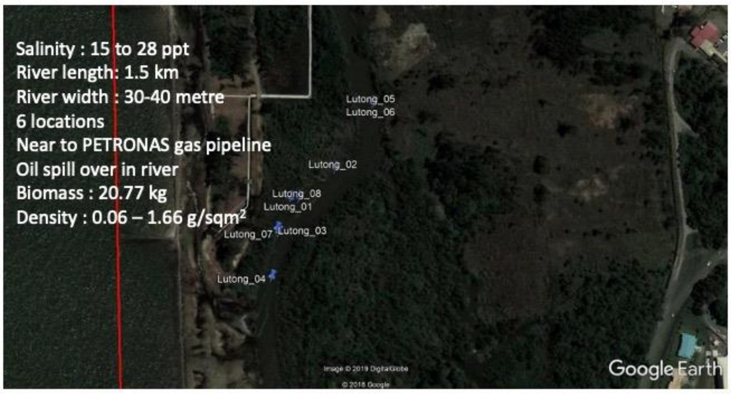


Proposed Tiger Prawn Refugia Site (Juvenile)-3 rivers identified, Pasu, Lutong and Sibuti river)

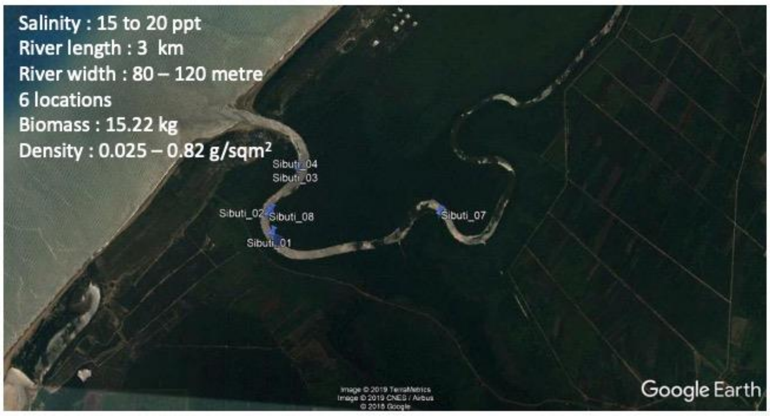
Site 1 : Pasu river



Site 2 : Lutong river

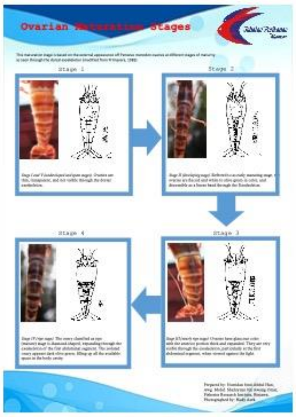


Site 3 : Sibuti river



Posters on refugia displayed at Refugia gallery

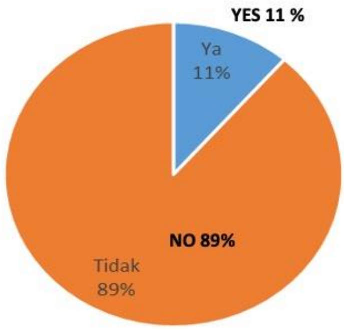
Posters on display at Tiger Prawn Refugia gallery, Miri Fisheries Office



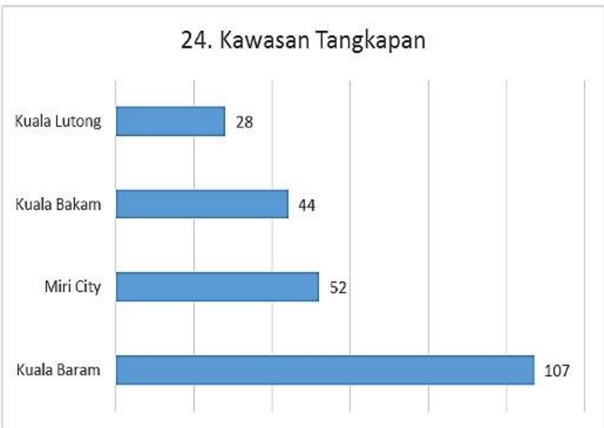
Kajian sosio-ekonomi UITM-JPLS 2016

Socio-Economic Survey – Tiger Prawn

Do you know about the Tiger Prawn Refugia?



Socio-economic Study (by UiTM-JPLS, 2016)



Number of respondents: 231

Prohibition of Tiger Prawn Fisheries during Breeding Season

(by UiTM-JPLS, 2016)

Refugia Related Papers 2019

- Ryon Siow, Nurridan Abdul Han, Hadil Rajali and Richard Rumpet. 2019. The Establishment of Fisheries Refugia as a New Approach to Sustainable Management of Fisheries in Malaysian Waters. Paper presented at the World Seafood Congress (WSC), 9 – 11 September 2019, Penang, Malaysia.
- Ryon Siow and Abd Haris Hilmi bin Ahmad Arshad. 2019. The Composition and Density of Fish Resources in the Surrounding Waters Off Tioman Island and Tinggi Island, Malaysia. Paper presented at the International Conference on Oceanography and Sustainable Marine Production (ICOSMaP 2019), 29 – 31 October 2019, Kuantan, Pahang, Malaysia.

Refugia Related Papers 2019

- Nurridan Abdul Han, Hadil Rajali and Richard Rumpet. 2019. Fundamental studies on juvenile tiger prawn (*Penaeus monodon*) resources in Miri rivers, Sarawak in line with fisheries refugia concept. Paper presented at the International Conference on Oceanography and Sustainable Marine Production (ICOSMaP 2019), 29 – 31 October 2019, Kuantan, Pahang, Malaysia.
- Nurridan Abdul Han. 2019. Fish refugia as a new tool for fisheries management in Malaysian waters. Paper presented at the Fisheries Research Institute Seminar, 25 – 27 November 2019, Glami Lemi, Negeri Sembilan, Malaysia.

Conferences

3. Financial Report (Until December 2019)

Financial Performance (until 31 December 2019)

CODE	ALLOCATION (USD)	EXPENSES (USD)	EXPENSES PERCENTAGE (%)	BALANCE (USD)	BALANCE PERCENTAGE (%)
1000	55,121.00	45,310.00	73.36	7,663.00	26.64
2000	20,000.00	0.00	0.00	20,000.00	100.00
3000	44,936.00	6,457.00	56.50	3,484.00	43.50
4000	4,800.00	12,872.00	236.00	-6,550.00	0.00
5000	783.00	0.00	0.00	783.00	100.00
TOTAL	**125,640.00**	**64,639.00**	**51.45**	**61,001.00**	**48.55**

Financial Performance Details (Code 1000) (until 31 December 2019)

CODE	ALLOCATION (USD)	EXPENSES (USD)	EXPENSES PERCENTAGE (%)	BALANCE (USD)	BALANCE PERCENTAGE (%)
1100 (Project Personal)	10,181.00	9,756.00	95.83	425.00	4.17
1200 (Consultants)	1,943.00	1,309.00	67.37	634.00	32.63
1600 (Travel)	42,997.00	34,245.00	79.65	8,752.00	20.35
TOTAL	**55,121.00**	**45,310.00**	**82.20**	**9,811.00**	**17.80**

Financial Performance Details (Code 2000) (until 31 December 2019)

CODE	ALLOCATION (USD)	EXPENSES (USD)	EXPENSES PERCENTAGE (%)	BALANCE (USD)	BALANCE PERCENTAGE (%)
2200 (Sub Contracts) (MoU)	20,000.00	0.00	0.00	20,000.00	100.00
TOTAL	**20,000.00**	**0.00**	**0.00**	**20,000.00**	**100.00**

Financial Performance Details (Code 3000) (until 31 December 2019)

CODE	ALLOCATION (USD)	EXPENSES (USD)	EXPENSES PERCENTAGE (%)	BALANCE (USD)	BALANCE PERCENTAGE (%)
3200 (Group Training)	28,436.00	4,696.00	16.51	23,740.00	83.48
3300 (Meetings /Conferences)	16,500.00	1,761.00	10.67	14,739.00	89.33
TOTAL	**44,936.00**	**6,457.00**	**56.50**	**38,479.00**	**85.63**

Financial Performance Details (Code 4000) (until 31 December 2019)

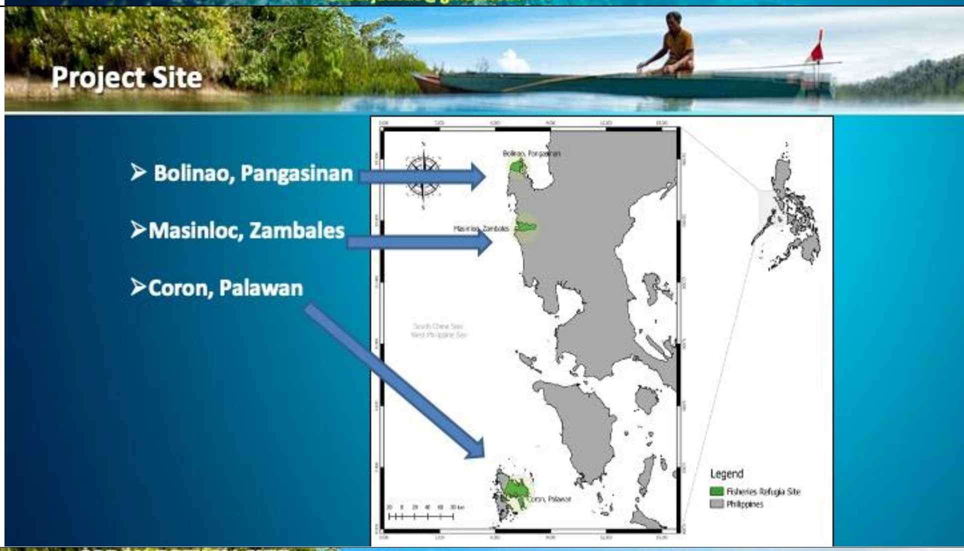
CODE	ALLOCATION (USD)	EXPENSES (USD)	EXPENSES PERCENTAGE (%)	BALANCE (USD)	BALANCE PERCENTAGE (%)
4300 (Premises)	4,800.00	12,872.00	268.16	-8,072.00	0.00
TOTAL	**4,800.00**	**12,872.00**	**268.16**	**-8,072.00**	**0.00**

Financial Performance Details (Code 5000) (until 31 December 2019)

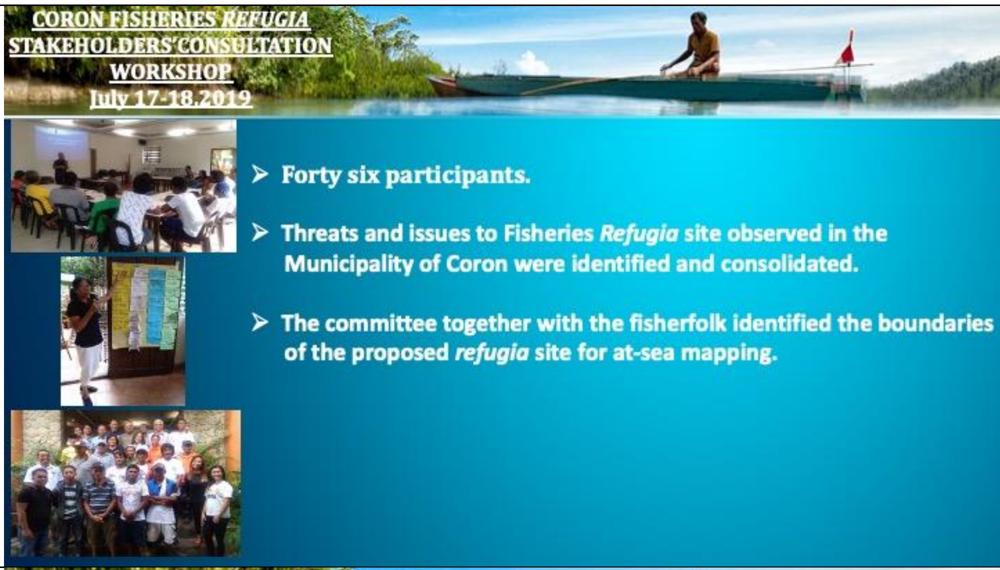
CODE	ALLOCATION (USD)	EXPENSES (USD)	PERCENTAGE EXPENSES (%)	BALANCE (USD)	PERCENTAGE BALANCE (%)
5200 (Reporting Cost)	783.00	0.00	0.00	783.00	100.00
TOTAL	**783.00**	**0.00**	**0.00**	**783.00**	**100.00**

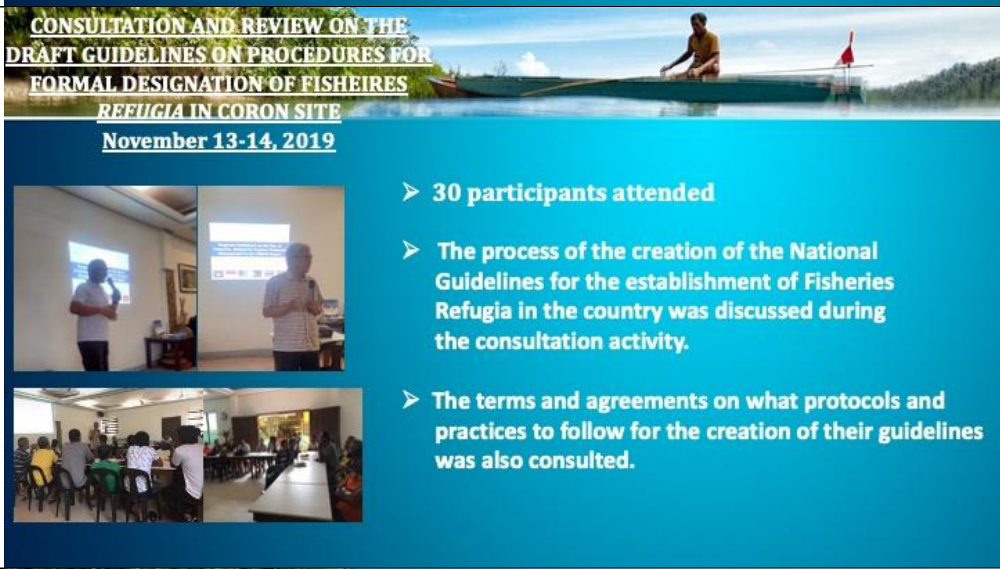
ANNEX 7


UNEP-GEF- SEAFDEC
Establishment and Operation of a
Regional System of Fisheries Refugia
in the South China Sea and Gulf of Thailand
(Philippines)
Accomplishment Report 2019
Meetings, Workshops and Trainings
Val M. Borja
National Scientific and Technical Committee FocalmPoint
National Fisheries Research and Development Institute
Corporate 101 Building 101 Mother Ignacia, Quezon City Philippines
valborja1029@gmail.com


Project Site
➢ Bolinao, Pangasinan
➢ Masinloc, Zambales
➢ Coron, Palawan
Legend
Fisheries Refugia Site
Philippines


CORON REFUGIA SITE
MANAGEMENT COMMITTEE (RSMC)
CONSULTATION MEETING
July 16, 2019
➢ A total of 21 participants
➢ Participants together with the Refugia Management Team discussed and finalized the recommended members for the Coron Refugia Site Management.
➢ Finalize the ToR of the members.
➢ It was identified and agreed during the meeting that Lutjanidae (Lutjanus argentimaculatus)species will be managed under the fisheries refugia site.

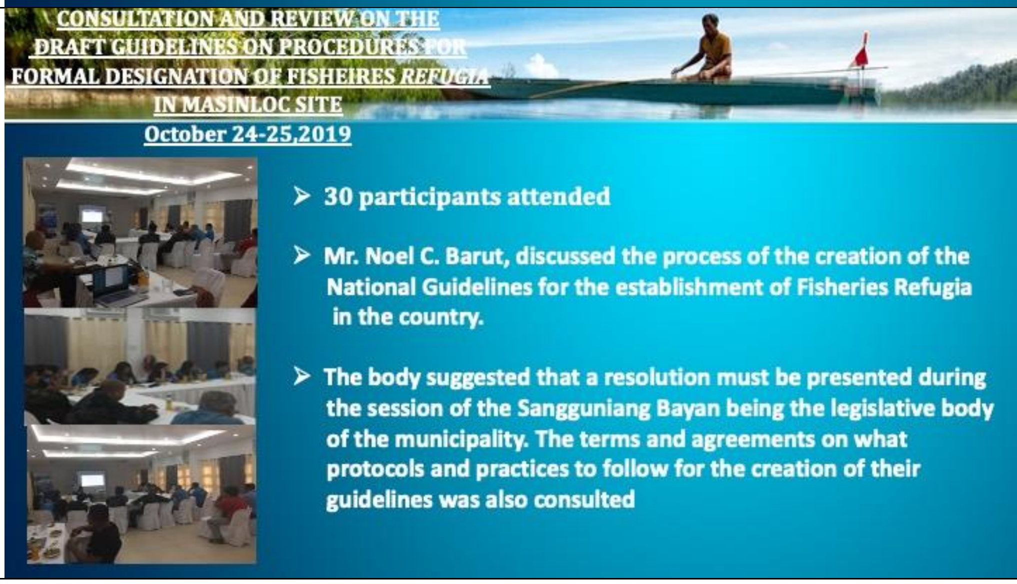

CORON FISHERIES REFUGIA STAKEHOLDERS'CONSULTATION WORKSHOP
July 17-18,2019
Forty six participants.
Threats and issues to Fisheries Refugia site observed in the Municipality of Coron were identified and consolidated.
The committee together with the fisherfolk identified the boundaries of the proposed refugia site for at-sea mapping.


CONSULTATION AND REVIEW ON THE DRAFT GUIDELINES ON PROCEDURES FOR FORMAL DESIGNATION OF FISHEIRES REFUGIA IN CORON SITE
November 13-14, 2019
30 participants attended
The process of the creation of the National Guidelines for the establishment of Fisheries Refugia in the country was discussed during the consultation activity.
The terms and agreements on what protocols and practices to follow for the creation of their guidelines was also consulted.


MASINLOC REFUGIA SITE MANAGEMENT COMMITTEE (RSMC) CONSULTATION MEETING
August 13, 2019
20 participants
Provisional Terms of Reference for the Masinloc Fisheries Refugia Site-based Management Committee was finalized.
Identified and agreed on the species to be managed under the fisheries refugia site, tentatively, Sardinella fimbriata (Bilis), Pterocaesio tesellata (Terong), and Auxis thazard (Tulingan).
The Masinloc RSMC suggested two activities for capacity building namely, Law Enforcement Training and EAFM Training.
BFAR- Provincial Fisheries Office gave a room in their office to serve as the Refugia Center in Masinloc, Zambales.

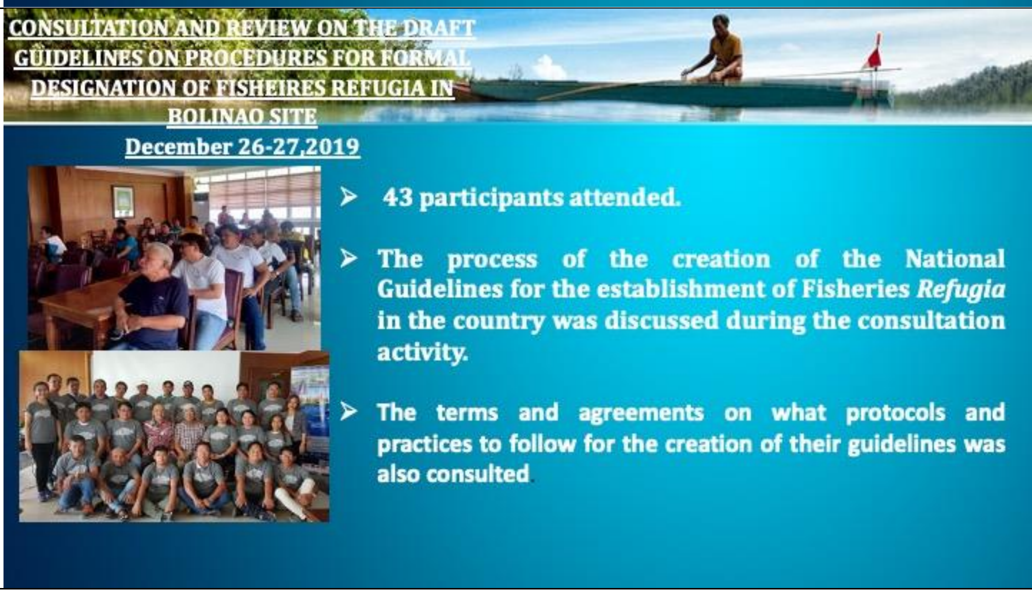

MASINLOC FISHERIES *REFUGIA* STAKEHOLDERS' CONSULTATION WORKSHOP
August 14-16, 2019
➢ 45 participant
➢ The threats and issues were identified and consolidated.
➢ Executive Order organizing the *Refugia* Site Management Committee of the Municipality of Masinloc was established.

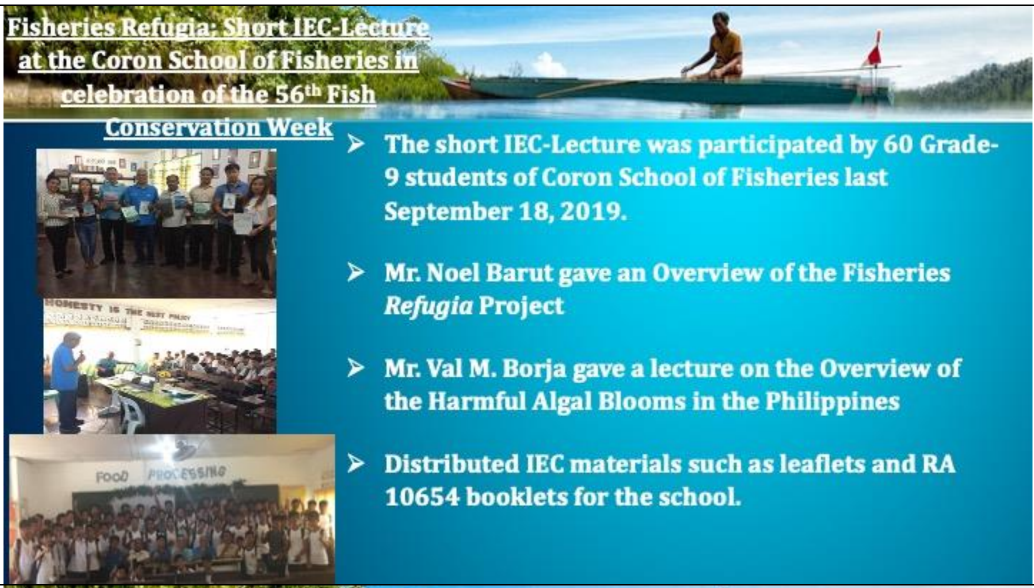

BOLINAO FISHERIES *REFUGIA* STAKEHOLDERS' CONSULTATION WORKSHOP
August 27-30,2019
➢ 40 participants
➢ The priority fishery resources such as Siganids species were finalized.
➢ The threats and issues in the site regarding fisheries resources and fishery management were identified and were discussed as well.
➢ The proposed *Refugia* site will further be legalized in Bolinao after the conduct of the at-sea mapping wherein five of their Marine Protected Areas will be included.
➢ The Chairman of the Bolinao RSMC, Hon. Alfonso Celeste, provided a room in the Tourism Office of the municipality to serve as the *Refugia* Center in the site.
➢ Executive Order organizing the *Refugia* Site Management Committee of the Municipality of Bolinao, Pangasinan was established

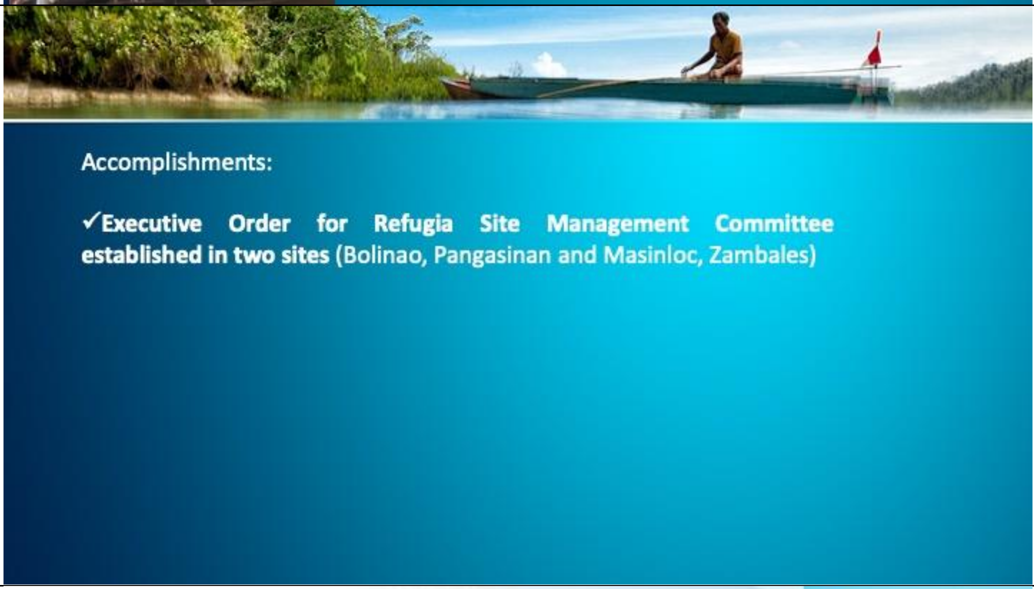

CONSULTATION AND REVIEW ON THE DRAFT GUIDELINES ON PROCEDURES FOR FORMAL DESIGNATION OF FISHEIRES *REFUGIA* IN MASINLOC SITE
October 24-25,2019
➢ 30 participants attended
➢ Mr. Noel C. Barut, discussed the process of the creation of the National Guidelines for the establishment of Fisheries Refugia in the country.
➢ The body suggested that a resolution must be presented during the session of the Sangguniang Bayan being the legislative body of the municipality. The terms and agreements on what protocols and practices to follow for the creation of their guidelines was also consulted

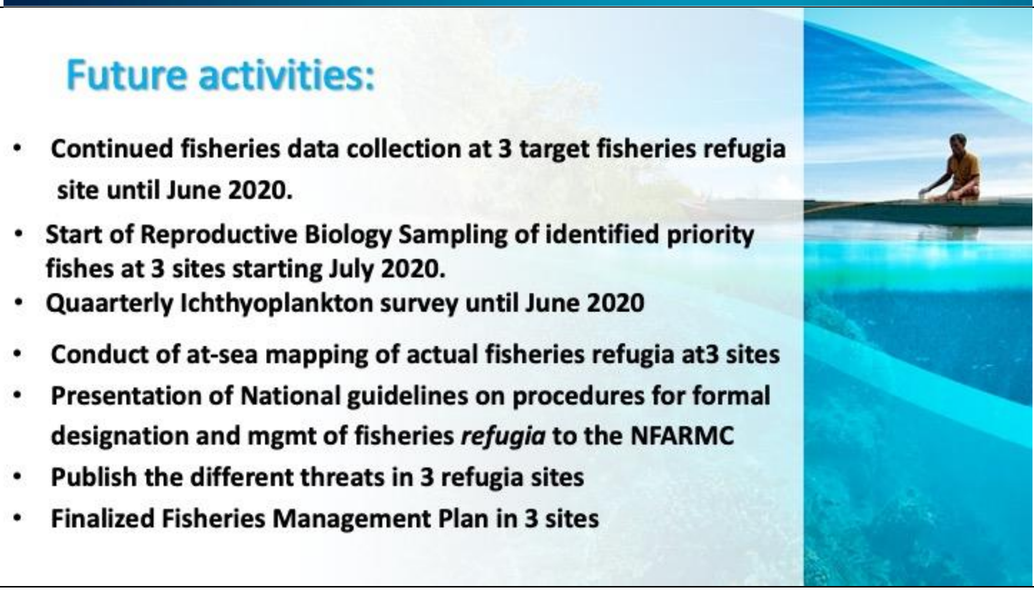

ESSENTIAL ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT TRAINING (BOLINAO AND MASINLOC SITE
November 4-8, 2019
30 participants
Capacity building for two municipalities identified as their needs prior to the drafting of the management plan for the fisheries refugia site.
The activity was graced by Dr. Lilian C. Garcia, Interim Executive Director of NFRDI and Regional Director of BFAR IV, Wilfredo Cruz.


ESSENTIAL ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT TRAINING (CORON SITE)
November 18-20,2019
30 Participants attended
Capacity building for the site identified as one of their prior to the drafting of the management plan for the fisheries refugia site.
The activity was graced by Dr. Lilian C. Garcia, Interim Executive Director of NFRDI, by Dr. Somboon Siriraksophon, Project Director of SEAFDEC UNEP GEF Fisheries Refugia Project, Project Coordinating Unit, SEAFDEC/Training Department together with Mr. Weerasak Yingyuad, Project Technician and Fishing Gear Technician


CONSULTATION AND REVIEW ON THE DRAFT GUIDELINES ON PROCEDURES FOR FORMAL DESIGNATION OF FISHEIRES REFUGIA IN BOLINAO SITE
December 26-27,2019
43 participants attended.
The process of the creation of the National Guidelines for the establishment of Fisheries Refugia in the country was discussed during the consultation activity.
The terms and agreements on what protocols and practices to follow for the creation of their guidelines was also consulted


Fisheries Refugia: Short IEC-Lecture at the Coron School of Fisheries in celebration of the 56th Fish Conservation Week
➢ The short IEC-Lecture was participated by 60 Grade-9 students of Coron School of Fisheries last September 18, 2019.
➢ Mr. Noel Barut gave an Overview of the Fisheries *Refugia* Project
➢ Mr. Val M. Borja gave a lecture on the Overview of the Harmful Algal Blooms in the Philippines
➢ Distributed IEC materials such as leaflets and RA 10654 booklets for the school.


Accomplishments:
✓**Executive Order for Refugia Site Management Committee established in two sites** (Bolinao, Pangasinan and Masinloc, Zambales)


Future activities:
• Continued fisheries data collection at 3 target fisheries refugia site until June 2020.
• Start of Reproductive Biology Sampling of identified priority fishes at 3 sites starting July 2020.
• Quaarterly Ichthyoplankton survey until June 2020
• Conduct of at-sea mapping of actual fisheries refugia at3 sites
• Presentation of National guidelines on procedures for formal designation and mgmt of fisheries *refugia* to the NFARMC
• Publish the different threats in 3 refugia sites
• Finalized Fisheries Management Plan in 3 sites

Future activities:

- National Fisheries Refugia Committees and National Scientific and Technical Committees will be convene.
- Conduct Information, Education and Communication (IEC) Campaign In the coastal barangays/areas in 3 fisheries refugia sites.

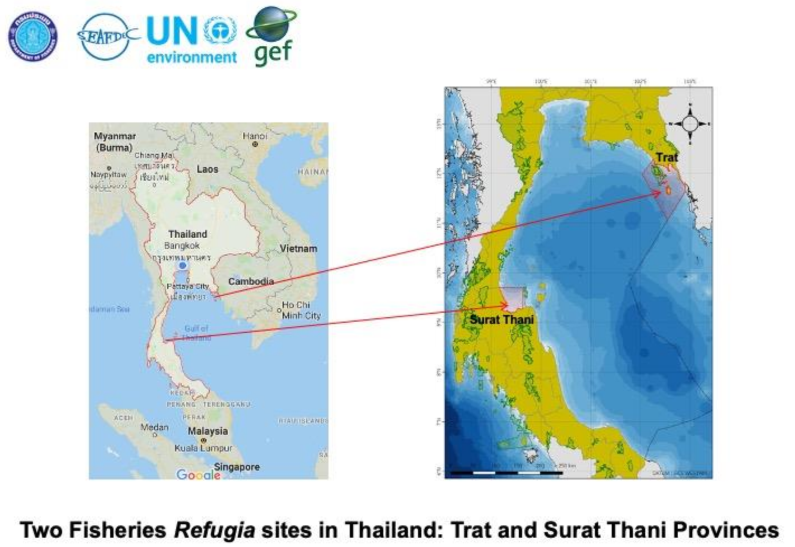
Budgetary Allotment for the Fisheries *Refugia* Project from 2017-2020

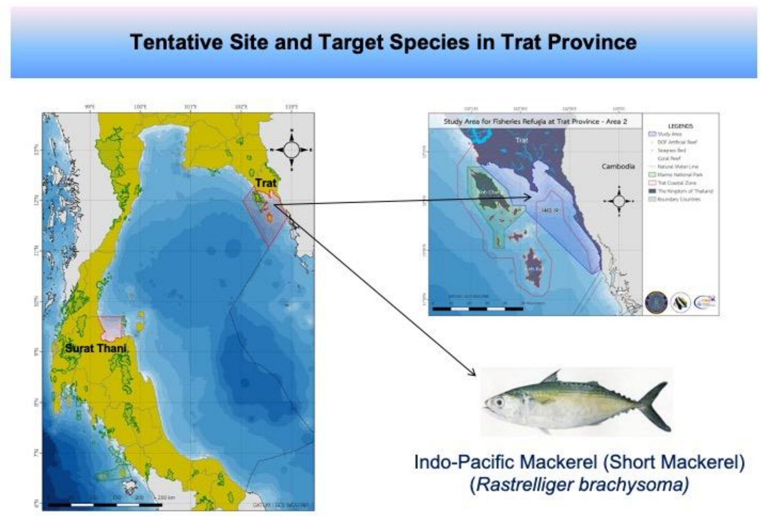
	UNEP/GEF/SEAFDEC (USD)	NFRDI Counterpart (PhP)
2017	$ 4,275.00	PhP 1,648,327.53
2018	$ 27,230.63	PhP 2,476,604.00
2019	$ 63,196.53	Php 1,816,176.00
2020	-	Php 1,872,000.00
TOTAL	**$ 94,702.16**	**PhP 7,813,107.53**

Thank You...

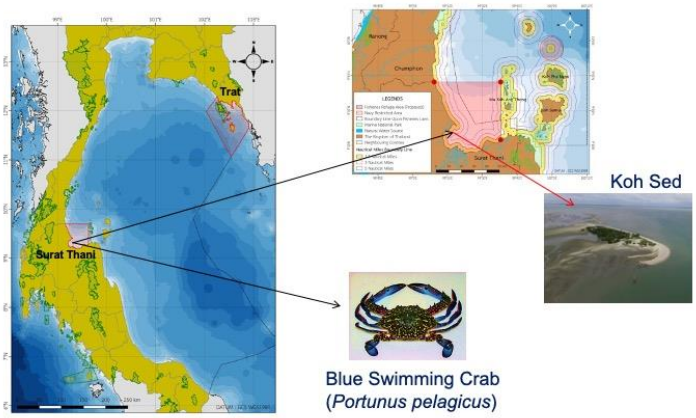
ANNEX 8


Progress of
Fisheries *Refugia*
Project Implementation:
Thailand


Myanmar (Burma)
Hanoi
Laos
Thailand
Bangkok
Vietnam
Cambodia
Ho Chi Minh City
Malaysia
Kuala Lumpur
Singapore
Trat
Surat Thani
Two Fisheries *Refugia* sites in Thailand: Trat and Surat Thani Provinces


Tentative Site and Target Species in Trat Province
Trat
Surat Thani
Cambodia
Indo-Pacific Mackerel (Short Mackerel)
(*Rastrelliger brachysoma*)

Tentative Site and Target Species in Surat Thani Province



Overall Project Activities as of 31 Dec 2019: THAILAND

Thailand Main Activities

2017, Apr: Appointment of "Thailand's National Fisheries Refugia Committee" and "Thailand's National Scientific and Technical Committee"

2017, Jul: Preliminary survey on fisheries resources and fishing communities in Samui Island, Surat Thani Province

2017, Aug: Preliminary survey on fisheries resources and fishing communities in Chang Strait, Trat Province

UN environment gef

Thailand Main Activities

2017, Sep: Stakeholder initiation meeting in Trat Province

2017, Sep: Stakeholder initiation meeting in Koh Samui, Surat Thani Province

2018, Jan: Appointment of "Site-Based Fisheries Refugia Management Board in Samui Island of Surat Thani Province"

2018, Mar: Appointment of "Site-Based Fisheries Refugia Management Board in Chang Strait of Trat Province"

UN environment gef

Thailand Main Activities

2018, Feb: Stakeholder Consultation Workshop in Trat Province

UN environment gef

Thailand Main Activities

2018, Apr: Stakeholder Consultation Workshop in Samui Island, Surat Thani Province

Thailand Main Activities

2018, Aug: 1st Meeting of National Fisheries Refugia Committee at DOF, Bangkok

2018, Oct: 1st Consultation Meeting for Project Implementation at DOF, Bangkok

Thailand Main Activities

2018, Oct: 2nd Meeting of National Fisheries Refugia Committee at DOF, Bangkok

2018, Nov: 2nd Consultation Meeting for Project Implementation at DOF, Bangkok

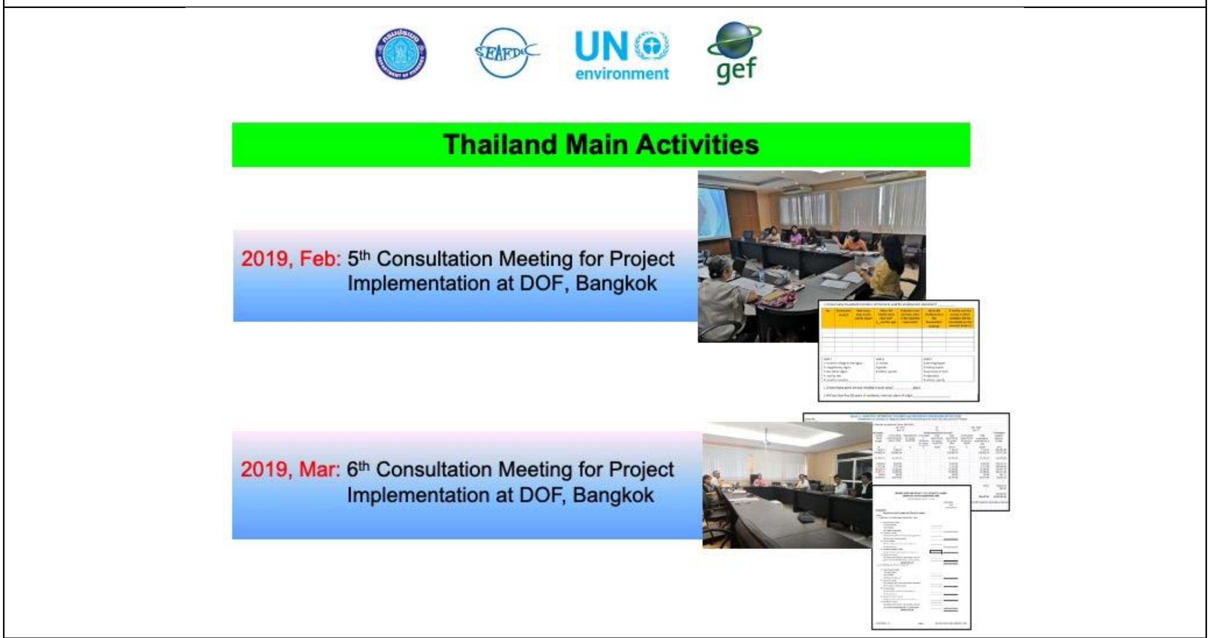
Thailand Main Activities

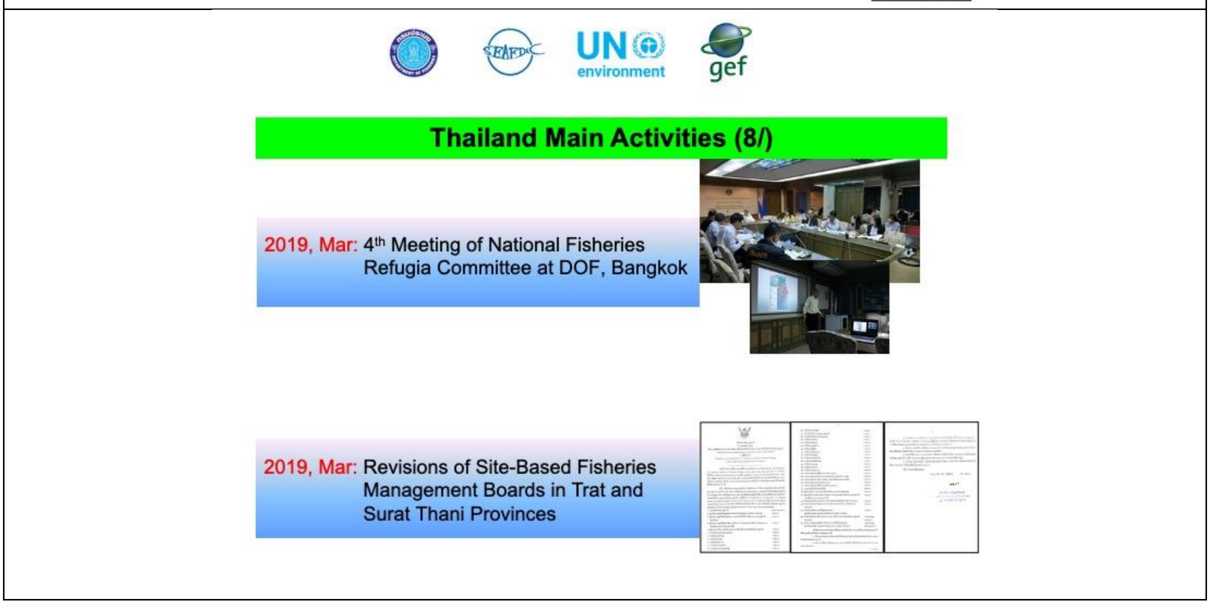
2018, Nov: Revisions of "Thailand's National Fisheries Refugia Committee" and "Thailand's National Scientific and Technical Committee"

2018, Dec: 1st Meeting of National Scientific and Technical Committee at DOF, Bangkok

2019, Jan: 3rd Meeting of National Fisheries Refugia Committee at DOF, Bangkok


Thailand Main Activities
2019, Jan: 3rd Consultation Meeting for Project Implementation at Surat Thani Province
2019, Feb: 4rd Consultation Meeting for Project Implementation at Trat Province


Thailand Main Activities
2019, Feb: 5th Consultation Meeting for Project Implementation at DOF, Bangkok
2019, Mar: 6th Consultation Meeting for Project Implementation at DOF, Bangkok


Thailand Main Activities (8/)
2019, Mar: 4th Meeting of National Fisheries Refugia Committee at DOF, Bangkok
2019, Mar: Revisions of Site-Based Fisheries Management Boards in Trat and Surat Thani Provinces

Thailand Main Activities

2019, Apr: 1st Meeting of Site-Based Fisheries Management Board in Trat Province

2019, Apr: 1st Meeting of Site-Based Fisheries Management Board in Surat Thani Province

Thailand Main Activities

2019, Jun: 5th Meeting of National Fisheries Refugia Committee at DOF, Bangkok

2019, Oct: 6th Meeting of National Fisheries Refugia Committee at DOF, Bangkok

Thailand Main Activities

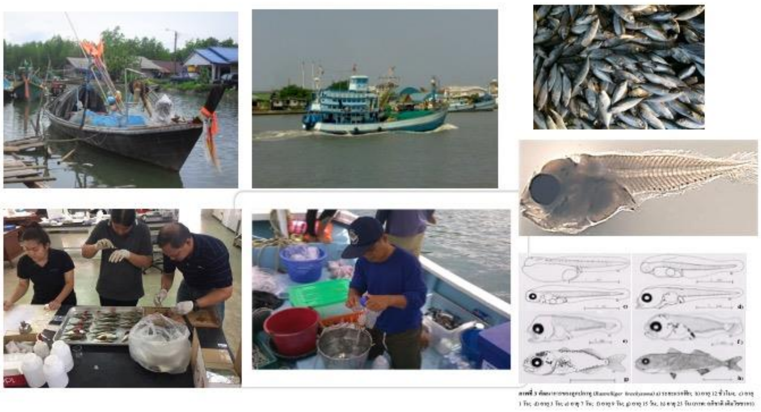
2019, Nov: 2nd Meeting of National Scientific and Technical Committee at DOF, Bangkok

2019, Dec: 2nd Meeting of Site-Based Fisheries Management Board in Trat Province

Activities for In-Catch Co-finance

2017-2018 Activity for In-Catch Co-finance

Investigation on life cycle of Indo-Pacific mackerel in the Gulf of Thailand



2018 Activities for In-Catch Co-finance

1. Study on stock assessment in the Gulf of Thailand (Catch per Unit of Effort: CPUE)

2018
Activities for In-Catch Co-finance

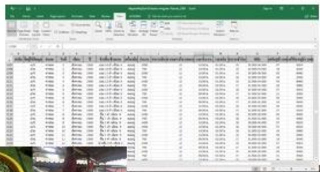
2. Survey on fisheries resources for assessment of the Maximum Sustainable Yield (MSY) in the Gulf of Thailand






2019
Activity for In-Catch Co-finance

Study on fishery biology, socio-economics, and ecosystems which related to the Blue Swimming Crab Fishery Improvement Program (FIP)" in Ban Don Bay of Surat Thani Province






Overall Implementation Results as of 31 Dec 2019: THAILAND (by Components)

Component 1:

Identification and management of fisheries and critical habitat linkages at 2 priority fisheries *refugia* in Thailand

- Conducted a review of existing information and data on fisheries and coastal habitats, including needs at fisheries *refugia* sites in **Trat and Surat Thani**
- Conducted consultation workshops to secure community and fishermen support in information and data collection in **Trat and Surat Thani**
- designed and conducted site-based surveys to produce fisheries and habitat profile reports for 2 sites: **Trat and Surat Thani**
- Conducted fisheries surveys at **Trat** site

Component 1:

Identification and management of fisheries and critical habitat linkages at 2 priority fisheries *refugia* in Thailand

- Conducted consultations to draft maps of fisheries *refugia* for short mackerel in **Trat** and blue swimming crab in **Surat Thani**
- Prepared map for *refugia* in **Trat** and elicit fishermen input to boundary delineation through consultation
- Conducted assessment of environmental and social impacts of designation of site as *refugia* in **Trat**
- Conducted consultation to identify key threats to fisheries *refugia* site and identify management measures in **Trat**

Component 2:

Improving the management of critical habitats for fish stocks of transboundary significance via national actions to strengthen the enabling environment and knowledge-base for fisheries refugia management in Thailand

- Identified and documented key threats from fishing and the environment to fish stock and critical habitat linkages in **Trat** and **Surat Thani**
- Compiled information and data derived from abundance surveys for short mackerel in **Trat**
- Compiled information and data derived from surveys on size-frequency of short mackerel in **Trat**
- Compiled information and data on landings of short mackerel in **Trat**

Component 2:

Improving the management of critical habitats for fish stocks of transboundary significance via national actions to strengthen the enabling environment and knowledge-base for fisheries refugia management in Thailand

- Prepared an information of fish eggs and larvae samples of short mackerel collected from **Trat** waters

Component 3:

Information Management and Dissemination in support of national-level implementation of the fisheries *refugia* concept in Thailand

- Captured best practices in the establishment and operation of fisheries *refugia* (for short mackerel and blue swimming crab)

Component 4:

National coordination for integrated fish stock and critical habitat management in Thailand

- Developed and agreed ToR, membership & operational rules for National Fisheries *Refugia* Committee (NFRC)
- Established and convened quarterly meetings of NFRC
- NFRC reviewed and endorsed quarterly work plans and progress and financial reports, including tracking of the progress of the project
- Established and convened meetings of the National Scientific and Technical Committee

Component 4:

National coordination for integrated fish stock and critical habitat management in Thailand

- Provided technical and scientific inputs to planning of activities in components 1, 2 and 3
- Reviewed governance arrangements at **Trat** and **Surat Thani** sites to identify required ToR and membership of site-based management boards, including links to other local planning bodies
- Established and convened meetings of site-based management boards in **Trat** and **Surat Thani**


Thank You
JANUARY 2018
FEBRUARY 2018
MARCH 2018
APRIL 2018

ANNEX 9

PROGRESS REPORT ON PROJECT ACTIVITIES

SEAFDEC/UNEP/GEF/INDONESIA

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

Ngurah N. Wiadnyana
National Technical and Scientific Focal Point
Indonesia

Viet Nam, 5 -7 February 2020

PROGRESS REPORT

Outputs	Expected completion date	Implementation status as of end of reporting period expressed in %	Comments if variance, Describe any problems in delivering outputs
Outputs 1: Adopted management plans			
Activity 1.1: Developing fisheries and coastal habitat information and data collection programmes for 14 priority fisheries refugia sites	November 2020	70.25 %	Fisheries and coastal habitat information and data collection program has been established. One of the output of this activity is fisheries refugia profile report that already compiled based on available data and information, however Numerous data and information should be enriched in order to build comprehensive policy in establish fisheries refugia.
Activity 1.2: Facilitating agreement among stakeholders on the boundaries of fisheries refugia at 14 priority fisheries refugia sites	September 2020	0 %	
Activity 1.3: Developing Community-Based Management Plans for 14 priority fisheries refugia sites	August 2020	0 %	
Activity 1.4: Establishing operational management for 14 priority fisheries refugia sites	December 2020	0 %	
Activity 1.5: Strengthening civil society and community organization participation in the management	December 2020	0 %	

Activity 2.1: Enhancing policy guidance for improved management of the effects of fishing on critical habitats	December 2020	0 %	
Activity 2.2: Defining the policy and legal basis for formal designation and establishment of fisheries refugia in Indonesia	December 2020	0 %	
Activity 2.3: Development of national guidelines on the establishment and operation of fisheries refugia	December 2020	0 %	
Activity 2.4: Reforming national policy, legal and planning frameworks for demarcating	December 2020	0 %	
Activity 2.4: Reforming national policy, legal and planning frameworks for demarcating boundaries and managing refugia	December 2020	0 %	
Activity 2.5: Enhancing access to information relating to status and trends in fish stocks and their habitats in Bangka Belitung and West Kalimantan	December 2020	0 %	
Activity 2.6: Improving national-level management and sharing of information and data on fish early life history in Bangka Belitung and West Kalimantan	December 2020	0 %	
Output 3: Routine communications on progress and lessons learned prepared and shared Annual results reports published and disseminated National and regional web portals for knowledge management and information exchange accessible online			

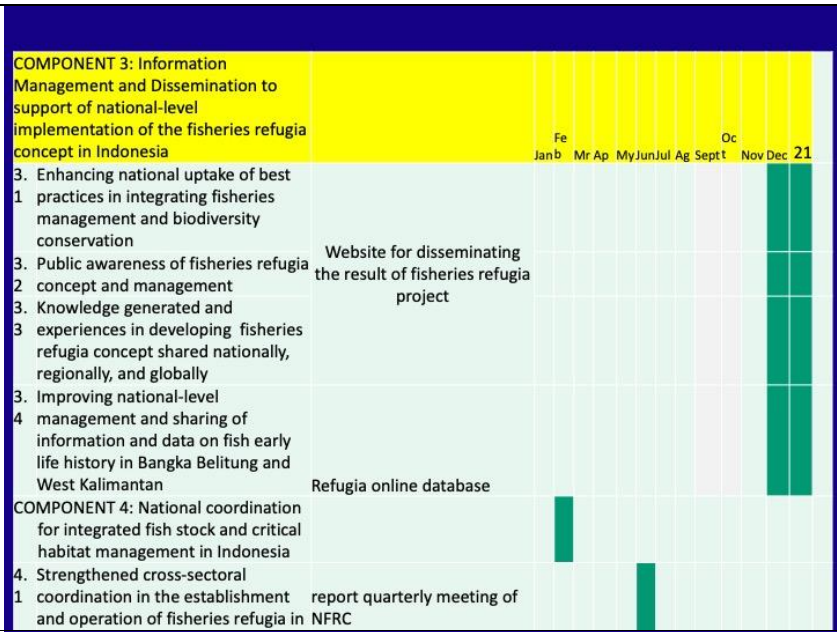
Activity 3.1: Enhancing national uptake of best practices in integrating fisheries management and biodiversity conservation	December 2020	0 %	
Activity 3.2: Improving community acceptance of area based approaches to marine management	December 2020	0 %	
Activity 3.3: Knowledge generated and experiences in developing fisheries refugia concept shared nationally, regionally, and globally	December 2020	0 %	
Output 4: Regular reports of meetings of national and regional project management bodies Reports of independent mid-term and terminal project evaluations			
Activity 4.1: Strengthened cross-sectoral coordination in the establishment and operation of fisheries refugia in Indonesia	December 2020	18.88 %	-

WORK PLAN 2020

	Activity Description	Output	Q1-2020			Q2-2020			Q3-2020			Q4-2020			2021
			Jan	Feb	Mr	Ap	My	Jun	Jul	Ag	Sept	Oct	Nov	Dec	
	COMPONENT 1: Identification and management of fisheries and critical habitat linkages at 2 priority fisheries refugia in Indonesia														
1.1	Developing fisheries and coastal habitat information and data collection programmes for Kalimantan Barat														
1.1.1	finalize fisheries refugia profile report	fisheries refugia profile report													
1.1.2	Pre-survey or initiation meeting with local government in West Kalimanta & Bangka Belitung	data & information regarding current status of target species & fisheries management in west Kalimantan & Bangka Belitung													
1.1.3	Site based survey in West Kalimantan & Bangka Belitung	data & information regarding habitat condition, abundance or production of target specie, community groups of fishermen, regulation & policy in fisheries management													

	Activity Description	Output	Q1-2019			Q2-2019			Q3-2019			Q4-2019			2020
			Jan	Feb	Mr	Ap	My	Jun	Jul	Ag	Sept	Oct	Nov	Dec	
1.2	Facilitating agreement among stakeholders on the boundaries of fisheries refugia at the Bangka Belitung and Kalimantan Barat	Map of proposed fisheries refugia site													
1.3	Designing Community-Based Management Plans for fisheries refugia in Kalimatan Barat	Management plan document including community participation, capacity building programmes for management volunteers													
1.4	Designing operational management for fisheries refugia in Kalimantan Barat														
1.5	Enhancing access to information relating to status and trends in fish stocks and their habitats in Bangka Belitung and West Kalimantan	Fisheries refugia profile report that enriched with information of trend production of species target in fisheries refugia site.													

	COMPONENT 2: Improving the management of critical habitats for fish stocks via national actions to strengthen the enabling environment and knowledge-base for fisheries refugia management in Indonesia		Jan	Feb	Mr	Ap	My	Jun	Jul	Ag	Sept	Oct	Nov	Dec	21
2.1	Enhancing policy guidance for improved management of the effects of fishing on critical habitats	reports on policy, legal and institutional aspects of fisheries refugia management plan													
2.2	Defining the policy and legal basis for formal designation and establishment of fisheries refugia in Indonesia														
2.3	Development of national guidelines on the establishment and operation of fisheries refugia	National guidelines on fisheries refugia establishment and management													



COMPONENT 3: Information Management and Dissemination to support of national-level implementation of the fisheries refugia concept in Indonesia		Jan	Feb	Mr	Ap	My	Jun	Jul	Ag	Sept	Oct	Nov	Dec	21
3.1 Enhancing national uptake of best practices in integrating fisheries management and biodiversity conservation	Website for disseminating the result of fisheries refugia project													
3.2 Public awareness of fisheries refugia concept and management														
3.3 Knowledge generated and experiences in developing fisheries refugia concept shared nationally, regionally, and globally														
3.4 Improving national-level management and sharing of information and data on fish early life history in Bangka Belitung and West Kalimantan	Refugia online database													
COMPONENT 4: National coordination for integrated fish stock and critical habitat management in Indonesia														
4.1 Strengthened cross-sectoral coordination in the establishment and operation of fisheries refugia in	report quarterly meeting of NFRC													

ANNEX 10

Ministry of Agriculture and Rural Development
DIRECTORATE OF FISHERIES

National Project Activities by Implementing Agency

Fisheries Refugia RSTC 3 Meeting
Hai Phong, 5-7 February 2019

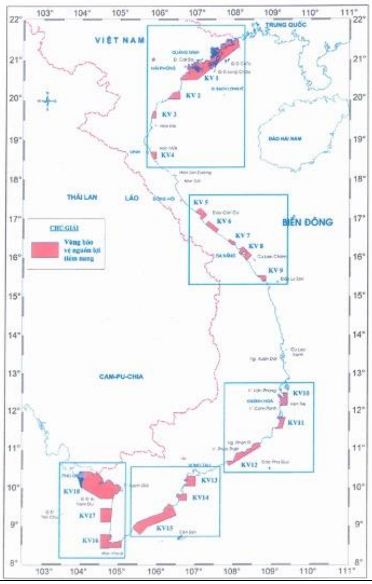
Activities by DFISH

- Overall Project Budget Plan approve by MARD
- National Project Steering Committee
- National Scientific and Technical Committee
- First meetings of NFRC and NSTC
- ODA registration to the Ministry of Finance
- To assign National Focal Point and National Scientific and Technical Focal Point
- To submit detailed project budget plan

Refugia Sites

- **Bach Long Vy – Hai Phong**
  - Small pelagic species
  - Reef fish
- **Hon Cau – Binh Thuan**
  - Scombridae
  - Bivalve mollusks
- **Phu Quoc – Kien Giang**
  - Anchovies
  - Short mackerel
  - Blue swimming crab

Refugia Sites (potential)



Thank you

ANNEX 11

The 3rd Meeting of the Regional Scientific and Technical Committee for
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, 5th – 7th February 2020, Classic Hoang Long Hotel, Hai Phong City, Viet Nam

ANNEX 11

OVERVIEW & PROFILES OF THE PRIORITY FISHERIES REFUGIA SITE

RSTC3 Refers to WP. 3 2

The 3rd Meeting of the Regional Scientific and Technical Committee for
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, 5th – 7th February 2020, Classic Hoang Long Hotel, Hai Phong City, Viet Nam

RSTC3 TARGET SPECIES OF THE 15 REFUGIA SITES 3

The 3rd Meeting of the Regional Scientific and Technical Committee for
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, 5th – 7th February 2020, Classic Hoang Long Hotel, Hai Phong City, Viet Nam

CONTENTS OF
FISHERIES REFUGIA PROFILE

1. Site name:
2. Geographic location (lat, long in degrees and minutes):
3. Site information:
   - Geography
   - History, population, socio-economy
   - Important coastal habitats in the area (Mangrove/Coral reefs/Seagrass/ etc.)
   - Number and types of fishing vessels operating in the refugia area
   - The species and size selectivity of the principal fishing gear used
   - The role of fisheries refugia in the production (and economic value) of priority species
   - Number of fisheries communities in the area
   - Existing fisheries management measure in the area of the site
   - Usage of refugia by threatened and endangered marine species
4. Priority species information:
   - Name (scientific/common/local name)
   - Morphology
   - Distribution
   - Life cycle and mating behavior
   - Length at first maturity / Size / Weight / Age
   - Gonadosomatic index and size frequency
   - Area of habitat in each stage/migration pattern
   - Importance of the site to life cycle of the species as nursery/spawning/feeding etc.
   - CPUE/Stock size/ MSY
5. Information for GIS mapping:
   - Fisheries refugia boundary
   - Fishing area by each fishing gear
   - Important coastal habitats
   - Area of habitat in each stage/migration pattern of priority species

RSTC3 4

ANNEX 12

FISHERIES *REFUGIA* PROFILE in Cambodia

ESTABLSIHMENT AND OPERATION OF A REGIONAL SYSTEM OF FISHERIES REFUGIA IN THE SOUTH CHINA SEA AND GULF OF THAILAND

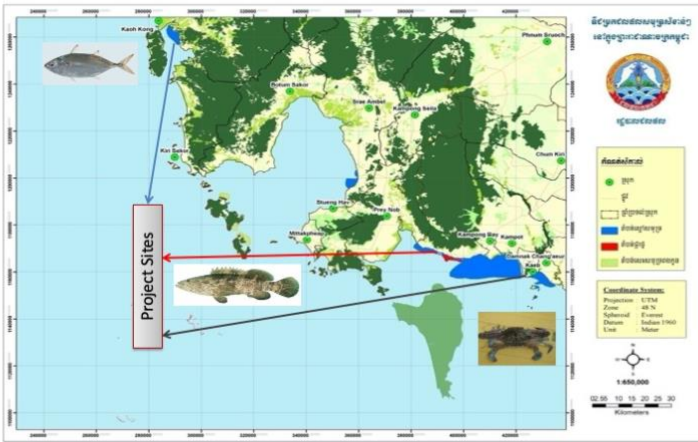
LENG SY VANN
Deputy Director of Department of Fisheries Conservation,
Fisheries Administration of Cambodia and
National Scientific and Technical Focal Point

Supported by Fisheries *Refugia* SEAFDEC/UNEP/GEF

05-07 February 2020

Classic Hoang Long Hotel, Hai Phong, Vietnam

1. PROJECT SITES



2. Geographic location:

Coordinate System by DATUM WGS 84

No.	Fisheries Refuguia Stie in Kep		Fisheries Refuguia Stie in Koh Kong		Fisheries Refuguia Stie in Kampot	
	Axis X	Axis Y	Axis X	Axis Y	Axis X	Axis Y
1	423116	1156590	282377	1268254	382441	1172512
2	425465	1156590	281280	1269992	383684	1171138
3	427983	1156590	279690	1272269	386075	1170367
4	430221	1155250	277268	1271174	387735	1169982
5	432582	1153840	277813	1270344	389382	1169150
6	431881	1151280	278294	1269592	391199	1168256
7	431242	1148940	278746	1268905	393229	1167326
8	430568	1146470	279161	1268570	395965	1166288
9	429338	1145600	280372	1267030	398716	1165876
10	427830	1144520			399789	1165970
11	422645	1144520			398789	1161564
12	419470	1144520			390925	1163877
13	420403	1147600			386383	1165318
14	421340	1150700			382784	1166554
15	422317	1153940			379214	1168819
16					382441	1172512

3. Site Information

3.1 Geography and Population

Province	Location	Land Area	Total Population
Kep	in southern Cambodia and is bordering to north with Kampot and South with Gulf of Thailand and Vietnam	187.25 km²	41,798
Koh Kong	in the West of the country and is bordering to the North with Pursat, to West with the Gulf of Thailand and to the South with Sihanouk ville.	10,045 km²	123,618
Kampot	in south-west part of the country and is joined boundary by Kampong Speu to the north, Takeo to the east, Kep and Vietnam as well as a long coastline on the Gulf of Thailand to the south and Preah Sihanouk to the west	4,873 km²	592,845

MoP, Report of Population Census of Cambodia in 2019

3.2 Socio Economy Status

Province	Socio economic status
Kep	Main occupation of people in Kep is depending on natural resources such as natural tourism field, fishing, salt farm, and rice field farming. So tourism and fishing activities have contributed very much to the enhancement of livelihood of people in Kep.
Koh Kong	Main income of people in Koh Kong is depending on agriculture and tourism field contributing very much to people economic development in Koh Kong, especially fishing activities.
Kampo	Main income of people in Kampot is depending on agriculture and tourism field contributing very much to the enhancement of livelihood of people in Kampot. Agricultural field consist of back pepper, durian, rubber, and salty farms. Tourism part are Historical/cultural areas, Wildlife sanctuaries and protected areas, and Preah Monivong National Park at 140,000 hectares in Bokor mountain

3.3. Important Coastal Habitat

Provinces	Mangroves (ha)	Coral Reef (ha)	Sea grass (ha)
Kep	1005	52	2,790
Koh Kong	62,000	602	3,993
Kampot	1,900	953	25,000
Total	64905	1607	31783

Source: DFC/FiA 2014

These habitats provide benefit to marine fisheries resource for feed, spawning habitat, nursery area, and hiding place.

3.4 Types of Fishing Vessel Operating in FR Sites

Province	Type of Fishing Vessel
Kep	-Length of fishing vessel = 7-9.5 m - Boat capacity= 5-13hp
Koh kong	-Length of fishing vessel= 6.5-9.5 -Boat capacity from 6-12hp
Kampot	-Length of fishing vessel = 7-9.5m - Boat capacity= 6.5-13hp

3.5 Species and size selectivity of principle fishing gear used

Province	Target species	Type of fishing gear used
Kep	Crab, shrimp, and fish	Crab gillnet, crab trap, fish gillnet, and trawl
Koh kong	Fish , shrimp, crab, and squid	Trawl, fish gillnet, crab gillnet, and crab trap
Kampot	Fish, blood cockle, shrimp, and crab	Fish gillnet, crab gillnet, crab trap, and trawl

3.6 Role of fisheries *refugia* in fish production

✓ Contributing to ensuring fish and crab stock in nature
✓ Reducing illegal fishing, and
✓Increasing in catching rate

3.7 Number of fisheries community in FR Site

Province	Number of Fisheries Community
Kep	Kep Cfi = 103 member and Dorng Klol Cfi=150 member
Koh Kong	1 CFi (Peam Krasob Community Fisheries) There are 340 members in CF
Kampot	Tropaing Ropaov Cfi= 548 members Prek Thnaon Cfi= 244 members

3.8 Existing fisheries management measure in FR Area

Province	Existing fisheries management Measure
Kep	Establishing two management committee for management for fisheries refugia at provincial level including FiA, FiAC, DoA, provincial line departments, and private sector: 1- Management Committee for Marine Fisheries Management Area chaired by Provincial Governor 2- Technical Working Group for Marine Fisheries Management Area chaired by Deputy Governor
Koh Kong	Planed to establishment one management committee for mackerel fisheries refugia will be approved officially this quarter 2020
Kampot	Not yet, still discuss with provincial authorities

3.9 Usage of refugia by threatened and endangered marine species

Contributing to protecting and restoring marine endangered species. For example dolphin now is increasing in fisheries refugia site in Koh Kong and Kep

4. Priority species information

Species	Local Name	Common Name
Rastrelliger Brachysoma	Trey Kamom Kan Tuy Kley	Short mackerel
Portunus pelagicus	Kdam Ses	Blue swimming crab
Epinephelus coioides	Trey Toke Kao	Oranges spotted

4.1 Morphology and Distribution

Species	Morphology character	Distribution
Rastrelliger Brachysoma	•Spinous dorsal fin yellowish with a black edge • Pectoral and pelvic fin dusky , other fins yellowish • Body very deep, its dept at posterior margin of opericle 3.7 to 4.3 times	It is found in Central Indo-West Pacific from the Andaman Sea east to Thailand, Indonesia, Papua New Guinea, Philippines, Solomon Islands and Fiji
Portunus pelagicus	• Body color is light blue and white spot pattern on full carapace	It is found in West Pacific Oceans including Japan, and Philippines troughout Southeast and East Asia, to Indonesia, the East of Australia, and Fidji Islands, and westward to the Red Sea and East Africa.
Epinephelus coioides	Head and body is full color with brownish orange spot in head to caudal fin	It is found in Indo-West Pacific including a Africa, Asia , Solomon Islands and Fiji, and Australia

4.2 Life cycle of Species and Mating behavior

Species	Life cycle of Species and Mating behavior
Rastrelliger Brachysoma	✓The larval stage ✓Juvenile stage, ✓Adults can reach 15 cm ✓Spawning period from November to May
Portunus pelagicus (*Sophana Chap et all, 2012*)	The blue swimming crab's lifecycle is divided into 3 main stages: the larval, juvenile and adult stages. ✓The larval stage includes the zoea and megalopa stages. The development from zoea to megalopa takes 12 days . ✓Juvenile stage, crabs can reach a size of 4 to 6 mm ✓Adults can reach a maximum size of 14 to 15cm ✓Spawning period from May to September
Epinephelus coioides	✓The larval stage takes 7-10days. ✓Juvenile stage can reach 45-50days ✓Adults can reach weight of 300 to 400g after 8 to 12 month of growth . ✓Spawning period from Mar to June

4.3 Length at First maturity /Size/Weight /Age

Species	Length at First maturity /Size/Weight /Age
Rastrelliger Brachysoma	Length at First Maturity= total length of 16.83 for male and 17.18cm for female Size= maximize size of 17.15cm for male and 17.70 cm for female Weight= 55.05g for male and 58.01 for female Age= ??
Portunus pelagicus	Length at First Maturity= carapace size of 10.5 cm for females and 9.6 cm for males Size= maximum size of 14 to 15 cm Weight= ?? Age= ??
Epinephelus coioides	Length at First Maturity= 25-30 cm Size= 55-75 Weight= 15kg Age= 2-3years

4.4 Gonadosomatic index and size frequency

- Short Mackerel (*Rastrelliger Brachysoma*)

Gonad stage	GSI Value for Male	GSI Value for Female
Immature (I)	0.35	0.29
Mature (II)	0.6	0.72
Ripening (III)	1.02	1.28
Ripe (IV)	1.72	2.07
Spent (V)	0.9	0.94

Field Research, 2019 on baseline survey of short mackerel in Koh Kong

4.4 Gonadosomatic index and size frequency

- Blue swimming crab (*Portunus pelagicus)*

Gonad stage	GSI Value for Male	GSI Value for Female
Immature (I)		
Mature (II)		
Ripening (III)		
Ripe (IV)		
Spent (V)		

4.4 Gonadosomatic index and size frequency
- Oranges spotted(*Epinephelus coioides)*

Gonad stage	GSI Value for Male	GSI Value for Female
Immature (I)		
Mature (II)		
Ripening (III)		
Ripe (IV)		
Spent (V)		

4.4 Gonadosomatic index and size frequency

- Epinephelus coioides

GSI Value	Gonad stage	Size frequency
<1	Immature (I)	
1-5	Maturing (II)	
5-10	Ripening (III)	
10-20	Ripe (IV)	
>20	Spent (V)	

Dawi et al, 2019: The gonad maturity development and spawning season of orange-spotted grouper (Epinephelus coioides) at Kwandang Bay, Gorontalo Province, Indonesia

4.5 Area of Habitat in each stage/migration pattern

- *Rastrelliger Brachysoma*

Gonad stage	Habitat for each stage	Migration pattern
Immature (I)		
Maturing (II)		
Ripening (III)		
Ripe (IV)		
Spent (V)		

4.5 Area of Habitat in each stage/migration pattern

- Portunus pelagicus (Blue swimming crab)

Gonad stage	Habitat for each stage	Migration pattern
Immature (I)		
Maturing (II)		
Ripening (III)		
Ripe (IV)		
Spent (V)		

4.5 Area of Habitat in each stage/migration pattern

- Epinephelus coioides

Gonad stage	Habitat for each stage	Migration pattern
Immature (I)		
Maturing (II)		
Ripening (III)		
Ripe (IV)		
Spent (V)		

4.6 Importance of site to life cycle of fish species as nursery/spawning/feed

- Fisheries Refugua site in Kep is rich of sea grass and fine sand, which provide feed, spawning, and nursery habitat of blue swimming during May to July.
- Fisheries Refugia site in Koh Kong is rich of feed for spawning and growth of mackerel
  Especially, that site is shallow water, providing suitable condiction for spawning and nursery habitat of mackerel November to January at Koh Kapi, Prek 3& 2, Boeung Kachang, Koh Yor, and Koh Nou
- Fisheries Refugia Site in Kampot is rich of sea grass, coral reef, mangroves which provide feed, spawning , and nursery habitat of grouper.

4.7 CPUE/Stock Size/MSY

*(**Sam Arth, 2014 : Status of Fisheries Resource along Coastal Cambodia:** A case study in trans-boundary area between Cambodia (Kep, Kampot and Preah Sihanouk provinces) and Vietnam (Kien Giang province, Phu Quoc island) in Gulf of Thailand)*

- CPUE for Crab gillnet in Kep

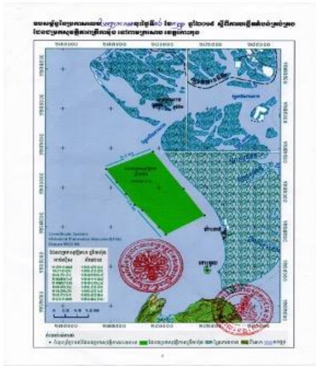
- Using engine boat in power from 13hp
- Using the crab gillnet length from 14500m
- Operating at nightime for three days
- Spending 10 hours /night
- Catching 15kg/day/boat

- CPUE for Crab Trap in Kep

- Crab trap size is, its width is about 20 cm, length is 40 cm, height is 15 cm and mesh size of net cover is 3-4 cm.
- Using engine boat in power from 6.5 - 13hp
- Using 1400 crab traps
- Operating at nigh time from 2 days
- Spending 9-10 hours /night
- Catching 23kg/day/boat

5. Information for GIS mapping

5.1 Fisheries Refugia Boundary



In principal, it has been approved by CFis, local authorities, DoA, and FiAC, but still discuss with provincial governor. It expect to be approved on next quarter

5.2 Fishing Area by each fishing gear

Provinces	Fishing Area by using each fishing gear
FR in Kep	Crab gillnet and trap from Koh Tbal, Mam Prang to Kh Ses in Dam Nak Chorng Oer district and Kep city, Kep province
FR in Koh Kong	Mackerel gillnet in Peam Krasob, Koh Kao, Koh Kapi, Bak Klorng, and Chroy Pors
FR in Kampot	Fish, crab, shrimp gillnet and trap in Tra Paing Ropoav and Prek Thnaot in Prek Thnaot commune, Tek Chhou district, Kampot province

5.3 Important coastal habitat

- It is feed, spawning , and nursery habitat and growth for marine animal species
- It provides benefit to CFi depending on fisheries resource through fishing to enhance their daily livelihood.


Thank you very much for your attention

ANNEX 13

REPORT ON PROFILES OF FISHERIES REFUGIA CANDIDATES: WEST KALIMANTAN AND BANGKA-BELITUNG WATERS

SEAFDEC/UNEP/GEF/INDONESIA

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

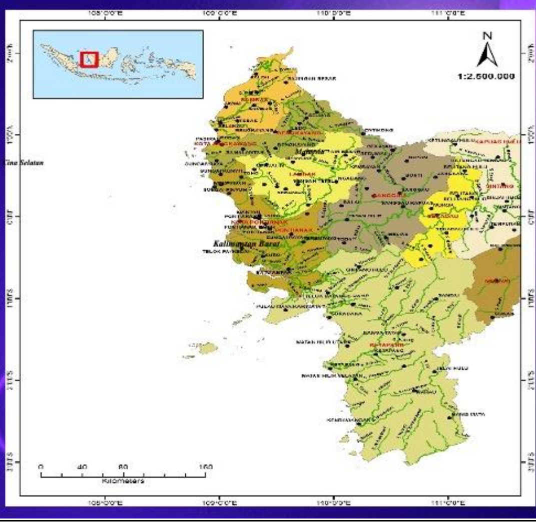
Ngurah N. Wiadnyana
National Technical and Scientific Focal Point
Indonesia

Viet Nam, 5 -7 February 2020

Candidates Fisheries Refugia Location

- Two locations: West Kalimantan and Bangka-Belitung waters were chosen for Fisheries Refugia Establisment
- West Kalimantan Waters are designated for shrimp (*Fenneropenaeus* spp)
- Bangka – Belitung Waters are designated for squids (*Uroteuthis chinensis*)

PROFILE OF WEST KALIMANTAN WATERS



IMPORTANT OF SHRIMP PRODUCTION

Shrimp types and its price at certain locations in West Kalimantan

Name of shrimps	Price (x 1,000 Rupiah/kg)			
	Pemangkat Zone	Kubu Raya Zone	Teluk Batang Zone	Ketapang Zone
Tiger prawn (Udang windu/wangkang)	60	80	80	80
White shrimp (Udang Putih/jerbung)	40	45	50	50
Endevour shrimp (Udang Dogol/bangkit)	35	32	40	40
Yellow shrimp (Udang kuning/DK/T/sudu)	25	28	25	25
Rainbow shrimp (Udang Krosok/udang merah/halus)	10	6	10	10
Yellow small-white shrimp (Udang ambai/sungkur)	-	15	-	-

IMPORTANT OF SHRIMP PRODUCTION

The number of fishing fleets in West Kalimantan in 2017

Type of Boat/Vessel	Total Number		%
1. Boat without motor		4,800	32.9
a. Jukung or Kano	: 1,000		
a. Small plank boat	: 1,000		
a. Medium plank boat	: 1,484		
a. Big plank boat	: 1,316		
2. Outboard fishing board		3,690	25.3
3. Fishing vessel		6,102	41.8
a. Less than 5GT	: 4,467		
a. 5 - 10 GT	: 1,068		
a. 10 - 20 GT	: 238		
a. 20 - 30 GT	: 224		
a. 30 - 50 GT	: 59		
a. More than 50 GT	: 46		
Total number of Fleets		14,592	

Important of Shrimp Production

The number of fishing gears in West Kalimantan in 2017

No.	Type of Fishing Gear	Total number (unit)	(%)
A.	Active Fishing Gear:		
1	Single Shrimp Dragged Gear	766	6.0
2	Seines (including bottom trawls, dredges)	1,899	14.8
3	Three layer net	2,828	22.0
4	Drag net / Plastic trawl	3,299	25.7
B.	Passive Fishing Gear:		
1	Lift net/Pound net	113	0.9
2	Gill nets (Sero)	1,168	9.1
3	Jermal (net, pole with chamber)	850	6.6
4	Plaited rattan fish trap (including bubu ambai)	1,175	9.1
5	Cast net	763	5.9

IMPORTANT OF SHRIMP PRODUCTION

The number of shrimp fishermen in research location

No.	District	Fishermen (persons)	Number of Fishermen Household	Gears (unit)						
				Seine nets	Bottom trawl	Gill net	Trammel net	Lift nets	Ambai trap	Togok Trap
1.	Tanjung Tempurung	-	1,453	884	400	30	-	6	113	20
2.	Tanjung Bunga	-	471	300	120	30	-	21	-	-
3.	Batu Ampar	-	436	-	-	200	100	86	20	30
4.	Teluk Batang	4.682	951	-	118	407	360	55	418	-
5.	Ketapang	328	1,072	1,263	173	472	392	46	288	173
6.	Pemangkat	9,238	1,474	240	1,263	505	197	-	14	-

Shrimp Fisheries Production

Institution

Several indicators to measure the readiness of the social system in accepting management programs are among others:

(1) community support level (social capital),

(2) (value system and local wisdom, and also customs,

(3) the potential of local institution,

(4) the significant value of the region for people's economy,

(5) potential threats to resources to be protected and

Institution

Supporting parameters for Social Economy and Institution along the Coast of West Kalimantan

No	Supporting Parameters (Socioeconomic Institution)	Zone					
		Tanjung Tempurung	Tj. Bunga	Pd. Tikar	Teluk Batang	Ketapang	Pemangkat
1.	Social Capital						
	1.1. Community Perception towards Significant Value of Resources	low	moderate	moderate	high	high	moderate
	1.2. Community participation in management activities	low	low	moderate	moderate	high	low (at a stage of attending the meeting)
2.	Value System & local wisdom	Existing, passive	Existing, active	Existing, active for particular interests	Not existing	Not existing	Not existing

Institution

Supporting parameters for Social Economy and Institution along the Coast of West Kalimantan

No	Supporting Parameters (Socioeconomic Institution)	Zones					
		Tanjung Tempurung	Tj. Bunga	Pd. Tikar	Teluk Batang	Ketapang	Pemangkat
3.	Potential threats to resources (extractive economy)				Safe enough	Safe enough	Safe enough
	3.1. terrestrial vegetation	Not safe	Not safe	Not safe	Low degraded	Prone to abrasion	Low degraded
	3.2. Fishery activities	Not safe	Not safe	Not safe	Safe (domination of trammel net)	Not safe (domination of trawl)	Not safe (destructive fishing gears are still used)
4.	Potential conflicts of benefit/interest	moderate	moderate	moderate	moderate	moderate	minimum

Institution

Supporting parameters for Social Economy and Institution along the Coast of West Kalimantan

No	Supporting Parameters (Socioeconomic Institution)	Zones					
		Tanjung Tempurung	Tj. Bunga	Pd. Tikar	Teluk Batang	Ketapang	Pemangkat
5.	Potential of Institution	Performing-maturing (performing co-management function)	Performing-maturing (performing co-management function)	norming (establishment of a value system)	Brainstorming	Brainstorming	Brainstorming
6.	Significant value of area for people's economy	Main source of livelihood/raw materials for people's industries/export	Main source of livelihood / part time	Main source of livelihood / part time	Main source of livelihood / export	Main source of livelihood / export	Main source of livelihood/raw materials for people's industries/export
	Resources contribution to the region				Significant enough	Significant enough	Significant enough
	Resources contribution to				Significant	Significant	Significant

Characteristics of coastal areas

Some characteristics of coastal areas of West Kalimantan and several development strategies that can be done are as follow:

- The villagers living in coastal areas of West Kalimantan can be categorized into two community groups, representatives of isolated villages and representatives of coastal villages.
- The social structures that lead to social polarization (two-class community structure) indicate that inequality and even backwardness have occurred.
- Rich of natural resources of the coastal areas of West Kalimantan, the protection of the environment of coastal areas is needed that should be carried out to create various sources of income of fishing community; it is not only from fishery and agricultural sectors, but also from non-agricultural sector.
- Based on socio-economic characteristics and natural resources owned, several alternative development strategies that can be implemented are: (1) for isolated villages; the development strategy that is possible to be done is combining participative strategy with welfare strategy, and (2) for fishing villages, integrated strategy should be implemented; it should combine growth strategy, welfare strategy, and participative strategy.

PROFILE OF WATERS ON COASTAL AREAS OF WEST KALIMANTAN

Critical Habitat for Juvenile Shrimps

No	Parameter	Unit	Coastal condition of West Kalimantan	Reference
	Biogeophyscal Aspects:			
1.	Abundance of Penaeid shrimp larvae	Ind/1,000 m^3	Location with the highest level of abundance compared to other locations.	Conservation of Shrimp Resources at Cempi Bay (Anonymous, 2012, 2013)
2.	Composition of Penaeid shrimp larvae against the total number of other shrimps	%	dominant	
3.	Abundance of Penaeid shrimp juvenile	Ind/1,000 m^3	Location with the highest level of abundance	

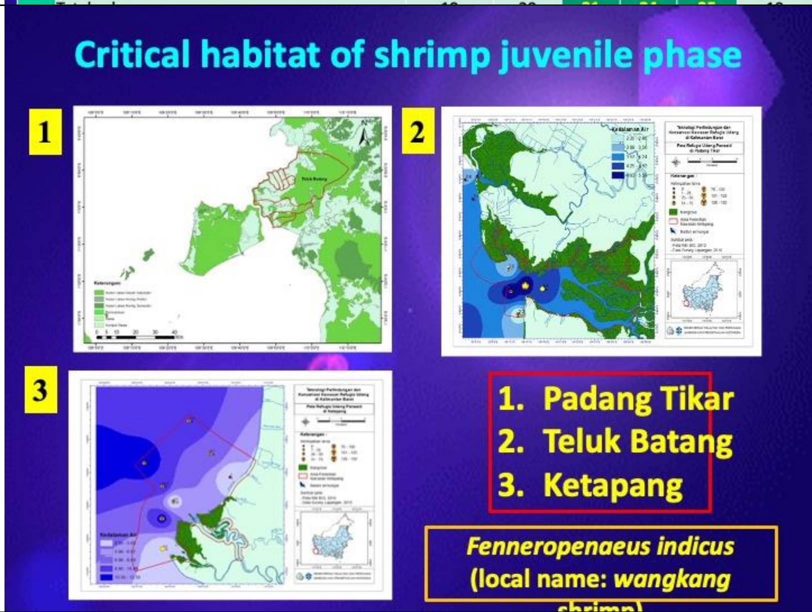
PROFILE OF WATERS ON COASTAL AREAS OF WEST KALIMANTAN

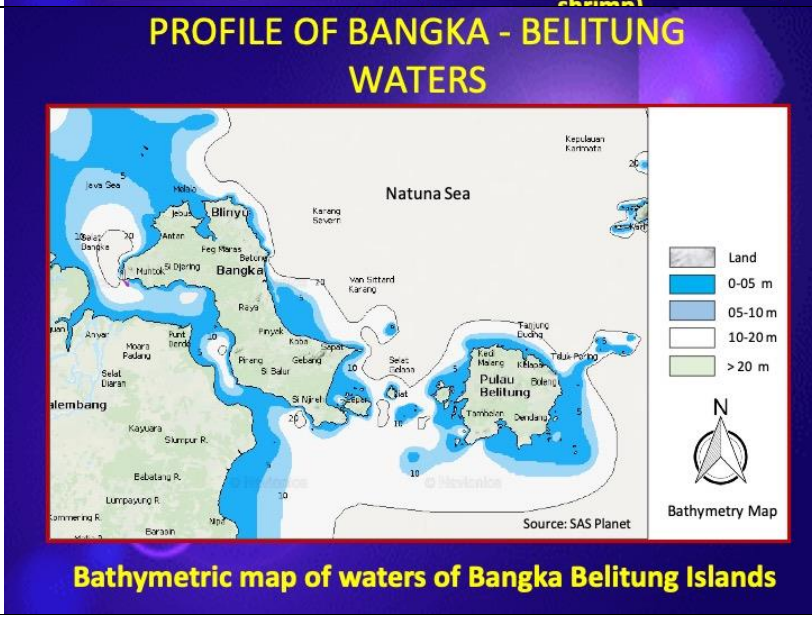
Critical Habitat for Juvenile Shrimps

No	Parameter	Unit	Coastal condition of West Kalimantan	Reference
5.	Depth of Water	m	>1-15m (relatively shallow)	
6.	Temperature of Water	^oC	27-32	KLH, 2004
7.	Turbidity of Water	NTU	0-5	KLH, 2004
8.	Basic Substrate of Water	quantitative	Sandy mud, sandy clay mud	Holthuis, 1980; delMundo, 2000; Pratiwi, 2008.
9.	pH	unit	7.5-8	KLH, 2004
12.	Mangrove Vegetation			

Matchability of waters for prospective shrimp refugia in West Kalimantan

No	Parameter of prospective penaeid shrimp refugia based on nursery area	Research Location					
		Tanjung Tempurung	Tanjung Bunga	Padang Tikar	Teluk Batang	Ketapang	Pemangkat
1	Penaeid shrimp						
	Penaeid larvae composition	3	2	3	3	3	1
	Penaeid juvenile composition	1	3	2	2	2	3
2	Water environment:						
	salinity	1	1	3	2	2	3
	turbidity	2	1	3	1	2	1
3	Mangrove :						
	Cover (%)	2	2	3	2	1	1
	Real mangrove type	1	2	3	1	1	1
	Nypa fruticans (ind/Ha)	3	1	2	1	1	1
	Density (ind/Ha)	1	2	3	3	3	
4	Destructive fishing gear	1	1	3	3	3	3
5	Utility						
6	Social capital						
	Community perception on significant value of resources	1	2	2	3	3	3
	Community participation in management activities	1	1	1	2	3	1
	Local wisdom	2	2	3	1	1	1

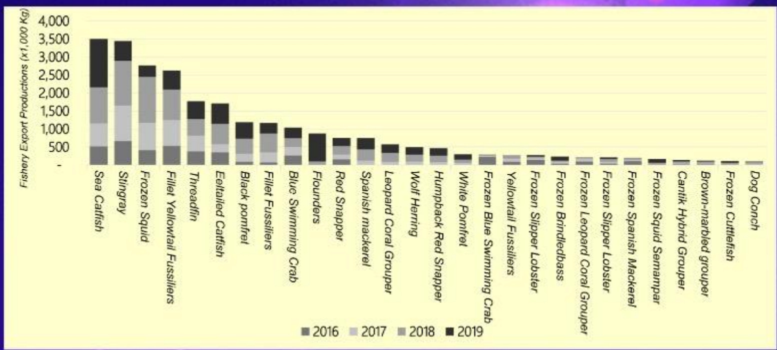




Selection of Superior Commodity of Small Pelagic (Squids)

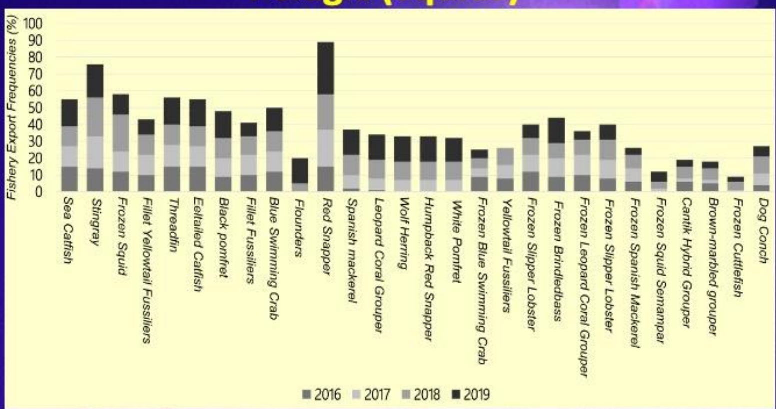
Fish Commodity	Value of Production	Value Function	Price (Rp/Kg)	Value Function	Area	Value Function	Value Added	Value Function	Combined	Average Value Function	Rank
Bared/spanish mackerel	309,960,060.70	0.52	65.00	0.52	2	0.67	2	1.00	2.710	0.678	1
Red snapper	590,566,495.10	1.00	65.00	0.52	2	0.67	1	0.50	2.690	0.673	2
Banana prawn	86,326,494.00	0.15	120.00	0.96	3	1.00	1	0.50	2.610	0.653	3
Leopard coral grouper	587,344,144.60	0.99	30.00	0.24	2	0.67	1	0.50	2.400	0.600	4
Mud crab	97,537,604.30	0.17	125.00	1.00	2	0.67	1	0.50	2.340	0.585	5
Squid	136,686,065.00	0.23	70.00	0.56	3	1.00	1	0.50	2.290	0.573	6
King mackerel	20,963,502.60	0.04	45.00	0.36	2	0.67	2	1.00	2.070	0.518	7
Threadfine bream	187,071,944.70	0.32	50.00	0.40	1	0.33	2	1.00	2.050	0.513	8
Fringescale sardine	126,800,428.30	0.21	25.00	0.02	2	0.67	2	1.00	1.900	0.475	9
Blue Swimming Crab	321,763,277.90	0.54	60.00	0.48	1	0.33	1	0.50	1.850	0.463	10
Seabass/White snapper	28,826,530.30	0.05	80.00	0.64	2	0.67	1	0.50	1.860	0.465	11
Anchovy	59,300,015.60	0.10	60.00	0.48	2	0.67	1	0.50	1.750	0.438	12
Round herring	143,504,150.20	0.24	8.00	0.06	1	0.33	2	1.00	1.630	0.408	13
Long jawed mackerel	63,910,456.00	0.11	45.00	0.36	2	0.67	1	0.50	1.640	0.410	14
White pomfret	121,313,890.90	0.21	25.00	0.20	2	0.67	1	0.50	1.580	0.395	15
Grouper	71,803,873.10	0.12	30.00	0.24	2	0.67	1	0.50	1.530	0.383	16
White pomfret	89,053,696.90	0.15	25.00	0.20	2	0.67	1	0.50	1.520	0.380	17
Threadfin	21,725,892.00	0.04	12.00	0.10	1	0.33	2	1.00	1.470	0.368	18
Giant trevally	134,132,136.80	0.23	50.00	0.40	1	0.33	1	0.50	1.460	0.365	19
Spotted sardine	60,722,195.70	0.10	3.00	0.02	1	0.33	2	1.00	1.450	0.363	20

Selection of Superior Commodity of Small Pelagic (Squids)



The quantity (in kg) of exported fishery commodities of Bangka Belitung Island Province in period of 2016-2018

Selection of Superior Commodity of Small Pelagic (Squids)



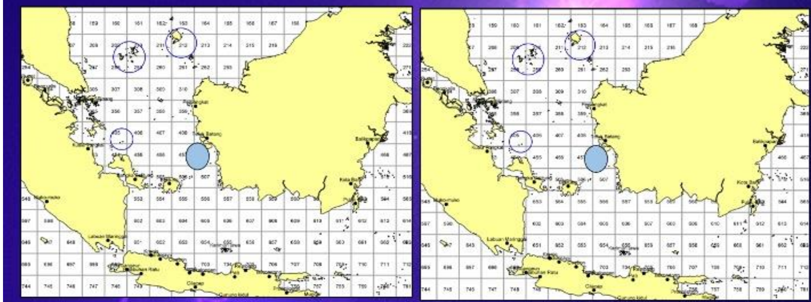
Fishery Commodity export frequency dynamics of Bangka Belitung Islands Province, 2016-2017

Selection of Superior Commodity of Small Pelagic (Squids)

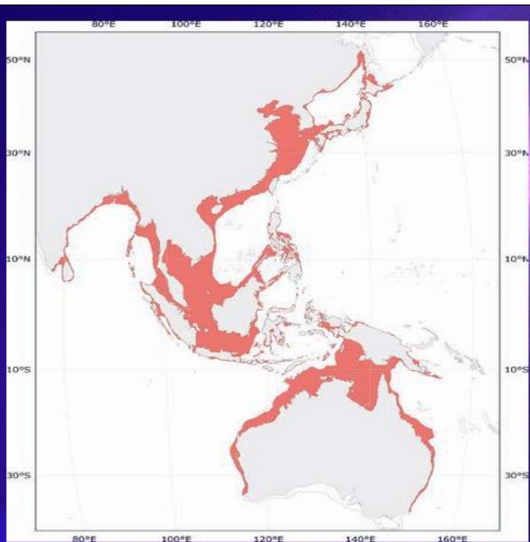
Commodity	Production Value (In Billion Rupiah)	Price (Rp/Kg)	Marketing Area	Fish Ranking In Bangka Belitung Islands Province	Commodity Ranking of Superior Small Pelagic Fish
Squid	136.7	70,000	1	6	1
Sardine	126.8	25,000	2	9	2
Anchovy	59.3	60,000	2	12	3
Japuh	143.5	8,000	1	13	4
Mackerel	63.9	45,000	2	14	5
Siro	60.7	3,000	1	20	6

Exp. Marketing Area: 1 = local; 2 = national; 3 = international

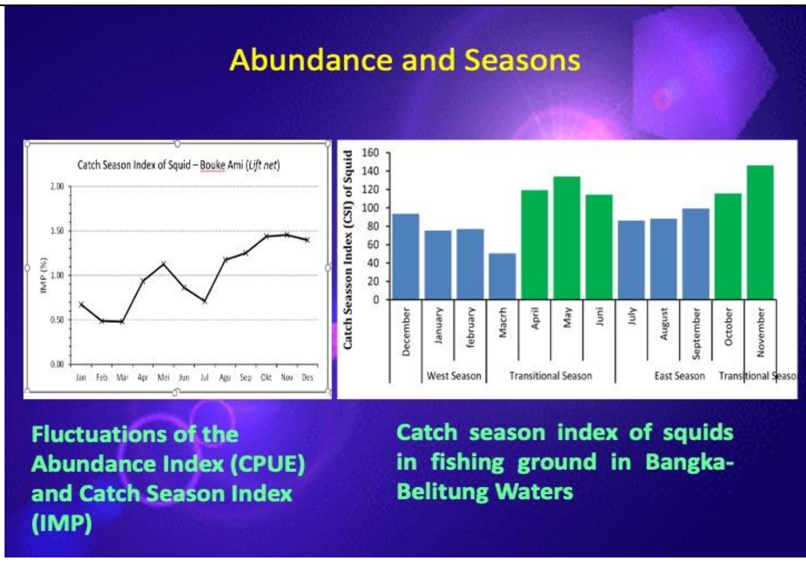
Characteristics of the Selected Superior Small Pelagic Species (Squid)

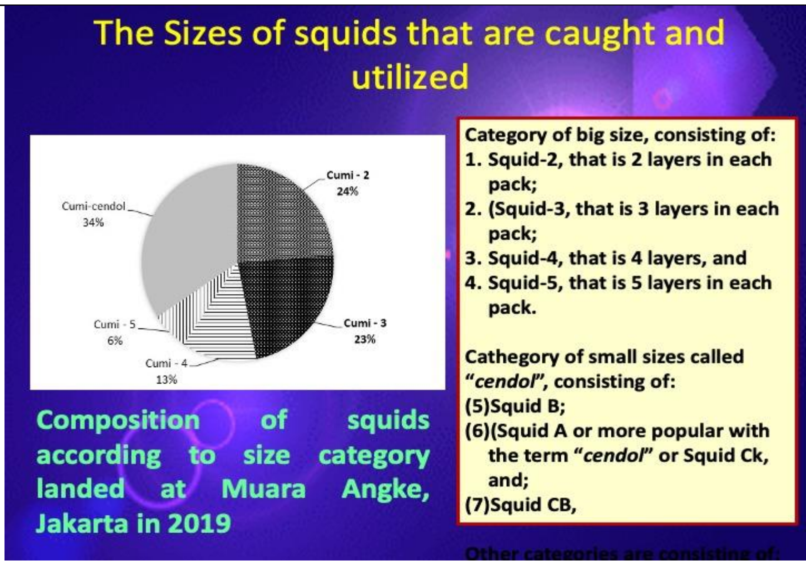


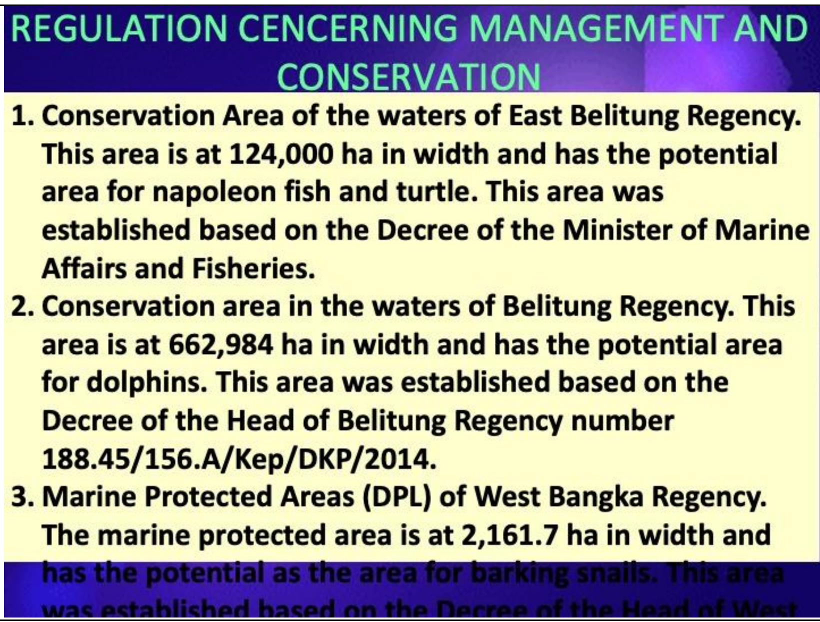
Map of fishing area of small pelagic fish and squids

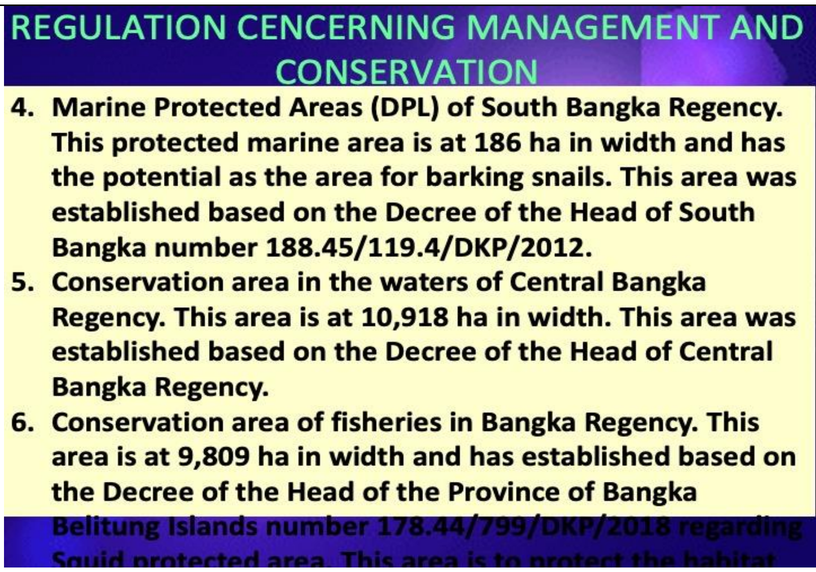


Distribution of *Uroteuthis chinensis* (Jereb et al., 2010).

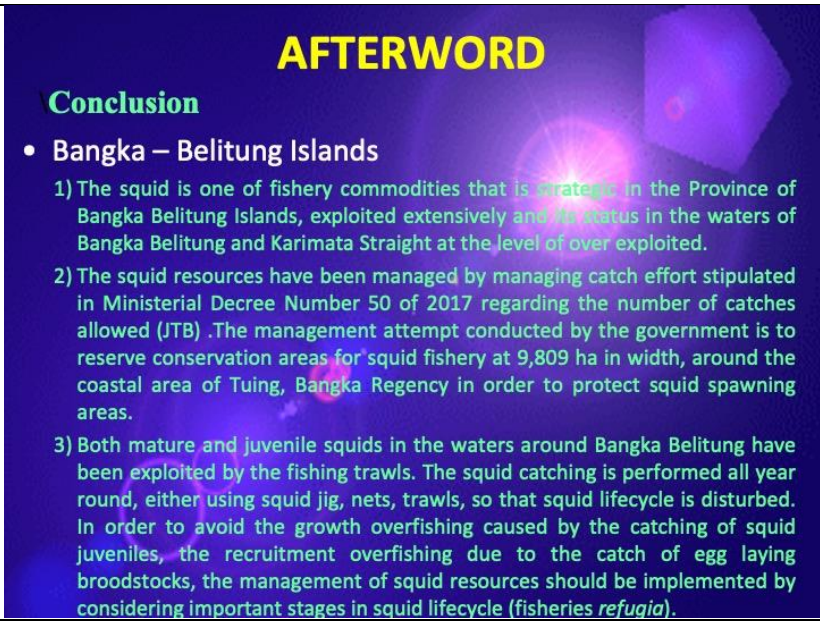

Abundance and Seasons
Catch Season Index of Squid – Bouke Ami (Lift net)
IMP (%)
Jan Feb Mar Apr Mei Jun Jul Agu Sep Okt Nov Des
Catch Seasson Index (CSI) of Squid
December January february March April May Juni July August September October November
West Season
Transitional Season
East Season
Transitional Season
Fluctuations of the Abundance Index (CPUE) and Catch Season Index (IMP)
Catch season index of squids in fishing ground in Bangka-Belitung Waters


The Sizes of squids that are caught and utilized
Cumi - 2 24%
Cumi-cendol 34%
Cumi - 3 23%
Cumi - 5 6%
Cumi - 4 13%
Composition of squids according to size category landed at Muara Angke, Jakarta in 2019
Category of big size, consisting of:
1. Squid-2, that is 2 layers in each pack;
2. (Squid-3, that is 3 layers in each pack;
3. Squid-4, that is 4 layers, and
4. Squid-5, that is 5 layers in each pack.
Cathegory of small sizes called "cendol", consisting of:
(5)Squid B;
(6)(Squid A or more popular with the term "cendol" or Squid Ck, and;
(7)Squid CB,


REGULATION CENCERNING MANAGEMENT AND CONSERVATION
1. Conservation Area of the waters of East Belitung Regency. This area is at 124,000 ha in width and has the potential area for napoleon fish and turtle. This area was established based on the Decree of the Minister of Marine Affairs and Fisheries.
2. Conservation area in the waters of Belitung Regency. This area is at 662,984 ha in width and has the potential area for dolphins. This area was established based on the Decree of the Head of Belitung Regency number 188.45/156.A/Kep/DKP/2014.
3. Marine Protected Areas (DPL) of West Bangka Regency. The marine protected area is at 2,161.7 ha in width and


REGULATION CENCERNING MANAGEMENT AND CONSERVATION
4. Marine Protected Areas (DPL) of South Bangka Regency. This protected marine area is at 186 ha in width and has the potential as the area for barking snails. This area was established based on the Decree of the Head of South Bangka number 188.45/119.4/DKP/2012.
5. Conservation area in the waters of Central Bangka Regency. This area is at 10,918 ha in width. This area was established based on the Decree of the Head of Central Bangka Regency.
6. Conservation area of fisheries in Bangka Regency. This area is at 9,809 ha in width and has established based on the Decree of the Head of the Province of Bangka
Belitung Islands number 178.44/799/DKP/2018 regarding


AFTERWORD
Conclusion
• West Kalimantan
1) The waters of Padang Tikar, Teluk Batang and Ketapang can be chosen as the prospective shrimp refugia areas at juvenile phase/stage in the nursery ground.
2) The type of preserved shrimp is *Fenneropenaeus indicus* (local name: *wangkang* shrimp)


AFTERWORD
Conclusion
• Bangka – Belitung Islands
1) The squid is one of fishery commodities that is strategic in the Province of Bangka Belitung Islands, exploited extensively and its status in the waters of Bangka Belitung and Karimata Straight at the level of over exploited.
2) The squid resources have been managed by managing catch effort stipulated in Ministerial Decree Number 50 of 2017 regarding the number of catches allowed (JTB) .The management attempt conducted by the government is to reserve conservation areas for squid fishery at 9,809 ha in width, around the coastal area of Tuing, Bangka Regency in order to protect squid spawning areas.
3) Both mature and juvenile squids in the waters around Bangka Belitung have been exploited by the fishing trawls. The squid catching is performed all year round, either using squid jig, nets, trawls, so that squid lifecycle is disturbed. In order to avoid the growth overfishing caused by the catching of squid juveniles, the recruitment overfishing due to the catch of egg laying broodstocks, the management of squid resources should be implemented by considering important stages in squid lifecycle (fisheries *refugia*).


FURTHER ACTIONS
West Kalimantan:
1. Conducting studies relating to the areas and spawning season.
• It still needs biology data and shrimp fishery including individual size of shrimp (to decide on the size when caught for the first time and when spawning for the first time), spawning season and spawning area, tendency of yield of catch per unit of effort based on types of fishing gears in nursery ground and shrimp fishing area.
• To get information about critical habitat of migration pathways and the habitat of shrimp pawning through interviews and with the assistance of Map of West Kalimantan Coast.
2. Deciding on the prospective of refugia area and disseminating to the stake holders (Local/Regional Government and local fishermen).
3. Analyzing *Fenneropenaeus* spp DNA.
4. Analyzing the composition of the catches of *F.indicus* and *F.merquensis* using bottom trawl and trammel net.
5. Encouraging Local Government to draw up regulations concerning the decision on prospective refugia area.


FURTHER ACTIONS/FOLLOW UP
Bangka Belitung Island:
To support refugia-based squid management, further study about the most dominant species of squid, *Uroteuthis chinensis* is needed, in particular concerning:
1. Determination of the lifecycle of the squid/spawning area
2. Squid distribution based on size and lifecycle
3. Distribution of size and gonad maturity level
4. Important habitat of squids in their respective stages of life


Terima Kasih
THANK YOU

ANNEX 14

FISHERIES REFUGIA PROFILE (MALAYSIA)

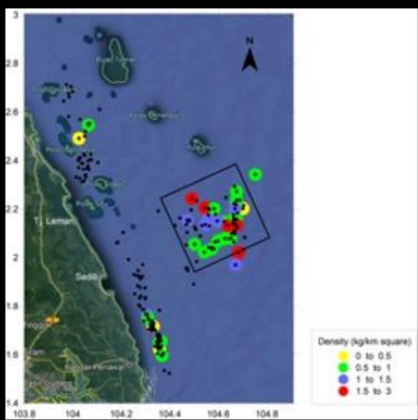
Lobster & Tiger Prawn

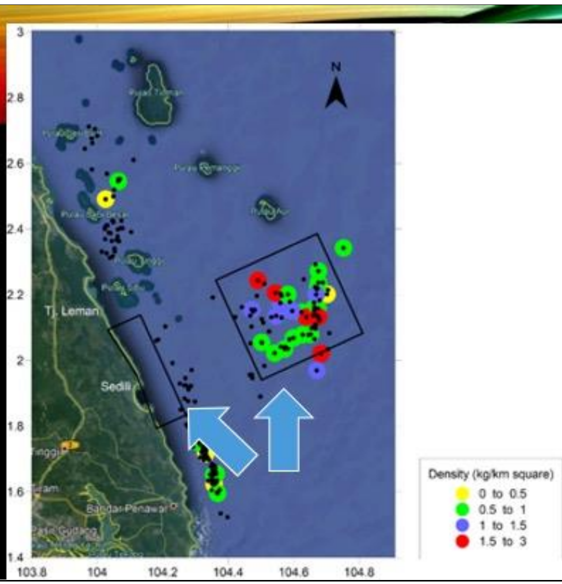
REFUGIA SPINY LOBSTER

PROPOSED LOBSTER REFUGIA SITE (OPTION A)

1. Site name: Tanjung Leman, East Johor, Malaysia
2. Geographic location (lat, long in degrees and minutes):
   - 2° 14.670'N, 104° 21.753'E
   - 2° 23.146'N, 104° 40.334'E
   - 2° 4.972'N, 104° 48.686'E
   - 1° 56.441'N, 104° 30.137'E

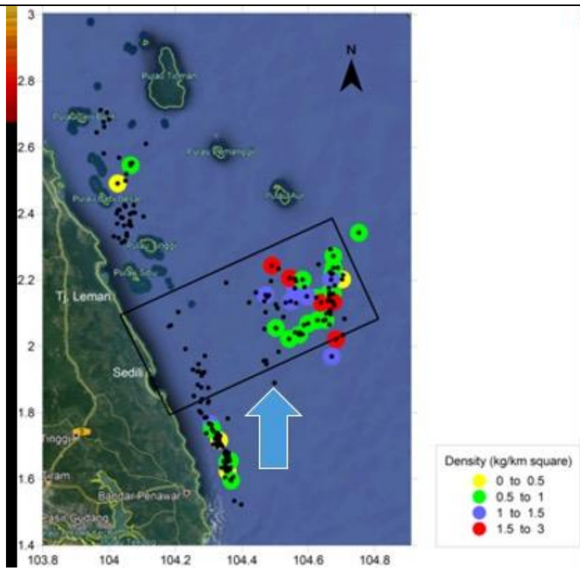
- 3. Site information:
- - Geography
  - South China Sea, open sea, 20 nautical miles from main shoreline, 5 nautical miles from nearest island (Aur Island), average water depth >20 m





PROPOSED LOBSTER REFUGIA SITE (OPTION B)

- Area size : 140,023 Ha / 1400 km2 (zone C) + 39,146 Ha / 391 km2 (zone A)
- Dimension: 20 x 20 nm + 5 x 20 nm
- Cover zone A and C
- Zone A protect juveniles during pre-spawning season
- Zone C protect spawners during spawning season



PROPOSED LOBSTER REFUGIA SITE (OPTION C)

- Area size : 287,636 Ha / 2876 km2
- Shoreline to 40 nm from mainland
- 5 nm from Aur Island
- Dimension: 20 x 40 nm
- Cover zone A, B and C
- **Need further discussions with stakeholders**

HISTORY, POPULATION, SOCIO-ECONOMY

- - **Aur Island**
- Races include Malay
- Small island, part of the Johor Marine Park (land area 7.2 km^2)
- Population about 217 (Source: Mersing District Office)
- Main economic activity : Tourism (5 chalet operators)
- Other economic activity: Agriculture, Fisheries
- Facilities : clean water, electricity: genset (private), postal, police station, community hall, school, mosque
- Island is an important stopover for local fishermen seeking shelter from bad weather

Important coastal habitats in the area;
-Coral reefs near Aur Island, muddy and sandy mud sediment at refugia site

NUMBER AND TYPES OF FISHING VESSELS OPERATING IN THE REFUGIA AREA

The species and size selectivity of the principal fishing :

- **Trawl nets (lobster as bycatch) – adult lobsters**
- **Gill / drift nets – mainly juveniles lobsters**
- **Traps – adult and juveniles lobsters**
- **Hooks and lines – adult lobsters**

Type of gear	No. of licensed fishing vessels (2018)	No. of fishermen (2018)
Trawl nets	199	1253
Gill / Drift nets	1525	3220
Stationary traps	17	39
Portable traps	17	108
Hooks & Lines	51	199
Fish purse seines	91	2562
Total	1900	7381

THE ROLE OF FISHERIES REFUGIA IN THE PRODUCTION (AND ECONOMIC VALUE) OF PRIORITY SPECIES

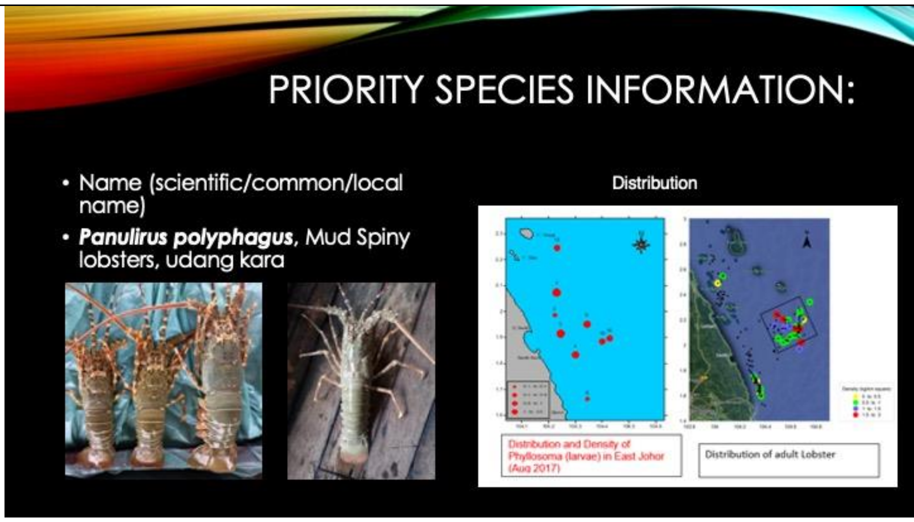
- Ensure the adult lobsters to breed and spawn during peak spawning period

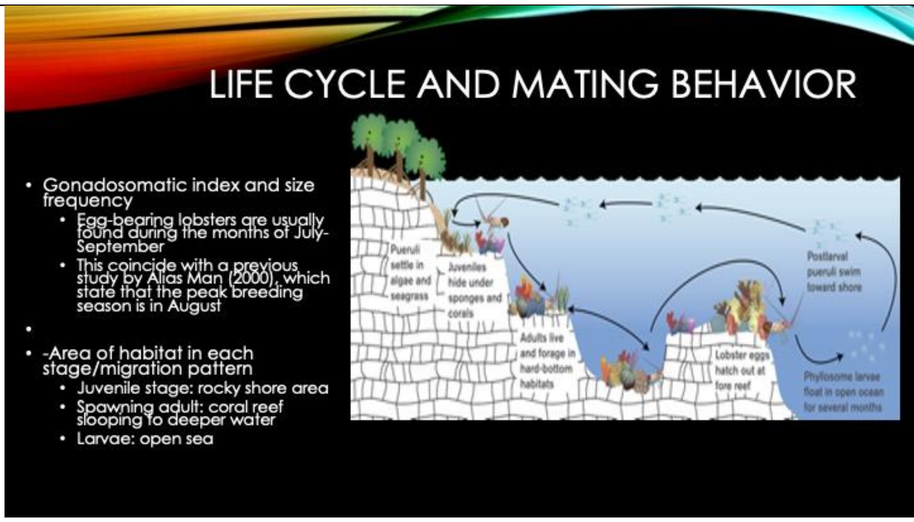
NUMBER OF FISHERIES COMMUNITIES IN THE AREA

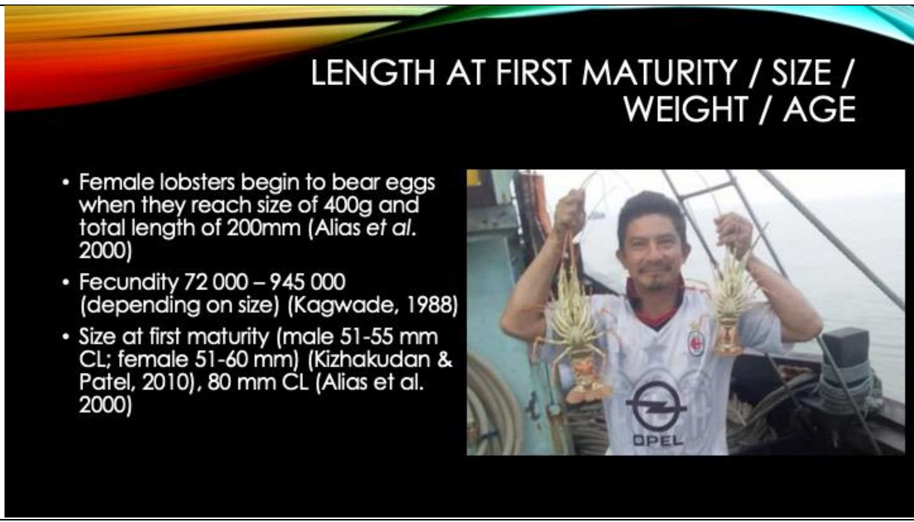
- 4 Fisherman Association:

  1. (Fishermen Association Mersing Area)
  2. (Fishermen Association Endau Area)
  3. (Fishermen Association Sedili Area)
  4. (Fishermen Association Pengerang Area)

- Existing fisheries management measure in the area of the site
  - 2 nautical miles no-take-zone surrounding the Marine Parks island (including Aur Island)
  - Fishing zoning system (gear type restriction and boat capacity restriction according to distance from the shoreline
- Usage of refugia by threatened and endangered marine species
  - Area are frequented by dolphins and sea turtles


PRIORITY SPECIES INFORMATION:
• Name (scientific/common/local name)
• ***Panulirus polyphagus***, Mud Spiny lobsters, udang kara
Distribution
Distribution and Density of Phyllosoma (larvae) in East Johor (Aug 2017)
Distribution of adult Lobster


LIFE CYCLE AND MATING BEHAVIOR
• Gonadosomatic index and size frequency
• Egg-bearing lobsters are usually found during the months of July-September
• This coincide with a previous study by Alias Man (2000), which state that the peak breeding season is in August
•
• -Area of habitat in each stage/migration pattern
• Juvenile stage: rocky shore area
• Spawning adult: coral reef slooping to deeper water
• Larvae: open sea
Pueruli settle in algae and seagrass
Juveniles hide under sponges and corals
Adults live and forage in hard-bottom habitats
Lobster eggs hatch out at fore reef
Postlarval pueruli swim toward shore
Phyllosome larvae float in open ocean for several months


LENGTH AT FIRST MATURITY / SIZE / WEIGHT / AGE
• Female lobsters begin to bear eggs when they reach size of 400g and total length of 200mm (Alias *et al.* 2000)
• Fecundity 72 000 – 945 000 (depending on size) (Kagwade, 1988)
• Size at first maturity (male 51-55 mm CL; female 51-60 mm) (Kizhakudan & Patel, 2010), 80 mm CL (Alias et al. 2000)
OPEL

INFORMATION FOR GIS MAPPING:

- - Fisheries refugia boundary
  - 2° 14.670'N, 104° 21.753'E
  - 2° 23.146'N, 104° 40.334'E
  - 2° 4.972'N, 104° 48.686'E
  - 1° 56.441'N, 104° 30.137'E
- - Fishing area by each fishing gear
  - Zon A: 0-5nm: Drift net, traps, rod and lines
  - Zon B: 5-12nm: trawlers, traps,
  - Zon C: 12nm-EEZ: trawlers

- - Important coastal habitats
  - Mangroves, mud flat, seagrass, coral reef.
- - Area of habitat in each stage/migration pattern of priority species
  - Juvenile stage: rocky shore area
  - Spawning adult: coral reef
  - Larvae: open sea

CPUE/Stock size/ MSY

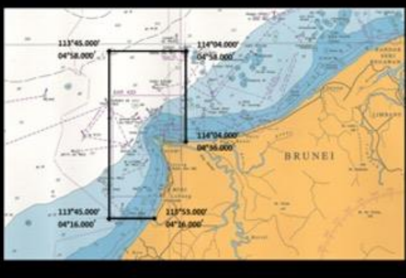
Table : The potential yield (metric ton) and exploitation rate (year^{-1}) of spiny lobster and slipper lobster in the East Johor waters from the year 2017 survey

Species	Spiny Lobster
Area, a (km^2)	1,812
Density, D (kg.km^{-2})	7.26
Biomass, Bc (metric ton)	26.3
Landing, Y (metric ton)	4 – 113
Mortality, M	0.45
Potential Yield, MSY (metric ton)	8 – 62
Exploitation Rate, E (year^{-1})	0.2 – 0.9

REFUGIA TIGER PRAWN (ADULT)

1. Site name:
   - Kuala Baram, Miri, Sarawak
2. Geographic location (lat, long in degrees and minutes):
   - 4° 45.000', 113° 57.000'
   - 4° 36.000', 114° 4.000'
   - 4° 23.000', 113° 58.000'
   - 4° 37.000', 113° 49.000'
3. Site information:

- - Geography
  - Nearby border of Brunei
- - History, population, socio-economy
  - Races include Iban, Malay, Orang Ulu, Kedayan, Kayan, Kelabit, Chinese
  - Socio-economy-Most of population are fishermen and farmers. Logging also one of the activities in Kuala Baram.



PROPOSED TIGER PRAWN REFUGIA SITE (JUVENILE)-

- 3 rivers identified,
- Pasu river
- Lutong river and
- Sibuti river

IMPORTANT COASTAL HABITATS IN THE AREA

- There are size able mangrove in Kuala Baram area,
- Coral reef are found offshore,Sibuti , Miri-Sibuti National Marine Park nearby (manage by Sarawak state government)
- In Miri waters, coral reef are located at the Miri-Sibuti Coral Reef National Park.
- It is the largest offshore national park in Sarawak, gazette in 2007 and comprises an area of 186,930 hectare.
- There is no seagrass beds in the vicinity.

Number and types of fishing vessels operating in the refugia area

Inboard powered Fishing vessel	5-9.9 GRT	10-14.9 GRT	15-19.9 GRT	20-24.9 GRT	25-39.9 GRT	40-69.9 GRT	70 GRTand above
No. of boats	1	2	2	10	17	41	4

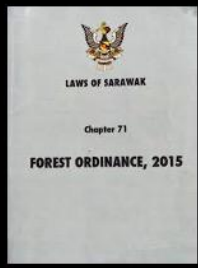
- Outboard powered fishing vessel- 376 boats

- The species and size selectivity of the principal fishing gear used:

- Mostly demersal species including tiger prawn. Fishing gears used is trawl, drift net, cast net

EXISTING FISHERIES MANAGEMENT MEASURE IN THE AREA OF THE SITE

-
- Fisheries Act 1985,
- Sarawak forestry Ordinance



PRIORITY SPECIES INFORMATION:

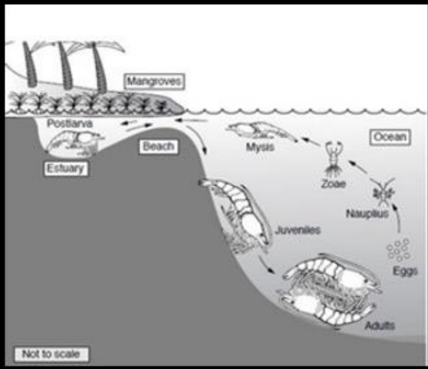
- - Name (scientific/common/local name)
  - ***Penaeus monodon***/Udang harimau/Tiger prawn
- - Morphology
  - The rostrum, extending beyond the tip of the antennular peduncle, has 6 to 8 (mostly 7) dorsal and 2 to 4 (mostly 3) ventral teeth, and is sigmoidal in shape.

DISTRIBUTION

- The giant tiger prawn is widely distributed throughout the greater part of the Indo-West Pacific region: South Africa, Tanzania, Kenya, Somalia, Madagascar, Saudi Arabia, Oman,
- Pakistan, India, Bangladesh, Sri Lanka, Indonesia, Thailand, Malaysia, Singapore, Philippines, Hongkong, Taiwan, Korea, Japan, Australia, and Papua New Guinea

LIFE CYCLE AND MATING BEHAVIOR

- The life history of *P. monodon* has an offshore planktonic larval phase of about 14 to 20 days,
- an estuarine, benthic postlarval and juvenile phase of over 6 months
- a coastal subadult phase of 5 to 6 months
- and an inshore and offshore ocean adult and spawning phase

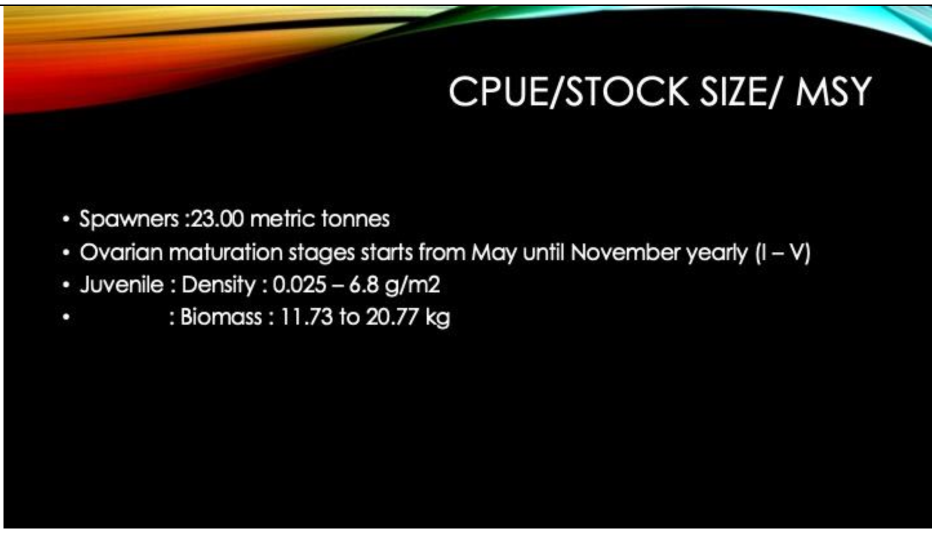


LENGTH AT FIRST MATURITY / SIZE / WEIGHT / AGE

- Male :
  - 37 mm Carapace length (CL),
  - 35 g Body weight(BW),
  - 10 months
- Female :
  - 47 mm CL,
  - 67.7 BW,
  - 10 months

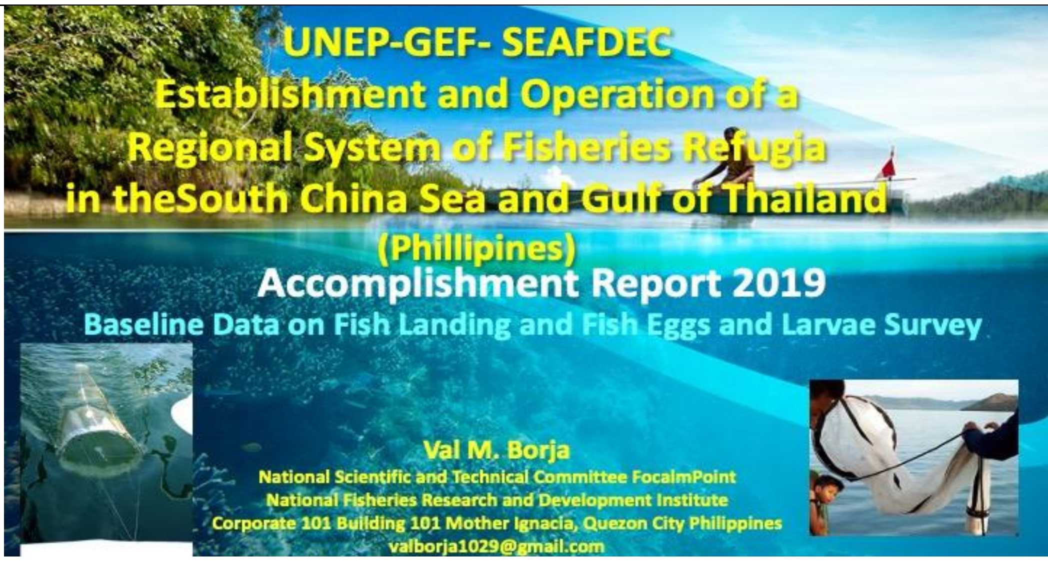
AREA OF HABITAT IN EACH STAGE/MIGRATION PATTERN

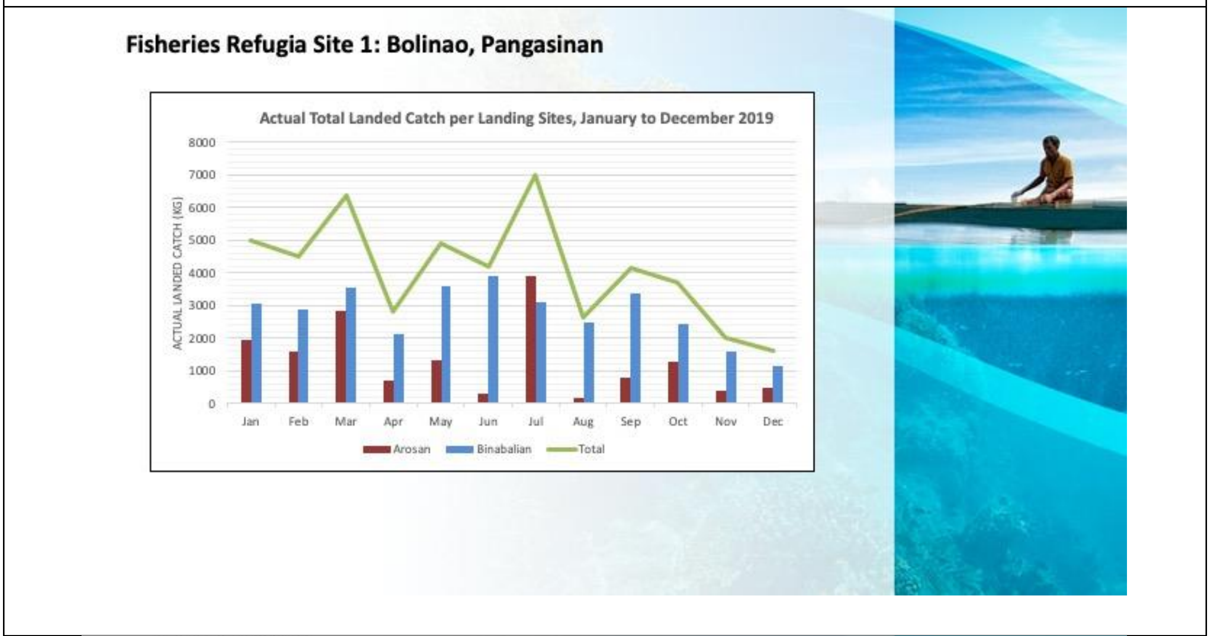
- *Penaeus monodon* is found at depths from 0 to 110 m, in
- habiting bottom mud and sand.
- Giant tiger prawn live in brackish, estuarine (juveniles) and marine (adults) environments (FAO, 1980).
- In its natural range, *P. monodon* frequents water temperatures of 18–34.5 oC and salinities of 5–45 ppt (Branford, 1981; Chen, 1990).
- It is even grown commercially at salinities of 1–5 ppt (Musig and Boonnom, 1998).
- Penaeus monodon appears to select muddy mangrove channels and often associates with marginal or floating vegetation (de Freitas, 1986).

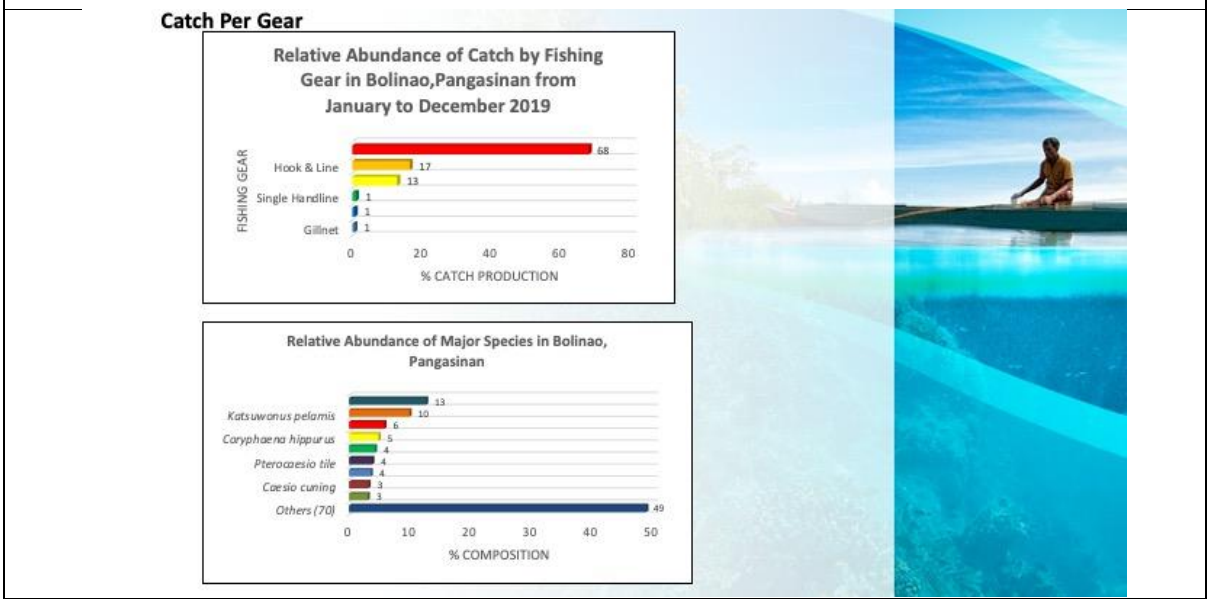

CPUE/STOCK SIZE/ MSY
• Spawners :23.00 metric tonnes
• Ovarian maturation stages starts from May until November yearly (I – V)
• Juvenile : Density : 0.025 – 6.8 g/m2
• : Biomass : 11.73 to 20.77 kg

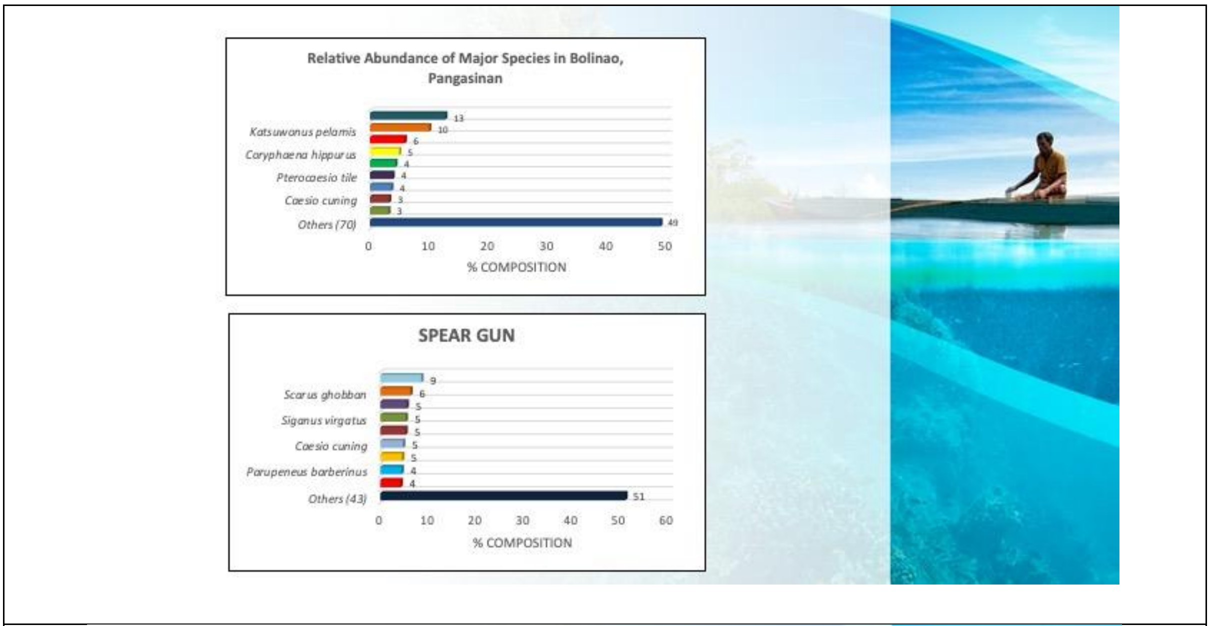

Thank you
Terima kasih

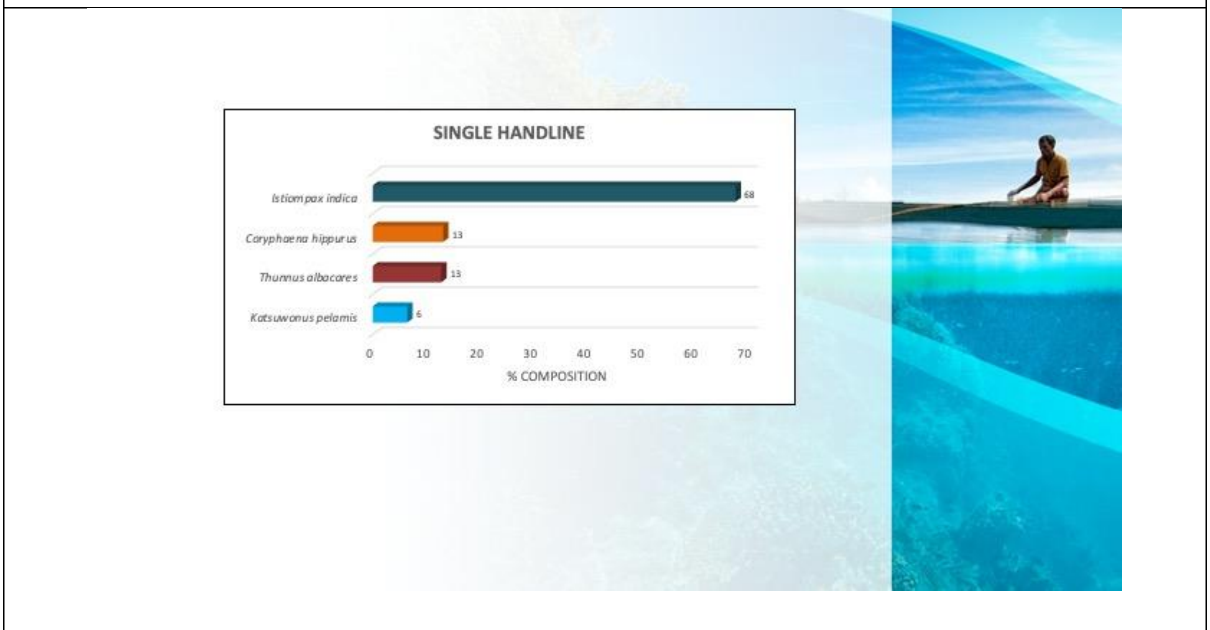
ANNEX 15

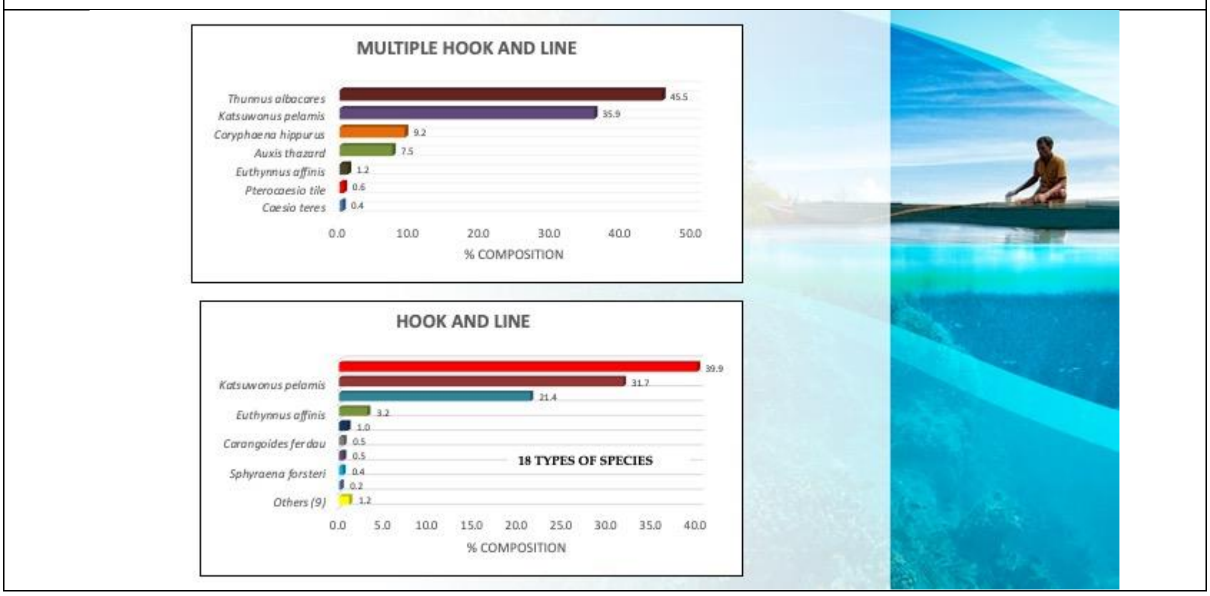

UNEP-GEF- SEAFDEC
Establishment and Operation of a
Regional System of Fisheries Refugia
in theSouth China Sea and Gulf of Thailand
(Phillipines)
Accomplishment Report 2019
Baseline Data on Fish Landing and Fish Eggs and Larvae Survey
Val M. Borja
National Scientific and Technical Committee FocalmPoint
National Fisheries Research and Development Institute
Corporate 101 Building 101 Mother Ignacia, Quezon City Philippines
valborja1029@gmail.com

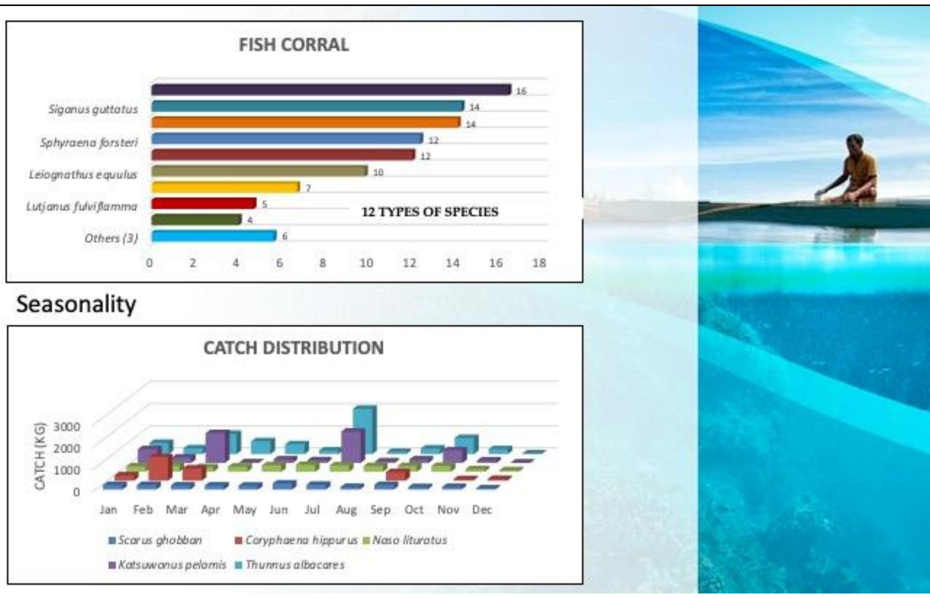

Fisheries Refugia Site 1: Bolinao, Pangasinan
Actual Total Landed Catch per Landing Sites, January to December 2019
ACTUAL LANDED CATCH (KG)
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Arosan
Binabalian
Total

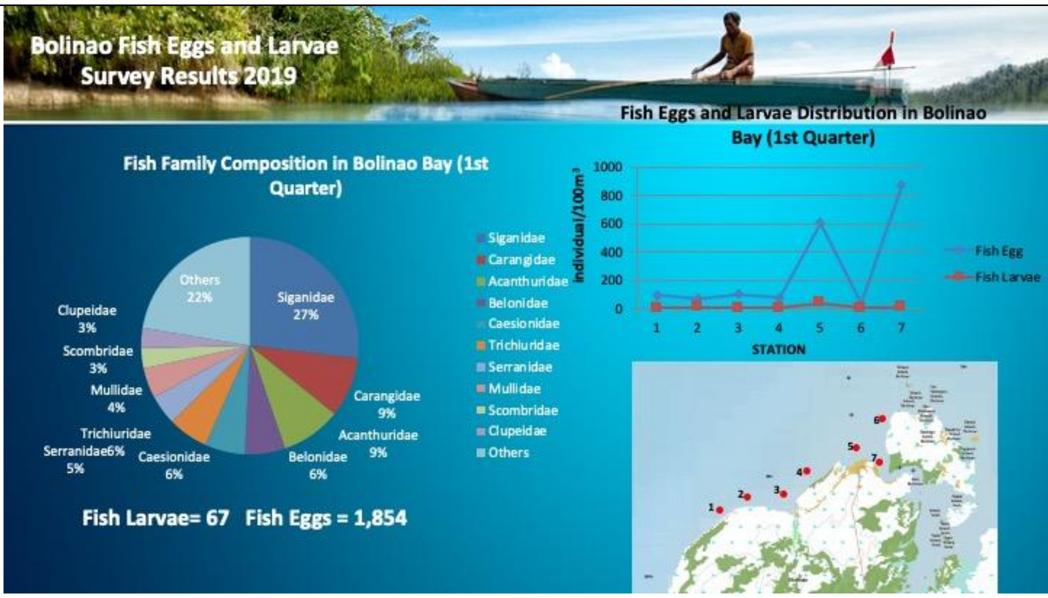

Catch Per Gear
Relative Abundance of Catch by Fishing Gear in Bolinao,Pangasinan from January to December 2019
FISHING GEAR
Hook & Line
Single Handline
Gillnet
68
17
13
1
1
1
0
20
40
60
80
% CATCH PRODUCTION
Relative Abundance of Major Species in Bolinao, Pangasinan
Katsuwonus pelamis
Coryphaena hippurus
Pterocaesio tile
Caesio cuning
Others (70)
13
10
6
5
4
4
4
3
3
49
0
10
20
30
40
50
% COMPOSITION

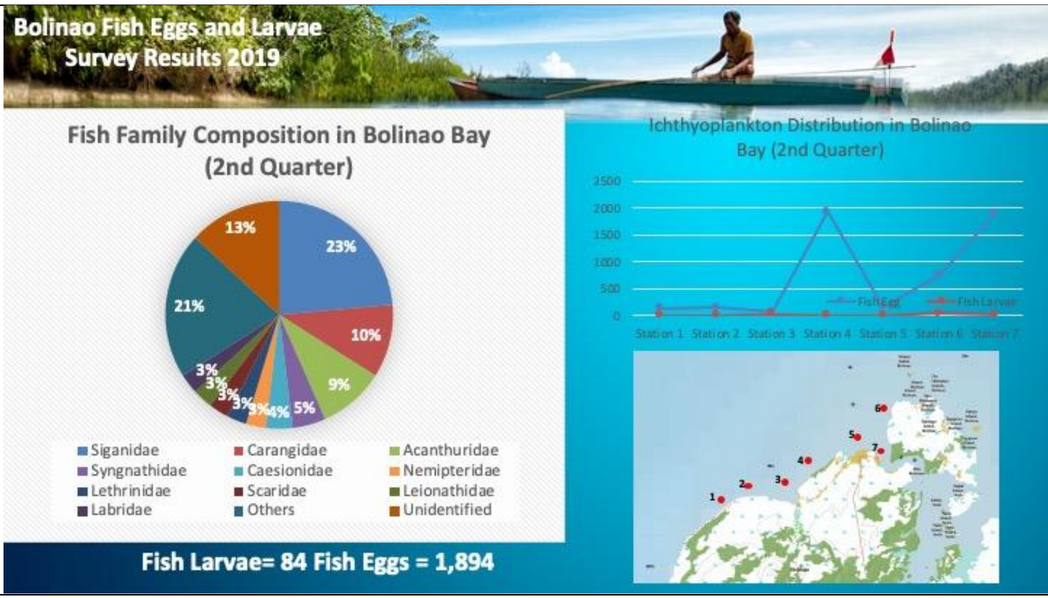

Relative Abundance of Major Species in Bolinao, Pangasinan
Katsuwonus pelamis
Coryphaena hippurus
Pterocaesio tile
Caesio cuning
Others (70)
13
10
6
5
4
4
4
3
3
49
0 10 20 30 40 50
% COMPOSITION
SPEAR GUN
Scarus ghobban
Siganus virgatus
Caesio cuning
Parupeneus barberinus
Others (43)
9
6
5
5
5
5
5
4
4
51
0 10 20 30 40 50 60
% COMPOSITION

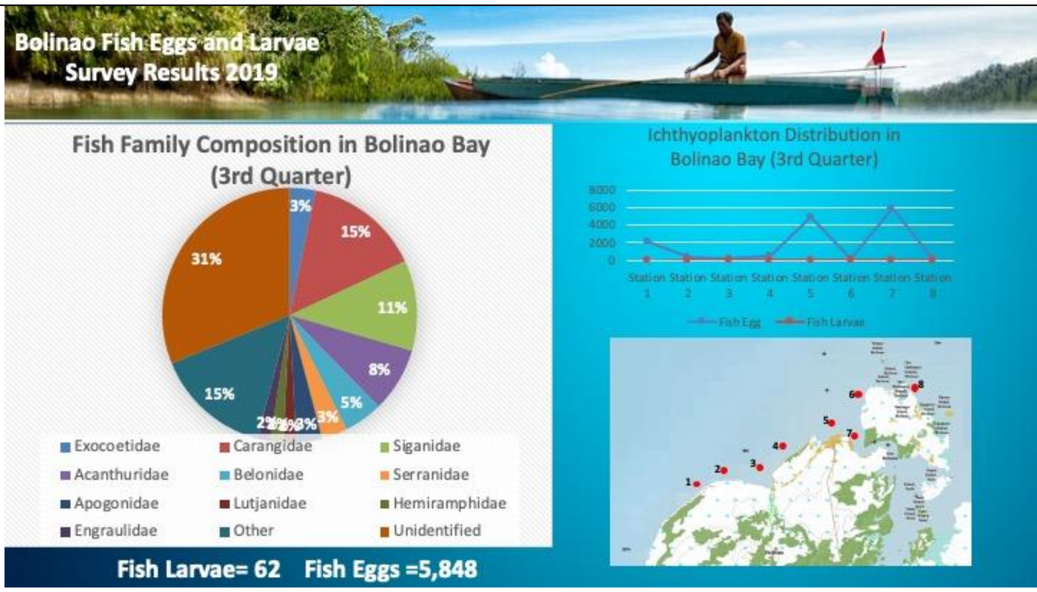

SINGLE HANDLINE
Istiompax indica
Coryphaena hippurus
Thunnus albacares
Katsuwonus pelamis
68
13
13
6
0 10 20 30 40 50 60 70
% COMPOSITION

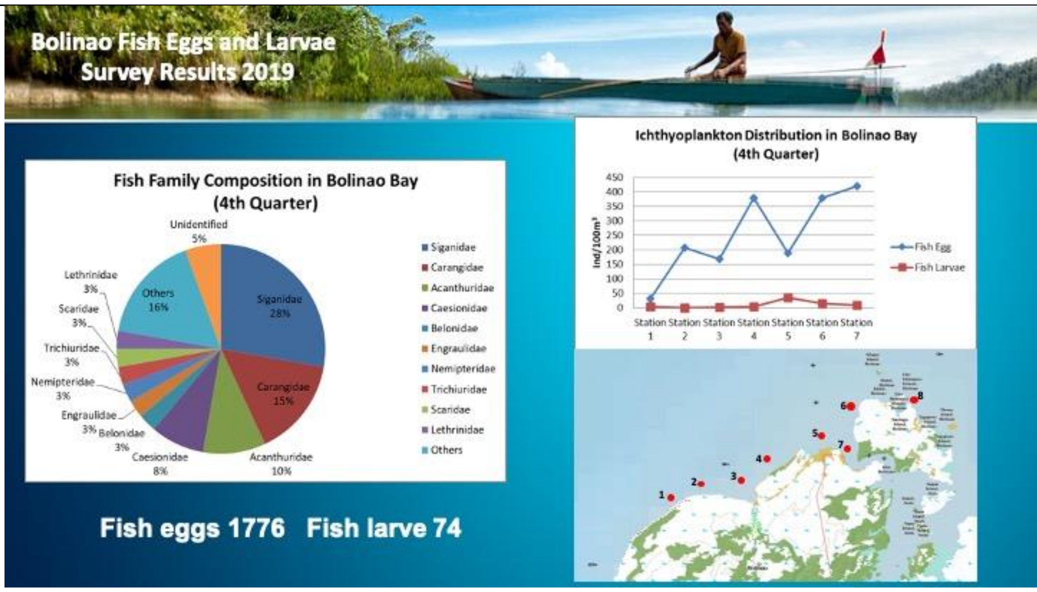

MULTIPLE HOOK AND LINE
Thunnus albacares
Katsuwonus pelamis
Coryphaena hippurus
Auxis thazard
Euthynnus affinis
Pterocaesio tile
Caesio teres
45.5
35.9
9.2
7.5
1.2
0.6
0.4
0.0 10.0 20.0 30.0 40.0 50.0
% COMPOSITION
HOOK AND LINE
Katsuwonus pelamis
Euthynnus affinis
Carangoides ferdau
Sphyraena forsteri
Others (9)
39.9
31.7
21.4
3.2
1.0
0.5
0.5
0.4
0.2
1.2
18 TYPES OF SPECIES
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0
% COMPOSITION


FISH CORRAL
Siganus guttatus
Sphyraena forsteri
Leiognathus equulus
Lutjanus fulviflamma
Others (3)
16
14
14
12
12
10
7
5
4
6
12 TYPES OF SPECIES
0 2 4 6 8 10 12 14 16 18
Seasonality
CATCH DISTRIBUTION
CATCH (KG)
3000
2000
1000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Scarus ghobban
Coryphaena hippurus
Naso lituratus
Katsuwonus pelamis
Thunnus albacares


Bolinao Fish Eggs and Larvae Survey Results 2019
Fish Family Composition in Bolinao Bay (1st Quarter)
Others 22%
Siganidae 27%
Clupeidae 3%
Scombridae 3%
Mullidae 4%
Trichiuridae
Serranidae 6%
5%
Caesionidae 6%
Belonidae 6%
Acanthuridae 9%
Carangidae 9%
Siganidae
Carangidae
Acanthuridae
Belonidae
Caesionidae
Trichiuridae
Serranidae
Mullidae
Scombridae
Clupeidae
Others
Fish Larvae= 67 Fish Eggs = 1,854
Fish Eggs and Larvae Distribution in Bolinao Bay (1st Quarter)
individual/100m³
1000
800
600
400
200
0
1 2 3 4 5 6 7
STATION
Fish Egg
Fish Larvae

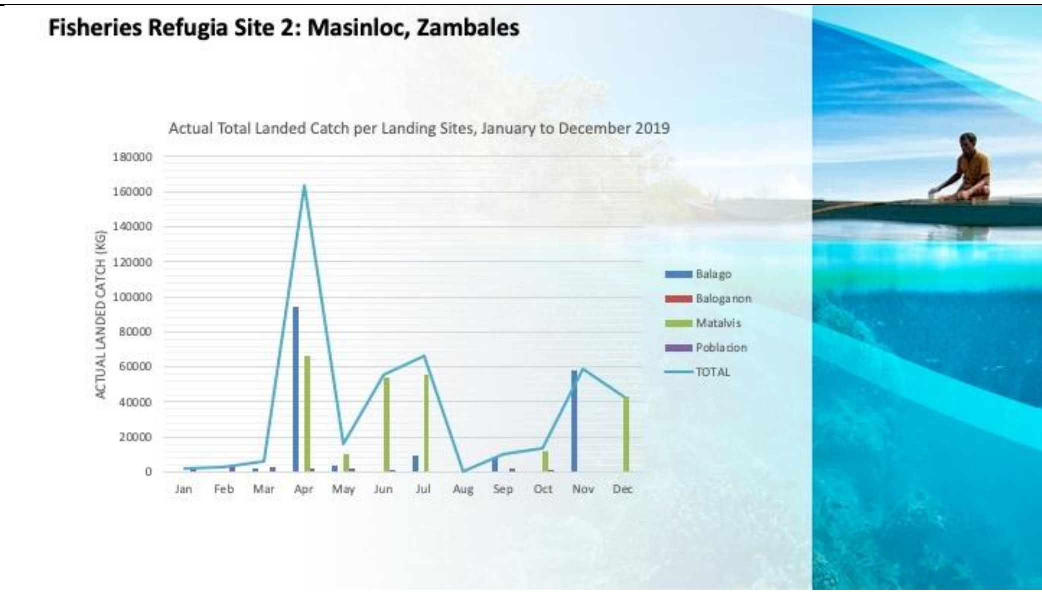

Bolinao Fish Eggs and Larvae Survey Results 2019
Fish Family Composition in Bolinao Bay (2nd Quarter)
23%
10%
9%
5%
4%
3%
21%
13%
Siganidae
Carangidae
Acanthuridae
Syngnathidae
Caesionidae
Nemipteridae
Lethrinidae
Scaridae
Leionathidae
Labridae
Others
Unidentified
Fish Larvae= 84 Fish Eggs = 1,894
Ichthyoplankton Distribution in Bolinao Bay (2nd Quarter)
2500
2000
1500
1000
500
0
Station 1 Station 2 Station 3 Station 4 Station 5 Station 6 Station 7
Fish Egg
Fish Larvae

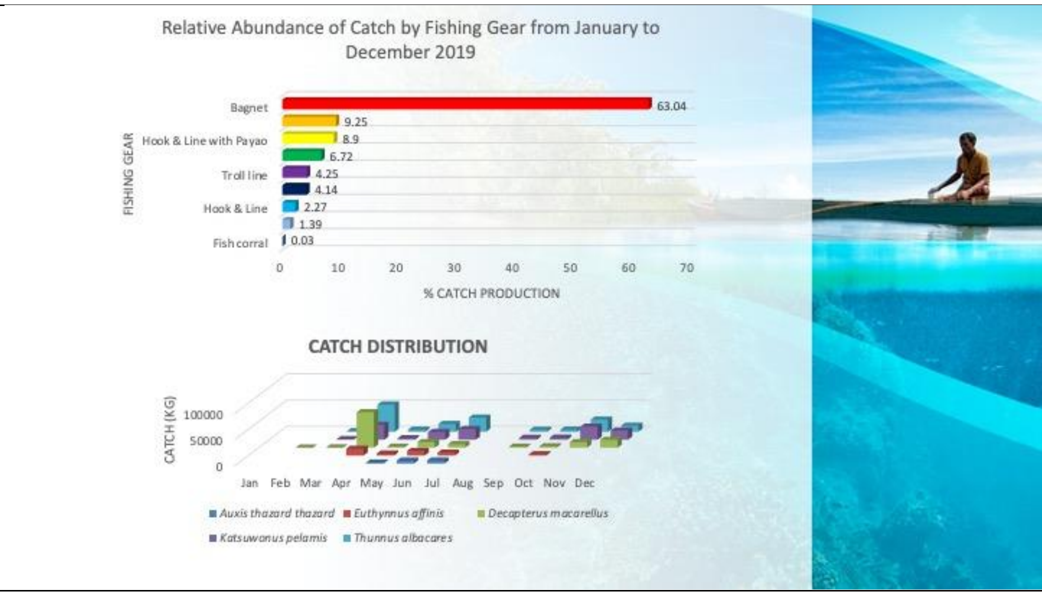

Bolinao Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Bolinao Bay
(3rd Quarter)
3%
15%
11%
8%
5%
3%
15%
31%
Exocoetidae
Carangidae
Siganidae
Acanthuridae
Belonidae
Serranidae
Apogonidae
Lutjanidae
Hemiramphidae
Engraulidae
Other
Unidentified
Ichthyoplankton Distribution in
Bolinao Bay (3rd Quarter)
Fish Egg
Fish Larvae
Fish Larvae= 62 Fish Eggs =5,848


Bolinao Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Bolinao Bay
(4th Quarter)
Unidentified
5%
Siganidae
28%
Carangidae
15%
Acanthuridae
10%
Caesionidae
8%
Others
16%
Lethrinidae
3%
Scaridae
3%
Trichiuridae
3%
Nemipteridae
3%
Engraulidae
3%
Belonidae
3%
Siganidae
Carangidae
Acanthuridae
Caesionidae
Belonidae
Engraulidae
Nemipteridae
Trichiuridae
Scaridae
Lethrinidae
Others
Ichthyoplankton Distribution in Bolinao Bay
(4th Quarter)
Ind/100m³
Fish Egg
Fish Larvae
Station 1
Station 2
Station 3
Station 4
Station 5
Station 6
Station 7
Fish eggs 1776 Fish larve 74

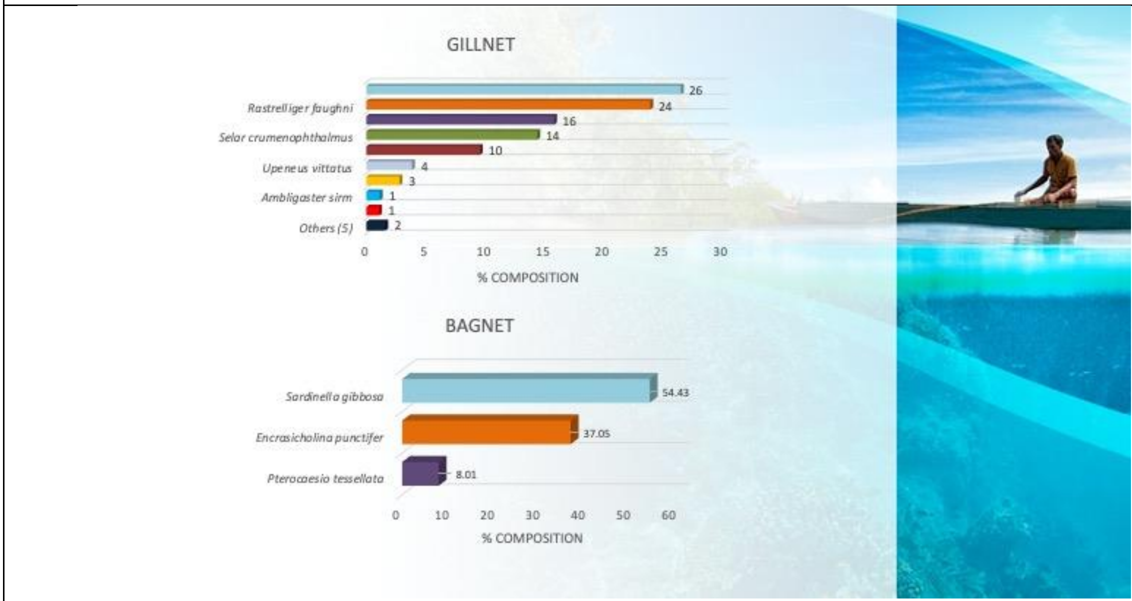

Total Ban in Catching "padas" juvenile siganids in Bolinao Pangasinan

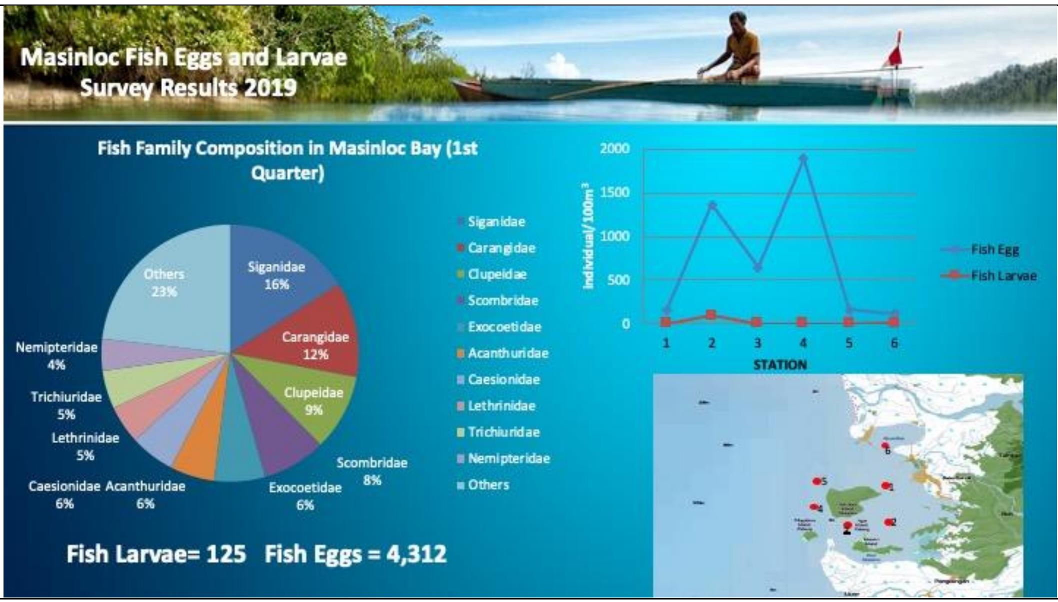

ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 202 "Fish for the People: Adaptation to a Changing Environment"
Closed Season for rabbit fish, *Siganus canaliculatus*
• Close season during spawning season
4th 5th and 6th day after the new moon
monthly for the entire year or for a few months only
• Banning of fine meshed gears catching rabbit fishes
Bohol, Philippines

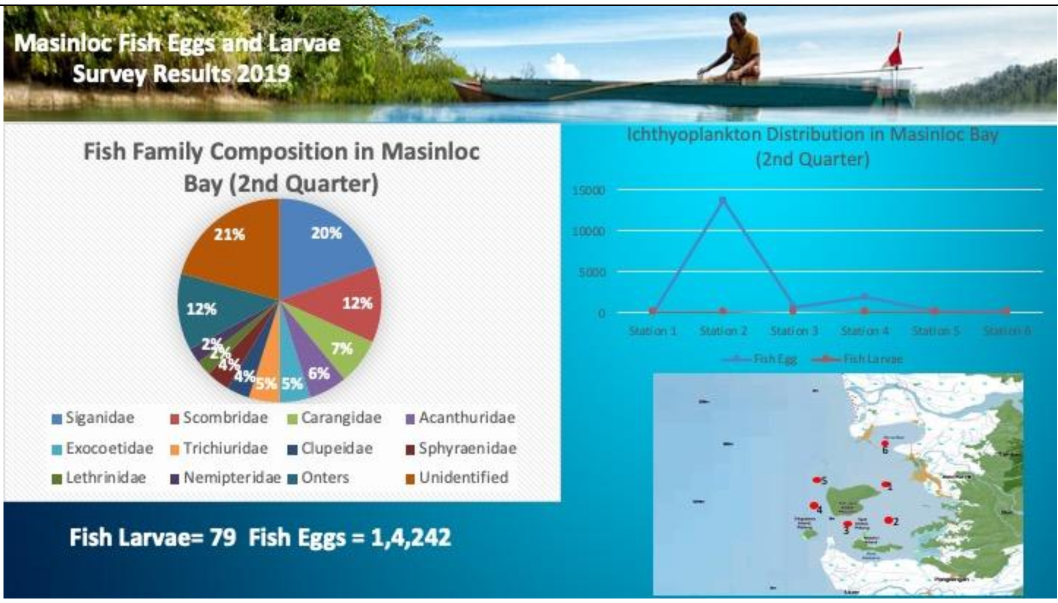

Fisheries Refugia Site 2: Masinloc, Zambales
Actual Total Landed Catch per Landing Sites, January to December 2019
ACTUAL LANDED CATCH (KG)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Balago
Baloganon
Matalvis
Poblacion
TOTAL

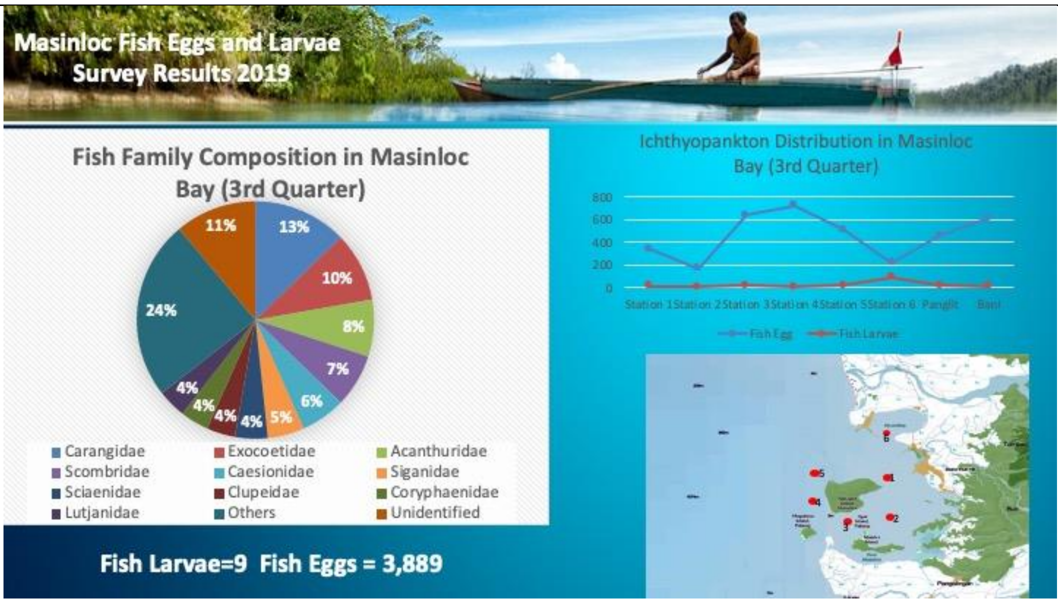

Relative Abundance of Catch by Fishing Gear from January to December 2019
FISHING GEAR
Bagnet
Hook & Line with Payao
Troll line
Hook & Line
Fish corral
63.04
9.25
8.9
6.72
4.25
4.14
2.27
1.39
0.03
0 10 20 30 40 50 60 70
% CATCH PRODUCTION
CATCH DISTRIBUTION
CATCH (KG)
100000
50000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Auxis thazard thazard
Euthynnus affinis
Decapterus macarellus
Katsuwonus pelamis
Thunnus albacares

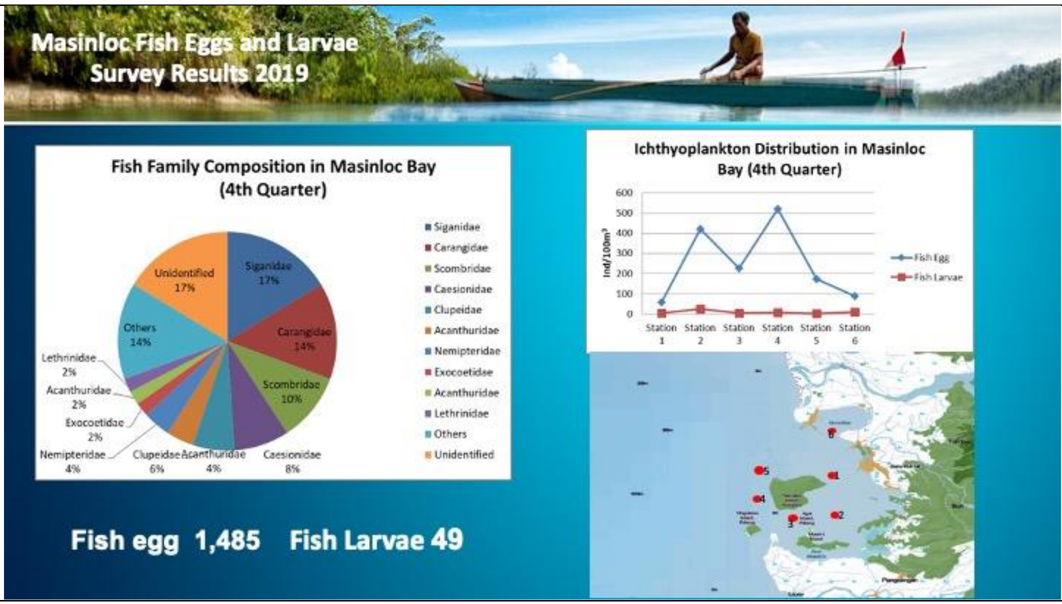

RING NET
Thunnus albacares 34
Katsuwonus pelamis 28
Decapterus macarellus 28
Euthynnus affinis 8
Auxis thazard thazard 3
0 5 10 15 20 25 30 35
% COMPOSITION
HOOK AND LINE
Thunnus obesus 54
Decapterus macarellus 40
Terapon jarbua 2
Epinephelus corallicola 2
Cephalopholis boenak 1
Trachinotus blochii 1
0 10 20 30 40 50 60
% COMPOSITION

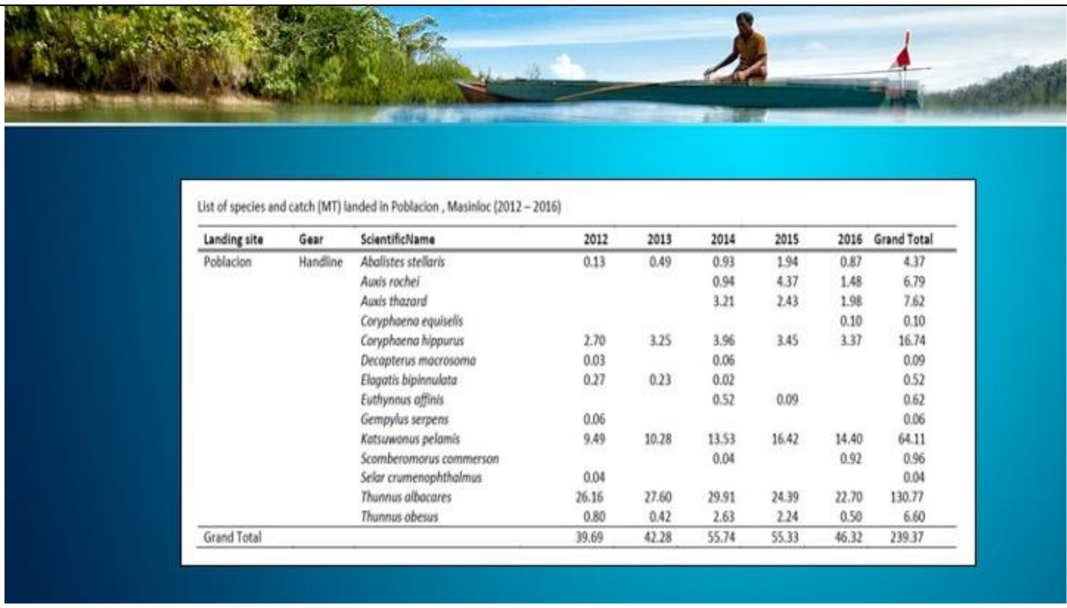

GILLNET
Rastrelliger faughni
Selar crumenophthalmus
Upeneus vittatus
Ambligaster sirm
Others (5)
26
24
16
14
10
4
3
1
1
2
0 5 10 15 20 25 30
% COMPOSITION
BAGNET
Sardinella gibbosa 54.43
Encrasicholina punctifer 37.05
Pterocaesio tessellata 8.01
0 10 20 30 40 50 60
% COMPOSITION


Masinloc Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Masinloc Bay (1st Quarter)
Siganidae 16%
Carangidae 12%
Clupeidae 9%
Scombridae 8%
Exocoetidae 6%
Acanthuridae 6%
Caesionidae 6%
Lethrinidae 5%
Trichiuridae 5%
Nemipteridae 4%
Others 23%
Siganidae
Carangidae
Clupeidae
Scombridae
Exocoetidae
Acanthuridae
Caesionidae
Lethrinidae
Trichiuridae
Nemipteridae
Others
Fish Larvae= 125 Fish Eggs = 4,312
2000
1500
1000
500
0
Individual/100m³
1 2 3 4 5 6
STATION
Fish Egg
Fish Larvae


Masinloc Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Masinloc Bay (2nd Quarter)
21%
20%
12%
12%
7%
6%
5%
5%
4%
Siganidae
Scombridae
Carangidae
Acanthuridae
Exocoetidae
Trichiuridae
Clupeidae
Sphyraenidae
Lethrinidae
Nemipteridae
Onters
Unidentified
Fish Larvae= 79 Fish Eggs = 1,4,242
Ichthyoplankton Distribution in Masinloc Bay (2nd Quarter)
15000
10000
5000
0
Station 1
Station 2
Station 3
Station 4
Station 5
Station 6
Fish Egg
Fish Larvae

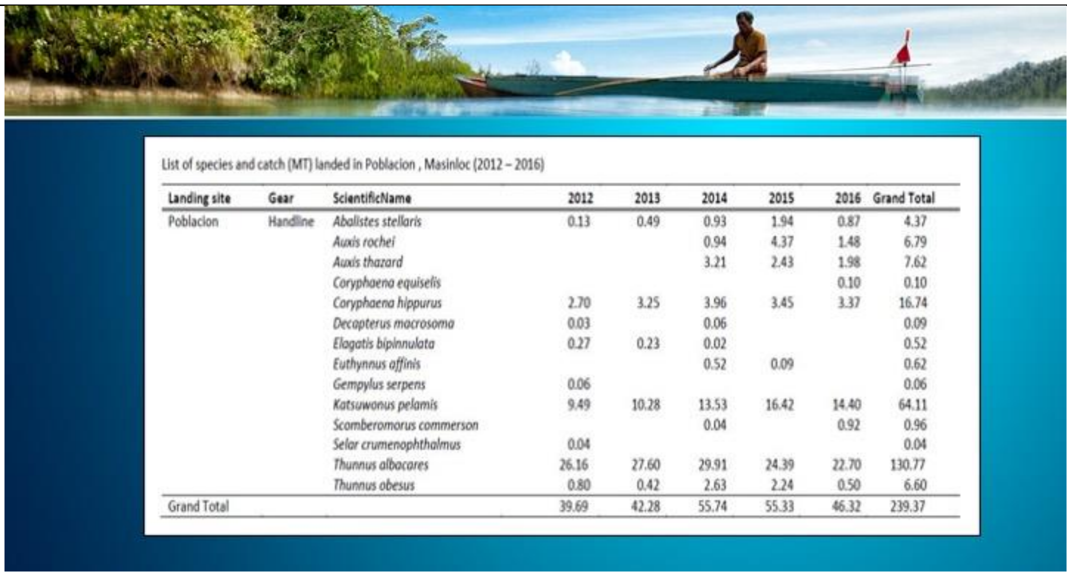

Masinloc Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Masinloc Bay (3rd Quarter)
11%
13%
10%
24%
8%
7%
6%
5%
4%
4%
4%
4%
Carangidae
Exocoetidae
Acanthuridae
Scombridae
Caesionidae
Siganidae
Sciaenidae
Clupeidae
Coryphaenidae
Lutjanidae
Others
Unidentified
Fish Larvae=9 Fish Eggs = 3,889
Ichthyopankton Distribution in Masinloc Bay (3rd Quarter)
800
600
400
200
0
Station 1
Station 2
Station 3
Station 4
Station 5
Station 6
Pangit
Bani
Fish Egg
Fish Larvae


Masinloc Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Masinloc Bay (4th Quarter)
Unidentified 17%
Siganidae 17%
Carangidae 14%
Others 14%
Scombridae 10%
Lethrinidae 2%
Acanthuridae 2%
Exocoetidae 2%
Nemipteridae 4%
Clupeidae 6%
Acanthuridae 4%
Caesionidae 8%
Siganidae
Carangidae
Scombridae
Caesionidae
Clupeidae
Acanthuridae
Nemipteridae
Exocoetidae
Acanthuridae
Lethrinidae
Others
Unidentified
Ichthyoplankton Distribution in Masinloc Bay (4th Quarter)
600
500
400
300
200
100
0
Ind/100m³
Station 1
Station 2
Station 3
Station 4
Station 5
Station 6
Fish Egg
Fish Larvae
Fish egg 1,485 Fish Larvae 49



List of species and catch (MT) landed in Poblacion , Masinloc (2012 – 2016)

Landing site	Gear	ScientificName	2012	2013	2014	2015	2016	Grand Total
Poblacion	Handline	*Abalistes stellaris*	0.13	0.49	0.93	1.94	0.87	4.37
		Auxis rochei			0.94	4.37	1.48	6.79
		Auxis thazard			3.21	2.43	1.98	7.62
		Coryphaena equiselis					0.10	0.10
		Coryphaena hippurus	2.70	3.25	3.96	3.45	3.37	16.74
		Decapterus macrosoma	0.03		0.06			0.09
		Elagatis bipinnulata	0.27	0.23	0.02			0.52
		Euthynnus affinis			0.52	0.09		0.62
		Gempylus serpens	0.06					0.06
		Katsuwonus pelamis	9.49	10.28	13.53	16.42	14.40	64.11
		Scomberomorus commerson			0.04		0.92	0.96
		Selar crumenophthalmus	0.04					0.04
		Thunnus albacares	26.16	27.60	29.91	24.39	22.70	130.77
		Thunnus obesus	0.80	0.42	2.63	2.24	0.50	6.60
Grand Total			39.69	42.28	55.74	55.33	46.32	239.37



List of species and catch (MT) landed in Poblacion , Masinloc (2012 – 2016)

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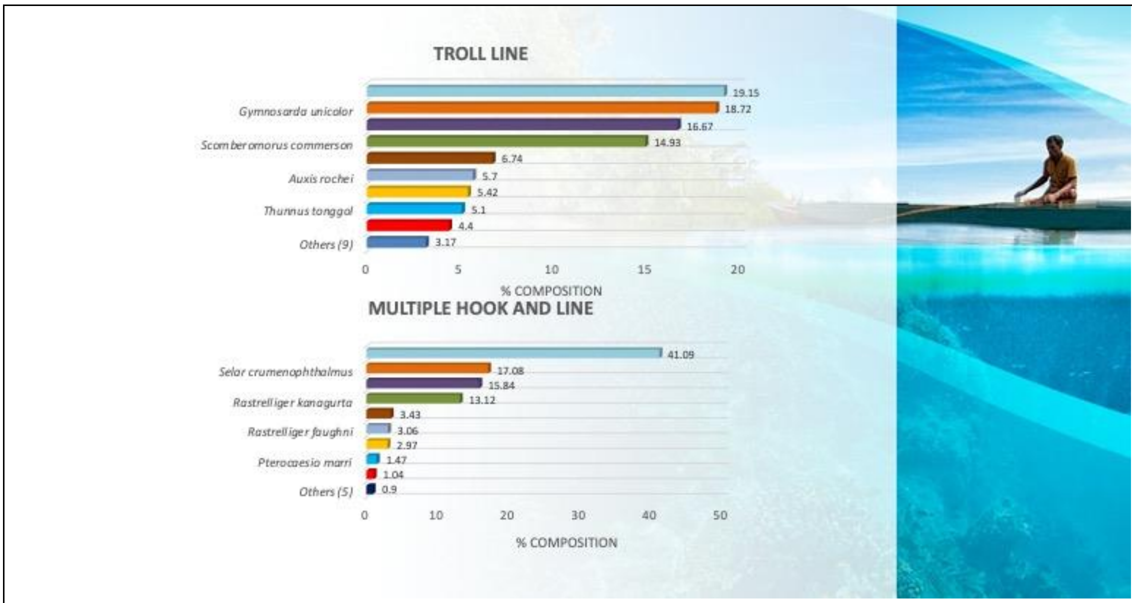
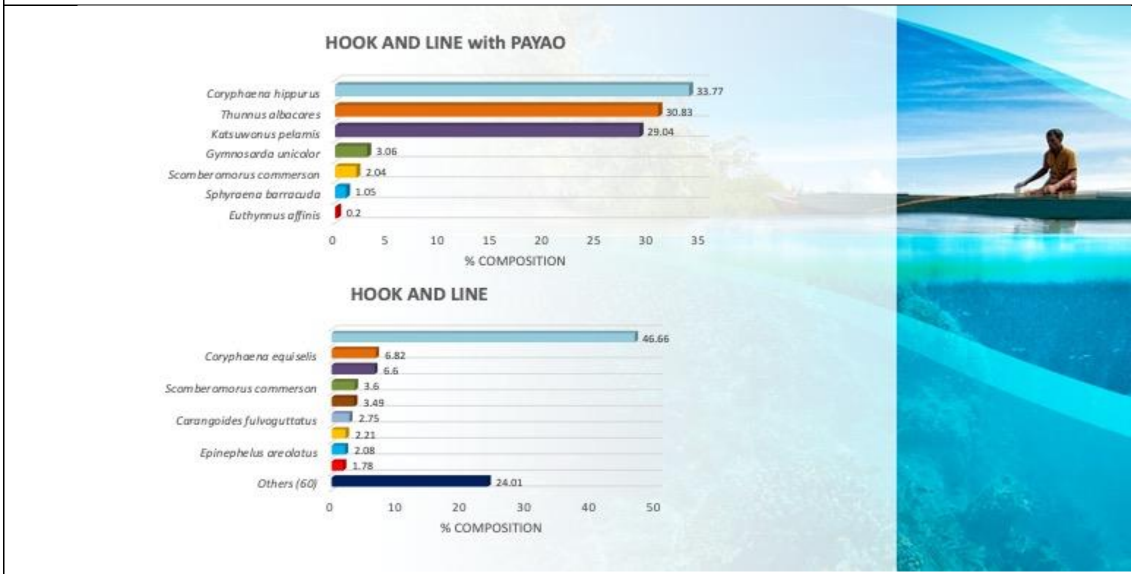
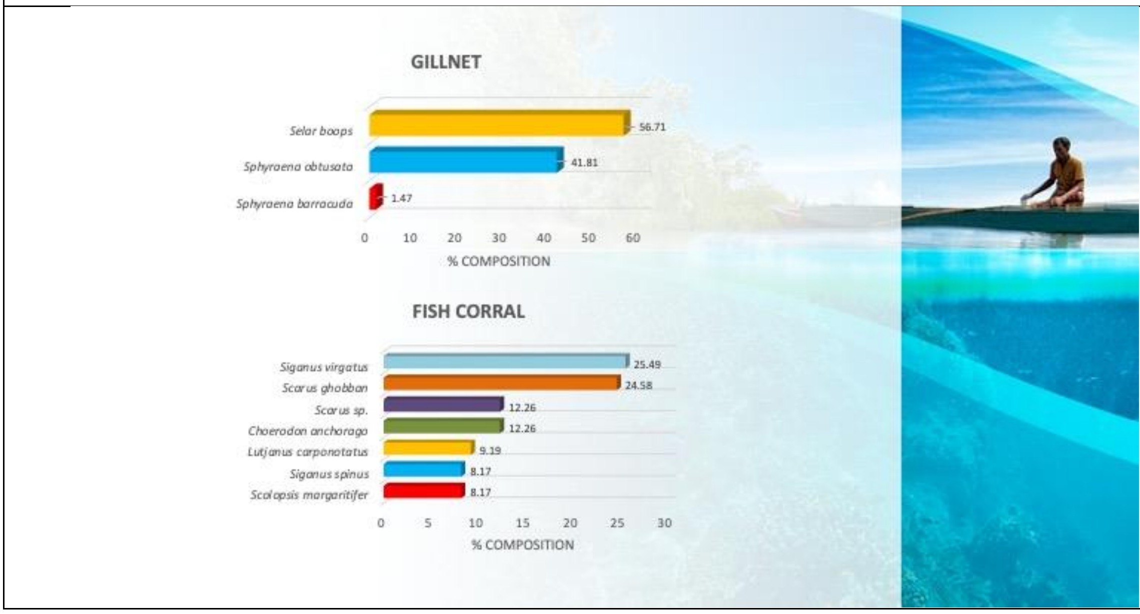
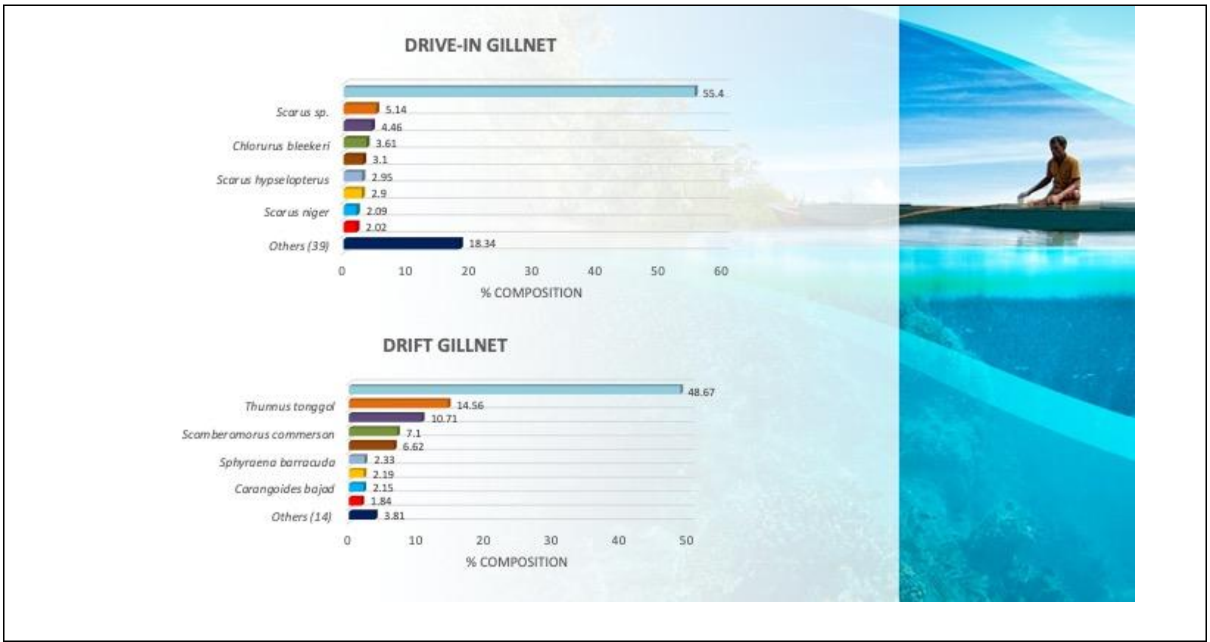
Poblacion	Handline	*Abalistes stellaris*	0.13	0.49	0.93	1.94	0.87	4.37
		Auxis rochei			0.94	4.37	1.48	6.79
		Auxis thazard			3.21	2.43	1.98	7.62
		Coryphaena equiselis					0.10	0.10
		Coryphaena hippurus	2.70	3.25	3.96	3.45	3.37	16.74
		Decapterus macrosoma	0.03		0.06			0.09
		Elagatis bipinnulata	0.27	0.23	0.02			0.52
		Euthynnus affinis			0.52	0.09		0.62
		Gempylus serpens	0.06					0.06
		Katsuwonus pelamis	9.49	10.28	13.53	16.42	14.40	64.11
		Scomberomorus commerson			0.04		0.92	0.96
		Selar crumenophthalmus	0.04					0.04
		Thunnus albacares	26.16	27.60	29.91	24.39	22.70	130.77
		Thunnus obesus	0.80	0.42	2.63	2.24	0.50	6.60
Grand Total			39.69	42.28	55.74	55.33	46.32	239.37


TROLL LINE
Gymnosarda unicolor
Scomberomorus commerson
Auxis rochei
Thunnus tonggol
Others (9)
19.15
18.72
16.67
14.93
6.74
5.7
5.42
5.1
4.4
3.17
0 5 10 15 20
% COMPOSITION
MULTIPLE HOOK AND LINE
Selar crumenophthalmus
Rastrelliger kanagurta
Rastrelliger faughni
Pterocaesio marri
Others (5)
41.09
17.08
15.84
13.12
3.43
3.06
2.97
1.47
1.04
0.9
0 10 20 30 40 50
% COMPOSITION

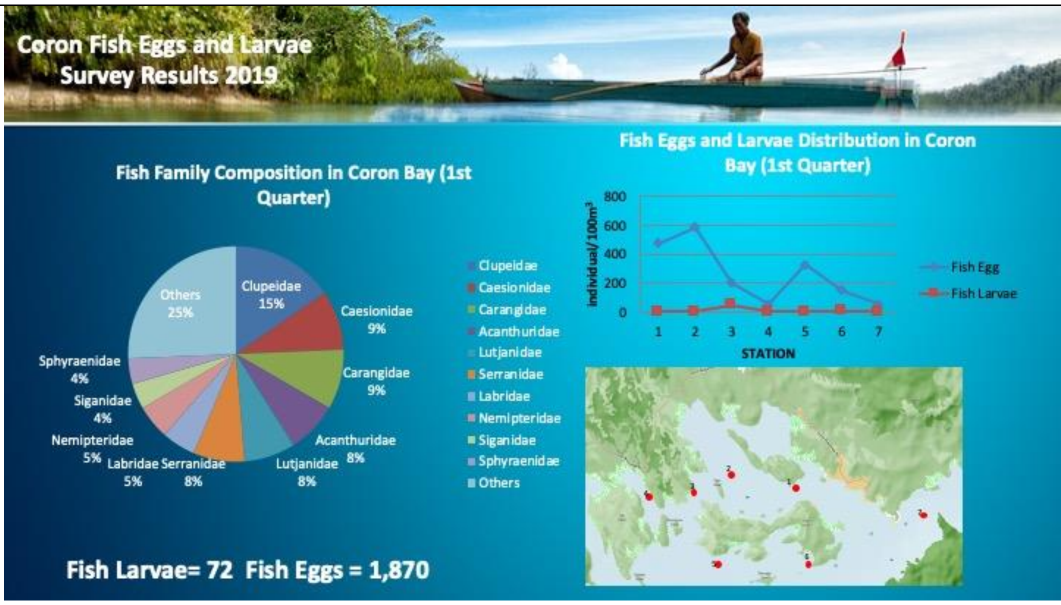

HOOK AND LINE with PAYAO
Coryphaena hippurus
Thunnus albacares
Katsuwonus pelamis
Gymnosarda unicolor
Scomberomorus commerson
Sphyraena barracuda
Euthynnus affinis
33.77
30.83
29.04
3.06
2.04
1.05
0.2
0 5 10 15 20 25 30 35
% COMPOSITION
HOOK AND LINE
Coryphaena equiselis
Scomberomorus commerson
Carangoides fulvoguttatus
Epinephelus areolatus
Others (60)
46.66
6.82
6.6
3.6
3.49
2.75
2.21
2.08
1.78
24.01
0 10 20 30 40 50
% COMPOSITION

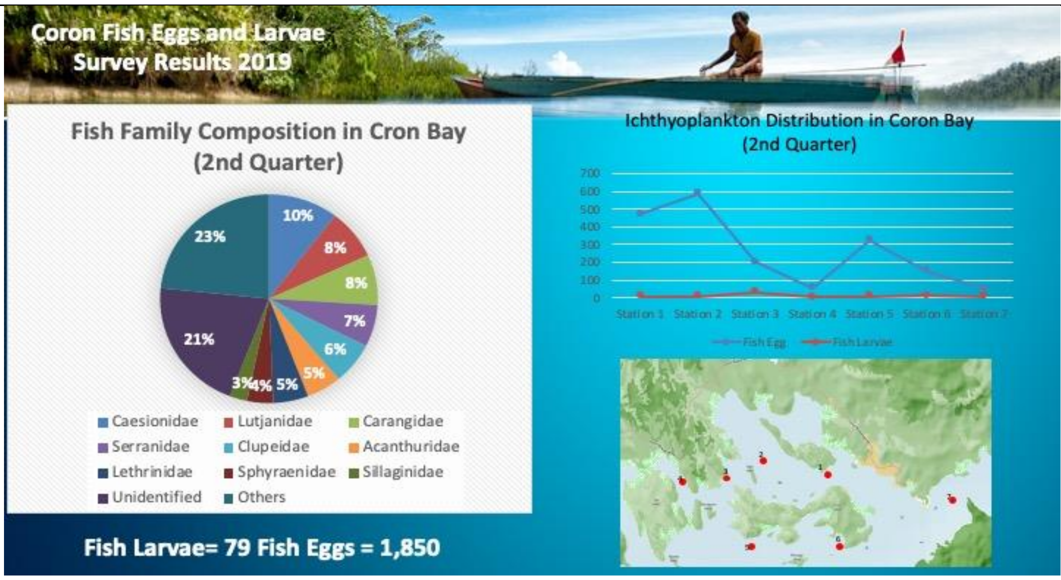

GILLNET
Selar boops
Sphyraena obtusata
Sphyraena barracuda
56.71
41.81
1.47
0 10 20 30 40 50 60
% COMPOSITION
FISH CORRAL
Siganus virgatus
Scarus ghobban
Scarus sp.
Choerodon anchorago
Lutjanus carponotatus
Siganus spinus
Scolopsis margaritifer
25.49
24.58
12.26
12.26
9.19
8.17
8.17
0 5 10 15 20 25 30
% COMPOSITION

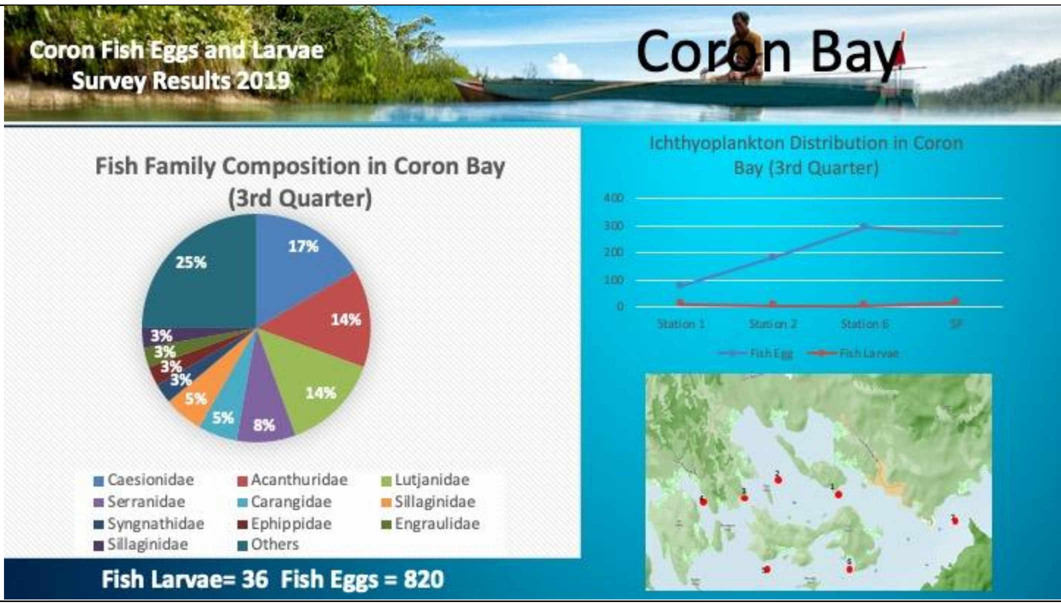

DRIVE-IN GILLNET
Scarus sp.
Chlorurus bleekeri
Scarus hypselopterus
Scarus niger
Others (39)
55.4
5.14
4.46
3.61
3.1
2.95
2.9
2.09
2.02
18.34
0 10 20 30 40 50 60
% COMPOSITION
DRIFT GILLNET
Thunnus tonggol
Scomberomorus commerson
Sphyraena barracuda
Carangoides bajad
Others (14)
48.67
14.56
10.71
7.1
6.62
2.33
2.19
2.15
1.84
3.81
0 10 20 30 40 50
% COMPOSITION


BOTTOM SET LONG LINE
Lutjanus lutjanus
Lethrinus lentjan
Caranx ignobilis
Lutjanus bohar
Lethrinus atkinsoni
Epinephelus areolatus
Epinephelus coioides
Pristipomoides multidens
Epinephelus maculatus
Others (74)
13.39
10.85
8.22
7.05
6.27
5.37
5.36
4.51
3.83
35.15
0 5 10 15 20 25 30 35 40
% COMPOSITION
BOTTOM SET GILLNET
Siganus canaliculatus
Lutjanus carponotatus
Epinephelus corallicola
Lethrinus genivittatus
Others (29)
30.22
15.52
9.78
6.42
5.95
4.49
4.43
3.28
2.49
17.41
0 10 20 30 40
% COMPOSITION

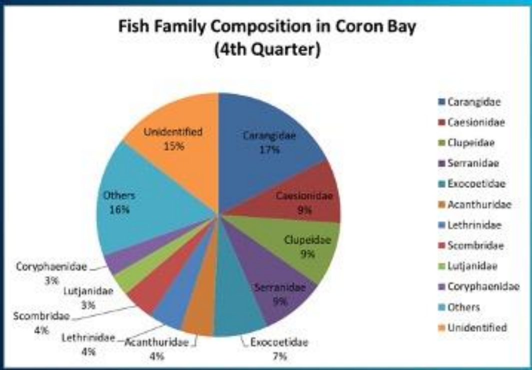

BOTTOM GILLNET
Selar crumenophthalmus
Caranx sexfasciatus
Megalaspis cordyla
Carangoides bajad
Sphyraena jello
Epinephelus corallicola
Plectorhinchus chaetodonoides
Alectis indicus
Lethrinus lentjan
Others (54)
22.84
7.88
6.71
5.17
4.7
4.4
4.35
4.08
3.94
35.93
0 5 10 15 20 25 30 35 40
% COMPOSITION
BAGNET
Spratelloides gracilis
Ambligaster sirm
Spratelloides lewisi
Rastrelliger kanagurta
Others (7)
29.8
29.75
16.84
7.95
4.12
4.07
2.38
2.06
1.22
1.81
0 5 10 15 20 25 30
% COMPOSITION

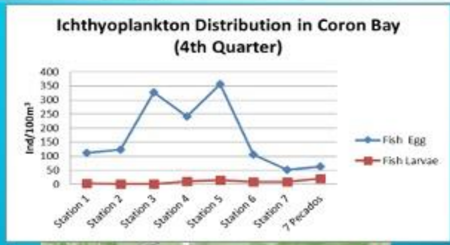

Coron Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Coron Bay (1st Quarter)
Clupeidae 15%
Caesionidae 9%
Carangidae 9%
Acanthuridae 8%
Lutjanidae 8%
Serranidae 8%
Labridae 5%
Nemipteridae 5%
Siganidae 4%
Sphyraenidae 4%
Others 25%
Clupeidae
Caesionidae
Carangidae
Acanthuridae
Lutjanidae
Serranidae
Labridae
Nemipteridae
Siganidae
Sphyraenidae
Others
Fish Eggs and Larvae Distribution in Coron Bay (1st Quarter)
individual/100m³
800
600
400
200
0
1 2 3 4 5 6 7
STATION
Fish Egg
Fish Larvae
Fish Larvae= 72 Fish Eggs = 1,870


Coron Fish Eggs and Larvae
Survey Results 2019
Fish Family Composition in Cron Bay (2nd Quarter)
10%
8%
8%
7%
6%
5%
5%
4%
3%
21%
23%
Caesionidae
Lutjanidae
Carangidae
Serranidae
Clupeidae
Acanthuridae
Lethrinidae
Sphyraenidae
Sillaginidae
Unidentified
Others
Ichthyoplankton Distribution in Coron Bay (2nd Quarter)
700
600
500
400
300
200
100
0
Station 1 Station 2 Station 3 Station 4 Station 5 Station 6 Station 7
Fish Egg
Fish Larvae
Fish Larvae= 79 Fish Eggs = 1,850


Coron Fish Eggs and Larvae
Survey Results 2019
Coron Bay
Fish Family Composition in Coron Bay (3rd Quarter)
17%
14%
14%
8%
5%
5%
3%
3%
3%
3%
25%
Caesionidae
Acanthuridae
Lutjanidae
Serranidae
Carangidae
Sillaginidae
Syngnathidae
Ephippidae
Engraulidae
Sillaginidae
Others
Ichthyoplankton Distribution in Coron Bay (3rd Quarter)
400
300
200
100
0
Station 1 Station 2 Station 6 SP
Fish Egg
Fish Larvae
Fish Larvae= 36 Fish Eggs = 820

Coron Fish Eggs and Larvae Survey Results 2019





Fish legs= 1,451 Fish Larvae=77

PRIORITY SPECIES OF THREE REFUGIA SITES (Bolinao, Pangasinan; Coron, Palawan; Masinloc Zambales)

Fisheries *Refugia* Site : Bolinao, Pangasinan
English Name : Golden-spotted Rabbitfish
Family : Siganidae
Common Name "Samaral"
Scientific Name : *Siganus punctatus*

Fisheries *Refugia* Site : Coron, Palawan
English Name : Mangrove Jack
Family : Lutjanidae
Common Name : "Mangagat"
Scientific Name : *Lutjanus argentimaculatus*

Fisheries *Refugia* Site : Masinloc, Zambales
English Name : Frigate Tuna
Family : Scombridae
Common Name : "Tulingan"
Scientific Name : *Auxis thazard*

Project Site	BOAT Registration (BoatR)	Fisherfolk Registration (FishR)
Bolinao, Pangasinan	1424	4941
Masinloc, Zambales	301	3927
Coron, Palawan	599	3897

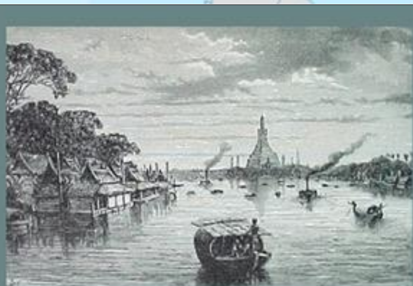
ANNEX 16

Geophaphy: Trat Province

- Areas: Land = 2,819 km^2
  Seas = 7,257 km^2
  Shoreline = 165 km
- Boundaries:
  North: Chanthaburi Province and Cambodia
  South: the Gulf of Thailand
  East: Cambodia (borderd by Banthat Mountains)
  West: Chanthaburi Province (boardered by Welu River)
- Main fresh water sources: Trat River, Welu River, Nam Chieo Canal
- Islands: 52 islands with Koh Chang is the third biggest island of Thailand (after Phuket and Koh Samui)
- Climate: one of the wettest places in Thailand (4,500 mm of rain per year)

History:

- The history of Trat can be traced back to the early 17^{th} century at Ayutthaya Kingdom; it was considered among the trade center cities of Southeast Asia.
- Trat has played an important role in the development of the country's stability and economy due to its strategic location as a checkpoint and buffer city. It was engaged in French-Thai War having Battle of Koh Chang in 1741.
- The population of Trat has long been a mix of Thai, Lao, Chinese, Khmer, and Vietnamese
- Trat is the most important border trade route between Cambodia and Thailand at Ban Hat Lek Border Market



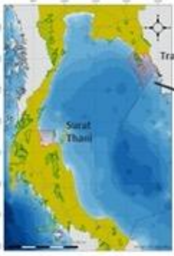
Population:

- Total 229,914 (2018)
    - Male 114,334
    - Female 115,580

Socio-economy:

- GDP 39,597 MB (2015)
    - GDP in agriculture sector 48%
    - GDP in non-agriculture sector 52%
    - GDP in fisheries sector 13%

Study Area for Fisheries *Refugia* Project



Geographic Location (tentative site for study):

1. 12°17'19.77"N 102°15'30.73"E
2. 11°59'2.55"N 102°2'6.96"E
3. 11°3'44.02"N 102°32'36.03"E
4. 411°39'3.38"N 102°54'38.18"E

กำพล ลอยชื่น loychuenk@gmail.com
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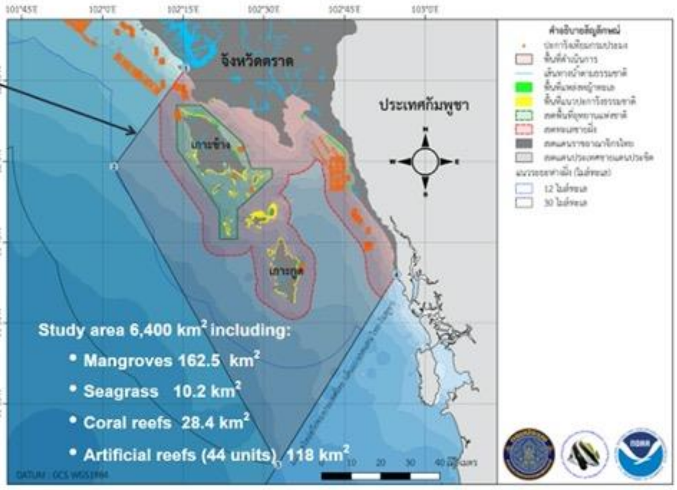

Numbers of Commercial Fishing Vessels

- **Total 798**
    - **low efficient boat 246**
    - **high efficient boat 552**

เรือประมง	จำนวน (ลำ)	
เครื่องมือประมงประสิทธิภาพต่ำ	**246**	**low efficient boat**
คราดหอยลาย	16	Short-necked clam dredges
คราดหอยอื่น	4	Other dredges
เบ็ดราว ยาวตั้งแต่ 100 เมตรขึ้นไป	15	Long line than 100 m
ลอบปลา	2	Fish trap
ลอบปู	72	Crabs trap
ลอบหมึก	2	Squids trap
ลอบหมึกสาย	9	Octopus Pot
อวนครอบหมึก	88	Squids falling nets
อวนติดตา	38	Gill net
เครื่องมือประมงประสิทธิภาพสูง	**552**	**high efficient boat**
เรือประกอบเครื่องกำเนิดไฟฟ้า	102	Light luring boat
อวนครอบปลากะตัก	208	Anchovy falling nets
อวนล้อมจับ	31	Purse seine
อวนล้อมจับปลากะตัก	17	Anchovy purse sine
อวนลากคานถ่าง	55	Beam trawls
อวนลากคู่	4	Pair trawls
อวนลากแผ่นตะเฆ่	135	0tther board trawls
ผลรวมทั้งหมด	**798**	

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Numbers of Small-Scale Fishing Vessels

➢ **Total 2,197**

ชนิดเครื่องมือประมง	จำนวน (ลำ)	
อวนติดตา (อวนกุ้ง)	667	Shrimp gill net
อวนติดตา (อวนปู)	390	Crab gill net
ลอบปู	263	Crab trap
อวนลากแผ่นตะเฆ่	115	0tther board trawls
อวนติดตา (ปลาอื่นๆ)	94	Gill net
อวนรุน	94	Push net
อวนติดตา (ปลาทู)	68	Indo pacific mackerel gill net
เบ็ดมือ	64	Hook and line
ลอบหมึก	48	Squids trap
อวนครอบปลากะตัก	47	Anchovy falling nets
เบ็ดราว	38	Long line than 100 m
เรือปั่นไฟ	32	Light luring boat
อวนครอบหมึก	32	Squids falling nets
อวนติดตา (ปลากระบอก)	27	Crab gill net
คราดหอยลาย	13	Short-necked clam dredges
ลอบปลา	12	Fish trap
เครื่องมืออื่นๆ	193	0tter
ผลรวมทั้งหมด	**2,197**	

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Fishing Communities

83 Villages in 21 Sub-districts of 6 Districts

1. Muang District	8 Sub-districts	23 Villages
2. Khlong Yai District	3 Sub-districts	18 Villages
3. Khao Saming District	2 Sub-districts	10 Villages
4. Laem Gnop District	4 Sub-districts	16 Villages
5. Koh Kut District	2 Sub-districts	8 Villages
6. Koh Chang District	2 Sub-districts	8 Villages

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Local Fishing Community Organizations

28 Groups	7 Groups	7 Groups	5 Groups
Coastal Fisheries	Offshore Fisheries	Fish Processing	Aquaculture

47 Groups

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Existing Fisheries Management Measures in Trat Site

1) Determination of fishing gears, fishing methods, and fishing areas prohibited from fishing in coastal seas
2) Determination of fishing gears, fishing methods, and fishing areas prohibited from fishing in 15 fishing grounds covering the area of 5,800 rai (9.28 km^2)
3) Determination of 4 aquatic sanctuaries
4) Notification on coastal seas: 3 nm from shoreline (commercial fisheries prohibited)

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ศูนย์วิจัยและพัฒนาประมงอ่าวไทยฝั่งตะวันออก (ระยอง)

Usage of *refugia* by threatened and endangered marine species in Trat Site

- Appearances of the following endangered species in the past 10 years
  - Irrawaddy dolphin (*Orcealla brevirostris*)

  - Finless porpoise (*Neophocaena phocinoides*)

  - Green turtle (*Chelonia mydas*)

  - Hawksbill (*Eretmochelys imbricata*)

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ศูนย์วิจัยและพัฒนาประมงอ่าวไทยฝั่งตะวันออก (ระยอง)

Catches and Species Compositions of the Principal Fishing Gears in Trat Site

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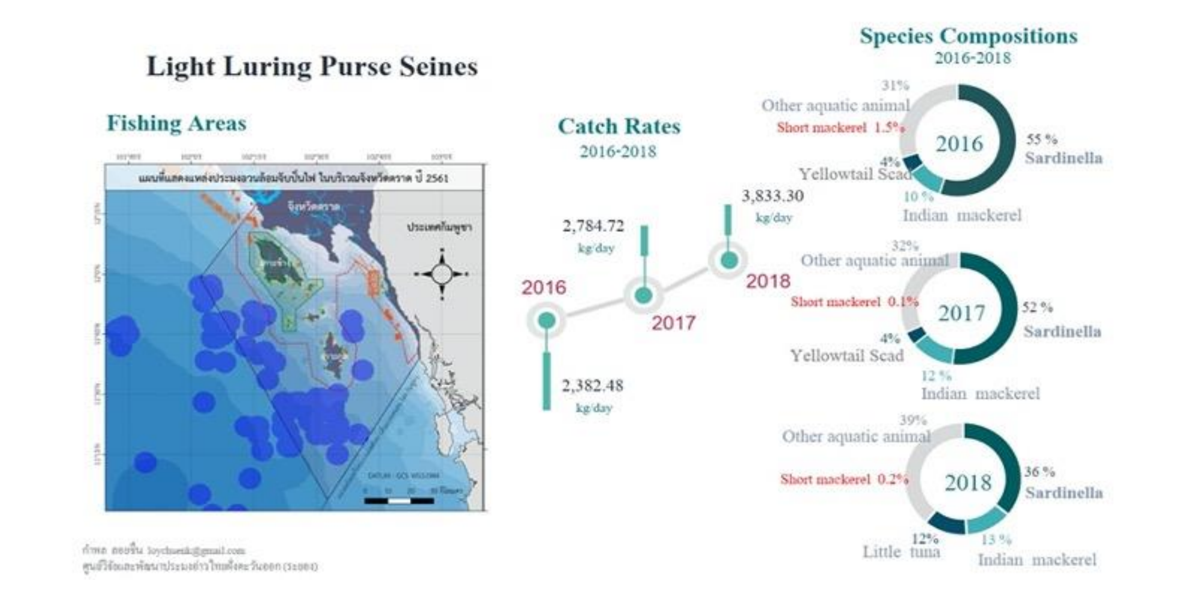
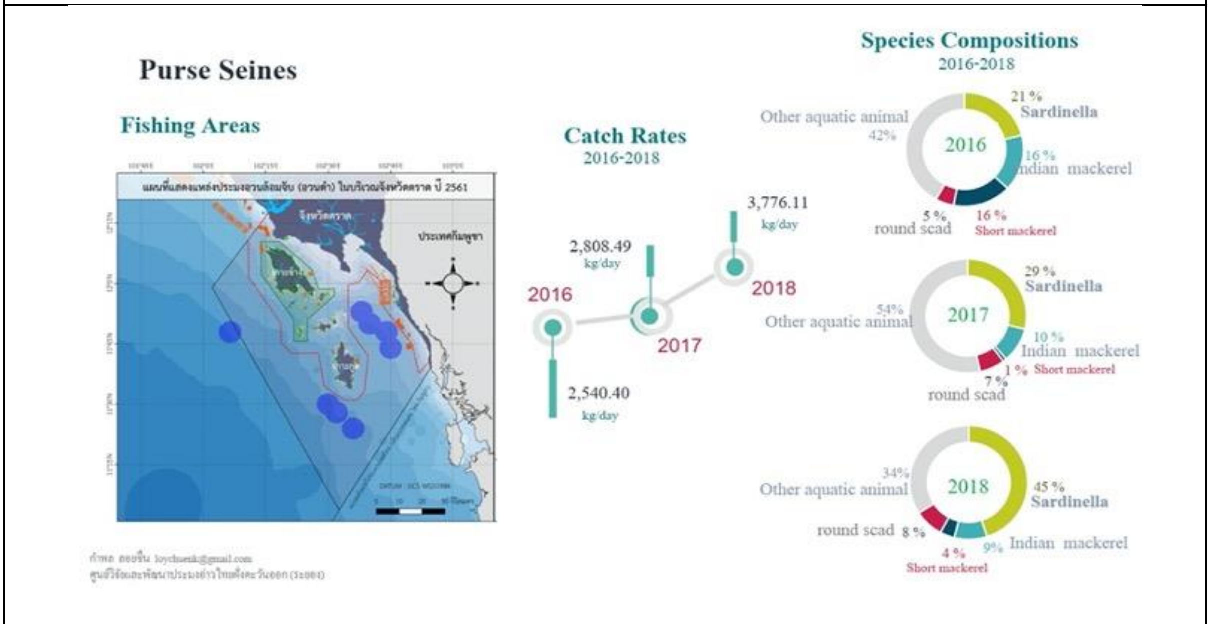
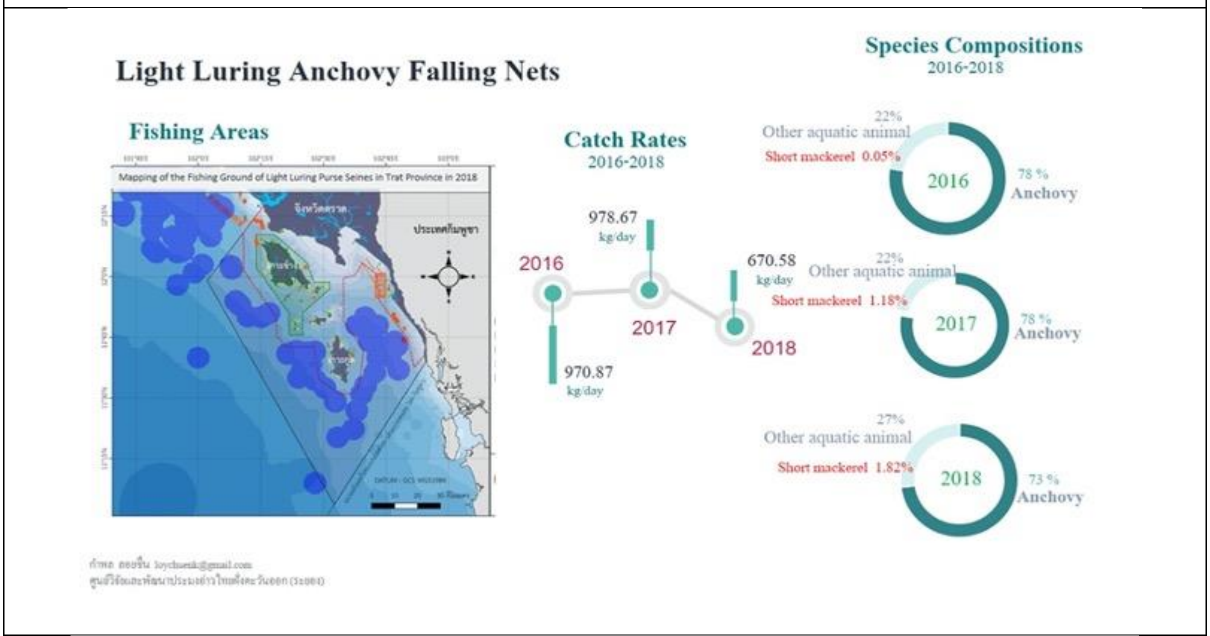
ศูนย์วิจัยและพัฒนาประมงอ่าวไทยฝั่งตะวันออก (ระยอง)

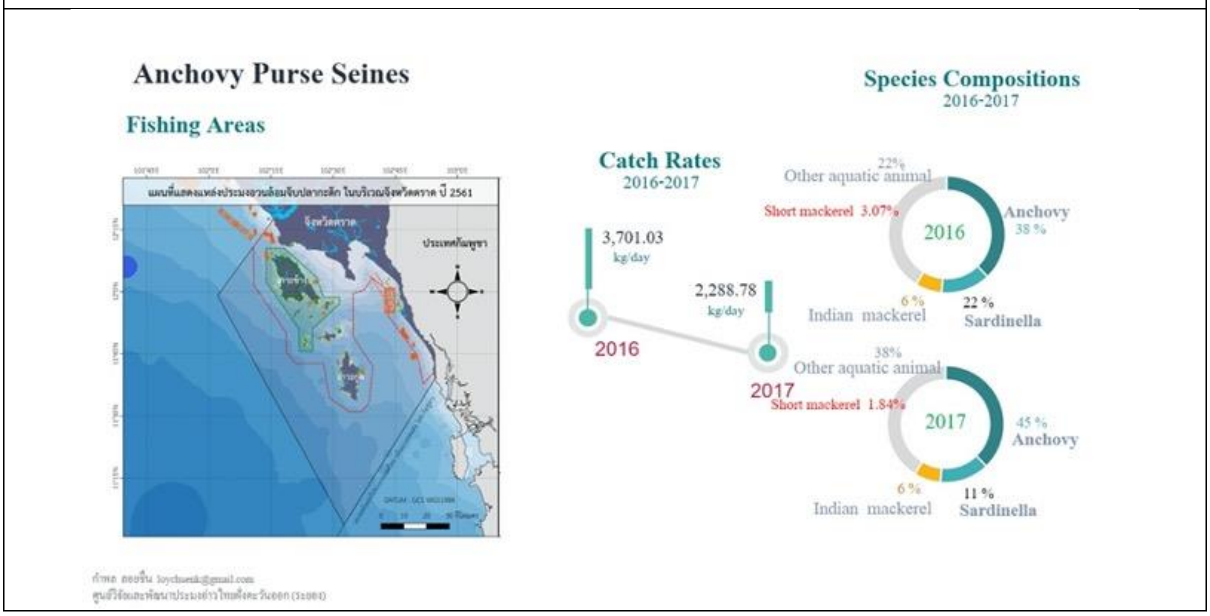

Principal Fishing Gears in Trat Site
Purse Seine
Anchovy Falling Net
Anchovy Purse Seine
Trawl
Crab Gill Net
Crab Trap
Shrimp Gill Net/ Trammel Net
Short Mackerel Gill Net

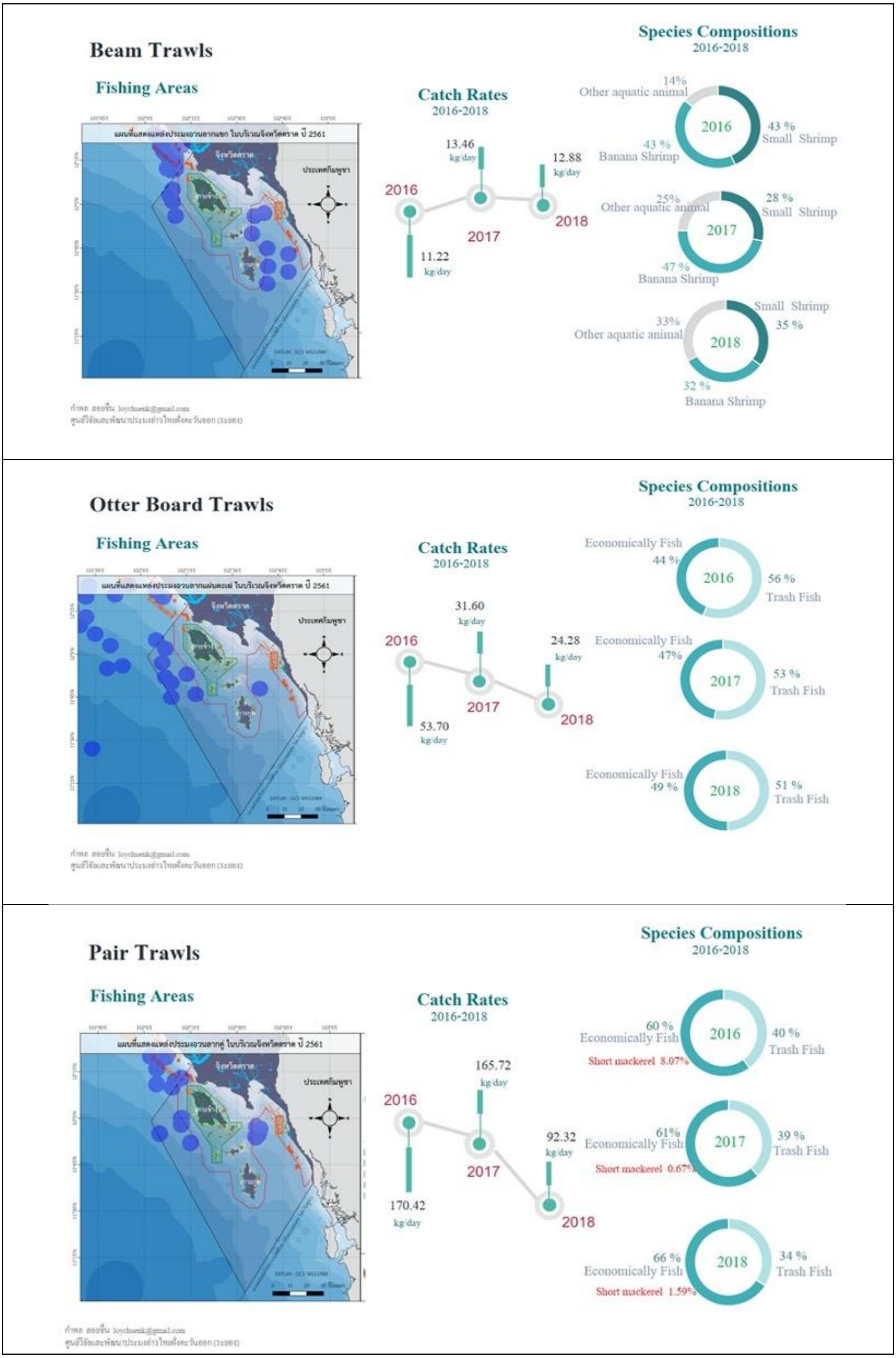

Light Luring Purse Seines
Fishing Areas
Catch Rates
2016-2018
2016
2,382.48
kg/day
2017
2,784.72
kg/day
2018
3,833.30
kg/day
Species Compositions
2016-2018
2016
31%
Other aquatic animal
Short mackerel 1.5%
4%
Yellowtail Scad
10 %
Indian mackerel
55 %
Sardinella
2017
32%
Other aquatic animal
Short mackerel 0.1%
4%
Yellowtail Scad
12 %
Indian mackerel
52 %
Sardinella
2018
39%
Other aquatic animal
Short mackerel 0.2%
12%
Little tuna
13 %
Indian mackerel
36 %
Sardinella

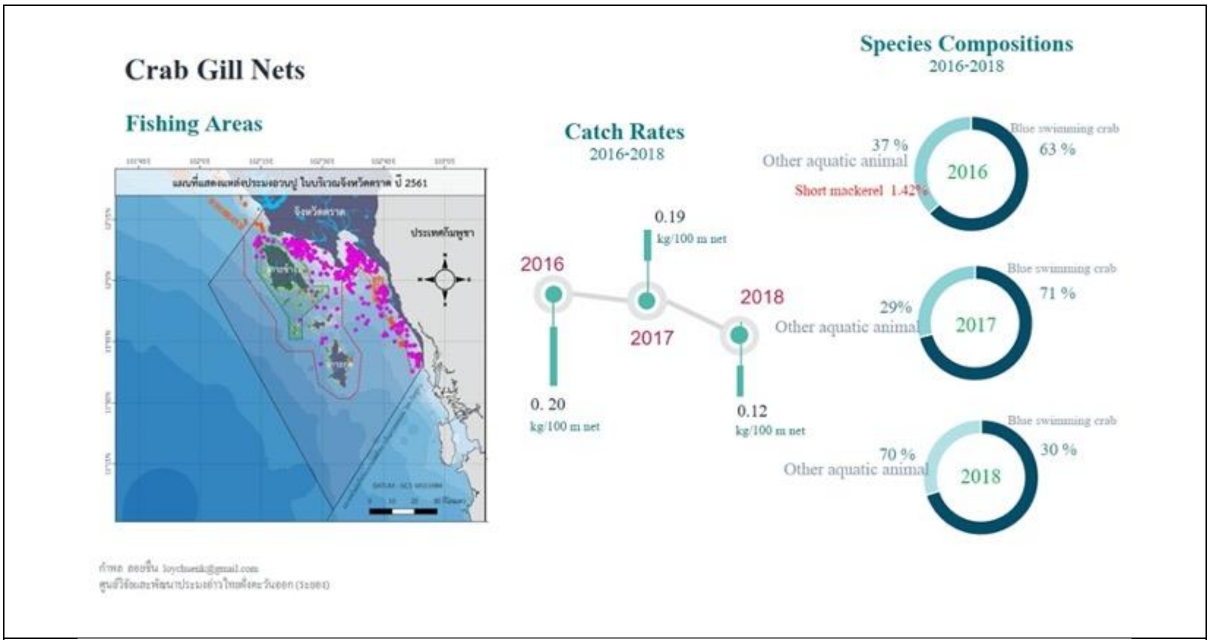

Purse Seines
Fishing Areas
Catch Rates
2016-2018
2016
2,540.40
kg/day
2017
2,808.49
kg/day
2018
3,776.11
kg/day
Species Compositions
2016-2018
2016
Other aquatic animal
42%
21 %
Sardinella
16 %
Indian mackerel
5 %
round scad
16 %
Short mackerel
2017
Other aquatic animal
54%
29 %
Sardinella
10 %
Indian mackerel
1 % Short mackerel
7 %
round scad
2018
34%
Other aquatic animal
45 %
Sardinella
round scad 8 %
4 %
Short mackerel
9%
Indian mackerel

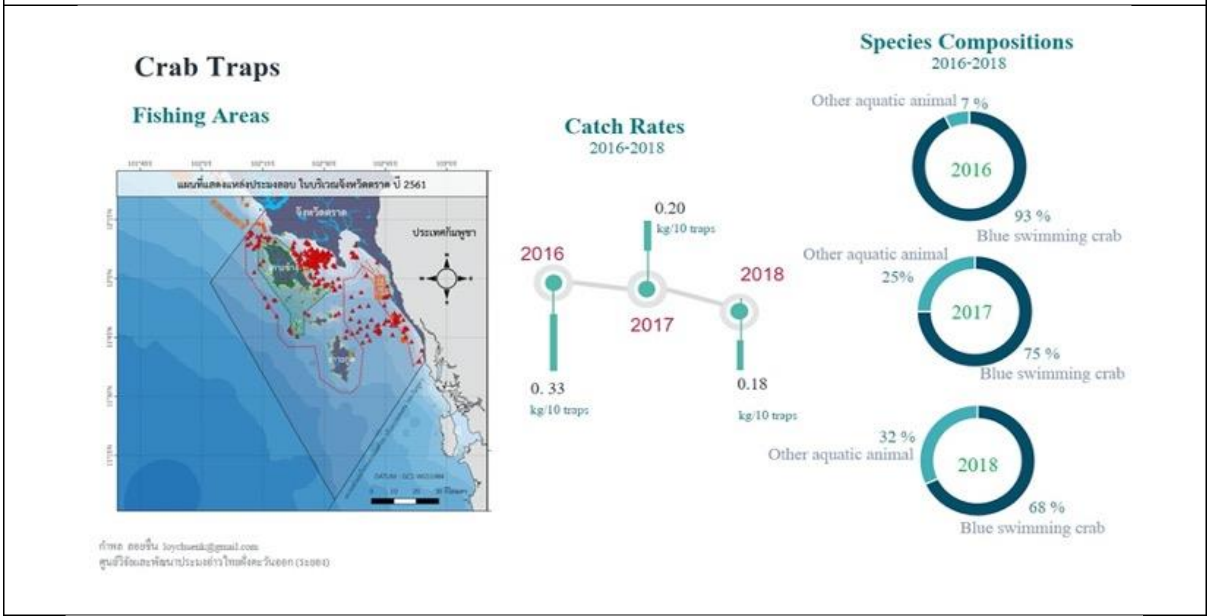

Purse Seines with Fish Aggregating Devices
Fishing Areas
Catch Rates
2016-2018
3,750.52
kg/day
3,383.74
kg/day
2016
2017
2018
3,016.64
kg/day
Species Compositions
2016-2018
Other aquatic animal
38%
24 %
Indian mackerel
2016
10 %
round Scad
Short mackerel 0.5%
6 %
Yellowtail Scad
22 %
Sardinella
24%
Other aquatic animal
20 %
Indian mackerel
Short mackerel 8.8%
2017
14%
Little tuna
21 %
round Scad
21 %
Sardinella
27%
Other aquatic animal
23 %
Indian mackerel
Short mackerel 0.1%
9 %
Big eyed scad
2018
16 %
Sardinella
35 %
round Scad

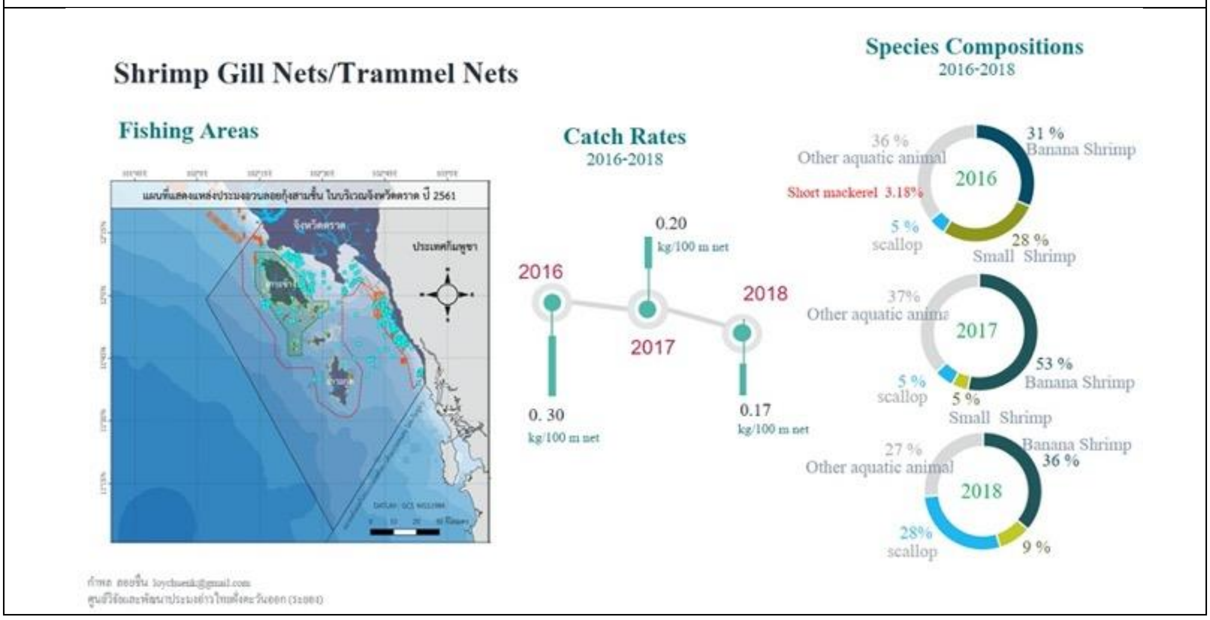

Light Luring Anchovy Falling Nets
Fishing Areas
Mapping of the Fishing Ground of Light Luring Purse Seines in Trat Province in 2018
Catch Rates
2016-2018
978.67
kg/day
670.58
kg/day
2016
2017
2018
970.87
kg/day
Species Compositions
2016-2018
22%
Other aquatic animal
Short mackerel 0.05%
2016
78 %
Anchovy
22%
Other aquatic animal
Short mackerel 1.18%
2017
78 %
Anchovy
27%
Other aquatic animal
Short mackerel 1.82%
2018
73 %
Anchovy

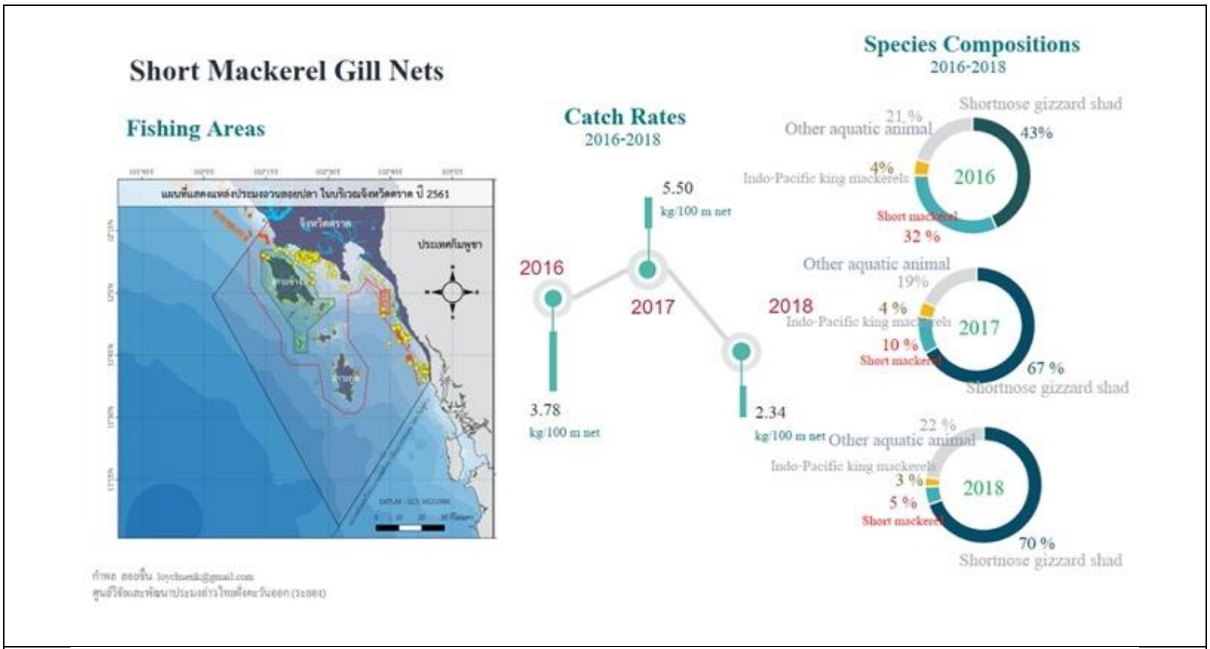

Anchovy Purse Seines
Fishing Areas
Catch Rates
2016-2017
3,701.03
kg/day
2,288.78
kg/day
2016
2017
Species Compositions
2016-2017
22%
Other aquatic animal
Short mackerel 3.07%
2016
Anchovy
38 %
6 %
Indian mackerel
22 %
Sardinella
38%
Other aquatic animal
Short mackerel 1.84%
2017
45 %
Anchovy
6 %
Indian mackerel
11 %
Sardinella

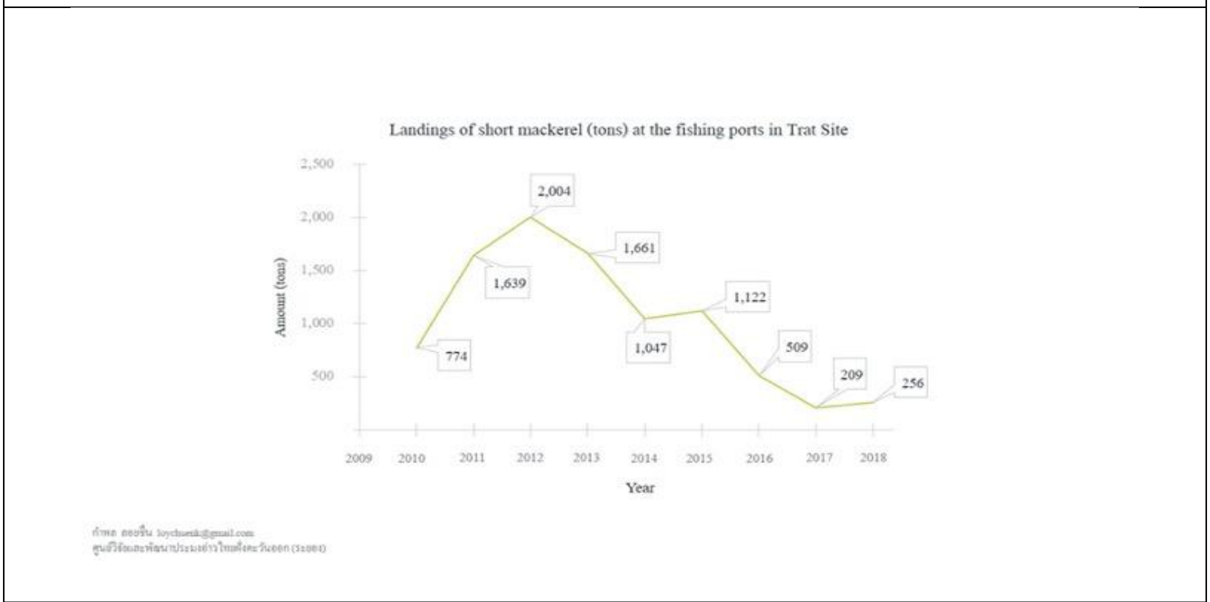

Beam Trawls
Fishing Areas
Catch Rates
2016-2018
2016
11.22 kg/day
2017
13.46 kg/day
2018
12.88 kg/day
Species Compositions
2016-2018
2016
14% Other aquatic animal
43 % Small Shrimp
43 % Banana Shrimp
2017
25% Other aquatic animal
28 % Small Shrimp
47 % Banana Shrimp
2018
33% Other aquatic animal
Small Shrimp 35 %
32 % Banana Shrimp
Otter Board Trawls
Fishing Areas
Catch Rates
2016-2018
2016
53.70 kg/day
2017
31.60 kg/day
2018
24.28 kg/day
Species Compositions
2016-2018
2016
Economically Fish 44 %
56 % Trash Fish
2017
Economically Fish 47%
53 % Trash Fish
2018
Economically Fish 49 %
51 % Trash Fish
Pair Trawls
Fishing Areas
Catch Rates
2016-2018
2016
170.42 kg/day
2017
165.72 kg/day
2018
92.32 kg/day
Species Compositions
2016-2018
2016
60 % Economically Fish
Short mackerel 8.07%
40 % Trash Fish
2017
61% Economically Fish
Short mackerel 0.67%
39 % Trash Fish
2018
66 % Economically Fish
Short mackerel 1.59%
34 % Trash Fish

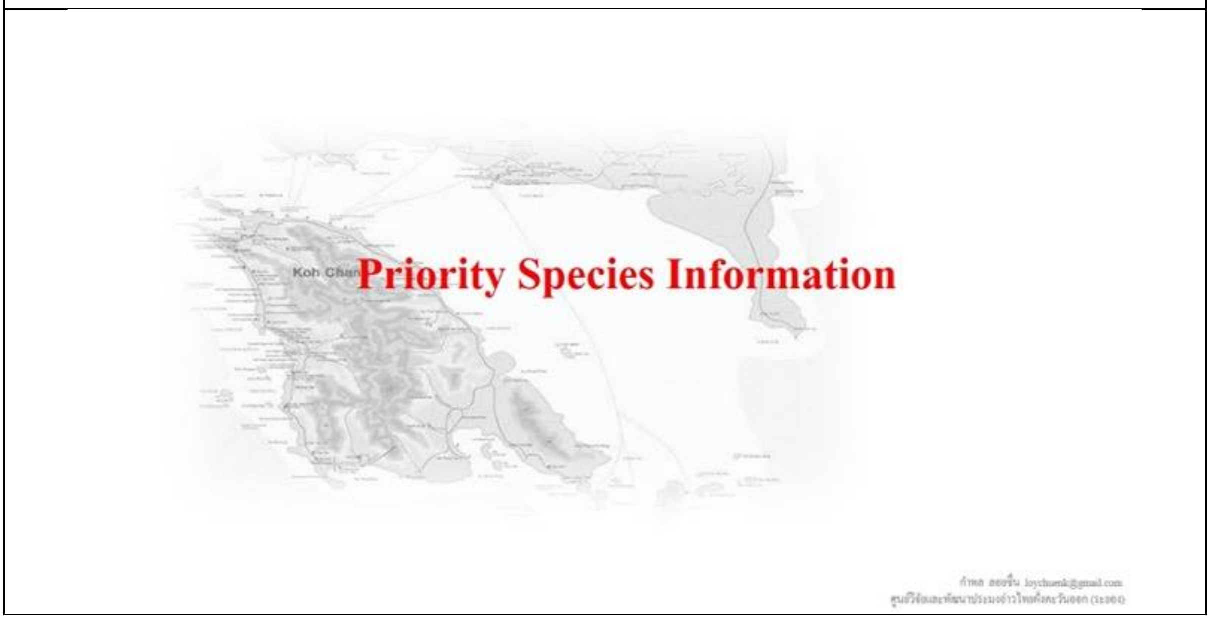

Crab Gill Nets
Fishing Areas
Catch Rates
2016-2018
2016
0. 20
kg/100 m net
2017
0.19
kg/100 m net
2018
0.12
kg/100 m net
Species Compositions
2016-2018
2016
37 %
Other aquatic animal
Short mackerel 1.42%
Blue swimming crab
63 %
2017
29%
Other aquatic animal
Blue swimming crab
71 %
2018
70 %
Other aquatic animal
Blue swimming crab
30 %


Crab Traps
Fishing Areas
Catch Rates
2016-2018
2016
0. 33
kg/10 traps
2017
0.20
kg/10 traps
2018
0.18
kg/10 traps
Species Compositions
2016-2018
Other aquatic animal 7 %
2016
93 %
Blue swimming crab
Other aquatic animal
25%
2017
75 %
Blue swimming crab
32 %
Other aquatic animal
2018
68 %
Blue swimming crab


Shrimp Gill Nets/Trammel Nets
Fishing Areas
Catch Rates
2016-2018
2016
0. 30
kg/100 m net
2017
0.20
kg/100 m net
2018
0.17
kg/100 m net
Species Compositions
2016-2018
36 %
Other aquatic animal
Short mackerel 3.18%
2016
31 %
Banana Shrimp
5 %
scallop
28 %
Small Shrimp
37%
Other aquatic anima
2017
5 %
scallop
5 %
Small Shrimp
53 %
Banana Shrimp
27 %
Other aquatic animal
2018
Banana Shrimp
36 %
28%
scallop
9 %


Short Mackerel Gill Nets
Fishing Areas
Catch Rates
2016-2018
5.50
kg/100 m net
2016
2017
3.78
kg/100 m net
2.34
kg/100 m net
Species Compositions
2016-2018
Shortnose gizzard shad
21 %
Other aquatic animal
43%
4%
Indo-Pacific king mackerels
2016
Short mackerel
32 %
Other aquatic animal
19%
2018
4 %
Indo-Pacific king mackerels
2017
10 %
Short mackerel
67 %
Shortnose gizzard shad
22 %
Other aquatic animal
Indo-Pacific king mackerels
3 %
2018
5 %
Short mackerel
70 %
Shortnose gizzard shad


Landings of short mackerel (tons) at the fishing ports in Trat Site
2,500
2,000
1,500
1,000
500
Amount (tons)
774
1,639
2,004
1,661
1,047
1,122
509
209
256
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year


Priority Species Information

Common Name: Short mackerel, Indo-Pacific mackerel

Scientific Name: *Rastrelliger brachysoma* (Bleeker, 1851)

Thai Local Name: Pla Thu (Pla = Fish)

Morphology: Body very deep; head equal to or less than body depth; gill rakers very long, visible when mouth is opened; snout pointed; silver body colour; colour of spinous dorsal fin yellowish with a black edge, pectoral and pelvic fins dusky, other fins yellowish

Length at First Maturity (L_{50}/L_m): 16.98 cm

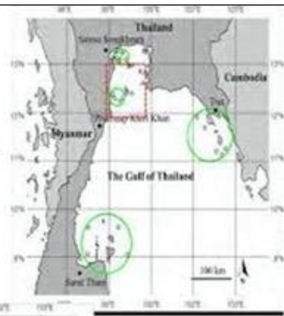
Size: L_∞ = 22.23 cm, common length = 16-18 cm

MSY: 112,416 tons

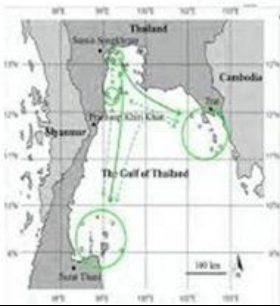
Distribution: Indo-Pacific Region; from Andaman Sea to Thailand, Indonesia, Papua New Guinea, Philippines, Solomon Islands and Fiji, at water temperature of 20-30°C and water depth of 15-200 m

Populations of Short Mackerel in the Gulf of Thailand

➢ There are possibly 4 different populations in the Gulf of Thailand, namely, **Trat**, Samut Songkram, Prachuap Kiri Khan, and Surat Thani



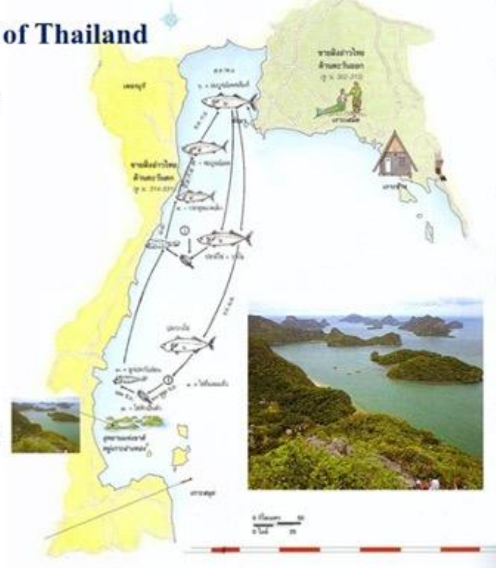
➢ Stocks were found migrate among the 4 populations:
- **Trat** – Samut Songkhram
- **Trat** – Prachuap Khiri Khan
- Surat Thani – Samut Songkhram
- Surat Thani – Prachuap Khiri Khan



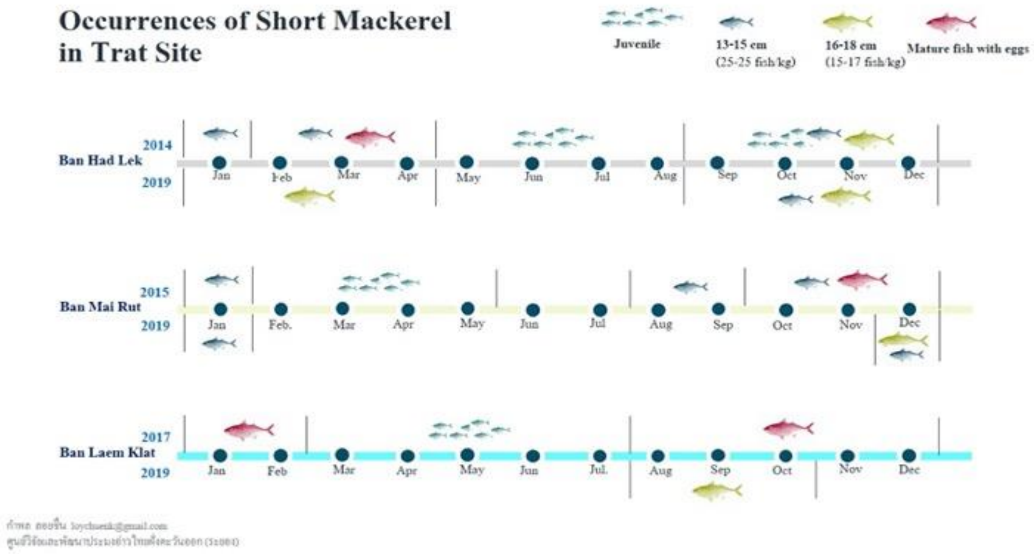
Cited from: SEAFDEC. 2017. Report of the Experts Group Meeting on Stock Status and Geographical Distribution of Anchovy, Indo-Pacific Mackerel and Blue Swimming Crab (AIB) Species in the Gulf of Thailand, Bangkok, Thailand, 22-23 September 2016, Southeast Asian Fisheries Development Center.

Life Cycle of Short Mackerel in the Gulf of Thailand

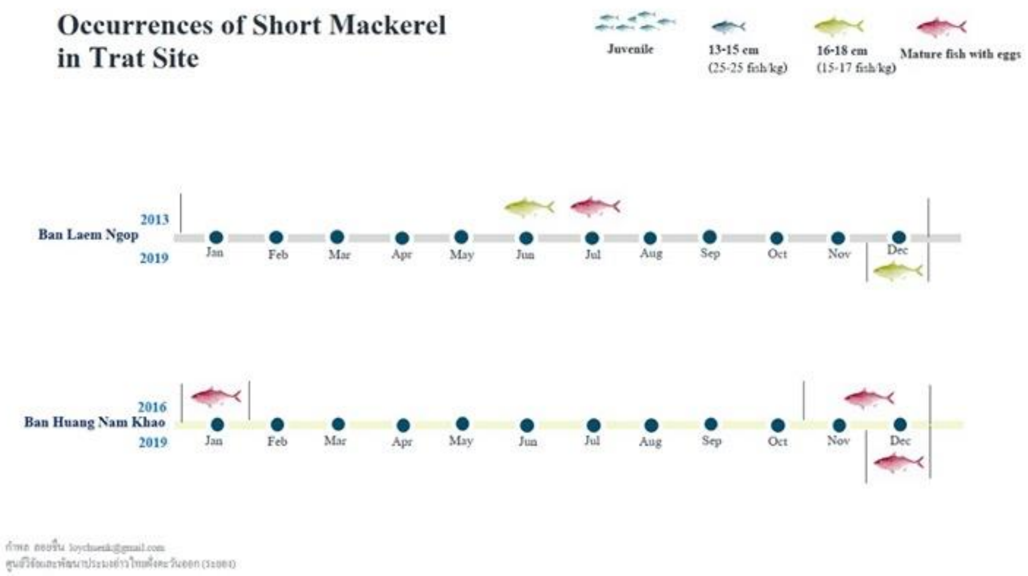
1. **Short mackerel** mainly spawn in the peak spawning season during February- April in the middle Gulf of Thailand, off Prachuap Kiri Khan and Chumphon Provinces.
2. The larvae drift to the coastal seas and grow up while ongoing move north toward the nutrient-rich area in the upper Gulf of Thailand.
3. The fish of maturing stage reach the upper Gulf around August-September, feeding until mature in October-November, During the time of December – January, they move back to the south and continually spawn in the same spawning ground around February- April



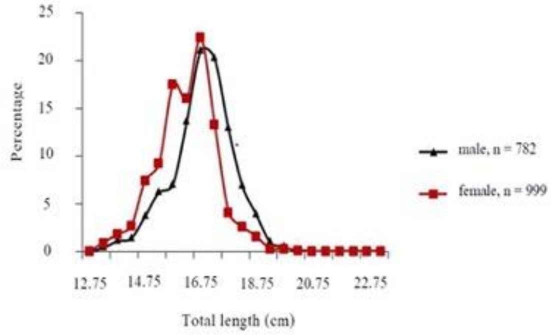
Occurrences of Short Mackerel in Trat Site



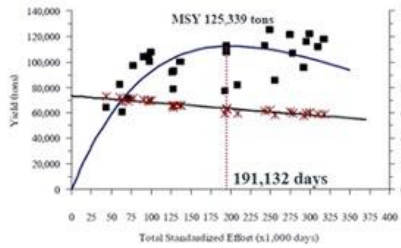
Occurrences of Short Mackerel in Trat Site



Size Frequency of Short Mackerel in the Eastern Gulf of Thailand



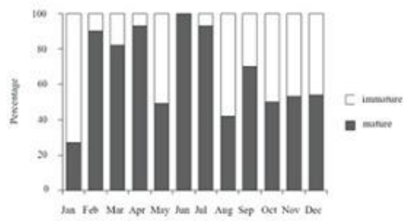
Total standard fishing efforts *vs* total catches and CPUEs for short mackerel gill net fisheries in Thai Waters



ภาพที่ 8 แสดงความสัมพันธ์ระหว่างปริมาณแรงงานประมงมาตรฐาน (จำนวนวันทำประมงของเครื่องมืออวนล้อมติดปลาทู) กับปริมาณการจับปลาทูทั้งหมด (เมตริกตัน) และอัตราการจับต่อหน่วยการลงแรงประมง (กิโลกรัม/วัน) ของการประมงปลาทู ระหว่างปี 2515 - 2552 ตามวิธีการของ Fox

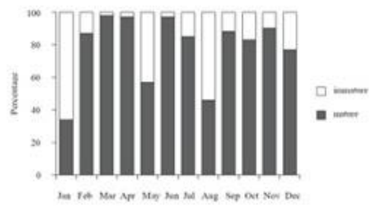
Figure 8 Relationship between total standard fishing effort (#day of mackerel encircling gill net) and total catch and CPUE (kgs/day) of Indo-Pacific mackerel fisheries, 1982 - 2009 by Fox's model

Annual Maturation of Short Mackerel in Trat Site



ภาพที่ 5 ร้อยละของระยะเจริญพันธุ์ของปลาทู (*Rastrelliger brachysoma*) เพศผู้บริเวณจังหวัดตราด ปี 2552

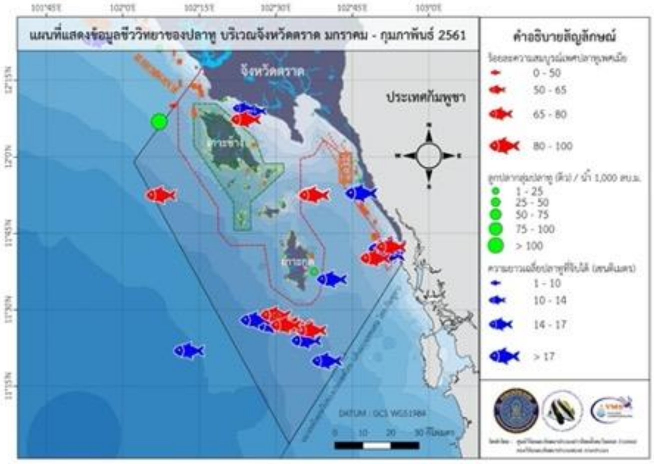
Figure 5 Percentage of male mature of Indo-Pacific mackerel (*Rastrelliger brachysoma*) in Trat Province, 2009



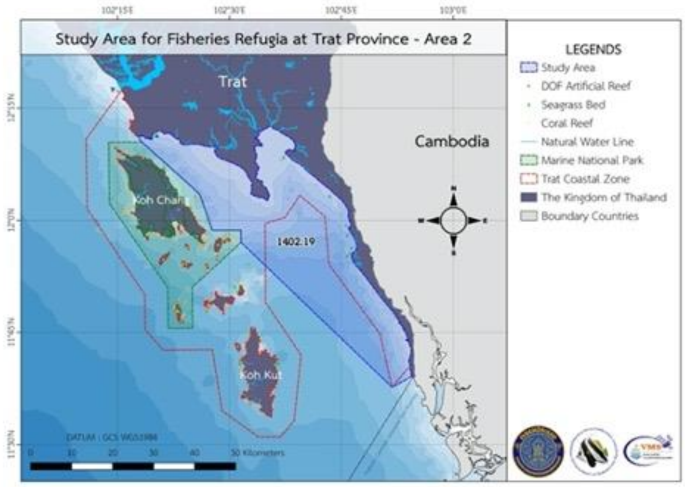
ภาพที่ 6 ร้อยละของระยะเจริญพันธุ์ของปลาทู (*Rastrelliger brachysoma*) เพศเมียบริเวณจังหวัดตราด ปี 2552

Figure 6 Percentage of female mature of Indo-Pacific mackerel (*Rastrelliger brachysoma*) in Trat Province, 2009

Distributions of larval, juvenile, adult, mature, and fully mature short mackerel in Trat Site during peak spawning period: January – February 2018



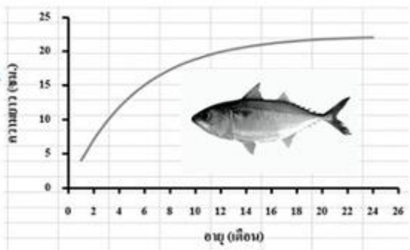
Tentative actual fisheries *refugia* boundary, prepared for community forums in Trat Site

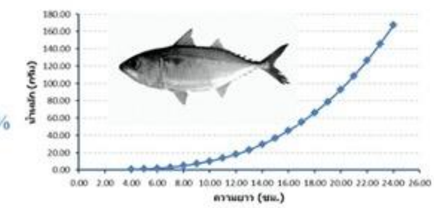


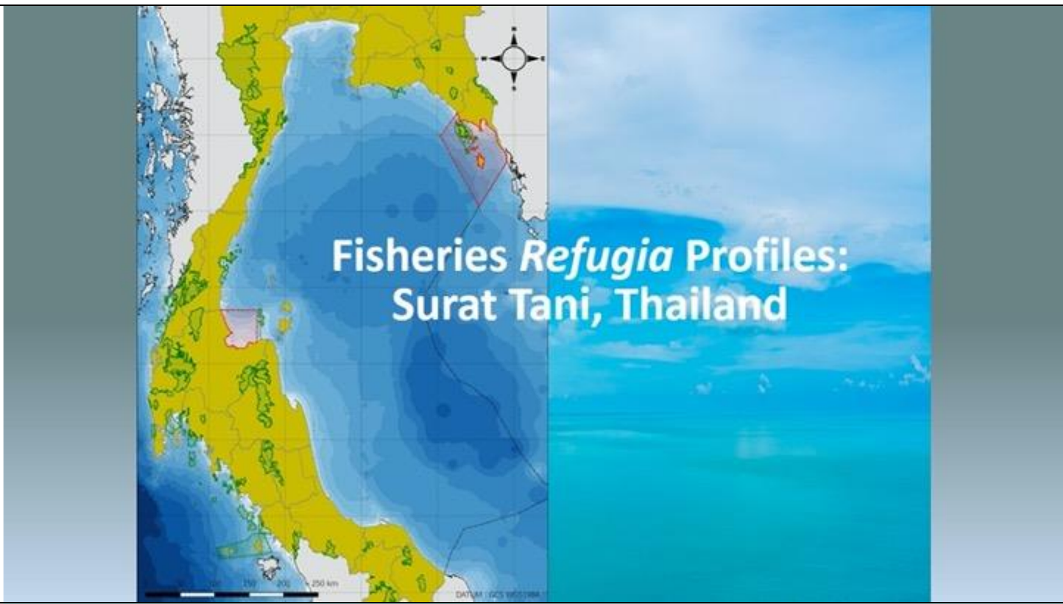
Estimated population of short mackerel while implementing fisheries *refugia* management

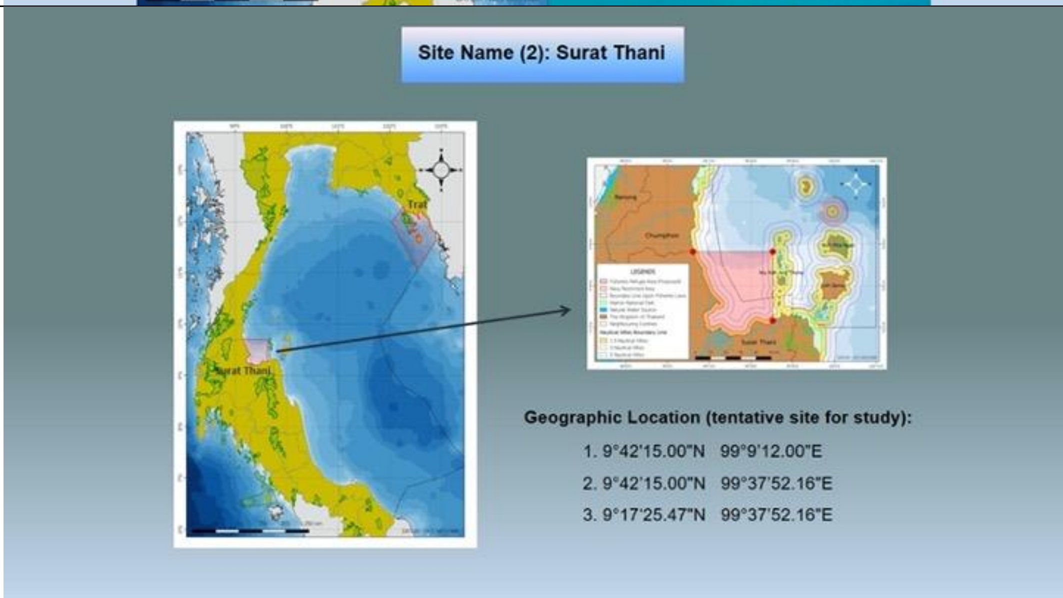
1. **256,000 kg** landing of short mackerel (in 2018)
2. **25,600 kg** landing of short mackerel in 10 % of fishing area and 2 month (Jan-Feb)

   average weight 73 g/fish (17 cm)
3. equal to a number of **350,685 fish**
4. which was **175,342 female fish**
5. **17,534,246,575.34 eggs** by 100,000 spawners
6. **175,342,465 larvae** hatch rate = 1%
7. survive to marketable size **1,753,424 fish** survival rate = 1%
8. **= 127,100 kg** weight of survival/year






Fisheries *Refugia* Profiles:
Surat Tani, Thailand


Site Name (2): Surat Thani
Trat
Surat Thani
Geographic Location (tentative site for study):
1. 9°42'15.00"N 99°9'12.00"E
2. 9°42'15.00"N 99°37'52.16"E
3. 9°17'25.47"N 99°37'52.16"E


Geophaphy: Surat Tani Province
Areas:
Land = 12,892 km² (the Largest of the southern provinces of Thailand)
Islands = 419 km²
Shoreline = 157 km
Boundaries:
North: Ranong and Chumphon Provinces, and the Gulf of Thailand
South: Krabi and Nakhon Si Thammarat Provinces
East: Nakhon Si Thammarat Province and the Gulf of Thailand
West: Phang Nga Province
Main fresh water sources: the Tapi River and the Phum Duang River
Islands: 108 islands (the most in the GoT) ; Koh Samui is the second biggest island of Thailand (after Phuket), and Mu Koh Ang Thong is a Marine National Park
Climate: tropical climate with fairly stable temperatures throughout the year at the average of 27°C, having rainfall around 1,850 mm per year

History:

- It can be traced back to the prehistoric times when Semang (Sakai) and original Malays lived in **Surat Thani.** .
- In the 13th century, the city became a part of the Srivijaya Empire which ruled over the malay Peninsula as well as parts of Java.
- When the empire collapsed, it was divided into 3 main areas: Chaiya, Thathong, and Kiri Rat, which were ruled by Nakhon Si Thammarat under King Rama IV.
- These 3 areas were eventually combined under just the name Chaiya, which was later changed to **Surat Thani**
- **Surat Thani** means "city of the good people". It is also known as "the city of a hundred islands" as there are many big and small islands in the Gulf of Thailand lay off the coast of the province.

Population:

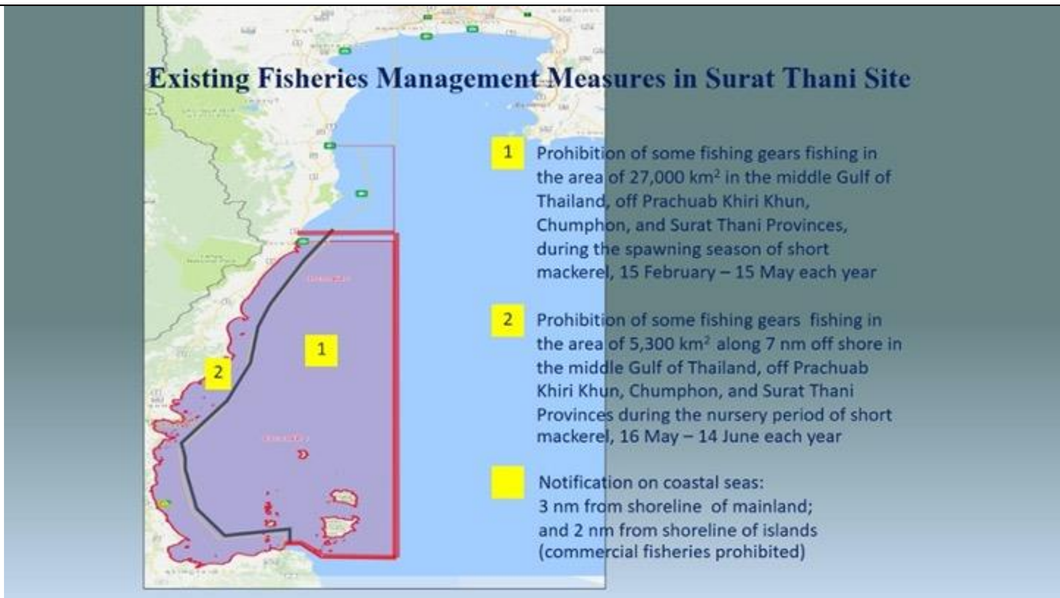
- Total 1,063,501 (2018)
  Density 83/km^2

Economy:

- GDP 191,177 M฿ (2015)
  - GDP in agriculture sector 26%
  - GDP in non-agriculture sector 74%
- Economic Composition
  - Vending
  - Hotel and tourism
  - Agriculture
  - Fisheries

Main Fishing Gears in Surat Thani Site

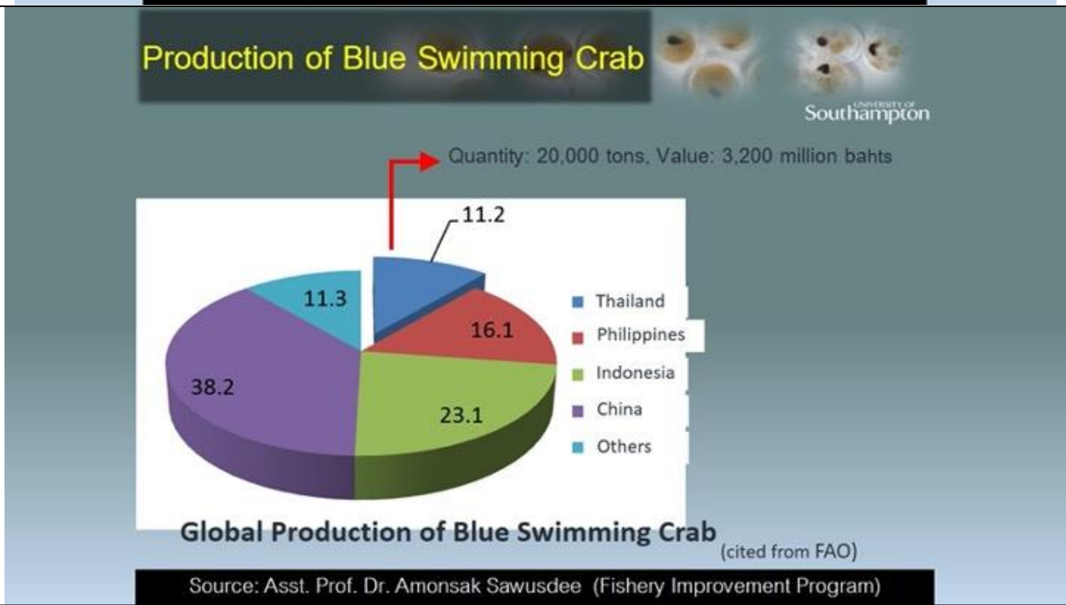
- Otter trawl
- Pair trawl
- Beam trawl
- Purse seine
- Anchovy purse seine
- Gill net
- Crab trap
- Crab gill net

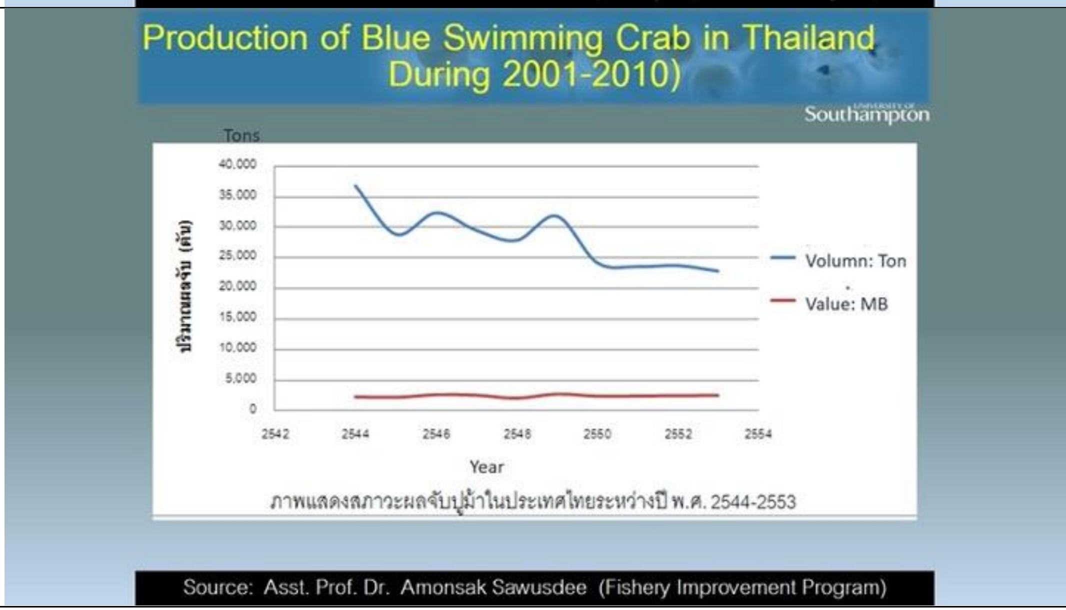

Existing Fisheries Management Measures in Surat Thani Site
1
2
1 Prohibition of some fishing gears fishing in the area of 27,000 km² in the middle Gulf of Thailand, off Prachuab Khiri Khun, Chumphon, and Surat Thani Provinces, during the spawning season of short mackerel, 15 February – 15 May each year
2 Prohibition of some fishing gears fishing in the area of 5,300 km² along 7 nm off shore in the middle Gulf of Thailand, off Prachuab Khiri Khun, Chumphon, and Surat Thani Provinces during the nursery period of short mackerel, 16 May – 14 June each year
Notification on coastal seas:
3 nm from shoreline of mainland;
and 2 nm from shoreline of islands
(commercial fisheries prohibited)


Some Information of
Blue Swimming Crab Resources, Fisheries,
and Ecosystem in Surat Thani Site


Blue Swimming Crab
University of Southampton
Common Name: Blue Swimming Crab
Scientific Name: Portunus pelagicus, Linnaeus (1758)
Thai Local Name: Pu Ma (Pu = Crab)
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Distribution of Blue Swimming Crab
Southampton
Coastal areas of the tropical and temperate zones, as well as estuary along Africa, Indian Ocean, Indo-Pacific, and Australia
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

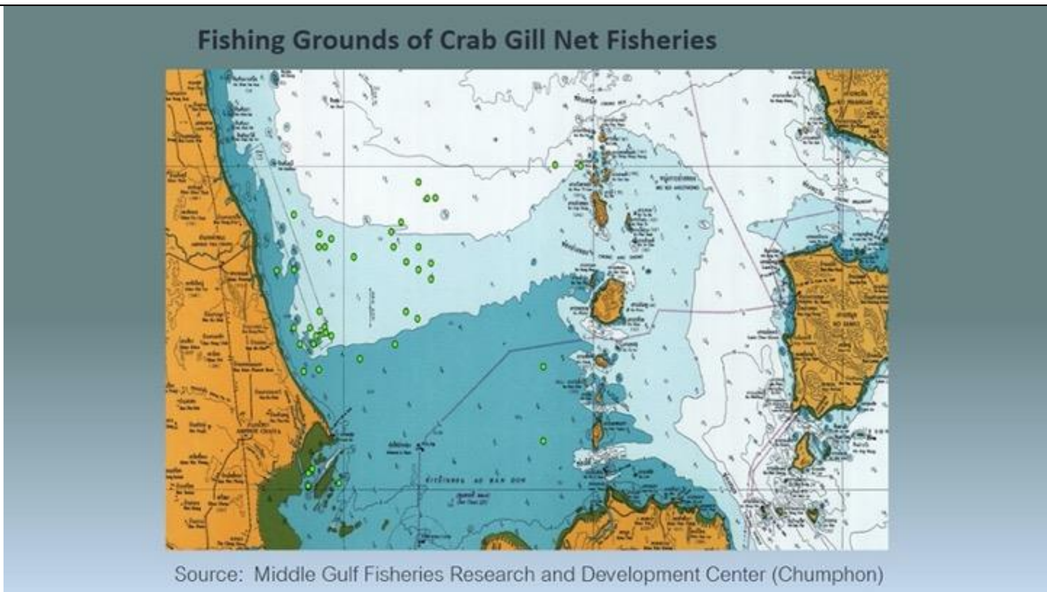

Production of Blue Swimming Crab
Southampton
Quantity: 20,000 tons, Value: 3,200 million bahts
11.2
11.3
16.1
38.2
23.1
Thailand
Philippines
Indonesia
China
Others
Global Production of Blue Swimming Crab
(cited from FAO)
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Production of Blue Swimming Crab in Thailand During 2001-2010)
Southampton
Tons
ปริมาณผลจับ (ตัน)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2542
2544
2546
2548
2550
2552
2554
Year
Volumn: Ton
Value: MB
ภาพแสดงสภาวะผลจับปูม้าในประเทศไทยระหว่างปี พ.ศ. 2544-2553
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

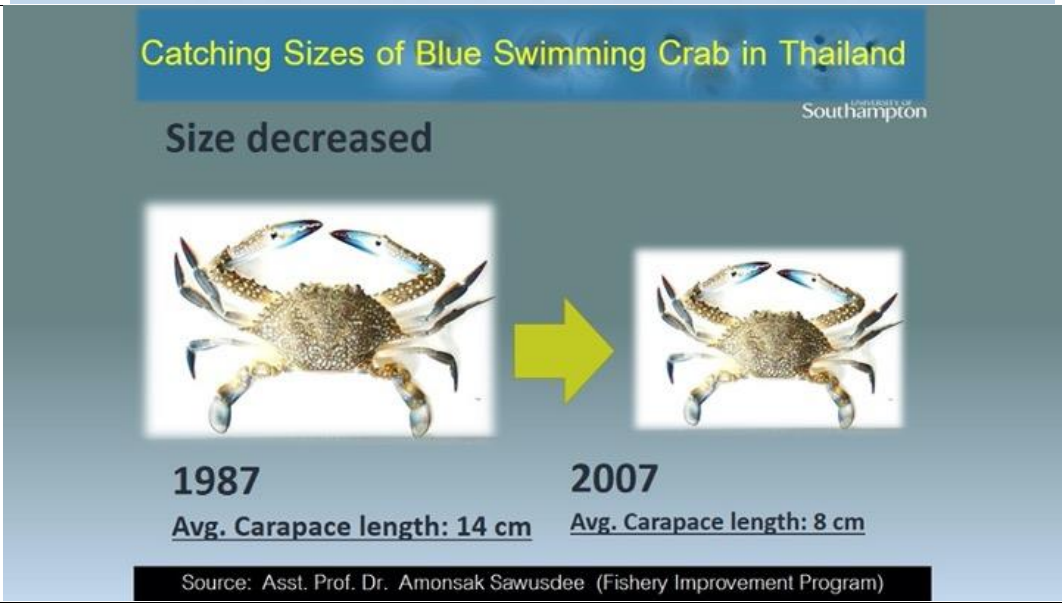

Fishing Gears for Blue Swimming Crab
Southampton
Gill Net
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

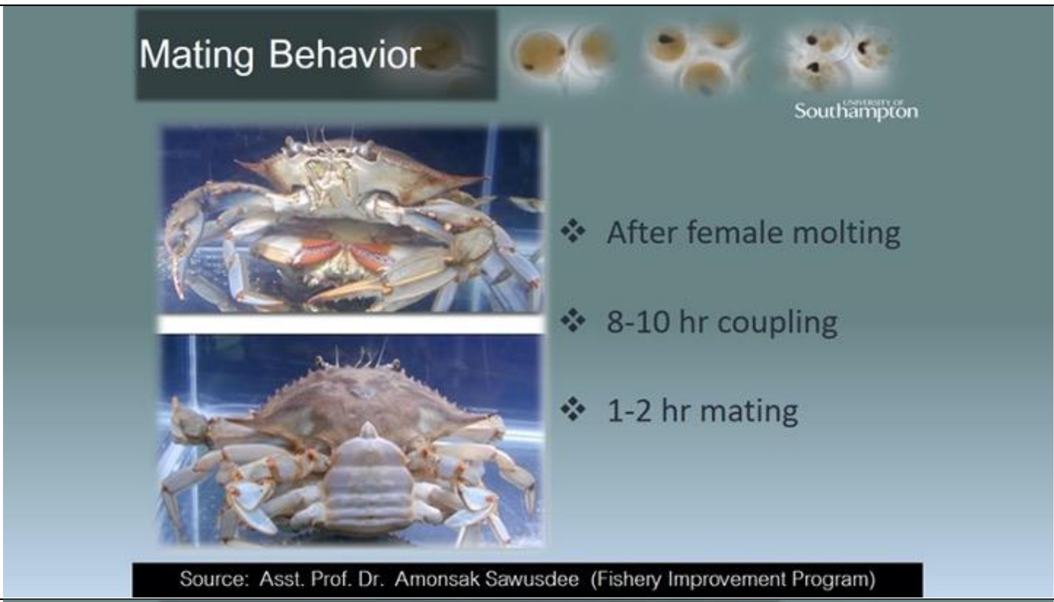

Fishing Gears for Blue Swimming Crab
Southampton
Collapsible Crab Trap
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

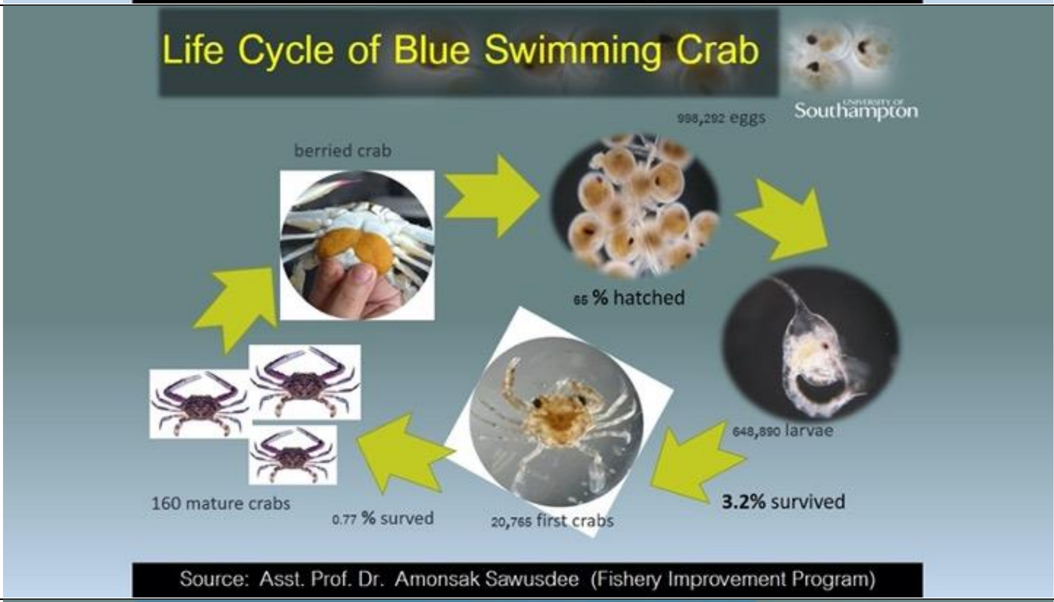

Collapsible Crab Trap
Southampton
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

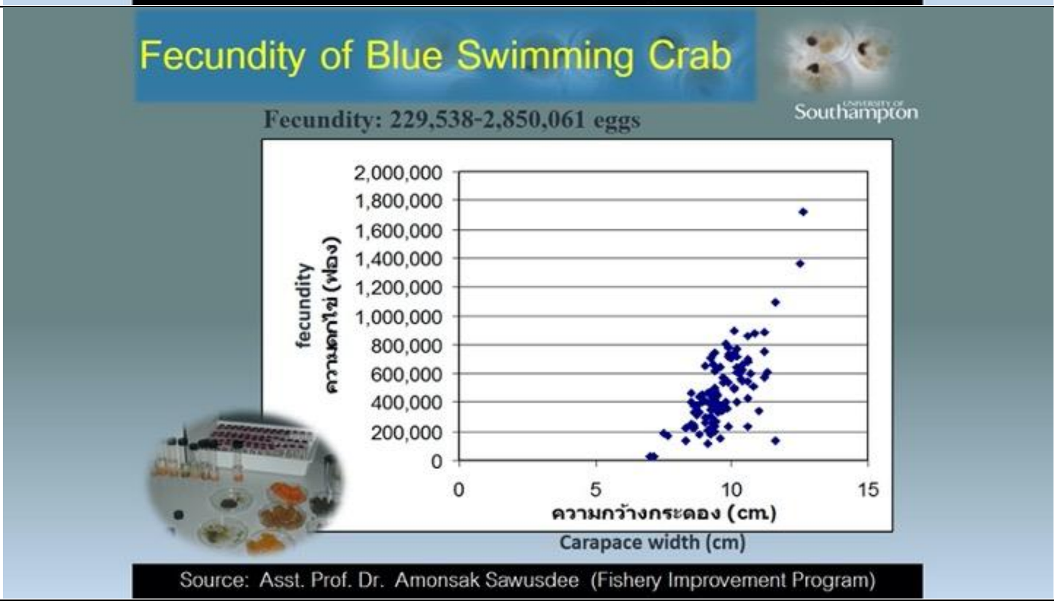

Fishing Grounds of Crab Gill Net Fisheries
Source: Middle Gulf Fisheries Research and Development Center (Chumphon)


Fishing Grounds of Crab Trap Fisheries
Source: Middle Gulf Fisheries Research and Development Center (Chumphon)


Catching Sizes of Blue Swimming Crab in Thailand
University of Southampton
Size decreased
1987
Avg. Carapace length: 14 cm
2007
Avg. Carapace length: 8 cm
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

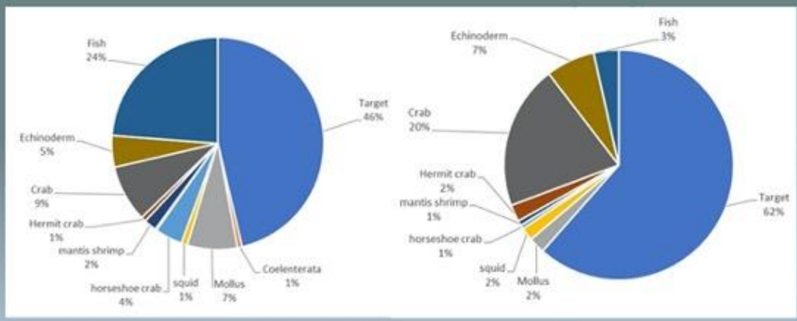

Mating Behavior
Southampton
❖ After female molting
❖ 8-10 hr coupling
❖ 1-2 hr mating
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Life Cycle of Blue Swimming Crab
Southampton
998,292 eggs
berried crab
65 % hatched
648,890 larvae
3.2% survived
20,766 first crabs
0.77 % surved
160 mature crabs
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Fecundity of Blue Swimming Crab
Southampton
Fecundity: 229,538-2,850,061 eggs
fecundity
ความดกไข่ (ฟอง)
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
0
5
10
15
ความกว้างกระดอง (cm.)
Carapace width (cm)
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

Catch Composition by Weight

สัดส่วนองค์ประกอบชนิดเชิงน้ำหนักตัวจากเครื่องมืออวนและลอบ



Crab Gill Net

Crab Trap

Source: Asst. Prof. Dr. Amonsak Sawusdee, (Fishery Improvement Program)

Catch Composition (%) of Crab Gill Net Fisheries in Surat Thani Site in 2018

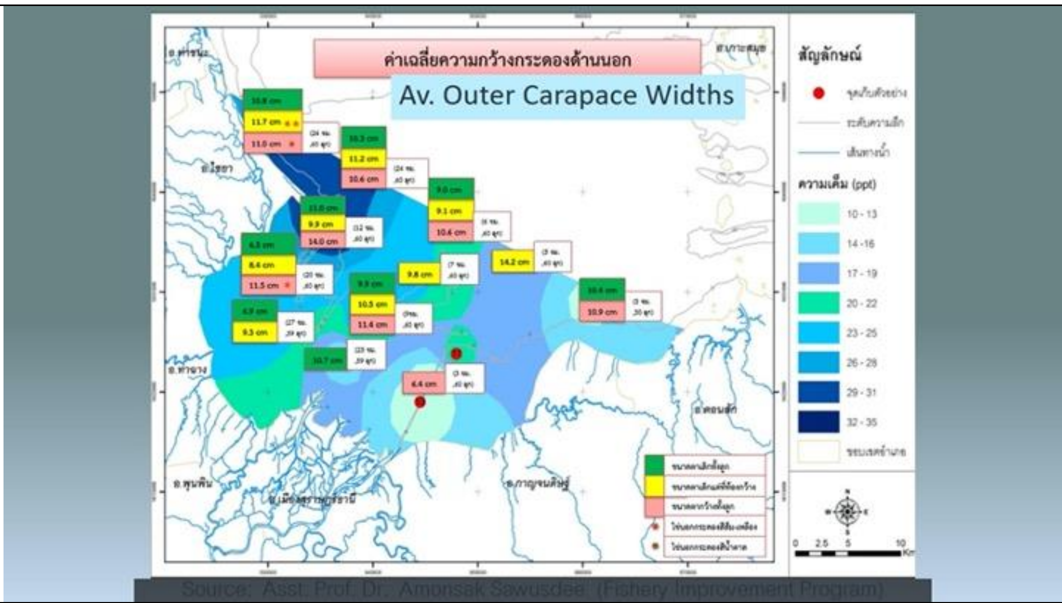
สัตว์น้ำ	Jan	Feb	March	April	May	June	July	Aug.
กลุ่มกั้ง	3.49	0.00	0.00	0.18	0.00	0.00	0.45	4.68
กลุ่มกุ้ง	0.00	0.28	0.00	0.00	0.00	0.00	0.90	0.00
กลุ่มปลา	36.51	4.30	0.00	0.00	0.00	0.00	11.96	0.07
กลุ่มปู								
- Portunus pelagicus	53.81	92.15	97.94	98.14	98.40	98.67	84.81	93.63
- Charybdis feriatus	0.00	3.27	1.67	1.68	1.60	0.38	1.07	0.86
- other crab	6.19	0.00	0.40	0.00	0.00	0.95	0.21	0.77
กลุ่มหมึก	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00
กลุ่มหอย	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
สัตว์น้ำอื่นๆ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ผลรวม	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
อัตราการจับ (กก./อวน 100 เมตร)	0.12	0.46	0.29	0.63	0.19	0.19	0.41	0.27

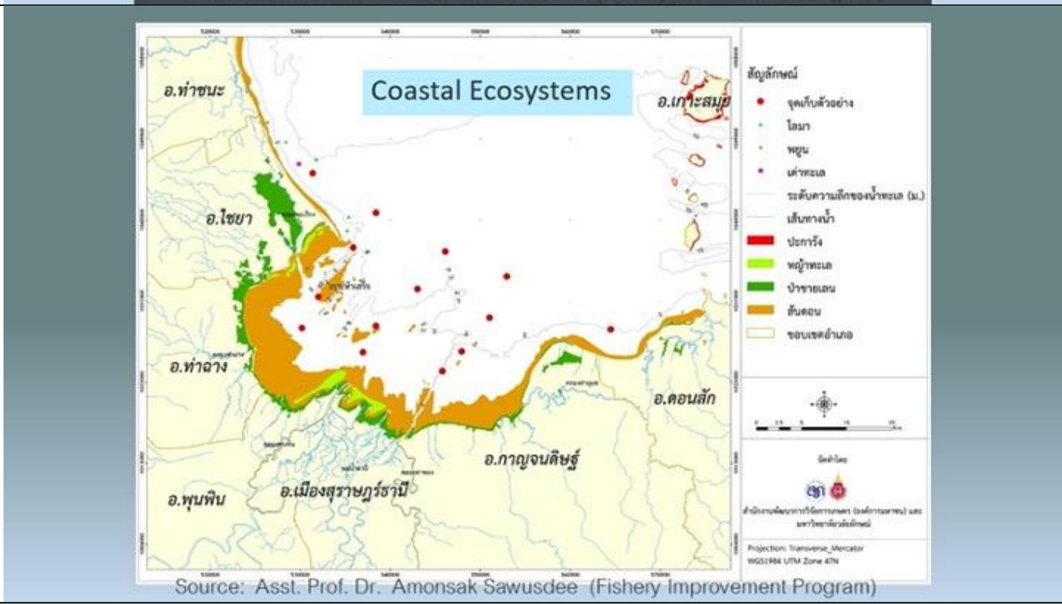
Source: Middle Gulf Fisheries Research and Development Center (Chumphon)

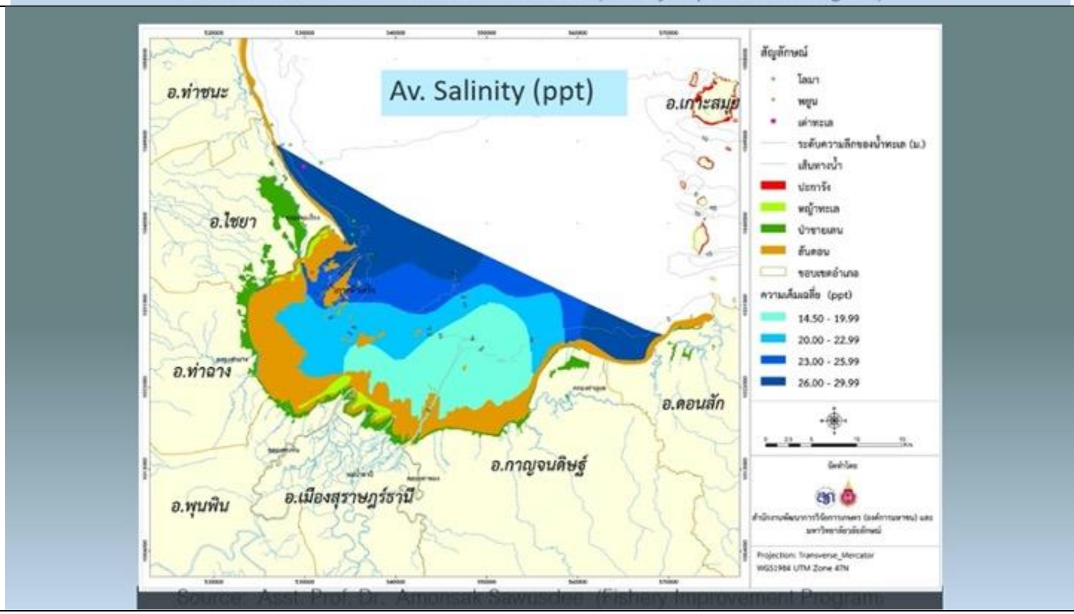
Catch Composition (%) of Crab Trap Fisheries in Surat Thani Site in 2018

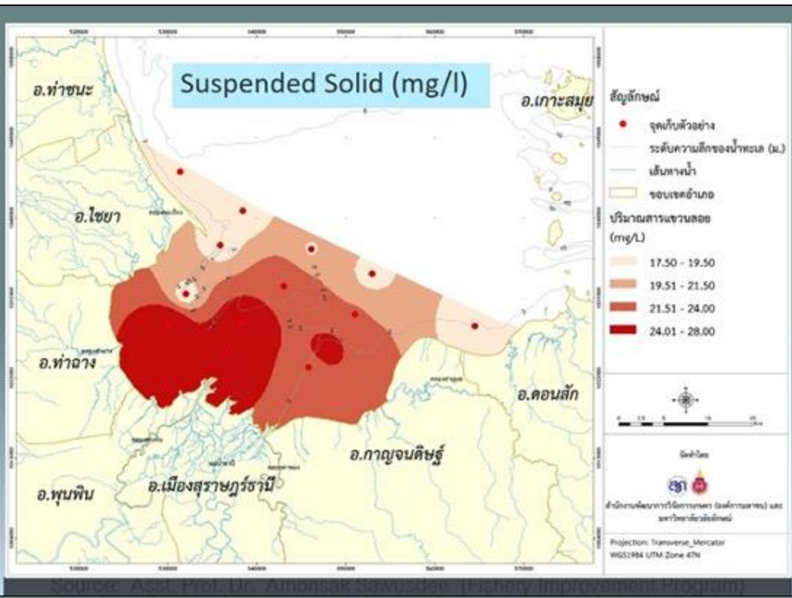
สัตว์น้ำ	Jan	Feb	March	April	May	June	July	Aug.
กลุ่มกั้ง	0.00	0.83	0.00	0.00	0.28	0.00	0.00	0.00
กลุ่มปู								
Portunus pelagicus	93.00	87.73	62.86	84.16	91.19	73.84	94.89	100.00
Charybdis feriatus	6.42	9.84	25.16	15.68	8.50	4.90	3.88	0.00
other crab	0.58	0.99	11.98	0.16	0.02	21.25	0.00	0.00
กลุ่มหมึก	0.00	0.61	0.00	0.00	0.00	0.00	1.23	0.00
ผลรวม	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
อัตราการจับ (กก./ลอบ 10 ลูก)	0.130	0.104	0.144	0.127	0.172	0.263	0.219	0.242

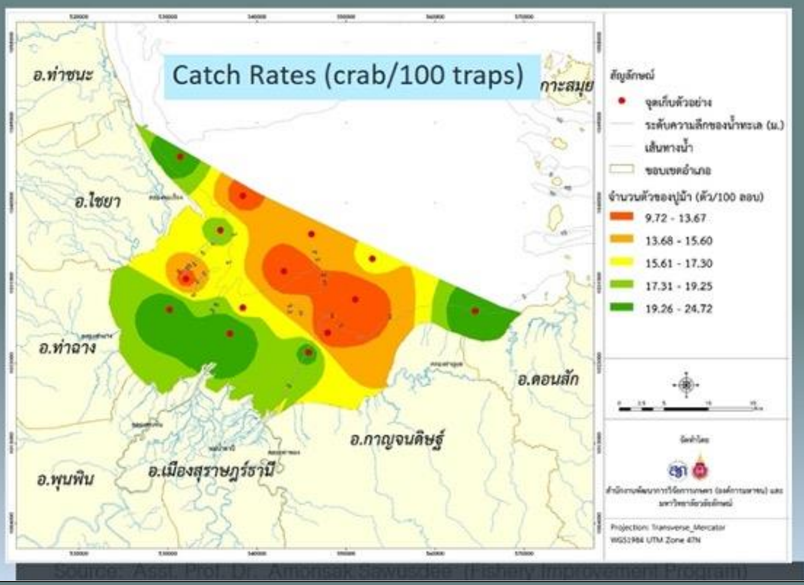
Source: Middle Gulf Fisheries Research and Development Center (Chumphon)

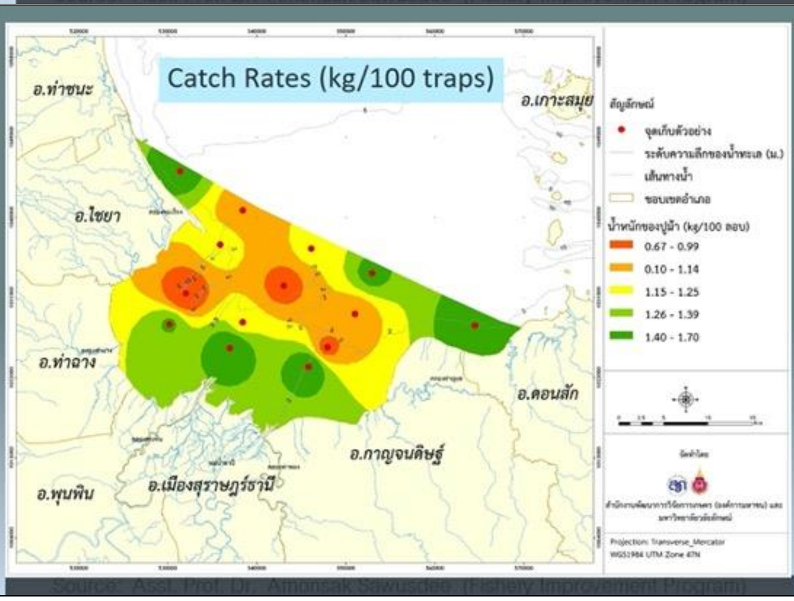

ค่าเฉลี่ยความกว้างกระดองด้านนอก
Av. Outer Carapace Widths
สัญลักษณ์
ความเค็ม (ppt)
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

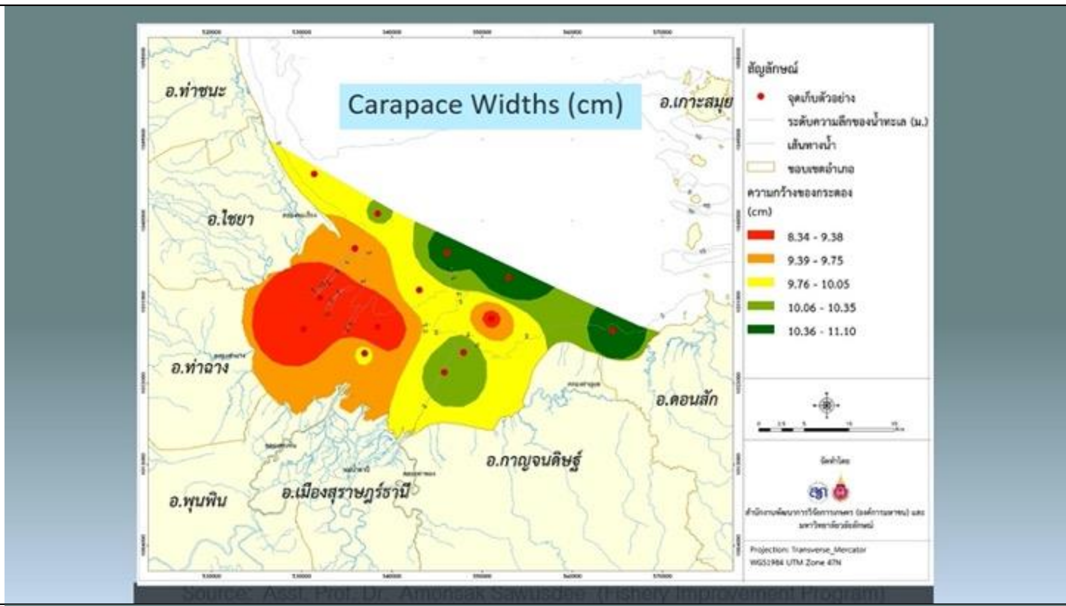

Coastal Ecosystems
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

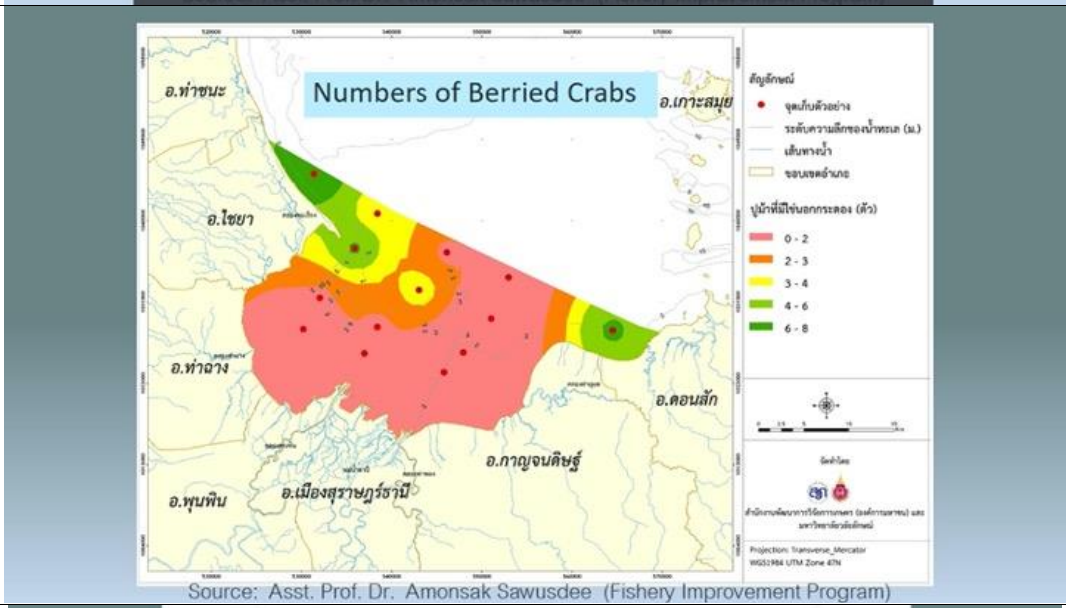

Av. Salinity (ppt)
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
14.50 - 19.99
20.00 - 22.99
23.00 - 25.99
26.00 - 29.99
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Suspended Solid (mg/l)
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
จุดเก็บตัวอย่าง
ระดับความลึกของน้ำทะเล (ม.)
เส้นทางน้ำ
ขอบเขตอำเภอ
ปริมาณสารแขวนลอย (mg/L)
17.50 - 19.50
19.51 - 21.50
21.51 - 24.00
24.01 - 28.00
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Catch Rates (crab/100 traps)
อ.ท่าชนะ
กาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
จุดเก็บตัวอย่าง
ระดับความลึกของน้ำทะเล (ม.)
เส้นทางน้ำ
ขอบเขตอำเภอ
จำนวนตัวของปูม้า (ตัว/100 ลอบ)
9.72 - 13.67
13.68 - 15.60
15.61 - 17.30
17.31 - 19.25
19.26 - 24.72
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Catch Rates (kg/100 traps)
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
จุดเก็บตัวอย่าง
ระดับความลึกของน้ำทะเล (ม.)
เส้นทางน้ำ
ขอบเขตอำเภอ
น้ำหนักของปูม้า (kg/100 ลอบ)
0.67 - 0.99
0.10 - 1.14
1.15 - 1.25
1.26 - 1.39
1.40 - 1.70
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Carapace Widths (cm)
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
จุดเก็บตัวอย่าง
ระดับความลึกของน้ำทะเล (ม.)
เส้นทางน้ำ
ขอบเขตอำเภอ
ความกว้างของกระดอง (cm)
8.34 - 9.38
9.39 - 9.75
9.76 - 10.05
10.06 - 10.35
10.36 - 11.10
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)

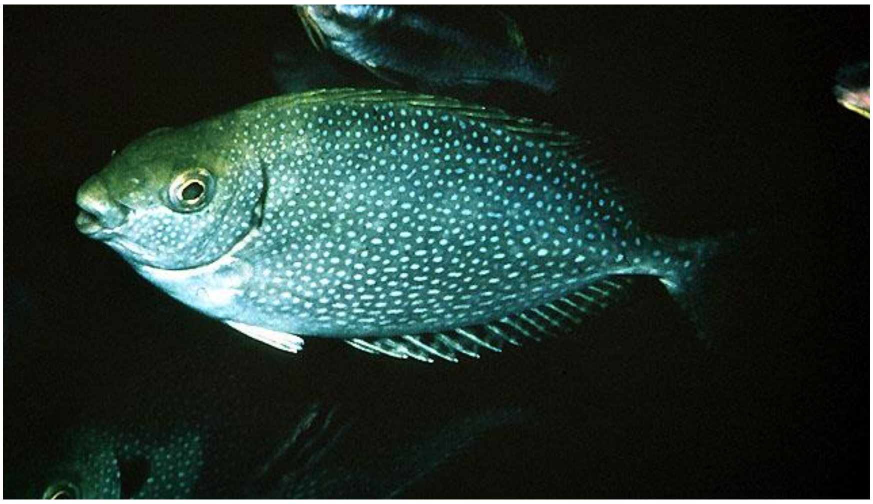

Numbers of Berried Crabs
อ.ท่าชนะ
อ.เกาะสมุย
อ.ไชยา
อ.ท่าฉาง
อ.ดอนสัก
อ.กาญจนดิษฐ์
อ.พุนพิน
อ.เมืองสุราษฎร์ธานี
สัญลักษณ์
จุดเก็บตัวอย่าง
ระดับความลึกของน้ำทะเล (ม.)
เส้นทางน้ำ
ขอบเขตอำเภอ
ปูม้าที่มีไข่นอกกระดอง (ตัว)
0 - 2
2 - 3
3 - 4
4 - 6
6 - 8
Source: Asst. Prof. Dr. Amonsak Sawusdee (Fishery Improvement Program)


Thank You
CHINA
BURMA
VIETNAM
LAOS
THAILAND
PHILIPPINES
MALAYSIA
INDONESIA

ANNEX 17

Siganus fuscescens

Rabbit fish, Mottled spinefoot



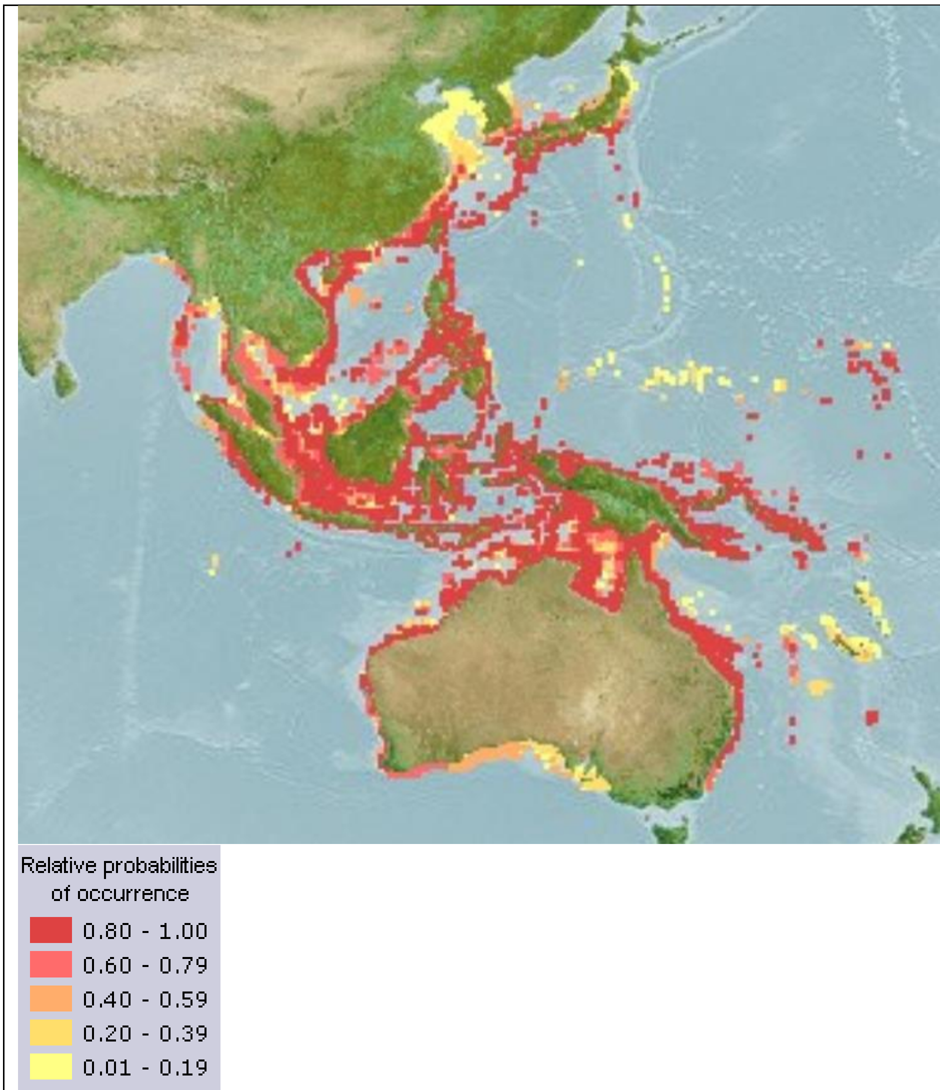
Taxonomy	
Kingdom	Animalia
Subkingdom	Bilateria
Infrakingdom	Deuterostomia
Phylum	Chordata
Subphylum	Vertebrata
Infraphylum	Gnathostomata
Megaclass	Osteichthyes
Superclass	Actinopterygii
Class	Actinopteri
Subclass	Neopterygii
Infraclass	Teleostei
Megacohort	Osteoglossocephalai
Supercohort	Clupeocephala
Cohort	Euteleosteomorpha
Subcohort	Neoteleostei
Infracohort	Eurypterygia
Section	Ctenosquamata
Subsection	Acanthomorphata
Division	Acanthopterygii
Subdivision	Percomorphaceae
Series	Eupercaria
Order	Perciformes

Suborder	Acanthuroidei
Family	Siganidae
Genus	*Siganus*
Species	*Siganus fuscescens*

A. Environment/Ecology:

Marine; brackish; reef-associated; oceanodromous (Ref. 51243); depth range 1 - 50 m (Ref. 9813). Tropical; 42°N - 37°S, 90°E - 171°E

B. Distribution:



Western Pacific: southern Korea, southern Japan, Ogasawara Islands, Taiwan, southern China, Malaysia, Singapore, Thailand, Andaman Islands, Indonesia, Philippines, Yap, Palau, Pohnpei (Caroline Islands), Solomon Islands, Papua New Guinea, Vanuatu, New Caledonia, and Australia. Often misidentified as *Siganus canaliculatus* (Ref. 2334).

C. Length at first maturity / Size / Weight / Age:

Maturity: L_m 5.6 range ? - ? cm Max length : 40.0 cm TL male/unsexed; (Ref. 9813); common length : 25.0 cm TL male/unsexed; (Ref. 9813)

D. Short description

Dorsal spines (total): 13; Dorsal soft rays (total): 10; Anal spines: 7; Anal soft rays: 9; Vertebrae: 13. Body olive green or brown above, silvery below; fish frequently with a dark patch below origin of lateral line. Adults become mottled when frightened. Slender, pungent, venomous spines. Preopercular angle 89°-95°. Lower half to 2/3 of cheeks commonly covered with weak, scattered scales. Midline of thorax between pelvic ridges. Differs from *S. argenteus* in details of coloration and less deeply forked tail (Ref. 37816).

E. Biology

Inhabits algal and seagrass flats and shallow lagoon and coastal reefs (Ref. 9710, 11230). Forms schools. Mainly diurnal. Juveniles feed on filamentous algae, adults feed on leafy algae and seagrasses (Ref. 9710). Commercially cultured in Japan. Commonly found in large estuaries (Ref. 9002). Anterolateral glandular groove with venom gland (Ref. 57406).

F. Life cycle and mating behavior

In Belau, ripe individuals form pre-spawning congregations of 30-60 individuals in shoal areas of inner reef flats; spawning occurs on the 4th or 5th day of the new moon; spawning sites are near reef edge. About 300,000 eggs/female at a single spawning. Individuals that spawn in consecutive yrs. & that 2+ yr. class fish could spawn more than once in a single season. Aug (Ref 1754) in Belau.

G. Fisheries

In Bolinao, Philippines

H. IUCN Red List Status

GEOGRAPHIC RANGE

- Taxonomy

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Siganidae
Genus:	*Siganus*

- **Geographic Range**

NUMBER OF LOCATIONS

UPPER DEPTH LIMIT : 1 metres
LOWER DEPTH LIMIT : 50 metres

- **Population**

DESCRIPTION

Genetic structuring of populations was detected in the Philippines based on mitochondrial DNA (Magsino and Meñez 2008), suggesting that populations may need to be managed as separate stocks. In the Philippines, this species is very heavily exploited but still one of the most common and abundant siganids in markets (K. Carpenter pers. comm. 2015).

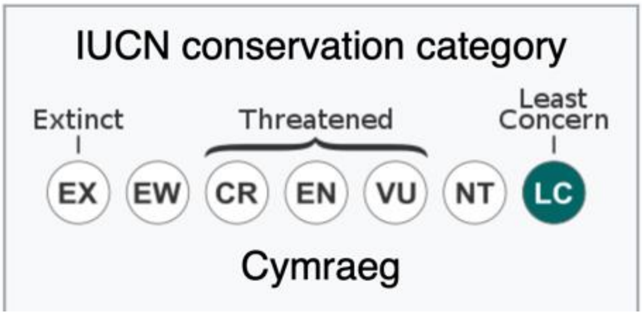
Densities of this species is low to moderate in Raja Ampat and Solomon Islands based on underwater visual surveys (A. Green unpublished data). Surveys around the remote islands of the Solomons showed a mean density of 1.2/ha and data from Raja Ampat showed a mean density of 2.1/ha (A. Green, unpublished data).

- **Habitat and Ecology**

This species is typically found in shallow coastal waters in algal, seagrass and reef habitats to depths of 50 m and appears to prefer clear water (Lieske and Myers 1994, Yamada *et al.* 1995). As juveniles, this species is locally very abundant, forming schools averaging 200 individuals, but up to 5,000. Adults feed on brown and green algae, while juveniles prefer filamentous algae and seagrasses (Woodland 2001). The maximum recorded length for this species is 40 cm TL (Woodland 1997).

- **THREATS**

This species is heavily exploited in parts of its range but this does not currently appear to be a major threat.



- **Use and Trade**

This species is caught with small seine nets, set nets, traps, and by spearing. Adults are marketed fresh, but juveniles are often dried and sold in very large numbers (Woodland 2001).

- **Conservation Actions**

There are no known species-specific conservation measures in place; however, it may occur in marine protected areas throughout its range..

I. More Information:

1) Stocks

(NA)

2) Ecology

Ecology of *Siganus fuscescens*

Main Ref.	Woodland, D.J., 1990
Distribution	Brackishwater • **estuaries/lagoons/brackish seas** Highighted items on the list are where *Siganus fuscescens* may be found.
Remarks	Feeds almost continually during daylight and settles at night to sleep. At Heron Is., the young adults at the water's edge under the lip of the beachrock pavement; older adults against the bases of coral clumps on outer reef flat. A sleeping fish adopt a camouflage pattern (Ref. 1419). Aggregates in March, April and May to spawn (Ref. 1363). Also Ref. 58534.
Substrate	
Special habitats	**Beds:** sea grass; **Coral Reefs**;
Special habitats Ref.	Broad, G., 2003
Feeding	
Feeding type	mainly plants/detritus (troph. 2-2.19)
Feeding type ref	Woodland, D.J., 1990
Feeding habit	grazing on aquatic plants
Trophic level(s)	(see table below)

	Original sample		**Unfished population**		**Remark**
Estimation method	Troph	s.e.	Troph	s.e.	
From diet composition	2.03	0.06			Troph of adults and juv./adults from 1 study.
Ref.					
From individual food items	2.28	0.13			Trophic level estimated from a number of food items using a randomized

						resampling routine.

3) Diet

Food and Feeding Habits: Diet Composition *Siganus fuscescens*

n = 1

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
plants	98	2.0	juv./adults	Kenya	Gazi Bay	111352

4) Reproduction

Reproduction of *Siganus fuscescens*

Main Ref.	Woodland, D.J., 1990
Mode	dioecism
Fertilization	external
Spawning aggregation	Yes. **Ref.** SCRFA, Science and Conservation of Fish Aggregations, 2018
Batch spawner	Yes. **Ref.** Bryan, P.G., B.B. Madrisan and J.P. McVey, 1975
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Description of life cycle and mating behavior	In Belau, ripe individuals form prespawning congregations of 30-60 individuals in shoal areas of inner reef flats; spawning occurs on the 4th or 5th day of the new moon; spawning sites are near reef edge. About 300,000 eggs/female at a single spawning. Individuals that spawn in consecutive yrs. & that 2+ yr. class fish could spawn more than once in a single season. Aug (Ref 1754) in Belau.
Search for more references on reproduction	Scirus

5) Maturity

Maturity studies for *Siganus fuscescens*

n = 2

Sort by ◉ Lm ○ Country ○ Locality ○ tm

Lm (cm)	Length (cm)	Age range (y)	tm (y)	Sex of fish	Country	Locality
5.0 TL	-	-		male	Philippines	Bolinao, Pangasinan
5.6 TL	-	-		female	Philippines	Bolinao, Pangasinan

6) Spawning

Spawning for *Siganus fuscescens*

n = 2

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
		111	111	111								Japan	Japan
111	111	111						111	111	111	111	Philippines	Pujada Bay, southeastern Mindanao (Aug 2002 - Jul 2003)

7) Spawning aggregation

Spawning Aggregations of *Siganus fuscescens*

Country	Spawning type	Aggregation type	Status
Palau	Pair spawning	Transient	Decreasing

8) Fecundity

Fecundity for *Siganus fuscescens*

Sort by ◉ Country ○ Locality

[n = 2]

Country	Locality	Absolute Fecundity	
		min	max
Micronesia	Belau	300,000	0
Philippines	Macambol, Pujada Bay, southeastern Mindanao (Aug 2002 - Jul 2003)	286,384	618,603

9) Eggs

Egg Characteristics of *Siganus fuscescens*

Main Ref.	Woodland, D.J., 1990
Place of Development	on the bottom (demersal)
Attributes	sticky
Additional Characters	Under culture conditions, hatching occurs 24-26 hr after spawning at 29°-32°C, 31-34 ppt salinity.
Get Information on	Scirus

10) Egg development

(NA)

11) Age/Size

List of Population Characteristics records for *Siganus fuscescens*

n = 2

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed		22.5		Philippines	Palawan / 1998-2004
unsexed		40			not specified

12) Growth

Growth parameters for *Siganus fuscescens*

Maximum Length 40cm TL

n = 1

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

ø = 2.73 **L inf** = 25.0 cm TL **K** = 0.9 Median record no. 1 1363Ref. 1363

Loo (cm)	Length Type	K (1/y)	Temp° C	Ø'	Country	Locality	Questionable	Captive
25.0	TL	0.850	28.0	2.73	Philippines	Bolinao, Pangasinan	No	No

13) Length-weight

Length-Weight Parameters for *Siganus fuscescens*

Length-weight (log *a* vs *b*) graph [n=4] Hide graph

Sort by a b Country Locality

Score	a	b	Sex	Length (cm)	Length type	r^2	n	Country	Locality

0.91	0.03700	2.510	unsexed	6.7 - 22.5	TL	0.907	192	Philippines	Palawan / 1998-2004
0.97	0.02660	3.009	mixed		SL	0.973		Philippines	Pujada Bay, southeastern Mindanao (Aug 2002 - Jul 2003)
0.98	0.01620	3.010	unsexed	3.0 - 29.5	TL	0.980	468	New Caledonia	
0.99	0.01373	3.068	mixed	3.0 - 29.5	FL	0.992	481	New Caledonia	

14) Length-length

Length-length Parameters for *Siganus fuscescens*

[n=3]

Unknown length	a	b	Known length	Sex of fish
FL	0.000	0.940	TL	unsexed
SL	0.000	0.895	FL	unsexed
SL	0.000	0.841	TL	unsexed

15)

16) Length-frequencies

List of frequency studies for *Siganus fuscescens*

Locality	Year from - to	Sex	Gear	Frequency type
Bolinao reef, Pangasinan, Philippines	1987 - 1988	unsexed/mixed	gillnets	% of sample

17) Morphometrics

Morphometric Data for *Siganus fuscescens*

n = 3

Picture Name	Length		Lifestage	Aspect ratio
Sifus_u0.gif		none	unsexed	1.95
Sifus_u2.jpg	20.8	FL	unsexed	2.65
Sifus_u4.jpg		none	unsexed	2.07

Picture Used	Sifus_u0.gif
Sex	unsexed
Total length (TL)	547 pixels

Standard length	83.9 % TL
Fork length	94.1 % TL
Pre-anal length	40.4 % TL
Pre-dorsal length	18.1 % TL
Pre-pelvic length	22.5 % TL
Pre-pectoral length	17.7 % TL
Body depth	32.4 % TL
Head length (HL)	17.9 % TL
Eye diameter	31.6 % HL
Pre-orbital length	38.8 % HL
Aspect ratio of caudal fin	1.94772
Picture Used	Sifus_u2.jpg
Size (cm)	20.8 FL
Sex	unsexed
Locality	
Total length (TL)	565 pixels
Standard length	84.1 % TL
Fork length	94.0 % TL
Pre-anal length	41.1 % TL
Pre-dorsal length	18.8 % TL
Pre-pelvic length	24.4 % TL
Pre-pectoral length	16.3 % TL
Body depth	32.9 % TL
Head length (HL)	17.7 % TL
Eye diameter	33.0 % HL
Pre-orbital length	33.0 % HL
Aspect ratio of caudal fin	2.65042

Picture Used	Sifus_u4.jpg
Sex	unsexed
Total length (TL)	552 pixels
Standard length	83.0 % TL
Fork length	95.5 % TL
Pre-anal length	40.6 % TL
Pre-dorsal length	19.7 % TL
Pre-pelvic length	23.0 % TL

Pre-pectoral length	19.7 % TL
Body depth	31.9 % TL
Head length (HL)	19.7 % TL
Eye diameter	42.2 % HL
Pre-orbital length	28.4 % HL
Aspect ratio of caudal fin	2.07135
Remarks	1

18) Morphology

Morphology Data of *Siganus fuscescens*

Identification keys
Abnormalities

Main Ref.	Woodland, D.J., 1990
Appearance refers to	Male; Female
Descriptive characteristics of juvenile and adult	
Striking features	none
Body shape lateral	fusiform / normal
Cross section	compressed
Dorsal head profile	more or less straight
Type of eyes	more or less normal
Type of mouth/snout	more or less normal
Position of mouth	terminal
Type of scales	cycloid scales
Diagnosis	Body olive green or brown above, silvery below; fish frequently with a dark patch below origin of lateral line. Adults become mottled when frightened. Slender, pungent, venomous spines. Preopercular angle 89°-95°. Lower half to 2/3 of cheeks commonly covered with weak, scattered scales. Midline of thorax between pelvic ridges. Differs from *S. argenteus* in details of coloration and less deeply forked tail (Ref. 37816).
Ease of Identification	likely to be confused with closely related species.
Meristic characteristics of Siganus fuscescens	
Lateral Lines	1 Interrupted: No
Scale rows above lateral line	16 - 21
Barbels	0
on lower limb	20 - 25
on upper limb	5 - 7
total	25 - 32

Vertebrae	
preanal	10 - 10
total	13 - 13

Fins

Dorsal fin(s)

Attributes	extending over most of the back length
Fins number	1
Finlets No.	Dorsal 0 - 0
	Ventral 0 - 0
Spines total	13 - 13
Soft-rays total	10 - 10
Adipose fin	absent

Caudal fin

Attributes	forked; more or less normal

Anal fin(s)

Fins number	1
Spines total	7 - 7
Soft-rays total	9 - 9

Paired fins

Pectoral	Attributes more or less normal
	Spines 0
	Soft-rays 15 - 17
Pelvics	Attributes more or less normal
	Position thoracic behind origin of D1
	Spines 2
	Soft-rays 3 - 3

19) Larvae

Larvae Information Summary for *Siganus fuscescens*

Main Ref:	Woodland, D.J. 1990

Yolk-sac larvae

Place of development	planktonic
Larval area	Northwestern Pacific (Japan)

Newly hatched larvae averaged 2.1 mm in length; have a neutral buoyancy at 32.2 ppt salinity & swarm actively towards the surface; begin to feed 3 days after hatching (diet include phyto- & zoo- plankton). Metamorphosis to juvenile depend on nutritional status, occurs when larvae is 20-24 mm SL.

Post larvae

Striking feature	some dorsal fin rays very elongated
Striking shape lateral	normal (not striking)
Striking feature	some dorsal fin rays very elongated
Shape of gut	triangular
Peritoneum	with row of melanophores
Pectorals	normal
Pelvics	with elongated fin rays

20) Recruitment

(NA)

21) Abundance

Abundance List for *Siganus fuscescens*

n = 8

Country	Locality	Year	Qualitative Value	Ref.
Australia	Fog Bay	1988 - 1988	absent	78120
Australia	Gulf of Carpentaria (Eastern Deep)	1988 - 1988	rare	78120
Australia	In the Gulf of Carpentaria (Eastern Deep)	1988 - 1988	absent	78120
Australia	Melville Island and Joseph Bonaparte Gulf	1988 - 1989	absent	78120
Australia	off Goulbourn Is and Gulf of Carpentaria (Shallow)	1988 - 1988	absent	78120
Australia	off Melville Island (Western Deep)	1988 - 1988	absent	78120
Australia	Off the Goulburn Is and Gulf of Carpentaria	1988 - 1988	absent	78120
Australia	Shark Bay, Western Australia	2009 - 2009	very common	115274

References

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4. Lieske, E. and Myers, R. 1994. *Collins Pocket Guide. Coral reef fishes. Indo-Pacific & Caribbean including the Red Sea*. Haper Collins Publishers.
5. Magsino, R.M. and Juinio-Meñez, M.A. 2008. The influence of contrasting life history traits and oceanic processes on genetic structuring of rabbitfish populations *Siganus argenteus* and *Siganus fuscescens* along the eastern Philippine coasts. *Marine Biology* 154(3): 519-532.
6. Woodland, D. 1997. Siganidae. Spinefoots, rabbitfishes. In: Carpenter, K.E. and Niem, V. (eds), *FAO Identification Guide for Fishery Purposes. The Western Central Pacific*, pp. 3627-3650. FAO, Rome.
7. Woodland, D. 2001. Siganidae. Rabbitfishes (spinefoots). In: Carpenter, K.E. and Niem, V. (eds), *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol. 6. Bony fishes part 4 (Labridae to Latimeriidae), estuarine crocodiles, sea turtles, sea snakes and marine mammals.*, pp. 3627-3650. Food and Agriculture Organization of the United Nations, Rome.
8. Yamada, U., Shirai, S., Irie, T., Tokimura, M., Deng, S., Zheng, Y., Li, C., Kim, Y.U. and Kim, Y.S. 1995. *Names and illustrations of fishes from the East China Sea and the Yellow Sea*. Overseas Fishery Cooperation Foundation, Tokyo, Japan.

ANNEX 18

Fenneropenaeus merguiensis

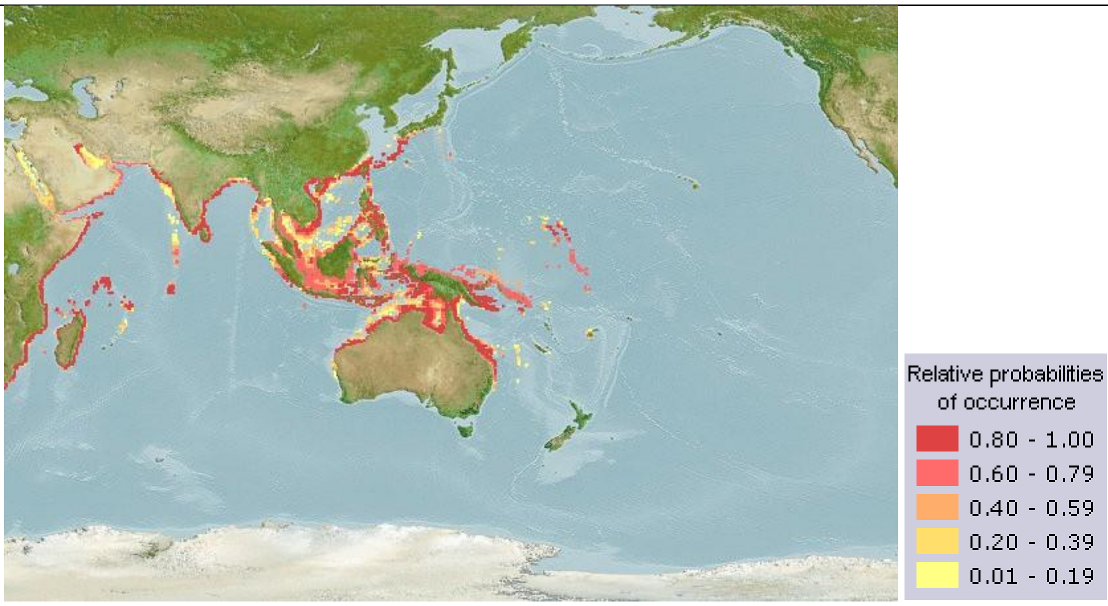
Banana prawn

Scientific classification	
Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Crustacea
Class:	Malacostraca
Order:	Decapoda
Suborder:	Dendrobranchiata
Family:	Penaeidae
Genus:	*Fenneropenaeus*
Species:	***F. merguiensis***
Binomial name	
Fenneropenaeus merguiensis (De man, 1888)	
Synonyms [1]	
• *Penaeus merguiensis* de Man, 1888	

J. Environment/Ecology:

Benthic; brackish; depth range 10 - 55 m (Ref. 8), usually ? - 20 m (Ref. 10). Tropical, preferred 28°C (Ref. 107945); 28°N - 29°S, 39°E - 168°E (Ref. 356)

K. Distribution:



Note: Distribution range colours indicate degree of suitability of habitat which can be interpreted as probabilities of occurrence.

Indo-West Pacific: from Kenya and the Persian Gulf to Hong Kong and Australia.

L. Length at first maturity / Size / Weight / Age:

Maturity: L_m ?, range 3 - ? cm Max length : 24.0 cm TL male/unsexed; (Ref. 8); max. published weight: 50.00 g (Ref. 116487

M. Short description

No dark brown transverse bands on the carapace and abdomen, which are uniformly glabrous. Uniformly high proximal part of triangular rostrum is particular in fully grown female. Rostrum usually armed with 7 or 8 dorsal and 5 or 6 ventral teeth. No lateral spines on telson. Color: in life, cream to yellow, sometimes minutely speckled with brown, olive green or light green pigments. Brown banded antennules; brown antennae not banded; legs and pleopds are yellowish, sometimes tinged with brown or pink; uropods with combinations of yellowish green and brownish shades. Upper margin of rostrum is fringed with brown in fully grown individuals.

N. Biology

Maximum depth from Ref. 10. Maximum standard length: 24.0 cm (Ref. 356). Caught mainly by trawl, gill net, fish corral, push net and filter net (Ref. 10). Occurs in bottom mud or sandy-mud substrates in marine and estuarine environments (Ref. 8). Inhabits shallow open sea or in the mouth of a river and bay areas where water is more or less turbid (Ref. 374). Adult species

periodically form aggregations or 'schools' offshore (Ref. 100847). Omnivore (Ref. 116259). Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer (Ref. 833). Spawning happened throughout the year with one peak in September (Ref. 94177).

O. Life cycle and mating behavior

Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer.

P. Fisheries

The species is commercially of major importance in the Persian Gulf and in Pakistan (Longhurst, 1970:280,281; Tirmizi, in Litt.). In India this species has often been confused with *Penaeus indicus* so that its present economic status is not quite accurately known, but Jones (1967: 1333) pointed out that it definitely contributes to the commercial fishery along the Karwar coast of W. India. Kurian & Sebastian (1976:100) reported that there is a small fishery for this species "in the middle region of east and west coasts" of India, while "juveniles are fished from estuaries". it is not mentioned for Bangladesh by Ahmad (1957), so that it is possible that a confusion with *P. indicus* has occurred here also. *P. merguiensis* is also important off the northwestern coast of Malaya, and possibly the west coast of Thailand, and the Philippines (Longhurst, 1970:284-290). In Indonesia it is taken by trawlers off E. Sumatra, the south coast of Java, off Borneo and in the Arafura Sea, being the dominant species there. In Australia it is the most important commercial species of Queensland, and also in Western Australia it may become very important (Racek, 1955:222; 1957:12). In the Gulf of Papua it is trawled for; the catch is frozen.It plays a role in pond culture in Thailand (Shigueno, 1975:120) and in Indonesia. The total catch reported for this species to FAO for 1999 was 78 743 t. The countries with the largest catches were Indonesia (65 230 t) and Thailand (9 200 t).

Q. IUCN Red List Status

(NA)

R. More Information:

22) Stocks

(NA)

23) Ecology

Ecology of *Fenneropenaeus merguiensis*

Main Ref.	Holthuis, L.B., 1980
distribution	Brackishwater • **estuaries/lagoons/brackish seas**

	Highighted items on the list are where *Fenneropenaeus merguiensis* may be found.
Remarks	Occurs in bottom mud or sandy-mud substrates in marine and estuarine environments (Ref. 8). Inhabits shallow open sea or in the mouth of a river and bay areas where water is more or less turbid (Ref. 374). Adult species periodically form aggregations or 'schools' offshore (Ref. 100847). Omnivore (Ref. 116259).

Substrate

Substrate	**Benthic**: mobile; **Soft Bottom**: sand; mud;
Substrate Ref.	del Mundo, C.M., 2000
Special habitats	
Special habitats Ref.	

Feeding

feeding type	mainly animals (troph. 2.8 and up)
feeding type ref	Wassenberg, T.J. and B.J. Hill, 1993
feeding habit	hunting macrofauna (predator)
feeding habit ref	Wassenberg, T.J. and B.J. Hill, 1993
trophic level(s)	see table below

	original sample		**unfished population**		**Remark**
estimation method	Troph	s.e.	Troph	s.e.	
From diet composition					
Ref.					
From individual food items	3.77	0.36			Trophic level estimated from a number of food items using a randomized resampling routine.

24) Diet

(NA)

25) Reproduction

Reproduction of *Fenneropenaeus merguiensis*

Main Ref.	Ruppert, E.E., R.S. Fox and R.D. Barnes, 2004
Mode	dioecism
Fertilization	
Spawning Frequency	
Batch Spawner	No
Reproductive Guild	bearers External brooders
Description of life cycle and mating behavior	Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer.
Search for more references on reproduction	Scirus

26) Maturity

Maturity studies for *Fenneropenaeus merguiensis*

n = 1

Sort by Lm Country Locality tm

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	2.5	-		0.5	-			unsexed		Unspecified

27) Spawning

Spawning for *Fenneropenaeus merguiensis*

n = 1

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
								111				Indonesia	Kotabaru waters, South Kalimantan

28) Spawning aggregation

(NA)

29) Fecundity

(NA)

30) Eggs

(NA)

31) Egg development

(NA)

32) Age/Size

List of Population Characteristics records for *Fenneropenaeus merguiensis*

n = 4

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed	50.00 g			Philippines	Unspecified, Philippines
male		18.3		India	Maharashtra / 2014-2014
male		19.5		Philippines	Unspecified, Philippines
female		24		Philippines	Unspecified, Philippines

33) Growth

Growth parameters for *Fenneropenaeus merguiensis*

Maximum Length 24cm TL

n = 19

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Auximetric graph	[n = 7]
M vs K graph	[n = 18]
M vs Linf graph	[n = 18]
Longevity vs 3/K graph	[n = 2]

ø = 1.62 **L inf** = 5.0 cm CL **K** = 1.7 Median record no. 10 Ref. 85250

Loo (cm)	Length Type	K (1/ y)	to	Sex	M (1/y)	Temp° C	Lm	Ø'	Country	Locality	Questionable	Captive
3.80	CL	4.160						1.78	USA	Gulf of Carpentaria	Yes	No

3.95	CL	1.800	-0.08	M	2.90			1.45	Iran	Strait of Hormoz	Yes	No
4.43	CL	1.400			1.96			1.44	Indonesia	Kotabaru, South Kalimantan	Yes	No
4.45	CL	1.310		M	3.70	29.00		1.41	Indonesia	Cilacap, south coast of Java	Yes	No
4.90	CL	1.625			2.16			1.59		Arafura Sea	Yes	No
4.99	CL	1.425			1.97			1.55		Arafura Sea	Yes	No
5.00	CL	1.400			1.95			1.54		Arafura Sea	Yes	No
5.00	CL	1.475			2.01			1.57		Arafura Sea	Yes	No
5.00	CL	1.500	-0.09	F	2.50			1.57	Iran	Strait of Hormoz	No	No
5.01	CL	1.650			2.17			1.62		Arafura Sea	Yes	No
5.02	CL	1.650			2.16			1.62		Arafura Sea	Yes	No
5.04	CL	1.875			2.35			1.68		Arafura Sea	Yes	No
5.15	CL	1.050		F	3.10	29.00		1.44	Indonesia	Cilacap, south coast of Java	No	No
5.20	CL	1.750			1.81			1.68		Arafura Sea	Yes	No
19.20	TL	2.000		F	3.18			2.87	India	Maharashtra	No	No
19.90	TL	1.400		M	2.50			2.74	India	Maharashtra	No	No
20.50	TL	2.000		M	3.13			2.92	India	Maharashtra	No	No
25.20	TL	1.200		M	2.11			2.88	India	Maharashtra	No	No
25.20	TL	1.900		F	2.85			3.08	India	Maharashtra	No	No

34) Length-weight

Length-Weight Parameters for *Fenneropenaeus merguiensis*

Length-weight (a vs b) graph	[n=2]	Median Record No. 2 **a** = 0.9497 cm CL **b** = 2.8015 Ref. 118083

Sort by b Country Locality

a	b	Doubtful?	Sex	Length (cm)	Length type	No.	Country	Locality
0.9147	2.785	No	female	1.3 - 4.7	CL	633	Iran	Strait of Hormoz / 2012-2013
0.9497	2.802	No	male	1.3 - 3.7	CL	705	Iran	Strait of Hormoz / 2012-2013

35) Length-length

(NA)

36) Length-frequencies

(NA)

37) Morphometrics

(NA)

38) Morphology

Morphology data of *Fenneropenaeus merguiensis*

Identification keys

Main Ref.	Motoh, H., 1980

Descriptive characteristics of juvenile and adult

Diagnosis	No dark brown transverse bands on the carapace and abdomen, which are uniformly glabrous. Uniformly high proximal part of triangular rostrum is particular in fully grown female. Rostrum usually armed with 7 or 8 dorsal and 5 or 6 ventral teeth. No lateral spines on telson. Color: in life, cream to yellow, sometimes minutely speckled with brown, olive green or light green pigments. Brown banded antennules; brown antennae not banded; legs and pleopds are yellowish, sometimes tinged with brown or pink; uropods with combinations of yellowish green and brownish shades. Upper margin of rostrum is fringed with brown in fully grown individuals.

Meristic characteristics of Fenneropenaeus merguiensis

Lateral Lines	Interrupted: No

Fins

Dorsal fin(s)

Finlets No.	Dorsal
	Ventral

Paired fins

Pectoral	Attributes
	spines
	soft-rays
Pelvics	Attributes
	Position
	spines
	soft-rays

39) Larvae

(NA)

40) Recruitment

(NA)

41) Abundance

(NA)

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ANNEX 19

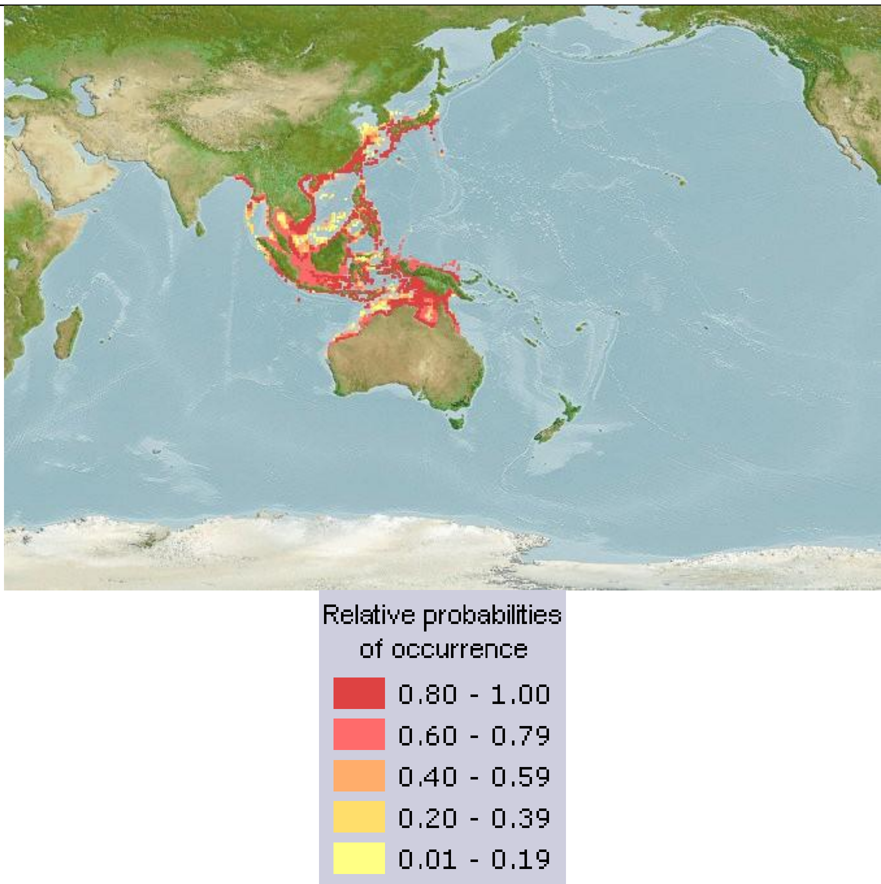
Portunus pelagicus
Blue Swimming Crab

Scientific classification	
Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Crustacea
Class:	Malacostraca
Order:	Decapoda
Infraorder:	Brachyura
Family:	Portunidae
Genus:	*Portunus*
Species:	***P. armatus***
Binomial name	
Portunus armatus (Linnaeus, 1758)	
Synonyms	
Cancer pelagicus Linnaeus, 1758	

S. Environment/Ecology:

Reef-associated; brackish; depth range 0 - 65 m (Ref. 111223). Tropical, preferred 26°C (Ref. 107945); 35°N - 15°S, 99°E - 137°E

T. Distribution:



A tropical species, blue swimmer crabs are found in estuaries and inshore marine waters, mainly between Nickol Bay and Dunsborough. They are also found off northern and eastern Australia and are widely distributed in the Indian and Pacific oceans, including the east coast of Africa and southern Japan. They have even been found in the Mediterranean Sea, having entered via the Suez Canal.

U. Length at first maturity / Size / Weight / Age:

Maturity: L_m 7.3, range 3 - ? cm
Max length : 20.0 cm CW male/unsexed; (Ref. 343)
Blue swimmer crabs are sometimes called 'blue manna'. In WA, they can grow to have a carapace up to 25 centimetres wide and a claw span up to 80 centimetres. The biggest blue swimmer crab caught in WA weighed more than a kilogram. These crabs belong to the Portunidae family, which also includes other large, edible crabs found in Australia such as mud crabs. Crabs from this family can usually be recognised by their flat, discshaped hind legs, used as paddles for swimming and by the nine spikes, called horns, along their carapace, either side of their eyes.
Size limit A Blue Swimmer Crab is undersized if the carapace is less than 11 cm when measured from side to side at the base of the largest spines. Size limits apply in all waters of the state
Length at First Maturity= carapace size of 10.5 cm for females and 9.6 cm for males Size= maximum size of 14 to 15 cm Weight= ?? Age= ??(FiA,2020).

V. Short description

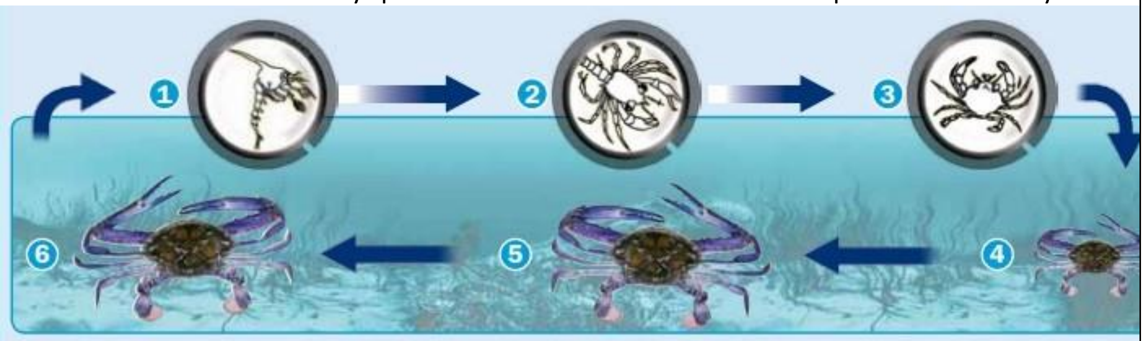
Carapace rough to granulose, regions discernible; front with 4 acutely triangular teeth; 9 teeth on each anterolateral margin, the last tooth 2 to 4 times larger than preceding teeth. Chelae elongate in males; larger chela with conical tooth at base of fingers; pollex ridged. Color: males with blue markings, females dull green.

W. Biology

Matures at about 1 year. Collected mainly by artisanal traps, trawls, beach seines, cylindrical wire traps, folding traps, pots, hop nets, drop nets, and sunken crab gill nets. In shallow waters, it is caught using beach seines, rakes, and dab nets. Sold in local markets (fresh or frozen) and for the crab-flesh canning industry. Most widely sold in markets of Southeast Asia, including the Philippines (Ref. 343). Maximum depth from Ref. 801. Immediate subtidal to a depth of 40 m (Ref. 801), on sandy to sandy-muddy substrates in areas near reefs, mangroves, and sea grass and algal beds (Ref. 343). Juveniles tend to occur in shallow intertidal areas (Ref. 343). Burrows in sand when disturbed; carnivorous and voracious predator (Ref. 801). Host to protozoans, helminths and crustaceans (Ref. 104981). Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer (Ref. 833). Spawning occurs throughout the year, with peaks in December, March and August (Ref. 119312).

X. Life cycle and mating behavior

The timing and movements of blue swimmer crabs vary between locations. Estuarine crabs, such as those living in the Leschenault Inlet, Peel-Harvey Estuary and Swan River, tend to move from estuaries into nearby marine waters during winter. Crabs in marine embayments such as Cockburn Sound and Shark Bay spend their entire lives within different parts of the embayment.



Juvenile crabs

By autumn, most megalopae have formed into juvenile crabs with a recognisable crab shape and carapace three to six centimetres wide. They continue growing rapidly.

Mating

Most blue swimmer crabs mate in autumn. The males moult first, so that their shells have hardened beforehand. A courting male then catches a female and carries her beneath him for four to 10 days while fending off other males. The male helps the female to moult and then turns her over to mate while she is still soft-shelled. After mating, he continues to carry her around and protect her for another three-to-four days while her
shell hardens. A male may mate with several females during one season. The female crabs retain the males' sperm over winter until their ovaries develop – helped, it is thought, by the rising water temperature in spring.

Y. Fisheries

Mainly collected by artisanal traps, trawls, beach seines, cylindrical wire traps, folding traps, pots, hop nets, drop nets and crab gill nets. The total catch reported for this species to FAO for 1999 was 133 938 t. The countries with the largest catches were China (52 577 t) and Philippines (34 076 t). For sale in local markets (frozen or fresh) and for the crab-flesh canning industry. It attains lower prices than Scylla although crabs of *Portunus* are taken in larger quantities.

Z. IUCN Red List Status

(NA)

AA. More Information:

42) Stocks

(NA)

43) Ecology

Ecology of ***Portunus Pelagicus***

Main Ref.	Ng, P.K.L., 1998
distribution	Marine - Neritic • **littoral zone** • **sublittoral zone** Brackishwater • **estuaries/lagoons/brackish seas** • **mangroves** Highighted items on the list are where *Portunus pelagicus* may be found.
Remarks	Immediate subtidal to a depth of 40 m (Ref. 801), on sandy to sandy-muddy substrates in areas near reefs, mangroves, and sea grass and algal beds (Ref. 343). Juveniles tend to occur in shallow intertidal areas (Ref. 343). Burrows in sand when disturbed; carnivorous and voracious predator (Ref. 801). Host to protozoans, helminths and crustaceans (Ref. 104981).

Substrate

Substrate	**Benthic**: mobile; demersal; megabenthos; **Soft Bottom**: sand; mud;
Substrate Ref.	Ng, P.K.L., 1998
Special habitats	**Beds:** algae/seaweed; sea grass; **Coral Reefs**;
Special habitats Ref.	Ng, P.K.L., 1998

Associations

Ref.	Ng, P.K.L., 1998
associations	parasitism;
Associated with	protozoa *Opercularielia* sp., *Acineta* sp., *Thelohania* sp., *Nematopsis* sp., *Ameson* sp., *Hematodinium* sp.; helminths planoceroid turbellarian, tetraphyllid cestode, *Levinseniella* sp., *Polypocephalus moretonensis*, *Carcinonemertes mitsukurii*; crustaceans *Choniosphaera indica*, *Sacculina granifera*, *Octolasmis* spp., *Chelonibia patula* (Ref. 104981).
Association remarks	
Parasitism	outside host (*Chelonibia patula* is found on the crab's carapace (Ref. 104981).) inside host (All species are endoparasitic except *Chelonibia patula* (Ref. 104981).)

Feeding

feeding type	plants/detritus+animals (troph. 2.2-2.79)
feeding type ref	de Lestang, S., I.C. Platell and M.E. Potter, 2000
feeding habit	hunting macrofauna (predator)
feeding habit ref	de Lestang, S., I.C. Platell and M.E. Potter, 2000
trophic level(s)	see table below

	original sample		**unfished population**		**Remark**
estimation method	Troph	s.e.	Troph	s.e.	
From diet composition	2.48	0.19			Troph of juv./adults.
Ref.	de Lestang, S., I.C. Platell and M.E. Potter, 2000				
From individual food items	3.54	0.46			Trophic level estimated from a number of food items using a randomized resampling routine.

44) Diet

Food and Feeding Habits: Diet Composition *Portunus Pelagicus*

n = 35

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747

detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	59	2.5	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South,	8747

					115°40'East), Australia	
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
detritus	55	2.6	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747
zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747

	zoobenthos	33	3.1	juv./adults	Australia	Leschenault estuaries (33°12'South and 115°40'East)	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	
	zoobenthos	29	3.2	juv./adults	Australia	Peel-Harvey (32°40'South, 115°40'East), Australia	8747	

45) Reproduction

Reproduction of *Portunus Pelagicus*

Main Ref.	Ruppert, E.E., R.S. Fox and R.D. Barnes, 2004
Mode	dioecism
Fertilization	
Spawning Frequency	two seasonal peaks per year
Batch Spawner	No
Reproductive Guild	bearers External brooders
Description of life cycle and mating behavior	Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer.
Search for more references on reproduction	Scirus

46) Maturity

Maturity studies for *Portunus Pelagicus*

n = 10

Lm vs Linf graph

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	7.9	-	9.0		-			mixed	Australia	Moreton Bay
	7.0	-	8.0		-			unsexed	Qatar	Doha
	3.2	-			-			female	Iran	Bandar Abbas, Hormozgan / 2006-2007
	6.0	-	6.5		-			mixed	Oman	Gulf of Oman and Arabian Sea / 2011-2012
4.4 CL		-			-			female	India	Kakinada/ Jan 1979-Dec 1980
7.5 CW	5.8	-			-			female	Thailand	Kung Krabaen Bay/ 2008-2009
7.5 CW	5.8	-			-			female	Thailand	Kung Krabaen Bay, Chanthaburi / 2008-2009
9.6 CW		-			-			unsexed	India	Karnataka/ 2011-2012
9.6 CW		-			-			female	India	Karnataka / 2001-2005

	12.0 CW		-			-			mixed	Indonesia	Kendari Bay / 2016-2016	

47) Spawning

Spawning for *Portunus Pelagicus*

n = 9

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
2	3	0	3	3	3	3	3	2	2	2	3	Iran	Bandar Abbas, Hormozgan
				111							111	Indonesia	Bone Bay, Sulawesi
111	111	111					111	111	111		111	Qatar	Doha
111								111	111	111	111	India	Kakinada/ Jan 1979-Dec 1980
111	111	111	111	111	111	111	111	111	111	111	111	India	Karnataka
111	111	111	111	111	111	111	111	111	111	111	111	India	Kerala
3	3	6	2	1	1	3	4	2	3	2	4	Thailand	Kung Krabaen Bay, Chanthaburi
111	111	111	111	111	111	111	111	111	111	111	111	Indonesia	Pangkep
111	111	111	111	111	111	111	111	111	111	111	111	India	Tuticorin

48) Spawning aggregation

(NA)

49) Fecundity

Fecundity for *Portunus Pelagicus*

Sort by Country Locality

[n = 5]

Country	Locality	Absolute Fecundity			Relative Fecundity			Fecundity/length relationship	
		Min	Max	Mean	Min	Max	Mean	a	b
Australia	Moreton Bay	103,000	1,880,000	0				431.51	3.145
India	Palk Bay	60,000	1,976,398	0					
Iran	Bandar Abbas, Hormozgan	277,421	1,114,348	662,978					

Qatar	Doha	150	450,000	0				0.782	2.78
Thailand	Kung Krabaen Bay, Chanthaburi	148,237	1,448,180	572,138					

50) Eggs

Egg Characteristics of *Portunus Pelagicus*

The eggs are fertilised by the stored sperm and, when laid, they attach to hairs in a spongy mass under the female's abdomen. The eggs go from orange to black as they mature. The term for a female crab carrying egg clusters in this way is 'berried'. Any berried females caught by fishers must be returned to the water. The female incubates the eggs for about 18 days. When the embryos inside are mature she shakes the eggs off her abdomen and they hatch into zoea

51) Egg development

(NA)

52) Age/Size

List of Population Characteristics records for *Portunus Pelagicus*

n = 32

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed		7		Philippines	central Visayan region
female		7.4		Indonesia	Brebes coast, central Jawa
male		7.5		Indonesia	Brebes coast, central Jawa
male	675.00 g	9.2		Oman	Gulf of Oman and Arabian Sea / 2011-2012
female	730.00 g	9.6		Oman	Gulf of Oman and Arabian Sea / 2011-2012
female		9.989		Indonesia	PGN Bay, Labuhan Maringgai, East Lampung
female	136.70 g	10.1		Bahrain	Barbar, 2004-2005
male	227.69 g	11.5		Bahrain	Barbar, 2004-2005
male		12.08		Indonesia	PGN Bay, Labuhan Maringgai, East Lampung
unsexed		12.5		India	Karnataka/ 2011-2012

unsexed		13		India	Kerala/ 2011-2012
unsexed		14		India	Kerala/ 2012-2013
male		14.77		Indonesia	Lasongko Bay, central Buton / 2013-2014
female		14.83		Indonesia	Pati coast, central Jawa / 2012-2013
male		15.94		Indonesia	Pati coast, central Jawa / 2012-2013
unsexed		16		India	Karnataka and Goa
unsexed		16		India	Thoppukadu / 1995-1998
male		16		Bahrain	Unspecified, Bahrain
female		16.22		Indonesia	Lasongko Bay, central Buton / 2013-2014
male		16.5		India	Karnataka / 2001-2005
male	270.83 g	16.7		India	Karnataka / 1992-1994
female		17		India	Karnataka / 2001-2005
unsexed	409.00 g	17		Pakistan	Pakistan coastline, 2015-2015
unsexed		17.3		Iran	Bandar Abbas, Hormozgan / 2006-2007
female	317.26 g	17.3		India	Karnataka / 1992-1994
unsexed		18		India	Gulf of Mannar, Mandapam / 1995-1998
unsexed		18.2		India	Devipattinam / 1995-1998
female		18.5		Australia	Unspecified, Australia
male	420.00 g	18.6		China	Beibu Gulf, Hainan Islands, South China Sea, Mar 1997-Apr 1999

53) Growth

Growth parameters for *Portunus Pelagicus*

Maximum Length 20cm CW n = 52

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Auximetric graph	[n = 45]
Lm vs Linf graph	[n = 8]
M vs K graph	[n = 38]

M vs Linf graph	[n = 38]

ø = 2.61 **L inf** = 17.0 cm CW **K** = 1.4 Median record no. 27 Ref. 116321

Loo (cm)	Length Type	K (1/y)	to	Sex	M (1/y)	Temp° C	Lm	ø '	Country	Locality	Questionable	Captive
5.90	CL	1.900						1.82	Pakistan	Bhanbhore	Yes	Yes
8.11	CL	0.780		F	1.53			1.71	Indonesia	Brebes coast, central Jawa	No	No
8.14	CL	1.200		M	1.53			1.90	Indonesia	Brebes coast, central Jawa	Yes	No
10.28	CL	1.850		M	3.15			2.29	Oman	Gulf of Oman and Arabian Sea	No	No
10.96	CL	1.680		F	3.15			2.30	Oman	Gulf of Oman and Arabian Sea	No	No
11.91	CW	3.110	0.25	M				2.64	Australia	Leschenault Estuary and Koombana Bay	No	No
12.47	CW	2.670	0.25	F				2.62	Australia	Leschenault Estuary and Koombana Bay	Yes	No
12.59	CW	2.820	1.70					2.65	Australia	Peel-Harvey Estuary	Yes	No
12.89	CW	0.100	0.10					1.22	Australia	Peel-Harvey Estuary	Yes	No
13.10	CL	1.420						2.39	Pakistan	Miani Hor	No	Yes

14.26	CW	2.750		M	3.98			2.75	Thailand	Kung Krabaen Bay	No	Yes
14.26	CW	2.750		M	3.98			2.75	Thailand	Kung Krabaen Bay, Chanthaburi	No	No
14.80	CL	1.730						2.58	Pakistan	Korangi Creek	No	Yes
15.00	CW	2.370						2.73	Qatar	Doha	No	Yes
15.20	CW	0.930	-0.96	M	1.09			2.33	Indonesia	Lasongko Bay, central Buton	No	No
15.27	CW	1.500	0.57					2.54	Australia	Cockburn Sound	No	No
15.40	CW	1.090	-0.09	F	1.21	29.00	7.16300	2.41	Indonesia	Bone Bay, Sulawesi	No	No
15.57	CW	3.000	0.10					2.86	Australia	Peel-Harvey Estuary	No	No
15.90	CW	1.270	-0.08	M	1.33	29.00	7.16300	2.51	Indonesia	Bone Bay, Sulawesi	No	No
15.90	CW	2.630						2.82	Qatar	Doha	No	Yes
16.30	CW	1.500	0.59				9.60000	2.60	India	Karnataka and Goa	No	No
16.73	CW	1.130		F	2.07		7.52000	2.50	Thailand	Kung Krabaen Bay	No	Yes
16.73	CW	1.130		F	2.07		7.52000	2.50	Thailand	Kung Krabaen Bay, Chanthaburi	No	No
16.80	CW	1.200	-0.04	M	1.21	26.32		2.53	Iran	Bandar Abbas, Hormozgan	No	No
16.90	CW	1.700		M	2.50			2.69	India	Tamil Nadu	No	No

16.90	CW	1.300	-0.04	M	2.20			2.57	India	Karnataka	Yes	No
17.00	CW	1.400		F	1.50			2.61	India	Tamil Nadu	No	No
17.00	CW	1.400	-0.04	F	2.20			2.61	India	Karnataka	No	No
17.10	CW	1.600	-0.04	F	1.61			2.67	Thailand	Trang Province	No	No
17.30	CW	1.300	-0.08		2.50		9.60000	2.59	India	Karnataka	No	No
17.30	CW	0.680	-0.84	F	0.86			2.31	Indonesia	Lasongko Bay, central Buton	No	No
17.38	CW	1.200	-0.08	M	1.44			2.56	Indonesia	Pangkep	No	Yes
17.40	CW	1.600			1.54			2.69	India	Karnataka and Goa	No	Yes
17.61	CW	1.300			2.54			2.61	Philippines	Sorsogon Bay	No	Yes
17.79	CW	1.100	-0.04	F	1.13			2.54	Iran	Bandar Abbas, Hormozgan	No	No
17.90	CW	1.500	-0.04	M	1.61			2.68	Thailand	Trang Province	No	No
18.20	CW	0.910			1.07			2.48	Indonesia	Kendari Bay	Yes	No
18.50	CW	1.600		F	1.42			2.74	Iran	Persian Gulf and Oman Sea	No	No
18.50	CW	1.260	-0.00	M	1.27			2.63	Indonesia	Pati coast, central Jawa	No	No
18.64	CW	1.500	-0.06	F	1.27			2.72	Indonesia	Pangkep	No	Yes

18.70	CW	1.130	-0.00	F	1.18			2.60	Indonesia	Pati coast, central Jawa	No	No
19.10	CW	1.700		M	1.47			2.79	Iran	Persian Gulf and Oman Sea	No	No
19.50	CW	0.840		F				2.50	Philippines	Panay	No	Yes
19.50	CW	1.600		M	2.50		9.30000	2.78	India	Tuticorin	No	No
19.51	CW	1.000		F	2.11	29.00		2.58	India	Palk Bay and Gulf of Mannar	No	No
20.00	CW	0.870		M				2.54	Philippines	Panay	No	Yes
20.40	CW	0.970	-0.07	F	1.60			2.61	India	Karnataka	No	No
20.98	CW	0.840			1.82			2.57	Philippines	San Miguel Bay	No	Yes
21.00	CW	1.300		F	2.00		11.80000	2.76	India	Tuticorin	No	No
21.10	CW	1.140	-0.09	M	1.70			2.71	India	Karnataka	No	No
21.36	CW	0.870			1.85			2.60	Philippines	San Miguel Bay	No	No
22.30	CW	0.950		M	2.72	29.00		2.67	India	Palk Bay and Gulf of Mannar	No	No

54) Length-weight

Length-Weight Parameters for *Portunus Pelagicus*

Length-weight (a vs b) graph	[n=58]	Median Record No. 30 **a** = 0.1326 cm CW **b** = 2.9864 Ref. 117381

a	b	Doubtful?	Sex	Length (cm)	Length type	No.	Country	Locality

1.8368	1.720	Yes	male		CW	389	Philippines	Panay / 2002-2002
1.2035	1.850	Yes	female		CW	366	Philippines	Panay / 2002-2002
0.0216	2.340	Yes	male		CL	60	China	Hainan Island, North Bay / 1997-1999
0.9672	2.440	Yes	male		CL	419	Pakistan	Sindh and Balochistan coasts / 2015-2015
1.2974	2.511	Yes	male	3.2 - 6.1	CL	27	Egypt	Lake Timsah / 2014-2014
0.2040	2.560	No	male		CW	419	Pakistan	Sindh and Balochistan coasts / 2015-2015
0.3600	2.567	No	male		CW		Qatar	Ras Rakan to Al Wakrah / 2014-2014
0.2600	2.665	No	female		CW		Qatar	Ras Rakan to Al Wakrah / 2014-2014
0.9796	2.690	Yes	female	3.4 - 5.7	CL	77	Egypt	Lake Timsah / 2014-2014
0.3478	2.719	No	male	4.5 - 15.4	CW	170	India	Kakinada / 1979-1980
0.5248	2.720	Yes	female	7.1 - 11.8	CW	77	Egypt	Lake Timsah / 2014-2014
0.2171	2.725	No	mixed	4.5 - 15.4	CW	340	India	Kakinada / 1979-1980
0.2888	2.730	No	mixed		CL	897	Pakistan	Sindh and Balochistan coasts / 2015-2015
0.1120	2.748		female		CW	348	Iran	Bandar Abbas, Hormozgan / 2006-2007
0.1143	2.757		male		CW	424	Iran	Bandar Abbas,

								Hormozgan / 2006-2007
0.1198	2.790	No	mixed	7.0 - 17.0	CW	897	Pakistan	Sindh and Balochistan coasts / 2015-2015
0.1694	2.839	No	female	4.9 - 15.4	CW	170	India	Kakinada / 1979-1980
0.0855	2.860		female		CW	859	Indonesia	Kendari Bay / 2016-2016
0.8845	2.868		female	3.9 - 9.6	CL	414	Oman	Gulf of Oman and Arabian Sea / 2011-2012
0.1568	2.894	No	female		CW		Thailand	Kung Krabaen Bay / 2008-2009
0.0784	2.894		female		CW		Thailand	Kung Krabaen Bay, Chanthaburi / 2008-2009
1.1700	2.910	No	male		CW		Philippines	San Miguel Bay / 2011-2012
0.9670	2.910	No	female		CL	478	Pakistan	Sindh and Balochistan coasts / 2015-2015
0.0834	2.921		male		CW		Thailand	Kung Krabaen Bay, Chanthaburi / 2008-2009
0.1668	2.921	No	male		CW		Thailand	Kung Krabaen Bay / 2008-2009
1.2100	2.940	No	mixed		CW		Philippines	San Miguel Bay / 2011-2012
0.8138	2.950	No	female		CW	478	Pakistan	Sindh and Balochistan

								coasts / 2015-2015
1.2500	2.970	No	female		CW		Philippines	San Miguel Bay / 2011-2012
0.9333	2.970	Yes	male	6.4 - 11.8	CW	27	Egypt	Lake Timsah / 2014-2014
0.1326	2.986	No	female	2.6 - 14.8	CW	260	Pakistan	Pakistan coast / 2004-2005
0.8212	3.000	No	female		CL	10	Iran	Persian Gulf / 2009-2009
0.8559	3.000	No	male		CL	8	Iran	Persian Gulf / 2009-2009
1.0000	3.000	No	female	3.4 - 7.0	CL	56	Egypt	Lake Bardaweel / 2014-2014
0.1302	3.009	No	mixed	2.3 - 14.8	CW	540	Pakistan	Pakistan coast / 2004-2005
0.1312	3.028	No	male	2.3 - 13.5	CW	280	Pakistan	Pakistan coast / 2004-2005
0.0679	3.056	No	female		CW	1076		Peel-Harvey estuary (32°32' S, 115°43' E) / 1980-1981
0.1148	3.110	No	male	5.2 - 11.5	CW	163	Bahrain	Barbar / 2004-2005
1.3490	3.130	No	female	7.0 - 13.5	CW	56	Egypt	Lake Bardaweel / 2014-2014
0.0605	3.132	No	mixed		CW	80	China	Hainan Island, North Bay / 1997-1999
0.1422	3.153	No	male	3.2 - 7.2	CL	56	Egypt	Lake Bardaweel / 2014-2014
0.4510	3.177		male	2.7 - 9.2	CL	584	Oman	Gulf of Oman and Arabian Sea / 2011-2012

0.0425	3.186		female		CW		Thailand	Trang Province / 2006-2007
0.1016	3.213	No	female		CW	70	China	Hainan Island, North Bay / 1997-1999
0.0404	3.219		male		CW		Thailand	Trang Province / 2006-2007
0.0285	3.221		female		CW	158	India	Karnataka / 2001-2005
0.0292	3.253		female	8.0 - 17.3	CW	106	India	Karnataka / 1992-1994
0.0356	3.259		female		CW		Indonesia	Pati coast, central Jawa / 2012-2013
0.0466	3.260	No	male		CW	694		Peel-Harvey estuary (32°32' S, 115°43' E) / 1980-1981
0.1820	3.284	No	mixed		CL	70	China	Hainan Island, North Bay / 1997-1999
0.0555	3.310		male		CW	784	Indonesia	Kendari Bay / 2016-2016
0.1976	3.330	No	female		CL	60	China	Hainan Island, North Bay / 1997-1999
0.0220	3.342		male		CW		Indonesia	Pati coast, central Jawa / 2012-2013
1.8100	3.360	No	mixed	3.6 - 17.0	CW		Philippines	Unspecified
0.0234	3.366	No	unsexed		CW		India	Karnataka and Goa
0.0597	3.404	No	male		CW	70	China	Hainan Island, North Bay / 1997-1999

	2.7542	3.440	No	male	5.9 - 13.6	CW	54	Egypt	Lake Bardaweel / 2014-2014
	0.0201	3.486		male		CW	156	India	Karnataka / 2001-2005
	0.0132	3.617		male	8.1 - 16.7	CW	111	India	Karnataka / 1992-1994

55) Length-length

Length-length Parameters for *Portunus Pelagicus*

n=12

Unknown length	a	b	Known length	r	Length range (cm)			Sex of fish
CL	0.208	0.593	CW	0.97		-		male
CL	0.091	0.619	CW	0.96		-		female
CW	0.156	0.480	CL	0.87		-		male
CW	0.048	0.490	CL	0.9		-		female
CW	0.008	0.500	CL	0.92		-		female
CW	0.014	0.510	CL	0.95		-		male
CW	1.139	1.564	CL	0.92957	2.2	-	9.3	male
CW	0.499	1.640	CL	0.962393	2.7	-	8.5	female
CW	0.973	1.952	CL	0.983	2.7	-	9.2	male
CW	0.882	1.979	CL	0.984	3.9	-	9.6	female
OT	-0.269	0.848	CW	0.99		-		female
OT	-0.525	0.884	CW	0.99		-		male

56) Length-frequencies

(NA)

57) Morphometrics

(NA)

58) Morphology

(NA)

59) Larvae

(NA)

60) Recruitment

A term used by researchers to describe the addition of crabs or fish (juvenile or of legal size) to a population, either by reproduction or migration. Levels of recruitment of adult crabs to WA's blue swimmer crab populations fluctuate considerably. A range of environmental factors – including water temperature variations, the relative strength of wind and current systems, and the amount and timing of rainfall – can affect the survival and growth rates of crab larvae and juveniles. This in term leads to big fluctuations in the available crab harvest from time to time. Estuaries along WA's west coast, including the PeelHarvey near Mandurah, are under pressure from rapid population growth. This includes increases in recreational and commercial fishing activity, urban development and associated environmental change, which may also affect crab recruitment.

61) Abundance

(NA)

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ANNEX 20

Auxis thazard

Frigate Tuna

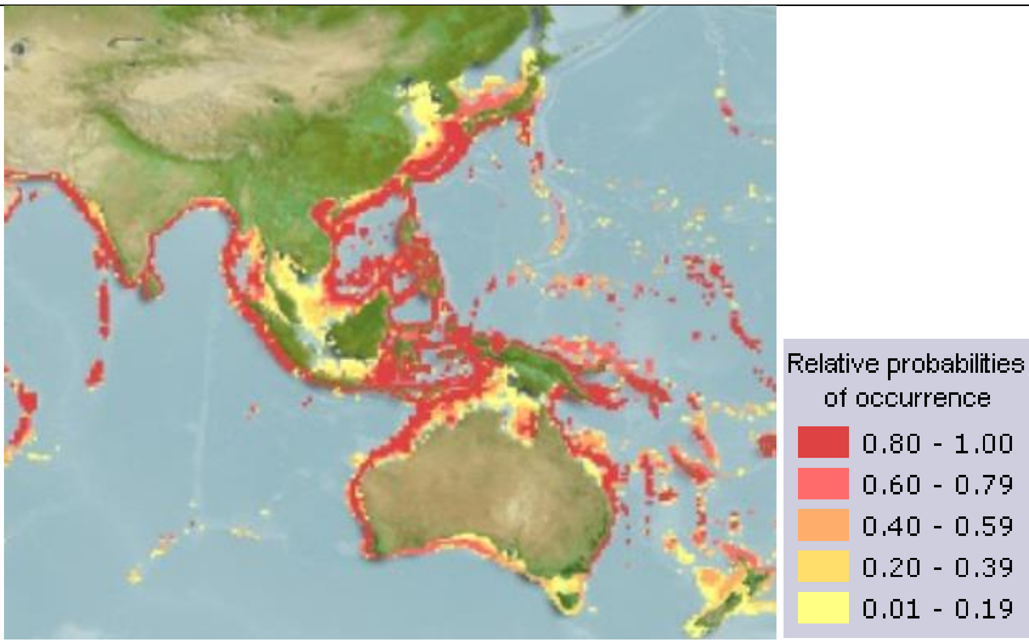
Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Scombriformes
Family:	Scombridae
Genus:	*Auxis*
Species:	***A. thazard***
Binomial name	
Auxis thazard (Lacepède, 1800)	
Synonyms[2]	

- *Scomber thazard* Lacepède, 1800
- *Scomber taso* Cuvier, 1832
- *Auxis tapeinosoma* Bleeker, 1854
- *Auxis hira* Kishinouye, 1915

BB. Environment/Ecology:

Marine; pelagic-neritic; oceanodromous (Ref. 51243); depth range 50 - ? m (Ref. 9340). Tropical; 27°C - 28°C; 61°N - 51°S, 180°W - 180°E

CC. Distribution:



Atlantic, Indian and Pacific (Western Central). Eastern Pacific population recognized as subspecies *Auxis thazard brachydorax* (Ref. 32349). Many authors have used the name *Auxis thazard* as including *Auxis rochei* in the belief that there was only a single worldwide species of *Auxis*. Highly migratory species, Annex I of the 1982 Convention on the Law of the Sea (Ref. 26139).

DD. Length at first maturity / Size / Weight / Age:

Maturity: L_m 29.5, range 29 - ? cm Max length : 65.0 cm FL male/unsexed; (Ref. 29114); common length : 60.0 cm TL male/unsexed; (Ref. 47377); max. published weight: 1.7 kg (Ref. 40637); max. reported age: 5 years (Ref. 29114)

EE. Short description

Dorsal spines (total): 10 - 12; Dorsal soft rays (total): 10-13; Anal spines: 0; Anal soft rays: 10 - 14. This species is distinguished by the following characters: a robust body, elongated and rounded; teeth small and conical, in a single series; total gill rakers on first gill arch 36-42; dorsal fins 2, D1 X-XII, separated from the second by a large interspace (at least equal to length of first dorsal-fin base), second dorsal fin followed by 8 finlets; anal fin followed by 7 finlets; pectoral fins short, but reaching past vertical line from anterior margin of scaleless area above corselet; a large single-pointed flap (interpelvic process) between pelvic fins; body naked except for the corselet, which is well developed and narrow in its posterior part (no more than 5 scales wide under second dorsal-fin origin); a strong central keel on each side of caudal-fin base between 2 smaller keels. Colour of back bluish, turning to deep purple or almost black on the head; a pattern of 15 or more narrow, oblique to nearly horizontal, dark wavy lines in scaleless area above lateral line; belly white; pectoral and pelvic fins purple, inner sides black (Ref 9684).

FF. Biology

Adults are epipelagic in neritic and oceanic waters (Ref. 9340). They feed on small fish, squids, planktonic crustaceans (megalops), and stomatopod larvae (Ref. 5213). Because of their abundance, they are considered an important element of the food web, particularly as forage for other species of commercial interest. They are preyed upon by larger fishes, including other tunas (Ref. 9987). Marketed fresh and frozen (Ref. 9340) and also utilized dried or salted, smoked and canned (Ref. 9987).

GG. Life cycle and mating behavior

In correlation with temperature and other environmental changes, the spawning season varies with areas, but in some place it may even extend throughout the year.

HH. Fisheries

Catches of Auxis are usually not identified to species because of current problems in identification. It may, however, be assumed that the Pacific and Indian Ocean catches reported by Japan, the Philippines and the Maldives are predominantly *A. thazard* . In the period from 1977 to 1980 these catches almost doubled to 122 995 metric tons, particularly due to increased landings by the Philippines, but decreased to about 98 000 metric tons 1981 (FAO, 1983). The total catch in 1996 (*Auxis rochei* and *A. thazard*) was 172 693 t. Mainly Philippines 88 969 t. No catch in 1999

II. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Scombridae
Genus:	*Auxis*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 0 metres
LOWER DEPTH LIMIT : 200 metres

RANGE DESCRIPTION
This species is present in the Atlantic, Indian, and Pacific oceans. It is considered vagrant in the Mediterranean Sea. However, there are only a few records of this species in the Atlantic as most of the *Auxis* in the Atlantic are *Auxis rochei*.
The Eastern Pacific population is recognized as a subspecies, *Auxis thazard brachydorax* (Collette and Aadland 1996), which occurs from California to the mouth of

the Gulf of California to Peru, and all the oceanic islands except Clipperton (Robertson and Allen 2006).

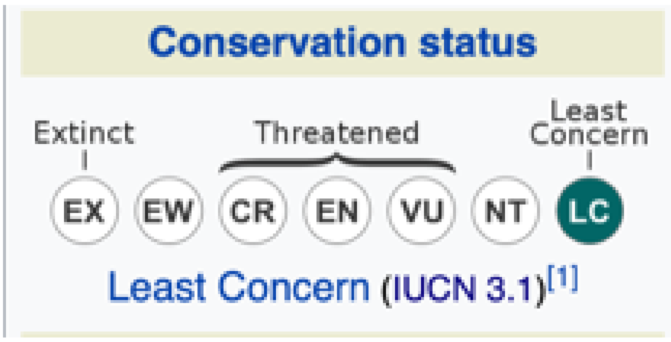
- **Population**
  CURRENT POPULATION TREND : Stable
  POPULATION SEVERELY FRAGMENTED : No

- **Habitat and Ecology**
  System : Marine
  Habitat type : Marine Oceanic
  Movement patterns : Full Migrant

- **Biological resource use** :
  Fishing & harvesting aquatic resource

- **Threats**
  This is a species with high commercial value. It is caught with beach seines, shore seines, drift nets, pursue seines, hook-and-line, gill nets and by trolling.

  Overall trends in the small tuna catch may mask declining trends for individual species because annual landings are often dominated by the landings of a single species. These fluctuations seem to be partly related to unreported catches, as these species generally comprise part of the bycatch and are often discarded, and therefore do not reflect the real catch. It is commonly believed that catches of small tunas are strongly affected by unreported or underreported data in all areas. Small tunas are exploited mainly by coastal fisheries and often by artisanal fisheries, although substantial catches are also made, either as target species or as bycatch, by purse seiners, mid-water trawlers, handlines, troll lines, driftnets, surface drifting long-lines and small scale gillnets. Several recreational fisheries also target small tunas. Since 1991, the use of fish aggregating devices (FADs) by tropical purse seiners may have led to an increase in fishing mortality of small tropical tuna species (STECF 2009). There is a general lack of information on the mortality of these species as bycatch, exacerbated by the confusion regarding species identification (ICCAT 2009).



- **Use and Trade**
  This species is fished throughout its range.

- **Conservation Action**

There are no known conservation measures for this species. It is a highly migratory species, Annex I of the 1982 Convention on the Law of the Sea (FAO Fisheries Department, 1994). No fishery management plan is currently in place except a prohibition on drift nets in EU countries. Data on the catch composition, biology and trends are now available from the Mediterranean and the Black Sea, thanks to the ICCAT/GFCM joint expert group in 2008. More information, particularly on specific fishing effort, is needed from all areas. The small tuna fishery seems to be quite important for the coastal communities, both economically and as a source of proteins. The ICCAT Standing Committee on Research and Statistics (SCRS) suggests that countries be requested to submit all available data to ICCAT as soon as possible, in order to be used in future meetings. No management recommendations have been presented by ICCAT due to the lack of proper data, historical series and analyses. ICCAT/SCRS, in 2008, reiterated its recommendation to carry out studies to determine the state of these stocks and the adoption of management solutions. ICCAT-SCRS in 2009 noted that there is an improvement in the availability of catch and biological data for small tuna species particularly in the Mediterranean and the Black Sea. However, biological information, catch and effort statistics for small tunas remain incomplete for many of the coastal and industrial fishing countries. Given that, many of these species are of high importance to coastal fishermen, especially in some developing countries, both economically and often as a primary source of proteins, therefore the SCRS recommends that further studies be conducted on small tuna species due to the limits of information available (STECF 2009).

JJ. More Information:

62) Stocks

(NA)

63) Ecology

Ecology of *Auxis thazard*

Main Ref.	Collette, B.B. and C.E. Nauen, 1983
Remarks	Epipelagic in neritic and oceanic waters (Ref. 9340). Feeds on small fish, squids, planktonic crustaceans (megalops), and stomatopod larvae (Ref. 5213). Because of their abundance, they are considered an important element of the food web, particularly as forage for other species of commercial interest. Preyed upon by larger fishes, including other tunas (Ref. 9987). Confined to oceanic salinities with strong schooling behavior. Though larvae have a high temperature tolerance (at least between 21.6 and 30.5°C), the widest among tuna species studied, their optimum temperature is between 27 and 27.9°C.

Feeding

Feeding type	mainly animals (troph. 2.8 and up)
Feeding type ref	Uchida, R.N., 1981
Feeding habit	hunting macrofauna (predator)

<table>
<tr><td>Feeding habit ref</td><td colspan="6">Collette, B.B. and C.E. Nauen, 1983</td></tr>
<tr><td rowspan="6">Trophic level(s)</td><td></td><td colspan="2">Original sample</td><td colspan="2">Unfished population</td><td>Remark</td></tr>
<tr><td>Estimation method</td><td>Troph</td><td>s.e.</td><td>Troph</td><td>s.e.</td><td></td></tr>
<tr><td>From diet composition</td><td>4.37</td><td>0.38</td><td>4.19</td><td>0.60</td><td>Troph of juv./adults from 2 studies.</td></tr>
<tr><td>Ref.</td><td colspan="5">Blaber, S.J.M., D.A. Milton, N.J.F. Rawlinson, G. Tiroba and P.V. Nichols, 1990</td></tr>
<tr><td>From individual food items</td><td>4.36</td><td>0.73</td><td></td><td></td><td>Trophic level estimated from a number of food items using a randomized resampling routine.</td></tr>
</table>

64) Diet

Food and Feeding Habits: Diet Composition *Auxis thazard*

n = 3

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
nekton	87	4.2	juv./adults	Colombia	Magdalena and La Guajira	56479
nekton	47	4.3	juv./adults	Solomon Is.		30531
nekton	60	4.5	juv./adults	Malaysia	Terengganu waters, east coast of Peninsular Malaysia, January 1993-June 1994	53850

65) Reproduction

Reproduction of *Auxis thazard*

Main Ref.	Collette, B.B. and C.E. Nauen, 1983
Mode	dioecism
Fertilization	external
Mating type	

Spawning frequency	Variable throughout range
Spawning aggregation	**Ref.**
Batch spawner	**Ref.**
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Description of life cycle and mating behavior	In correlation with temperature and other environmental changes, the spawning season varies with areas, but in some places it may even extend throughout the year.
Search for more references on reproduction	Scirus

66) Maturity

Maturity studies for *Auxis thazard*

n = 7

Lm vs Linf graph

Sort by Lm Country Locality tm

Lm (cm)	Length (cm)			Age range (y)		tm (y)	Sex of fish	Country	Locality
	35.0	-		-			unsexed	Hawaii	Hawaii
	29.0	-		-			unsexed	Japan	Japan
27.5 NG		-		-			unsexed	India	Kerala (2011-2012, 2014-2015)
29.7 NG		-		-		2.50	unsexed	India	Karnataka (2016)
29.7 NG		-		-			unsexed	India	Kerala (2012-2013)
30.0 FL		-		-			unsexed	Russia	Eastern atlantic
30.5 NG		-		-			unsexed	India	Karnataka (2011-2012)

67) Spawning

Spawning for *Auxis thazard*

n = 5

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality

111	111	111	111	111	111	111	111	111	111	111	111		Eastern Pacific
						111						Japan	Japan
111	111	111	111										North of the equator
111	111	111	111	111	111	111	111	111	111	111	111	Costa Rica	Off Costa Rica
111	111	111	111				111	111	111	111	111		Southern Indian Ocean

68) Spawning aggregation

(NA)

69) Fecundity

Fecundity for *Auxis thazard*

Sort by Country Locality

[n = 3]

Country	Locality	Absolute Fecundity		Relative Fecundity		
		min	max	Min	Mean	Max
	Southern Indian Ocean	200,000	1,060,000			
	to be filled	0	1,370,000			
India	Kerala (2014-2015)	0	0	103		127

70) Eggs

(NA)

71) Egg development

(NA)

72) Age/Size

List of Population Characteristics records for *Auxis thazard*

n = 7

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed		48		India	Karnataka, 2016

	unsexed		49		India	Annangkovil Parangipettai
	unsexed		50		India	Kerala (2011-2012)
	unsexed		50		South Africa	South Africa
	unsexed		51			Indian Ocean
	unsexed		58		Iran	Sistan and Balutchestan waters to Jask
	unsexed		58		Sri Lanka	Sri Lanka

73) Growth

Growth parameters for *Auxis thazard*

Maximum Length 65cm FL

n = 14

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Lm vs Linf graph	[n = 5]
M vs K graph	[n = 1]
M vs Linf graph	[n = 1]
Longevity vs 3/K graph	[n = 4]

ø = 3.36 **L inf** = 49.0 cm NG **K** = 1.0 Median record no. 8 116140Ref. 116140

Loo (cm)	Length Type	K (1/y)	to (years)	Sex	M (1/y)	Temp° C	Lm	ø'	Country	Locality	Questionable	Captive
36.6	FL	1.200				28.0		3.21	Philippines	Camotes Sea	No	No
40.5		0.850					11.8	3.14	Philippines	Davao Gulf	No	No
47.0	FL	0.730			0.87	28.5		3.21	Philippines	Bohol Sea	No	No
47.5	FL	0.700				27.0		3.20	Indonesia	Pelabuhan Ratu, West Java	No	No
48.2	TL	0.520						3.08	Taiwan	Taiwan Strait and adjacent waters	No	No
48.2	FL	0.523	-0.33			23.5	27.1	3.08	Taiwan	Taiwan Strait	No	No
48.4	FL	0.511				23.5	27.6	3.08	Taiwan	Taiwan Strait	No	No

49.0	NG	0.960						3.36	India	Goa (2014-2015)	No	No
49.0	NG	0.960	-0.09				30.5	3.36	India	Karnataka (2011-2012)	No	No
51.5		0.320	-0.83					2.93			No	No
51.5	FL	1.000				27.0		3.42	Indonesia	Pelabuhan Ratu, West Java	No	No
58.7	NG	1.200	-0.01				29.7	3.62	India	Karnataka, 2016	No	No
61.6	FL	0.830				12.5		3.50	Sri Lanka	Southwest	No	No
63.5	FL	0.720				28.5		3.46	Philippines	Moro Gulf	No	No

74) Length-weight

Length-Weight Parameters for *Auxis thazard*

Length-weight (log *a* vs *b*) graph [n=10]
Hide graph

Sort by a b Country Locality

Score	a	b	Sex	Length (cm)	Length type	r^2	n	Country	Locality
0.50	0.07700	2.509	unsexed					Japan	Shionomisaki
0.50	0.05470	2.700	unsexed		FL			South Africa	
0.50	0.00997	3.130	mixed		TL			Brazil	Southwestern EEZ
0.93	0.00890	3.170	Unsexed	24.6 - 31.7	FL	0.926	33	Brazil	Central coast, 1993-2000
0.95	0.00600	3.194	Unsexed	26.9 - 34.8	TL	0.951	34	Brazil	Central coast, 1993-2000
0.92	0.00800	3.228	unsexed	22.3 - 45.0	TL	0.920	261	India	Southern coast of Karnataka / 1999-2001
0.94	0.00800	3.273	Unsexed	23.0 - 29.3	SL	0.944	34	Brazil	Central coast, 1993-2000
0.50	0.00605	3.300	unsexed					Japan	Mikomoto

0.60	0.00180	3.334	unsexed				160	Sri Lanka	
0.91	0.00280	3.468	mixed	18.0 - 49.0	TL	0.907	618	India	Annangkovil Parangipettai

75) Length-length

Length-length Parameters for *Auxis thazard*

[n=5]

Unknown length	a	b	Known length	r	Length range (cm)	Sex of fish
SL	0.000	0.912	FL		-	unsexed
TL	0.000	1.034	FL		-	unsexed
TL	0.000	1.097	FL		-	unsexed
TL	0.000	1.113	SL		-	unsexed
TL	0.000	1.190	SL		-	unsexed

76) Length-frequencies

List of frequency studies for *Auxis thazard*

Locality	Year from - to	Sex	Gear	Frequency type
Bohol Sea, Philippines	1980-1980	unsexed/mixed	trawls	absolute number measured
Camotes Sea, Philippines	1983 - 1987	unsexed/mixed	various gears	absolute number measured
Indian Ocean (Pelabuhan Ratu, West Java), Indonesia	1980 - 1980	unsexed/mixed	trawls	absolute number measured
Indian Ocean (Pelabuhan Ratu, West Java), Indonesia	1981 - 1981	unsexed/mixed	trawls	absolute number measured
Moro Gulf, Philippines	1976 - 1977	unsexed/mixed	trawls	absolute number measured

77) Morphometrics

Morphometric Data for *Auxis thazard*

n = 3

Picture Name	Length		Lifestage	Aspect ratio
Autha_u1.jpg	42	FL	unsexed	6.86
Autha_u5.jpg	33.3	FL	unsexed	5.11
Autha_u6.jpg		none	unsexed	5.43

Picture Used	Autha_u1.jpg
Size (cm)	42 FL, 43.5
Sex	unsexed
Total length (TL)	611 pixels
Standard length	92.6 % TL
Fork length	95.3 % TL
Pre-anal length	63.5 % TL
Pre-dorsal length	28.3 % TL
Pre-pelvic length	26.8 % TL
Pre-pectoral length	24.7 % TL
Body depth	23.2 % TL
Head length (HL)	23.6 % TL
Eye diameter	20.1 % HL
Pre-orbital length	16.7 % HL
Aspect ratio of caudal fin	6.85739
Remarks	1

Picture Used	Autha_u5.jpg
Size (cm)	33.3 FL
Sex	unsexed
Total length (TL)	600 pixels
Standard length	89.8 % TL
Fork length	96.7 % TL
Pre-anal length	66.2 % TL
Pre-dorsal length	29.5 % TL
Pre-pelvic length	26.2 % TL
Pre-pectoral length	24.8 % TL
Body depth	25.0 % TL
Head length (HL)	23.0 % TL
Eye diameter	15.9 % HL
Pre-orbital length	19.6 % HL

Aspect ratio of caudal fin	5.10505

Picture Used	Autha_u6.jpg
Sex	unsexed
Total length (TL)	575 pixels
Standard length	84.0 % TL
Fork length	91.1 % TL
Pre-anal length	57.4 % TL
Pre-dorsal length	28.3 % TL
Pre-pelvic length	27.8 % TL
Pre-pectoral length	25.0 % TL
Body depth	20.0 % TL
Head length (HL)	23.7 % TL
Eye diameter	18.4 % HL
Pre-orbital length	33.1 % HL
Aspect ratio of caudal fin	5.43496

78) Morphology

Morphology Data of *Auxis thazard*

Identification keys

Abnormalities

Main Ref.	Collette, B.B., 2001

Sex attributes

Specialized organs	no special organs
Different appearance	males alike females
Different colors	males alike females

Descriptive characteristics of juvenile and adult

Striking features	none
Body shape lateral	fusiform / normal
Cross section	oval
Dorsal head profile	more or less straight
Type of eyes	more or less normal
Type of mouth/snout	more or less normal

Position of mouth	terminal
Diagnosis	This species is distinguished by the following characters: a robust body, elongated and rounded; teeth small and conical, in a single series; total gill rakers on first gill arch 36-42; dorsal fins 2, D1 X-XII, separated from the second by a large interspace (at least equal to length of first dorsal-fin base), second dorsal fin followed by 8 finlets; anal fin followed by 7 finlets; pectoral fins short, but reaching past vertical line from anterior margin of scaleless area above corselet; a large single-pointed flap (interpelvic process) between pelvic fins; body naked except for the corselet, which is well developed and narrow in its posterior part (no more than 5 scales wide under second dorsal-fin origin); a strong central keel on each side of caudal-fin base between 2 smaller keels. Colour of back bluish, turning to deep purple or almost black on the head; a pattern of 15 or more narrow, oblique to nearly horizontal, dark wavy lines in scaleless area above lateral line; belly white; pectoral and pelvic fins purple, inner sides black (Ref 9684).

Meristic characteristics of Auxis thazard

Lateral Lines	1 Interrupted: No
Barbels	0
Gill clefts (sharks/rays only)	absent
total	36 - 42

Fins
Dorsal fin(s)

Attributes	no striking attributes
Fins number	2
Finlets No.	Dorsal 8 - 8
	Ventral 7 - 7
Spines total	10 - 12
Soft-rays total	10 - 13
Adipose fin	absent

Caudal fin

Attributes	forked; more or less normal

Anal fin(s)

Fins number	1

Spines total	0 - 0
Soft-rays total	10 - 14

Paired fins

Pectoral	Attributes more or less normal
	Spines 0
	Soft-rays 23 - 24
Pelvics	Attributes more or less normal
	Position thoracic before origin of D1
	Spines
	Soft-rays

79) Larvae

Larvae Information Summary for *Auxis thazard*

(not available)

Main Ref:	Collette, B.B. and C.E. Nauen 1983

Yolk-sac larvae

	max	min	mod	Ref.
Length at birth (mm)	3.6	3.26		
Preanal L. % TL				

Place of development	planktonic
Larval area	to be filled
Yolk-sac	spherical
Other melanophores on tail	
Thirty-nine myomeres.	

Post larvae

Striking feature	teeth clearly visible		
Striking shape lateral		**dorsal**	normal (not striking)
Striking feature	teeth clearly visible		
Shape of gut	triangular		
Gas bladder early		**late**	
Spinal armature early	opercular spines only	**late**	opercular spines only
Pigmentation early			
Rows on tail	ventral row		
Other melanophores on tail	tail with single melanophore		
Melanophores on head + trunk	melanophores on head + trunk		

Pigmentation late			
Rows on tail	dorsal + ventral row		
Other melanophores on tail	tail with single melanophore		
Melanophores on head + trunk	melanophores on head + trunk		
Urostyle region early	unpigmented	**late**	unpigmented
Peritoneum	covered with melanophores		
Pectorals	normal		
Pelvics	normal (i.e. small or absent)		
@A. thazard@ = @A. auxis@ for months of presence of larvae.			

Meristic characters

	max	**min**	**mod**	**Ref.**
Total number of myomeres			39	65

80) Recruitment

(NA)

81) Abundance

See SEAFDEC study

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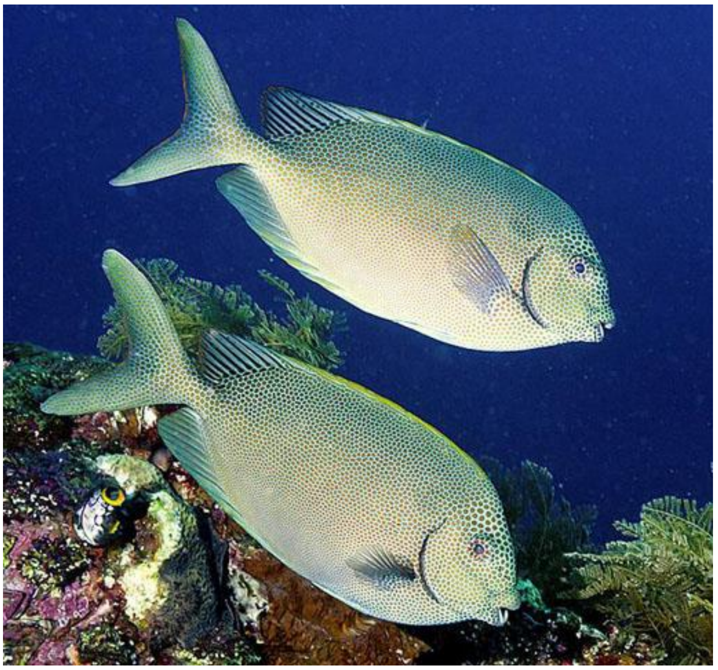
ANNEX 21

Siganus punctatus
Goldspotted spinefoot

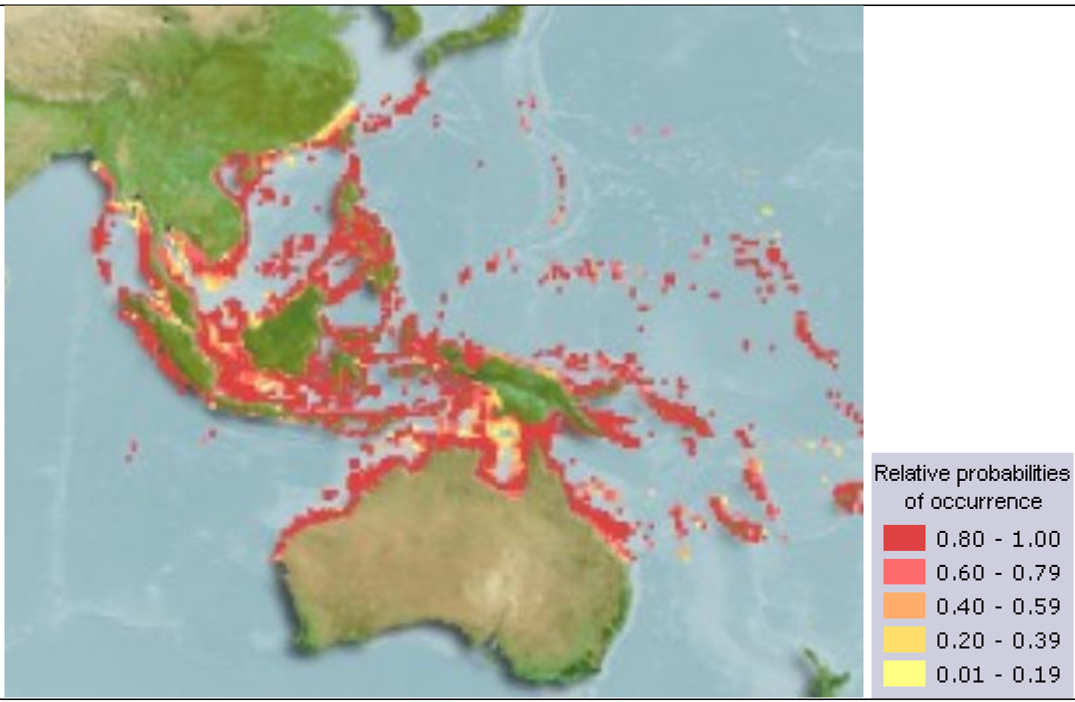


Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Siganidae
Genus:	*Siganus*
Binomial name	
Siganus punctatus (Schmeider & Forster, 1801)	
Synonyms[2]	
• *Amphacanthus punctatus* (Schmeider & Forster, 1801)	

KK. Environment/Ecology:

Marine; reef-associated; depth range 1 - 40 m (Ref. 1602). Tropical; 30°N - 25°S, 92°E - 160°W

LL. Distribution:



Western Pacific: fringe of the eastern sector of the Indian Ocean, Cocos (Keeling) Islands, Australia, Indonesia, Singapore, Gulf of Thailand, South China Sea, Philippines, Taiwan, Ryukyu Islands, Ogasawara Islands, Mariana Islands, Palau (Belau), Caroline Islands, Kapingamarangi Islands, Nauru and Niue. The species is replaced by its sibling, *Siganus stellatus*, in the Andaman Sea and regions which are located further west.

MM. Length at first maturity / Size / Weight / Age:

Maturity: L_m ?, range 24 - ? cm
Max length : 40.0 cm TL male/unsexed; (Ref. 9710); common length : 30.0 cm TL male/unsexed; (Ref. 9813)

NN. Short description

Dorsal spines (total): 13; Dorsal soft rays (total): 10; Anal spines: 7; Anal soft rays: 9; Vertebrae: 13. Color pattern changes with age; iris silver with 8-10 orange spots. Juveniles with a deep brown patch straddling the lateral line; the spot becoming obscured with increase in size. Stout, venomous spines not so pungent. Preopercular angle 87°-105°. Strong scales fully cover the cheeks. Midline of thorax scaled but not pelvic ridges.

OO. Biology

Occurs in clear lagoons and seaward reefs. Juveniles live in schools of up to about 50 fish with pairing commencing as small as 15 cm, but fish may still be schooling at 22 cm SL; older fish live in pairs. Feeds on benthic algae (Ref. 9813). Adults on deep coastal reefs, juveniles in shallow estuaries (Ref. 48637).

PP. Life cycle and mating behavior

Spawn in pairs. Spawning occurs around either new or full moons or both (Ref. 37816).

QQ. Fisheries

(NA)

RR. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Siganidae
Genus:	*Siganus*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 1 metres
LOWER DEPTH LIMIT : 40 metres

RANGE DESCRIPTION
This species is widely distributed in the western Pacific, from Cocos-Keeling Islands east to Samoa and from Australia to southern Japan (Woodland 2001). It is found to depths of 40 m (Myers 1991).

- **Population**

CURRENT POPULATION TREND : Unknow

- **Habitat and Ecology**

System : Marine
Habitat type : Marine Neritic

- **Threats**

This species is targeted in parts of its range but this does not currently appear to be a major threat.

- **Use and Trade**

This species is mainly caught in traps or by spearing; marketed fresh (Woodland 2001). It is opportunistically harvested by spearfishers in Palau (Chavarro *et al.* 2012).

- **Conservation Action**

There are no known species-specific conservation measures in place; however, it occurs in marine protected areas throughout its range.

SS. More Information:

82) Stocks

(NA)

83) Ecology

Ecology of *Siganus punctatus*

Main Ref.	Woodland, D.J., 1990
Distribution	Brackishwater • **estuaries/lagoons/brackish seas** Highighted items on the list are where *Siganus punctatus* may be found.
Remarks	Fish of 20 cm SL & larger live more often in pairs. Pairing observed in fish as small as 15 cm SL; but may school with about 50 individuals; smaller schools (< 5) of very small juveniles have been seen. Common along face of drop-offs at the reef edges. Typically, it grows to a larger size than other siganids (Ref. 1419).

Substrate

Special habitats	**Beds:** sea grass; **Coral Reefs**;
Special habitats Ref.	Unsworth, R.K., L.M. Nordlund and L.C. Cullen-Unsworth, 2018

Feeding

Feeding type	plants/detritus+animals (troph. 2.2-2.79)
Feeding type ref	Sano, M., M. Shimizu and Y. Nose, 1984
Feeding habit	grazing on aquatic plants
Trophic level(s)	(see table below)

Trophic level(s)

	Original sample		**Unfished population**		**Remark**
Estimation method	Troph	s.e.	Troph	s.e.	
From diet composition			2.77	0.08	
Ref.	Sano, M., M. Shimizu and Y. Nose, 1984				
From individual food items	2.00	0.00			Trophic level and s.e.

						inferred from exclusive plant/detritus food items.

84) Diet

Food and Feeding Habits: Diet Composition *Siganus punctatus*

n = 1

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
zoobenthos	74	2.8	recruits/juv.	Ryukyu Is.	Minatogawa, Okinawa Is.	6110

85) Reproduction

Reproduction of *Siganus punctatus*

Main Ref.	Myers, R.F., 1999
Mode	dioecism
Fertilization	external
Mating type	monogamy:
Spawning aggregation	Yes. **Ref.** SCRFA, Science and Conservation of Fish Aggregations, 2018
Batch spawner	**Ref.**
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Description of life cycle and mating behavior	Spawn in pairs. Spawning occurs around either new or full moons or both (Ref. 37816).
Search for more references on reproduction	Scirus

86) Maturity

Maturity studies for *Siganus punctatus*

n = 1

Sort by Lm Country Locality tm

Lm (cm)	Length (cm)	Age range (y)	tm (y)	Sex of fish	Country	Locality
	24.0 -	-		unsexed		Asia-Pacific Region

87) Spawning

(NA)

88) Spawning aggregation

Spawning Aggregations of *Siganus punctatus*

[n = 1]

Country	Spawning type	Aggregation type	Status
Solomon Is.	Unknown	Unknown	Unknown

89) Fecundity

(NA)

90) Eggs

(NA)

91) Egg development

(NA)

92) Age/Size

List of Population Characteristics records for *Siganus punctatus*

n = 3

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed		40			Asia-Pacific Region
unsexed		40		Global	East Indies
unsexed		40		Global	Not specified

93) Growth

(NA)

94) Length-weight

Length-Weight Parameters for *Siganus punctatus*

Length-weight (log *a* vs *b*) graph [n=5]
Hide graph

Sort by a b Country Locality

Score	a	b	Doubtful?	Sex	Length (cm)	Length type	r^2	SD b	SD log_{10} a	n	Country	Locality
0.00	0.01825	3.000		unsexed	21.0 - 21.0	TL				1		
0.00	0.03440	3.000	Yes	unsexed		SL				1		
0.95	0.01990	3.070		unsexed	16.1 - 32.0	FL	0.950	0.030	0.0484	1408	Guam	2009-2013
1.00	0.02060	3.207		unsexed	4.0 - 29.0	SL	0.999	0.064	0.0708	18	Philippines	Davao Gulf / 2009-2012
0.99	0.00949	3.276		mixed	10.0 - 36.5	FL	0.988			27	New Caledonia	

95) Length-length

Length-length Parameters for *Siganus punctatus*
[n=3]

Unknown length	a	b	Known length	r	Length range (cm)	Sex of fish
SL	0.000	0.800	TL		41.1 - 41.1	unsexed
SL	0.000	0.810	TL		21 - 21	unsexed
TL	-0.941	1.380	SL	0.997	4 - 29	unsexed

96) Length-frequencies

(NA)

97) Morphometrics

Morphometric Data for *Siganus punctatus*
n = 1

Picture Name	Length		Lifestage	Aspect ratio
Sipun_u2.jpg	24.8	SL	unsexed	2.91

Picture Used	Sipun_u2.jpg
Size (cm)	24.8 SL
Sex	unsexed
Total length (TL)	502 pixels
Standard length	85.3 % TL
Fork length	91.6 % TL
Pre-anal length	48.0 % TL
Pre-dorsal length	21.3 % TL
Pre-pelvic length	24.5 % TL
Pre-pectoral length	19.9 % TL
Body depth	40.6 % TL
Head length (HL)	20.7 % TL
Eye diameter	33.7 % HL
Pre-orbital length	37.5 % HL
Aspect ratio of caudal fin	2.90689

98) Morphology

Morphology Data of *Siganus punctatus*

Identification keys

Abnormalities

Main Ref.	Woodland, D.J., 1990
Appearance refers to	Male; Female
Descriptive characteristics of juvenile and adult	
Striking features	none
Body shape lateral	short and / or deep
Cross section	compressed
Dorsal head profile	more or less straight
Type of eyes	more or less normal
Type of mouth/snout	more or less normal
Position of mouth	terminal
Type of scales	cycloid scales
Diagnosis	Color pattern changes with age; iris silver with 8-10 orange spots. Juveniles with a deep brown patch straddling the lateral line; the spot becoming obscured with increase in size. Stout, venomous spines not so pungent. Preopercular angle 87°-105°. Strong scales fully cover the cheeks. Midline of thorax scaled but not pelvic ridges.

Meristic characteristics of Siganus punctatus

Lateral Lines	1 Interrupted: No
Scale rows above lateral line	23 - 27
Barbels	0
on lower limb	18 - 22
on upper limb	4 - 5
total	22 - 27
preanal	10 - 10
total	13 - 13

Fins

Dorsal fin(s)

Attributes	extending over most of the back length
Fins number	1
Finlets No.	Dorsal 0 - 0
	Ventral 0 - 0
Spines total	13 - 13
Soft-rays total	10 - 10
Adipose fin	absent

Caudal fin

Attributes	forked; more or less normal

Anal fin(s)

Fins number	1
Spines total	7 - 7
Soft-rays total	9 - 9

Paired fins

Pectoral	Attributes more or less normal
	Spines 0
	Soft-rays 16 - 17
Pelvics	Attributes more or less normal
	Position thoracic behind origin of D1
	Spines 1
	Soft-rays 5 - 5

99) Larvae

Larvae Information Summary for *Siganus punctatus*

Main Ref:	Alcala, A.C. and A.S. Cabanban 1986

Yolk-sac larvae

Place of development	planktonic
Larval area	coastal zone

100) Recruitment

(NA)

101) Abundance

(NA)

References

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ANNEX 22

Lutjanus argentimaculatus
Mangrove red snapper

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Lutjanidae
Genus:	*Lutjanus*
Species:	***L. argentimaculatus***

Binomial name

Lutjanus argentimaculatus
(Forsskål, 1775)

Synonyms

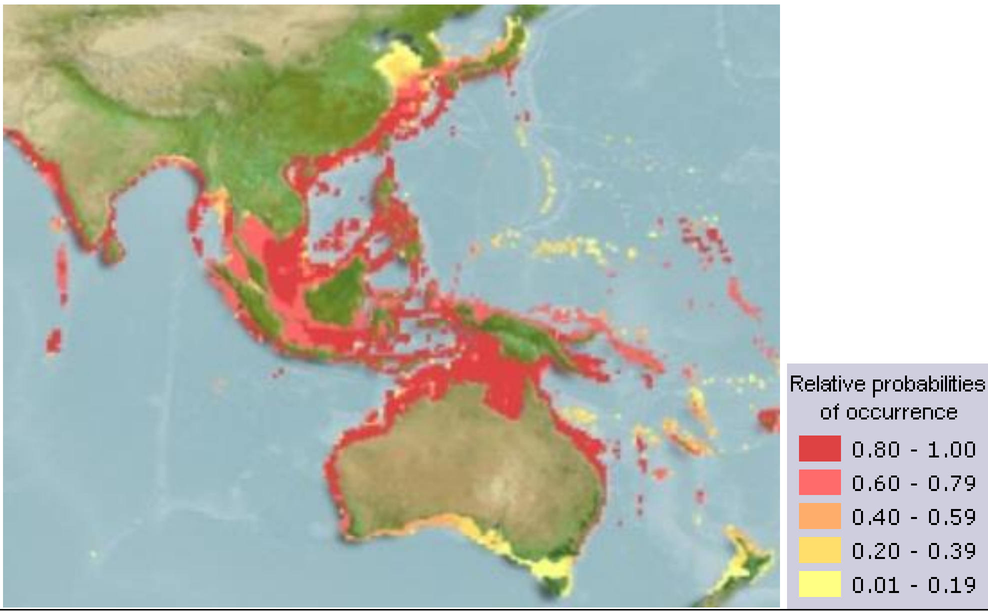
- *Sciaena argentimaculata* Forsskål, 1775
- *Sciaena argentata* J. F. Gmelin, 1789
- *Alphestes gembra* Bloch & J. G. Schneider, 1801
- *Alphestes sambra* Bloch & J. G. Schneider, 1801
- *Perca argentata* Bloch & J. G. Schneider, 1801
- *Mesoprion flavipinnis* G. Cuvier, 1828
- *Mesoprion olivaceus* G. Cuvier, 1828
- *Mesoprion taeniops* Valenciennes, 1830
- *Mesoprion griseoides* Guichenot, 1863
- *Mesoprion garretti* Günther, 1873
- *Lutianus jahngarah* F. Day, 1875
- *Diacopus superbus* Castelnau, 1878
- *Diacope superba* Castelnau, 1878

- *Mesoprion obscurus* W. J. Macleay, 1881
- *Mesoprion roseigaster* W. J. Macleay, 1881
- *Mesoprion sexfasciatus* W. J. Macleay, 1883
- *Lutianus salmonoides* Gilchrist & W. W. Thompson, 1908

TT. Environment/Ecology:

Marine; freshwater; brackish; reef-associated; oceanodromous (Ref. 51243); depth range 1 - 120 m (Ref. 9710). Subtropical; 16°C - 30°C (Ref. 2060); 39°N - 35°S, 26°E - 134°W (Ref. 54571)

UU. Distribution:



Indo-West Pacific: East Africa to Samoa and the Line Islands, north to the Ryukyu Islands, south to Australia. Has dispersed into the eastern Mediterranean (off Lebanon) via the Suez Canal but not well established there.

VV. Length at first maturity / Size / Weight / Age:

Maturity: L_m 57.0 range ? - ? cm Max length : 150 cm TL male/unsexed; (Ref. 3678); common length : 80.0 cm TL male/unsexed; (Ref. 55); max. published weight: 8.7 kg (Ref. 40637); max. reported age: 31 years (Ref. 82366)

WW. Short description

Dorsal spines (total): 10; Dorsal soft rays (total): 13-14; Anal spines: 3; Anal soft rays: 8. This species is distinguished by the following characters: body moderately deep, greatest depth 2.3 - 2.7 in SL; preopercular notch poorly developed; vomerine tooth patch crescentic; gill rakers of first gill arch 6-8 + 9-12 = 16-20 (including rudiments); scale rows on back more or less parallel to lateral line, or parallel below spinous part of dorsal fin and sometimes rising obliquely posteriorly, or rarely with entirely oblique rows. Colour of the body generally greenish brown on back, grading to reddish; belly silvery or whitish (deep water specimens usually overall reddish); juveniles with a series of about 8 white and streaks 2 blue across cheeks (Ref. 9821, 90102).

XX. Biology

A euryhaline species (Ref. 12743). Juveniles and young adults occur in mangrove estuaries, the lower reaches of freshwater streams (Ref. 30573, 48635, 44894) and tidal creeks (Ref. 44894). Adults are often found in groups around coral reefs (Ref. 9710). Eventually migrate offshore to deeper reef areas, sometimes penetrating to depths in excess of 100 m. Mainly nocturnal, this species feeds mostly on fishes and crustaceans. Excellent food fish (Ref. 5484, 44894). An important market species throughout the Indo-Pacific region, but never found in large quantities. A good aquaculture species because it doesn't get rancid easily when frozen (Ref. 47992). It commands a good export market price with no limit on body size (Ref. 47992). No reported damaging diseases (Ref. 47992). Found in Hong Kong live fish markets (Ref. 27253). Caught mainly with handlines, bottom longlines, and trawls; marketed mostly fresh and dried-salted (Ref. 9821). Maximum length is 104 cm, max weight 14.5 kg and max age 39 years for specimens from the east coast of Australia (pers. comm., Andrew McDougall, 2007).

YY. Life cycle and mating behavior

(NA)

ZZ. Fisheries

An important market species throughout the Indo-Pacific region, but never found in large quantities. Caught mainly with nets (redfishes gillnetting, snapper gillnetting), handlines, bottom longlines, and trawls . In 1983 a total catch of 7 815 t was reported to FAO (Fishing Areas 71, 51 and 57). Marketed either fresh or frozen also dried-salted.The total catch reported for this species to FAO for 1999 was 16 129 t. The countries with the largest catches were Malaysia (12 319 t) and Pakistan (3 195 t).

AAA. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Lutjanidae
Genus:	*Lutjanus*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 1 metres
LOWER DEPTH LIMIT : 120 metres

RANGE DESCRIPTION
Lutjanus argentimaculatus is distributed from eastern Africa (including Madagascar, Mauritius, Reunion and the central islands of the Federated States of Micronesia), north to the Red Sea and Persian Gulf, east to Samoa and Kiribati (the Line Islands), northwards to Japan (Ryukyu Islands), and southwards to Australia. It has dispersed into the eastern Mediterranean via the Suez Canal but is not well established there (Anderson and Allen 2001). This species is found between the depths of 1 to 120 m (Lieske and Myers 1994).

- **Population**

CURRENT POPULATION TREND : UNKNOW

- **Habitat and Ecology**

System : Marine
Habitat type : Marine Neritic, Marine Intertidal

- **Biological resource use** :

Fishing & harvesting aquatic resource

- **Threats**

This species is an important market species and is considered overexploited in some areas (e.g., United Arab Emirates). The estimated fishing mortality of 0.10 year-1 is greater than both the target (FSB40 = 0.05) and limit (FSB30 = 0.07) biological reference points. The estimated exploitation rate of *Lutjanus aregentimaculatus* is 0.46. Juvenile retention rate in the demersal trawl fishery was 96.7% for *Lutjanus aregentimaculatus (*Grandcourt *et al.* 2013). Grandcourt *et al.* (2013) concluded that *Lutjanus aregentimaculatus* could be exploited sustainably if they are able to reach sexual maturity before becoming vulnerable to capture. In order for this to occur, the specification of the juvenile escape panel in the demersal trap fishery needs to be revised. Further information is required on harvest levels and therefore the threat of fisheries on the species. In addition, in some areas (e.g., the Persian Gulf), the habitat for juveniles for this species has been seriously degraded. The juveniles depend on mangroves, which have been destroyed for coastal development projects, and depend on some amount of fresh water (inhabit brakish water), which is decreasing. However, we are lacking quantitative data that indicates the Gulf serves as a nursery area for juveniles (Grandcourt *et al.* 2013). This species is utilized for commercial aquaculture in Pakistan, China, Singapore, Malaysia, Thailand and the Philippines (Emata 1996, Emata *et al.* 1999, Hong and Zhang 2002).

Conservation status

Least Concern (IUCN 3.1)

- **Use and Trade**

  Lutjanus argentimaculatus is an important market species throughout its range but is not often found in large quantities. It is caught mainly with nets, handlines, bottom longlines, and trawls (Anderson and Allen 2001). Landings in Malaysia and Pakistan range from 1,000 to 10,000 metric tonnes (FishStatJ 2014). This species has been to spawned and reared in captivity (Lau and Li 2000) and a good aquaculture species because it doesn't get rancid easily when frozen (Lessa *et al* 1999). Grandcourt *et al.* (2013) concluded that *Lutjanus aregentimaculatus* could be exploited sustainably if they are able to reach sexual maturity before becoming vulnerable to capture. In order for this to occur, the specification of the juvenile escape panel in the demersal trap fishery needs to be revised. This species is utilized for commercial aquaculture in Pakistan, Singapore, Malaysia, Thailand and the Philippines (Emata *et al.* 1999).

- **Conservation Action**

  This species was listed as Least Concern in the Gulf (IUCN 2015). There are a number of marine protected areas that intersect with the range of *L. argentimaculatus* (IUCN UNEP 2014). Policies in the regulation and management of the harvest of this species are suggested, as well as further research regarding the habitats and ecology and the population dynamics and trends of the species.

BBB. More Information:

102) Stocks

(NA)

103) Ecology

Ecology of *Lutjanus argentimaculatus*

Main Ref.	Allen, G.R., 1985
Distribution	Brackishwater • **estuaries/lagoons/brackish seas** • **mangroves**
Remarks	Euryhaline species (Ref. 12743). Juveniles and young adults occur in mangrove estuaries, the lower reaches of

	freshwater streams (Ref. 30573, 48635, 44894) and tidal creeks (Ref. 44894). Adults are often found in groups around coral reefs (Ref. 9710). Eventually migrate offshore to deeper reef areas, sometimes penetrating to depths in excess of 100 m. Mainly nocturnal, feed mostly on fishes and crustaceans (Ref. 55). Habitat frequently consists of areas of abundant shelter in the form of caves or overhanging ledges. Carnivore (Ref. 57615).

Substrate

Substrate	**Hard Bottom**: rocky;
Substrate Ref.	Letourneur, Y., P. Chabanet, P. Durville, M. Taquet, E. Teissier, M. Parmentier, J.-C. Quéro and K. Pothin, 2004
Special habitats	**Coral Reefs**;
Special habitats Ref.	Nguyen, N.T. and V.Q. Nguyen, 2006

Feeding

Feeding type	mainly animals (troph. 2.8 and up)
Feeding type ref	Allen, G.R., 1985
Feeding habit	hunting macrofauna (predator)
Feeding habit ref	Allen, G.R., 1985
Trophic level(s)	

	Original sample		**Unfished population**		**Remark**
Estimation method	Troph	s.e.	Troph	s.e.	
From diet composition	3.58	0.49	3.64	0.67	Troph of juv./adults from 1 study.
Ref.	Kulbicki, M., Y.-M. Bozec, P. Labrosse, Y. Letourneur, G. Mou-Tham and L. Wantiez, 2005				
From individual food items	3.85	0.64			Trophic level estimated from a number of food items using a randomized resampling routine.

104) Diet

Food and Feeding Habits: Diet Composition *Lutjanus argentimaculatus*

n = 1

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
zoobenthos	81	3.6	juv./adults	New Caledonia	1985-1997	55797

105) Reproduction

Reproduction of *Lutjanus argentimaculatus*

Main Ref.	Allen, G.R., 1985
Mode	dioecism
Fertilization	external
Spawning aggregation	Yes. **Ref.** SCRFA, Science and Conservation of Fish Aggregations, 2018
Batch spawner	Yes. **Ref.** Allen, G.R., 1985
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Search for more references on reproduction	Scirus

106) Maturity

Maturity studies for *Lutjanus argentimaculatus*

n = 4

Sort by ◉ Lm ○ Country ○ Locality ○ tm

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	55.0	-			-			unsexed		Aisa-Pacific Region
49.0 SL		-			-			unsexed	South Africa	southern African estuaries
49.6 TL		-			-		4.00	male	Philippines	concrete tanks
57.0 TL		-			-		5.00	female	Philippines	concrete tanks

107) Spawning

Spawning for *Lutjanus argentimaculatus*
n = 2

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
111	111	111	111	111	111	111	111	111	111	111	111		At least in lower latitudes
		111	111	111	111	111	111	111	111	111		Philippines	floating-cages, SEAFDEC Marine substation

108) Spawning aggregation

Spawning Aggregations of *Lutjanus argentimaculatus*
[n = 1]

Country	Spawning type	Aggregation type	Status
Papua New Guinea	Unknown	Transient	Decreasing

109) Fecundity

(NA)

110) Eggs

(NA)

111) Egg development

(NA)

112) Age/Size

List of Population Characteristics records for *Lutjanus argentimaculatus*
n = 8

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed	8.7 kg			Global	unspecified
unsexed		42.6		Philippines	Palawan / 1998-2014
unsexed		57	31	Papua New Guinea	Lihir Island group (seamount), 1999-2002
unsexed		120		Global	East Indies
unsexed		120		India	Not specified

	unsexed		120		Iran	Persian Gulf and Oman Sea	
	unsexed		150			Aisa-Pacific Region	
	unsexed		150		South Africa	South Africa	

113) Growth

Growth parameters for *Lutjanus argentimaculatus*

Maximum Length 150cm TL

n = 2

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

M vs K graph	[n = 1]
M vs Linf graph	[n = 1]
Longevity vs 3/K graph	[n = 1]

ø = 3.31 **L inf** = 105.0 cm TL **K** = 0.2 Median record no. 22299Ref. 2299

Loo (cm)	Length Type	K (1/y)	M (1/y)	Temp° C	Ø'	Country	Locality	Questionable	Captive
55.6	SL	0.190			2.77	Papua New Guinea	Lihir Island group (seamount)	Yes	No
105.0	TL	0.187	0.25	27.0	3.31	Malaysia	East coast of peninsula	No	No

114) Length-weight

Length-Weight Parameters for *Lutjanus argentimaculatus*

Length-weight (log *a* vs *b*) graph [n=8]
Hide graph

Sort by a b Country Locality

Score	a	b	Sex	Length (cm)	Length type	r^2	SD b	SD $\log_{10}$ a	n	Country	Locality
0.99	0.03360	2.792	unsexed	5.5 - 67.5	FL	0.986			365	New Caledonia	lagoon
1.00	0.02900	2.810	unsexed	16.5 - 42.6	TL	0.996			13	Pac Is Trust Tr	Palawan / 1998-2014
1.00	0.05480	2.818	unsexed	16.5 - 57.0	SL	0.996	0.113	0.1647	14	Philippines	Davao Gulf /

											2009-2012
0.99	0.04590	2.823	unsexed	7.9 - 54.0	SL	0.994			8	South Africa	estuaries, 1993-99
0.99	0.02800	2.844	mixed	5.5 - 68.0	FL	0.994			308	New Caledonia	
0.98	0.01880	2.960	unsexed	31.4 - 68.7	FL	0.980	0.090	0.1471	85	Guam	2009-2013
0.50	0.00710	3.180	unsexed		TL					South Africa	
0.70	0.00540	3.206	unsexed	48.0 - 82.0	TL				37	Vanuatu	

115) Length-length

Length-length Parameters for *Lutjanus argentimaculatus*

[n=4]

Unknown length	a	b	Known length	Length range (cm)	Sex of fish
SL	0.000	0.841	FL	-	unsexed
SL	0.000	0.810	TL	79 - 79	unsexed
TL	0.000	1.018	FL	-	unsexed
TL	0.000	1.176	SL	-	unsexed

116) Length-frequencies

List of frequency studies for *Lutjanus argentimaculatus*

Locality	Year from - to	Sex	Gear	Frequency type
Tigak Island (Kavieng fish depot), Papua New Guinea	1981 - 1981	unsexed/mixed	other	absolute number measured

117) Morphometrics

Morphometric Data for *Lutjanus argentimaculatus*

n = 2

Picture Name	Length		Lifestage	Aspect ratio
Luarg_u1.jpg	44.7	SL	unsexed	1.69
Luarg_u6.jpg	7.5	SL	unsexed	1.44

Picture Used	Luarg_u1.jpg
Size (cm)	44.7 SL, 55.4
Sex	unsexed
Total length (TL)	575 pixels
Standard length	85.0 % TL
Fork length	98.3 % TL
Pre-anal length	59.5 % TL
Pre-dorsal length	32.7 % TL
Pre-pelvic length	31.7 % TL
Pre-pectoral length	28.0 % TL
Body depth	29.6 % TL
Head length (HL)	28.5 % TL
Eye diameter	16.5 % HL
Pre-orbital length	34.8 % HL
Aspect ratio of caudal fin	1.68896

Picture Used	Luarg_u6.jpg
Size (cm)	7.5 SL, 9.2
Sex	unsexed
Total length (TL)	578 pixels
Standard length	84.9 % TL
Fork length	98.8 % TL
Pre-anal length	56.1 % TL
Pre-dorsal length	31.0 % TL
Pre-pelvic length	31.1 % TL
Pre-pectoral length	29.4 % TL
Body depth	34.3 % TL
Head length (HL)	31.1 % TL
Eye diameter	24.4 % HL
Pre-orbital length	28.3 % HL
Aspect ratio of caudal fin	1.44383

118) Morphology

Morphology Data of *Lutjanus argentimaculatus*

Identification keys
Abnormalities

Main Ref.	Anderson, W.D. Jr. and G.R. Allen, 2001
Sex attributes	
Specialized organs	no special organs
Different appearance	males alike females
Different colors	males alike females
Descriptive characteristics of juvenile and adult	
Striking features	none
Body shape lateral	fusiform / normal
Cross section	oval
Dorsal head profile	more or less straight
Type of eyes	more or less normal
Type of mouth/snout	more or less normal
Position of mouth	terminal
Type of scales	ctenoid scales
Diagnosis	This species is distinguished by the following characters: body moderately deep, greatest depth 2.3 - 2.7 in SL; preopercular notch poorly developed; vomerine tooth patch crescentic; gill rakers of first gill arch 6-8 + 9-12 = 16-20 (including rudiments); scale rows on back more or less parallel to lateral line, or parallel below spinous part of dorsal fin and sometimes rising obliquely posteriorly, or rarely with entirely oblique rows. Colour of the body generally greenish brown on back, grading to reddish; belly silvery or whitish (deep water specimens usually overall reddish); juveniles with a series of about 8 white and streaks 2 blue across cheeks (Ref. 9821, 90102).
Meristic characteristics of Lutjanus argentimaculatus	
Lateral Lines	1 Interrupted: No
Scales on lateral line	44 - 48
Pored lateral line scales	44 - 48
Scales in lateral series	
Scale rows above lateral line	4 - 6
Barbels	0
on lower limb	9 - 12
on upper limb	6 - 8
total	16 - 20
Fins	
Dorsal fin(s)	
Attributes	extending over most of the back length
Fins number	1notched No
Finlets No.	Dorsal 0 - 0

	Ventral 0 - 0
Spines total	10 - 10
Soft-rays total	13 - 14
Adipose fin	absent

Caudal fin

Attributes	more or less truncate; more or less normal

Anal fin(s)

Fins number	1
Spines total	3 - 3
Soft-rays total	8 - 8

Paired fins

Pectoral	Attributes more or less normal
	Spines 0
	Soft-rays 16 - 17
Pelvics	Attributes more or less normal
	Position thoracic before origin of D1
	Spines 1
	Soft-rays 5 - 5

119) Larvae

Larvae Information Summary for *Lutjanus argentimaculatus*

Main Ref:	Okiyama, M. 1993
Yolk-sac larvae	
Place of development	planktonic
Larval area	Northwestern Pacific (Japan)
Post larvae	
Striking feature	none
Striking feature	none
Pectorals	normal
Pelvics	normal (i.e. small or absent)

120) Recruitment

(NA)

121) Abundance

(NA)

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ANNEX 23

Uroteuthis chinensis
Mitre squid

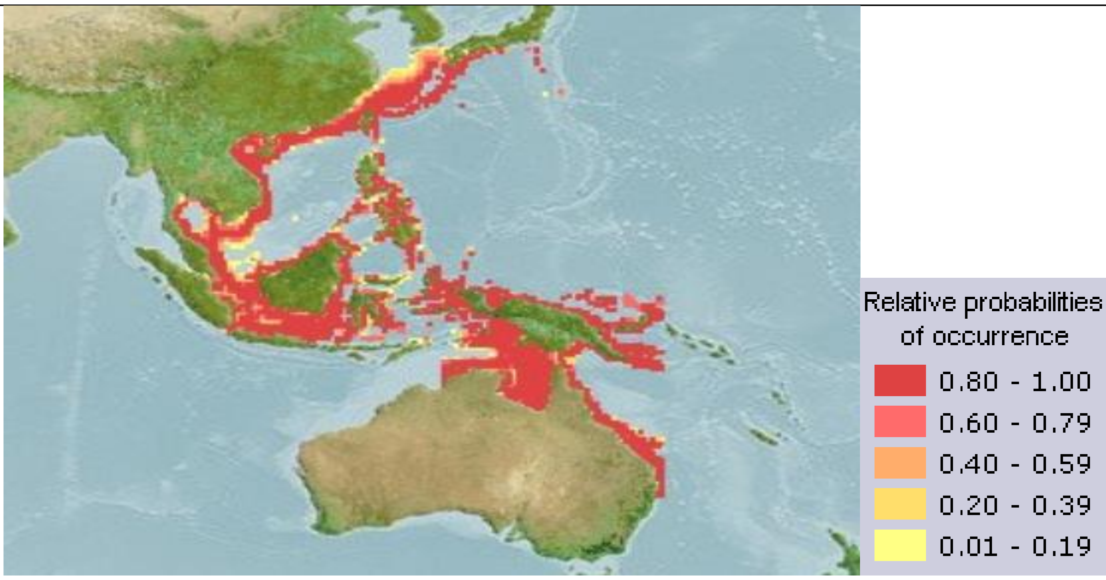
Scientific classification	
Kingdom:	Animalia
Phylum:	Mollusca
Class:	Cephalopoda
Order:	Myopsida
Family:	Loliginidae
Genus:	*Uroteuthis*
Binomial name	
Uroteuthis chinensis (Gray, 1849)	
Synonyms[2]	

- *Loligo chinensis* Gray, 1849
- *Loligo etheridgei* Berry, 1918
- *Loligo formosana* Sasaki, 1929

CCC. Environment/Ecology:

Demersal; non-migratory (Ref. 75930); depth range 15 - 170 m (Ref. 275), usually 40 - 150 m (Ref. 75930). Tropical; 21°C - 29°C (Ref. 75934); 34°N - 30°S, 99°E - 154°E (Ref. 275)

DDD. Distribution:



Note: Distribution range colours indicate degree of suitability of habitat which can be interpreted as probabilities of occurrence.

Indo-West Pacific.

EEE. Length at first maturity / Size / Weight / Age:

Maturity: L_m ?, range 6 - 8 cm Max length : 30.0 cm ML male/unsexed; (Ref. 275)

FFF.Short description

Uroteuthis is a genus of 14 species of common inshore squids of the Indo-West Pacific and is further subdivided into 3 subgenera. The members of the genus Uroteuthis are the only squids of the family Loliginidae that possess photophores (light-emitting organs) and all species in the genus have a pair of photophore organs on the ventral surface of their ink sac either side of their intestine.

Uroteuthis species range in size between 3 cm to 100 cm (mantle length). As with all other members of the family Loliginidae, they have a cornea that covers the lens of each eye, and have a gladius that extends the full length of the mantle and a gill that has a branchial canal.

GGG. Biology

Also caught by scoop nets and bamboo stake nets. Members of the class Cephalopoda are gonochoric. Male and female adults usually die shortly after spawning and brooding, respectively. Mating behavior: Males perform various displays to attract potential females for copulation. During copulation, male grasp the female and inserts the hectocotylus into the female's mantle cavity where fertilization usually occurs. Life cycle: Embryos hatch into planktonic stage and live for some time before they grow larger and take up a benthic existence as adults (Ref. 833).

HHH. Life cycle and mating behavior

Members of the class Cephalopoda are gonochoric. Male and female adults usually die shortly after spawning and brooding, respectively. Mating behavior: Males perform various displays to attract potential females for copulation. During copulation, male grasp the female and inserts the hectocotylus into the female's mantle cavity where fertilization usually occurs. Life cycle: Embryos hatch into planktonic stage and live for some time before they grow larger and take up a benthic existence as adults.

III. Fisheries

The mitre squid is both targeted and taken as bycatch throughout its range, but is not recorded separately in landing statistics. Jereb et al. (2010) estimate that this species comprises half the squid catch in the South China Sea, while Arkhipkin et al. (2015) estimate that it accounts for up to 90% of the total Chinese loliginid catch with a maximum catch of 100,000 tonnes. It is the predominant squid species in the Taiwan Strait (Liao et al. 2010) and is seasonally very common in Taiwanese fish markets (C.C. Lu, personal communication). This species represents about 76-80% of loliginid squid landings from squid light luring fisheries in Thai Waters (Songjitsawat and Sookbuntoeng 1988) and is the most commonly caught species in the East Indian Ocean (Arkhipkin et al. 2015). There are three main fishery areas in the South China Sea, each with different fishing seasons. The southern part of Hainan Island is fished April to September. The southwest part of Beibu Gulf is fished April to January. The Taiwan shoal is fished April to September. There is some variation in catch per unit effort across years (Arkhipkin et al. 2015), but no real trend.

JJJ. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Mollusca
Class:	Cephalopada
Order:	Myopsida
Family:	Loliginidae
Genus:	*Uroteuthis*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 10 metres
LOWER DEPTH LIMIT : 170 metres

RANGE DESCRIPTION
The mitre squid is widely distributed in coastal waters throughout the Indo-west Pacific. It has a depth range of 10-170 m but is most commonly found in the 30-50 m depth bracket (Arkhipkin *et al.* 2015). It is reported from the southern tip of India and Sri

Lanka and throughout the Bay of Bengal, extending southwards down the Malay Peninsula to Indonesia. It has been recorded throughout the Indo-west Pacific as far east as Papua New Guinea, southwards to northern, eastern and western coasts of Australia, and northwards to the Philippines, the South China Sea, the Gulf of Thailand, and coastal waters of continental Asia as far north and east as Japan and southeast Russia (Chotiyaputta *et al.* 1992, Nateewathana 1992, Jereb *et al.* 2010).

- **Population**

  CURRENT POPULATION TREND : Unknow

- **Habitat and Ecology**

  System : Marine
  Habitat type : Marine Neritic

- **Biological resource use** :

  Fishing & harvesting aquatic resource

- **Threats**

  Fishing is a potential threat to this species.

- **Use and Trade**

  The mitre squid is both targeted and taken as bycatch throughout its range, but is not recorded separately in landing statistics. Jereb *et al.* (2010) estimate that this species comprises half the squid catch in the South China Sea, while Arkhipkin *et al.* (2015) estimate that it accounts for up to 90% of the total Chinese loliginid catch with a maximum catch of 100,000 tonnes. It is the predominant squid species in the Taiwan Strait (Liao *et al.* 2010) and is seasonally very common in Taiwanese fish markets (C.C. Lu, personal communication). This species represents about 76-80% of loliginid squid landings from squid light luring fisheries in Thai Waters (Songjitsawat and Sookbuntoeng 1988) and is the most commonly caught species in the East Indian Ocean (Arkhipkin *et al.* 2015). There are three main fishery areas in the South China Sea, each with different fishing seasons. The southern part of Hainan Island is fished April to September. The southwest part of Beibu Gulf is fished April to January. The Taiwan shoal is fished April to September. There is some variation in catch per unit effort across years (Arkhipkin *et al.* 2015), but no real trend.

- **Conservation Action**

  There is a fishing ban in spawning grounds during the breeding season (Arkhipkin *et al*. 2015); it is not known whether any further conservation measures are needed. Research is required on the life history of the mitre squid, its population status and trends, and the impacts of fishing throughout its range.

KKK. More Information:

122) Stocks

There is some variation in catch per unit effort across years (Arkhipkin et al. 2015), but no real trend.

There is no information on the population status and trends of this species.

123) Ecology

Ecology of *Uroteuthis chinensis*

Substrate

Substrate	**Benthic**: mobile; demersal;

124) Diet

Feeding

feeding type	mainly animals (troph. 2.8 and up)
feeding type ref	Yunrong, Y., L. Yuyuan, Y. Shengyun, W. Guirong, T. Yajin, F. Qibin and L. Huosheng, 2013
feeding habit	hunting macrofauna (predator)
feeding habit ref	Yunrong, Y., L. Yuyuan, Y. Shengyun, W. Guirong, T. Yajin, F. Qibin and L. Huosheng, 2013
trophic level(s)	

	original sample		**unfished population**		**Remark**
estimation method	Troph	s.e.	Troph	s.e.	
From diet composition					
Ref.					
From individual food items	3.87	0.47			Trophic level estimated from a number of food items using a randomized resampling routine.

125) Reproduction

Reproduction of *Uroteuthis chinensis*

Main Ref.	Ruppert, E.E., R.S. Fox and R.D. Barnes, 2004
Mode	dioecism
Batch Spawner	No
Description of life cycle and mating behavior	Members of the class Cephalopoda are gonochoric. Male and female adults usually die shortly after spawning and brooding,

	respectively. Mating behavior: Males perform various displays to attract potential females for copulation. During copulation, male grasp the female and inserts the hectocotylus into the female's mantle cavity where fertilization usually occurs. Life cycle: Embryos hatch into planktonic stage and live for some time before they grow larger and take up a benthic existence as adults.
Search for more references on reproduction	Scirus

126) Maturity

Maturity studies for *Uroteuthis chinensis*

n = 2

Sort by ◉ Lm ○ Country ○ Locality ○ tm

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	5.5	-	8.0		-			female	China	Not specified, China
14.1 ML	4.6	-	12.8		-			male	China	Not specified, China

127) Spawning

Spawning for *Uroteuthis chinensis*

The mitre squid is a large-sized species: males grow to 49 cm mantle length, females to 31 cm mantle length, although they are commonly smaller than this. Males and females reach maturity at around 16 cm and 14 cm mantle length respectively, and maturity appears to be related to size rather than age. The sex ratio is 1:1.5 males to females (Arkhipkin et al. 2015). They spawn throughout the year but seasonal peaks in spawning activity are found. In Thai waters, these occur in March-June and August-November (Chotiyaputta 1995).

128) Spawning aggregation

(NA)

129) Fecundity

Fecundity ranges from 3,000 to 20,000 eggs (Arkhipkin et al. 2015).

130) Eggs

(NA)

131) Egg development

(NA)

132) Age/Size

(NA)

133) Growth

Growth parameters for *Uroteuthis chinensis*

Maximum Length 30cm ML
n = 3
Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Auximetric graph [n = 1]

ø = 3.46 **L inf** = 42.0 cm ML **K** = 1.7 Median record no. 2 Ref. 94032

Loo (cm)	Length Type	K (1/y)	Temp° C	Ø'	Country	Locality	Questionable	Captive
40.90	DL	0.490		2.91		Gulf of Thailand	No	No
42.00	ML	1.650	29.50	3.46	Thailand	Gulf of Thailand	Yes	No
44.10	ML	1.730	29.40	3.53	Thailand	Andaman Sea Coast	Yes	No

134) Length-weight

Length-Weight Parameters for ***Uroteuthis chinensis***

Length-weight (a vs b) graph [n=10] Median Record No. 6
a = 0.2132 cm ML
b = 2.2148

Sort by ◉ b ○ Country ○ Locality

a	b	Doubtful?	Sex	Length (cm)	Length type	No.	Country	Locality
1.1523	1.631	No	female		ML	450	Indonesia	Brondong
0.9693	1.684	No	mixed		ML	882	Indonesia	Brondong
0.7794	1.754	No	male		ML	432	Indonesia	Brondong
0.5210	1.803	No	male	8.4 - 37.0	ML	169	Indonesia	Bangka Regency
0.3964	1.820	Yes	male	5.0 - 28.6	ML	91	Thailand	Andaman Sea / 2005-2005
0.2132	2.215		unsexed		ML		China	Hainan Islands to Taiwan, 1997-1999
0.4946	2.217		unsexed		ML		China	South China Sea, 1997-1999

0.2204	2.229		unsexed		ML		China	Beibu Gulf, 1997-1999
0.1560	2.290	Yes	female	4.6 - 23.5	ML	32	Thailand	Andaman Sea / 2005-2005
0.1652	2.315	No	female	7.8 - 25.2	ML	223	Indonesia	Bangka Regency

135) Length-length

(NA)

136) Length-frequencies

(NA)

137) Morphometrics

(NA)

138) Morphology

(NA)

139) Larvae

Larvae Information Summary for *Uroteuthis chinensis*

Main Ref:	Dong, Z. 1991

Yolk-sac larvae

	max	min	mod	Ref.
Length at birth (mm)			0.3	75929
Larval area	Unspecified (China)			

140) Recruitment

(NA)

141) Abundance

(NA)

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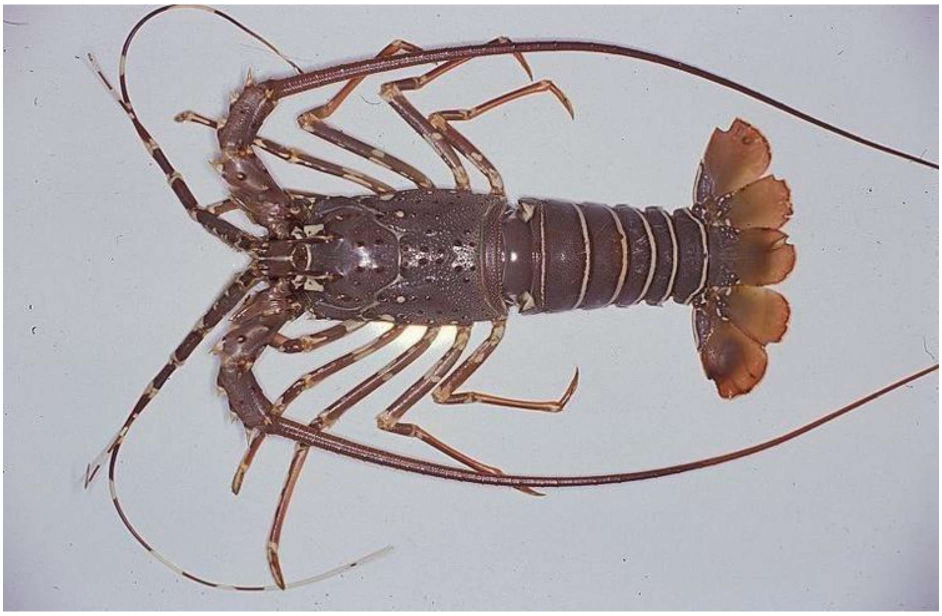
ANNEX 24

Panulirus polyphagus

Mud Spiny Lobster

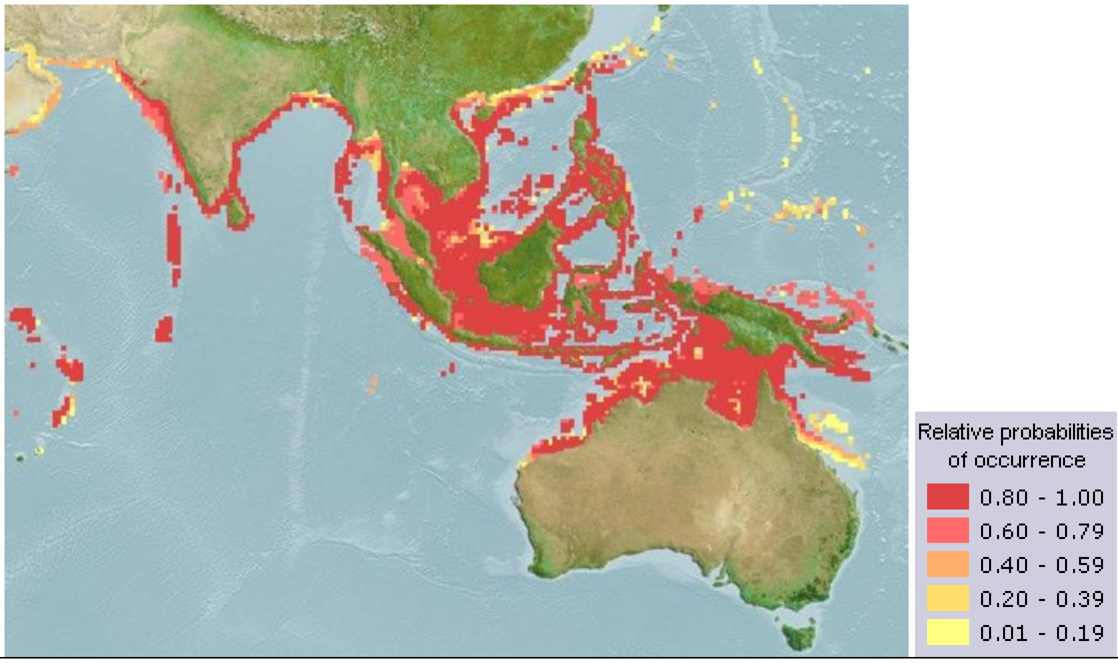


Scientific classification	
Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Crustacea
Class:	Malacostraca
Order:	Decapoda
Family:	Palinuridae
Genus:	*Panulirus*
Species:	***P. polyphagus***
Binomial name	
Panulirus polyphagus (Herbst, 1793)	
Synonyms	
• *Cancer (Astacus) polyphagus* Herbst, 1793 • *Palinurus fasciatus* Fabricius, 1798 • *Panulirus fasciatus* (Fabricius, 1798) • *Panulirus orientalis* Doflein, 1900	

LLL. Environment/Ecology:

Benthic; brackish; depth range 3 - 90 m (Ref. 4). Tropical; 26°N - 14°S, 64°E - 145°E (Ref. 107402)

MMM. Distribution:



Indo-West Pacific: from the coasts of Pakistan and India to Vietnam, the Philippines, Indonesia, Northwest Australia and the Gulf of Papua.

NNN. Length at first maturity / Size / Weight / Age:

Maturity: L_m 10.5 range ? - ? cm **Max length** : 40.0 cm TL male/unsexed; (Ref. 4); common length : 25.0 cm TL male/unsexed; (Ref. 4) **Maximum total body length** About 40 cm, common from 20 to 25 cm. Size at first maturity (male 51-55 mm CL; female 51-60 mm) (Kizhakudan & Patel, 2010), 80 mm CL (Alias et al. 2000)

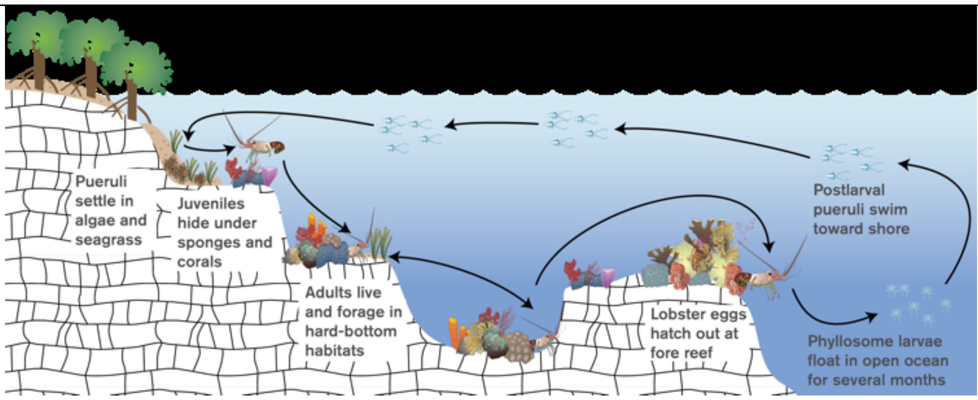
OOO. Short description

Panulirus polyphagus grows to a length of about 40 cm (16 in). The antennal plate bears two large spines and there are no transverse grooves on the abdominal segments. Distinctive colour features by which this species can be distinguished from other spiny lobsters include a greenish-grey background colour and a thin white band near the hind edge of each segment. In Europe, the otherwise similar native species, the north eastern Atlantic spiny crawfish (*Panulirus regius*), has four large spines on the antennal plate, and smooth grooves on the abdominal segments.

PPP. Biology

It has lengths of 40 cm, maximum total body length; 20 to 25 cm, common length. Occurs at a depth range from 3 to 90 m, but usually less than 40 m (Ref. 4). It is found on muddy substrates and sometimes on rocky bottoms near river mouths in turbid water (Ref. 4). Lives mainly at river-influenced shelf in shallow, turbid water with moderate run-off (Ref. 105109). In general, palinurids are mainly considered carnivores, usually feeding upon sluggish, easily captured animals where most material is eaten alive or freshly killed (Ref. 105260). Individuals reared in captivity fed on a natural diet of gastropods, clams, crabs, squids and fish (Ref. 105110). Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer (Ref. 833). Major spawning occurs in January and September, minor peaks were observed in March and June, occasional spawning were observed in April, May, August and October to December, least spawning occurs in February and July (Ref. 106340).

QQQ. Life cycle and mating behavior



- Gonadosomatic index and size frequency
    - Egg-bearing lobsters are usually found during the months of July – September.
    - This coincide with a previous study by Alias Man (2000). Which state that the peak breeding seasons is in August.
- Area of habitat in each stage/migration pattern
    - Juvenile stage : rocky shore area.
    - Spawning adult : coral reef slooping to deeper water.
    - Lavae : open sea

RRR. Fisheries

In the Bay of Bengal and the Gulf of Thailand, the species is quite important commercially. In India, the main fishing season extends from November to March. The animals are caught by trawling, but also with set nets, seines, etc.;they rarely enter traps. Sold fresh and frozen in local markets and also transported to the larger towns. Served regularly in restaurants in Thailand, and else-where. In Thailand, mounted dry specimens, usually in fancy glass cases, are sold as curios to tourists.

SSS.IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Arthropoda

Class:	Malacostraca
Order:	Decapoda
Family:	Palinuridae
Genus:	*Panulirus*

- ## Geographic Range

  NUMBER OF LOCATIONS
  UPPER DEPTH LIMIT : 3 metres
  LOWER DEPTH LIMIT : 90 metres

  RANGE DESCRIPTION
  This species has a broad geographic range from Pakistan and India to Viet Nam, the Philippines, Indonesia, northwest Australia, and the Gulf of Papua (Holthuis 1991).

- ## Population

  CURRENT POPULATION TREND : Unknow
  POPULATION SEVERELY FRAGMENTED : No

- ## Habitat and Ecology

  System : Marine
  Habitat type : Marine Neritic

- ## Biological resource use :

  Fishing & harvesting aquatic resource
  Logging & wood harvesting

- ## Threats

  This species is subject to localised over-exploitation by fisheries in India. It is also threatened by incidental catch in parts of its range where it is found on muddy substrates.

Conservation status

Least Concern (IUCN 3.1)[1]

- ## Use and Trade

  This species is harvested in India for food, particularly in the northwest and in Mumbai, where significant declines in landings have been recorded (Radhakrishnan *et al.* 2005). The fishing season extends from November to March (Holthuis 1991). Additionally a commercial fishery for this species is operating in Thailand selling caught lobsters in local markets and larger towns (Holthuis 1991).

- **Conservation Action**
  Management strategies for this species need to be developed and enforced to maintain the population at a sustainable level in regions where it is over-exploited. It is recommended that accurate fisheries data be collected and that there is regular monitoring of Catch Per Unit Effort (CPUE) data to create a baseline to measure trends into the future.

TTT. More Information:

142) Stocks

(NA)

143) Ecology

Ecology of *Panulirus Polyphagus*

Main Ref.	Holthuis, L.B., 1991
distribution	Brackishwater • **estuaries/lagoons/brackish seas** Highighted items on the list are where *Panulirus polyphagus* may be found.
Remarks	It is found on muddy substrates and sometimes on rocky bottoms near river mouths in turbid water (Ref. 4). Lives mainly at river-influenced shelf in shallow, turbid water with moderate run-off (Ref. 105109). In general, palinurids are mainly considered carnivores, usually feeding upon sluggish, easily captured animals where most material is eaten alive or freshly killed (Ref. 105260). Individuals reared in captivity fed on a natural diet of gastropods, clams, crabs, squids and fish (Ref. 105110).

144) Diet

(NA)

145) Reproduction

Reproduction of *Panulirus Polyphagus*

Main Ref.	Kagwade, P.V., 1988
Mode	dioecism
Fertilization	

Spawning Frequency	throughout the year, but peaking once
Batch Spawner	No
Reproductive Guild	bearers External brooders
Description of life cycle and mating behavior	Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer (Ref. 833).
Search for more references on reproduction	Scirus

146) Maturity

Maturity studies for *Panulirus Polyphagus*
n = 3

Lm (cm)	Length (cm)	Age range (y)	tm (y)	Sex of fish	Country	Locality
0.5 CL	-	-	2.20	female	India	Kovalam/ 1977-1978
20.5 TL	-	-		female	India	Sassoon Dock and Kasara Bunder/ 1976-1985
26.5 TL	-	-		male	India	Sassoon Dock and Kasara Bunder/ 1976-1985

147) Spawning

Spawning for *Panulirus Polyphagus*
n = 1

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
111	111	111	111	111	111	111	111	111	111	111	111	India	Sassoon Dock and Kasara Bunder

148) Spawning aggregation

(NA)

149) Fecundity

Fecundity 72 000 – 945 000 (depending on size). (Kagwade, 1988)

150) Eggs

(NA)

151) Egg development

(NA)

152) Age/Size

Size at first maturity (male 51-55 mm CL; female 51-60 mm) (Kizhakudan & Patel, 2010), 80 mm CL (Alias et al. 2000)

153) Growth

Growth parameters for *Panulirus Polyphagus*

Maximum Length 40cm TL n = 6

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Auximetric graph	[n = 6]
M vs K graph	[n = 4]
M vs Linf graph	[n = 4]

ø = 3.56 **L inf** = 43.8 cm CW **K** = 1.9 Median record no. 4 Ref. 116140

Loo (cm)	Length Type	K (1/y)	to	Sex	M (1/y)	Temp° C	Lm	Ø'	Country	Locality	Questionable	Captive
36.10	TL	1.580		F	2.29			3.31	India	Maharashtra	No	No
36.50	TL	1.830		M	2.51			3.39	India	Maharashtra	No	No
37.50	CW	1.600		F	2.20			3.35	India	Maharashtra	No	Yes
43.80	CW	1.900		M	2.40			3.56	India	Maharashtra	No	Yes
44.30	TL	0.223	0.20	F				2.64	India	Bombay	No	Yes
53.70	TL	0.200	0.60	M				2.76	India	Bombay	No	Yes

154) Length-weight

Length-Weight Parameters for *Panulirus Polyphagus*

Length-weight (a vs b) graph	[n=4]	Median Record No. 3 **a** = 0.4897 cm CL **b** = 3.1400 Ref. 106343

a	b	Doubtful?	Sex	Length (cm)	Length type	No.	Country	Locality
0.0806	2.616	No	female		TL		India	Unspecified

0.0472	2.802	No	male	TL	India	Unspecified
0.4897	3.140	No	male	CL	India	off Kovalam, Mangalore / 1977-1978
0.2570	3.710	No	female	CL	India	off Kovalam, Mangalore / 1977-1978

155) Length-length

Length-length Parameters for *Panulirus Polyphagus*

n=2

Unknown length	a	b	Known length	r	Length range (cm)	Sex of fish
CL	0.579	0.395	TL		-	female
CL	0.646	0.407	TL		-	male

156) Length-frequencies

(NA)

157) Morphometrics

(NA)

158) Morphology

(NA)

159) Larvae

(NA)

160) Recruitment

(NA)

161) Abundance

(NA)

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ANNEX 25

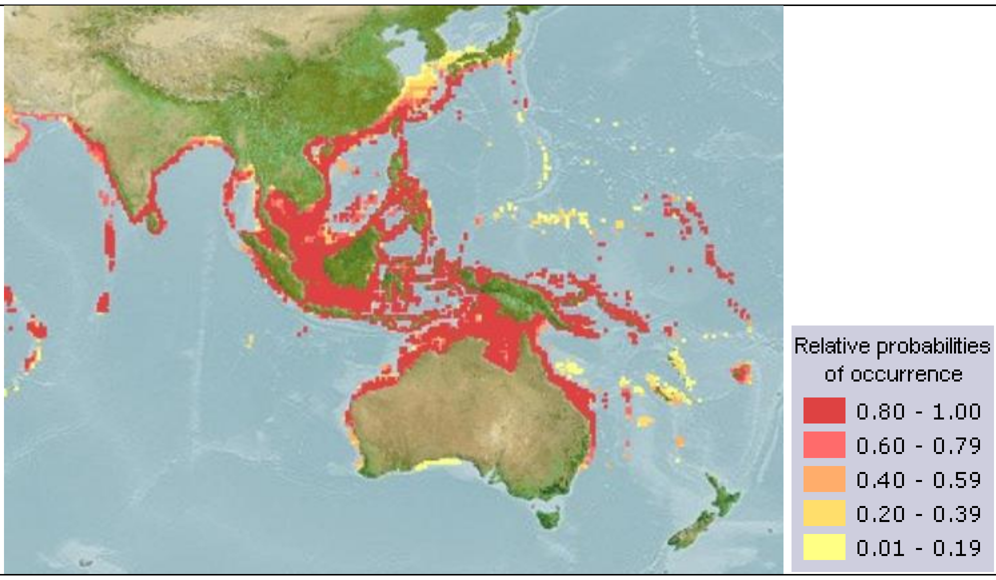
Epinephelus coioides
Orange-spotted grouper


Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Serranidae
Subfamily:	Epinephelinae
Genus:	*Epinephelus*
Species:	***E. coioides***
Binomial name	
Epinephelus coioides (Hamilton, 1822)	

UUU. Environment/Ecology:

Marine; brackish; reef-associated; depth range 1 - 100 m (Ref. 167). Subtropical; 37°N - 34°S, 28°E - 180°E (Ref. 5222)

VVV. Distribution:



Indo-West Pacific: Red Sea south to at least Durban, South Africa and eastward to Palau and Fiji, north to the Ryukyu Islands, south to the Arafura Sea (Ref. 9819) and Australia. Recently reported from the Mediterranean coast of Israel (Ref. 5222). Frequently misidentified as *Epinephelus tauvina* or *Epinephelus malabaricus* (Ref. 27362).

WWW. Length at first maturity / Size / Weight / Age:

Maturity: L_m 48.3, range 25 - 30 cm Max length : 120 cm TL male/unsexed; (Ref. 47613); max. published weight: 15.0 kg (Ref. 11228); max. reported age: 22 years (Ref. 3627) Length at First Maturity= 25-30 cm Size= 55-75 Weight= 15kg Age= 2-3years (FiA,2020)

XXX. Short description

Dorsal spines (total): 11; Dorsal soft rays (total): 13-16; Anal spines: 3; Anal soft rays: 8. This species is distinguished by the following characters: elongated body with greatest body depth at 2.9-3.7 in SL (for specimens 10-78 cm SL); head length 2.3-2.6 in SL. interorbital width 5.0-6.2 in HL; preopercle with enlarged serrae at angle and a broad shallow notch just above angle; upper edge of operculum straight or somewhat convex; maxilla reaches to or slightly past a vertical at rear edge of eye; upper jaw length 17-20% of SL; midlateral part of lower jaw with 2-3 rows of subequal teeth; gill rakers of first gill arch 8-10 + 14-17; pyloric caeca 50-60; lateral body scales rough, with minute auxiliary scales (body scales ctenoid except for nape, back, thorax, abdomen and above anal-fin base with cycloid scales); lateral-line scales 58-65; lateral-line tubes of anterior scales branched in adults. Colour: head and body tan dorsally, shading to whitish ventrally; numerous small brownish orange or reddish brown spots on head, body, and median fins; body with 5 faint, irregular, oblique, dark bars which bifurcate ventrally (irregular H-shaped bars); back with 3-4 blackish saddles; orange spots become poorly defined and darker with growth (Ref. 39231, 90102).

YYY. Biology

Inhabit turbid coastal reefs (Ref. 9710) and are often found in brackish water (Ref. 27362) over mud and rubble (Ref. 6390). Solitary (Ref 90102). Juveniles are common in shallow waters of estuaries over sand, mud and gravel and among mangroves (Ref. 6390). Feed on small fishes, shrimps, and crabs. Probably spawn during restricted periods and form aggregations when doing so (Ref. 27352). Females mature at 25 to 30 cm (2 to 3 years old), and sexual transition

occurs at 55 to 75 cm (Ref. 39231). Eggs and early larvae are probably pelagic (Ref. 6390). Has been tested in several countries as a potential species for mariculture (Ref. 43448). Caught with hook-and-line, traps, trawls, and lift nets. Common and expensive in markets of the region; sold fresh and kept alive at restaurants in Asian countries (e.g. Hong Kong and Taiwan Province of China) (Ref. 39231).

ZZZ. Life cycle and mating behavior

Pelagic spawner (Ref. 32184).

AAAA. Fisheries

(NA)

BBBB. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Epinephelidae
Genus:	*Epinephelus*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 0 metres
LOWER DEPTH LIMIT : 100 metres

RANGE DESCRIPTION
This species is distributed in the Indo-Pacific Ocean from Durban, South Africa; north along East Africa, including Madagascar, Reunion and Mauritius, to the Red Sea and Persian Gulf; east to Palau and Fiji; north to the Ryukyu Islands, Japan; and south to the Arafura Sea and northern Australia (Heemstra and Randall 1993). It has also migrated through the Suez Canal to the eastern Mediterranean (Randall 1995). Its depth range is zero to 100 metres.

- **Population**

CURRENT POPULATION TREND : Decreasing

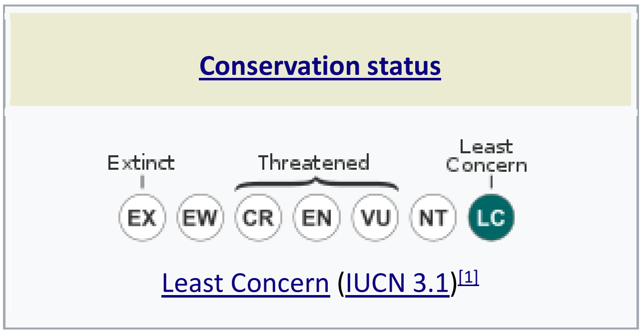
- **Habitat and Ecology**

System : Marine

Habitat type : Marine Neritic, Marine Intertidal
Generation Length : 12.5 years

- **Biological resource use** :
  Fishing & harvesting aquatic resource

- **Threats**
  Overfishing is a major threat to populations in the Persian Gulf (Grandcourt *et al*. 2005) and China, but this is not considered a major threat on a global-level at this time. Degradation of estuaries (juvenile habitat) and coral reefs (adult habitat) may also impact this species (Burke *et al*. 2002).



- **Use and Trade**
  This species is important to fisheries through much of its range. It supplies live and chilled fish markets, both domestic and international. Mariculture of this species is extensive in Southeast Asia (Sadovy 2000). It is cultured for local consumption in Thailand and Singapore and for export using mainly wild-caught juvenile seed (Heemstra and Randall 1993, Yashiro 1996). Hatchery production has recently increased. Juveniles are still taken from the wild for grow-out in mariculture operations, but this is very poorly documented. This species is one of the most common next to *E. awoara* used to supply the large mariculture industry of Fujian, China; however, *E. coioides* juveniles are mainly sourced from hatchery production, not wild-caught fisheries (Liu and Sadovy 2009). Spawning aggregations are targeted by local fishers via spear in Papua New Guinea (Hamilton 2003). It is the most important reef-associated, commercial species in the Persian Gulf and is mainly collected via demersal traps (Grandcourt *et al.* 2005) as well as longlines and trawls (Carpenter *et al.* 1997). In northern Oman, fishermen target this species with semicircular wire basket traps (McIlwain *et al.* 2016). It is also commonly taken as bycatch in the shrimp and cutlassfish trawl fisheries of Iran (Raeisi *et al*. 2011, Paighambari and Daliri 2012, Hosseini *et al*. 2012).

- **Conservation Action**
  Conservation measures directed to the Persian Gulf population have included reduction in fishing effort, modification of gear selectivity and the introduction of juvenile escape panels in the demersal trap fishery. In Qatar, fishery regulations include restricted mesh size, number of vessels, trip frequency and licensing (A. Al-Kuwary pers. comm. 2013). However, these measures were found to be ineffective (Grandcourt *et al*. 2011). Suggested alternative measures include a moratorium on the use of traps in the offshore demersal fishery of Abu Dhabi (Grandcourt *et al*. 2011). There are no

restrictions on fishing effort for this species in Oman (McIlwain *et al*. 2016). This species is under total protection in New South Wales, Australia (Public Consultation Document 2002) and there is a strict length limit enforced in Queensland, Australia (Fishing Industry Organization and Marketing Amendment Regulation 1993). This species was released on Hong Kong artificial reefs in Yan Chau Tong and Hoi Ha Wan Marine Park in 2001 as a part of restocking trial (Cheung 2001), it is not known if this improved recovery.

CCCC. More Information:

162) Stocks

(NA)

163) Ecology

Ecology of *Epinephelus coioides*

Main Ref.	Randall, J.E. and P.C. Heemstra, 1991
Distribution	Brackishwater • **estuaries/lagoons/brackish seas** • **mangroves** Highighted items on the list are where *Epinephelus coioides* may be found.
Remarks	Probably make frequent use of shelters, suggesting an 'ambush' method of feeding (Ref. 6390). Inhabit turbid coastal reefs (Ref. 9710) and are often found in brackish water (Ref. 27362) over mud and rubble (Ref. 6390). Juveniles are common in shallow waters of estuaries over sand, mud and gravel and among mangroves (Ref. 6390). Feed on small fishes, shrimps, and crabs. Probably spawn during restricted periods and form aggregations when doing so (Ref. 27352). Eggs and early larvae are probably pelagic (Ref. 6390).

Substrate

Substrate	**Benthic**; **Soft Bottom**: mud; **Hard Bottom**: rubble;
Substrate Ref.	Letourneur, Y., P. Chabanet, P. Durville, M. Taquet, E. Teissier, M. Parmentier, J.-C. Quéro and K. Pothin, 2004

164) Diet

Food and Feeding Habits: Diet Composition *Epinephelus coioides*

n = 1

Main Food	Percent	Trophic Level (y)	Predator Life Stage	Country	Locality	Ref.
nekton	37	4.0	adults	New Caledonia	1985-1997	55797
zoobenthos	37	4.0	adults	New Caledonia	1985-1997	55797

165) Reproduction

Reproduction of *Epinephelus coioides*

Main Ref.	Heemstra, P.C. and J.E. Randall, 1993
Mode	protogyny
Fertilization	external
Mating type	
Spawning frequency	one clear seasonal peak per year
Spawning aggregation	Yes. **Ref.** SCRFA, Science and Conservation of Fish Aggregations, 2018
Batch spawner	**Ref.**
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Description of life cycle and mating behavior	Pelagic spawner (Ref. 32184).
Search for more references on reproduction	Scirus

166) Maturity

Maturity studies for *Epinephelus coioides*

n = 5

ort by ◉ Lm ○ Country ○ Locality ○ tm

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	49.0	-			-			unsexed		Asia-Pacific Region
	25.0	-	30.0	2.0	-	3.0		female		Arabian Gulf

43.5 TL		-			-		2.70	female	United Arab Em.	coast of the Emirate of Abu Dhabi, Sept. 2000-March 2003
53.0 TL		-			-			female	India	North Andhra Region (17°01'N-19°22'N; 83°23'E-85°14'E), Sept 2009-Oct 2011
92.0 TL		-			-			male	India	North Andhra Region (17°01'N-19°22'N; 83°23'E-85°14'E), Sept 2009-Oct 2011

167) Spawning

Spawning for *Epinephelus coioides*

n = 1

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
		111	111	111								United Arab Em.	coast of the Emirate of Abu Dhabi, Sept. 2000-March 2003

168) Spawning aggregation

Spawning Aggregations of *Epinephelus coioides*

[n = 1]

Country	Spawning type	Aggregation type	Status
Papua New Guinea	Unknown	Unknown	Decreasing

169) Fecundity

Fecundity for *Epinephelus coioides*

Sort by ◉ Country ○ Locality

[n = 1]

Country	Locality	Absolute Fecundity	
		min	max
India	North Andhra Region (17°01'N-19°22'N; 83°23'E-85°14'E), Sept 2009-Oct 2011	43,618	463,940

170) Eggs

Egg Characteristics of *Epinephelus coioides*

Main Ref.	Ordinio-Aguilar, R., H. Kohno, A. Ohno, M. Moteki and Y. Taki, 1995

Place of Development	buoyant (pelagic)
Shape of Egg	spherical
Attributes	smooth, not sticky
Color of Eggs	transparent
Get Information on	Scirus

171) Egg development

(NA)

172) Age/Size

List of Population Characteristics records for *Epinephelus coioides*

n = 8

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed		95		Global	East Indies
unsexed		97.9	12.2	United Arab Em.	Abu Dhabi, 2002-2003
unsexed	1.5 kg	100		South Africa	Not specified
unsexed		100		Indonesia	Not specified
unsexed		111	22	Kuwait	Kuwait
unsexed		120			Asia-Pacific Region
unsexed		120		Oman	Not specified
unsexed		120		Iran	Persian Gulf and Oman Sea

173) Growth

Growth parameters for *Epinephelus coioides*

Maximum Length 120cm TL

n = 2

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

M vs K graph	[n = 1]
M vs Linf graph	[n = 1]
Longevity vs 3/K graph	[n = 1]

ø = 3.13 **L inf** = 97.9 cm TL **K** = 0.1

Median record no. 2

55546Ref. 55546

Loo (cm)	Length Type	K (1/y)	to (years)	M (1/y)	Temp° C	Ø'	Country	Locality	Questionable	Captive
93.0	TL	0.167		0.20	23.5	3.16	Kuwait		No	No
97.9	TL	0.140	-1.50			3.13	United Arab Em.	Abu Dhabi	No	No

174) Length-weight

Length-Weight Parameters for *Epinephelus coioides*

Length-weight (log *a* vs *b*) graph [n=6]
Hide graph

Sort by a b Country Locality

Score	a	b	Sex	Length (cm)	Length type	r^2	n	Country	Locality
0.96	0.01990	2.990	mixed	14.2 - 107.0	TL	0.956	440	India	Visakhapatnam, Andhra Pradesh / 2009-2011
0.60	0.01440	3.024	unsexed		TL		1912	Kuwait	
1.00	0.02160	3.053	unsexed	16.0 - 51.0	SL	0.995	15	Philippines	Davao Gulf / 2009-2012
0.99	0.01050	3.084	unsexed	6.5 - 111.0	TL	0.994	41	New Caledonia	lagoon
0.99	0.00990	3.102	mixed	6.5 - 111.0	FL	0.994	44	New Caledonia	
0.50	0.01020	3.232	Mixed		TL			United Arab Em.	Abu Dhabi, 2002-2003

175) Length-length

Length-length Parameters for *Epinephelus coioides*
[n=6]

Unknown length	a	b	Known length	r	Length range (cm)	Sex of fish
SL	-0.630	0.840	TL	0.999773	11.2 - 82.5	unsexed
TL	0.000	1.000	FL		-	unsexed
TL	0.000	1.148	SL		-	unsexed
TL	0.000	1.217	SL		-	unsexed
TL	0.349	1.223	SL	0.998	16 - 51	unsexed
TL	0.000	1.227	SL		-	unsexed

176) Length-frequencies

(NA)

177) Morphometrics

Morphometric Data for ***Epinephelus coioides***

n = 4

Picture Name	Length		Lifestage	Aspect ratio
Epcoi_u0.gif	31.9	SL	unsexed	0.99
Epcoi_u1.jpg	9.1	SL	juvenile	1.42
Epcoi_u3.jpg	12.9	SL	unsexed	1.25
Epcoi_u5.jpg	19.6	SL	unsexed	

Picture Used	EPCOI_U0.GIF
Size (cm)	31.9 SL
Sex	unsexed
Total length (TL)	584 pixels
Standard length	82.2 % TL
Fork length	100.0 % TL
Pre-anal length	59.9 % TL
Pre-dorsal length	32.4 % TL
Pre-pelvic length	30.5 % TL
Pre-pectoral length	32.0 % TL
Body depth	23.8 % TL
Head length (HL)	35.4 % TL
Eye diameter	11.6 % HL
Pre-orbital length	23.7 % HL
Aspect ratio of caudal fin	0.992808

Picture Used	Epcoi_u1.jpg
Size (cm)	9.1 SL, 11.2
Sex	juvenile
Total length (TL)	605 pixels
Standard length	87.1 % TL
Fork length	100.0 % TL
Pre-anal length	57.2 % TL
Pre-dorsal length	28.1 % TL
Pre-pelvic length	30.6 % TL

Pre-pectoral length	29.1 % TL
Body depth	26.3 % TL
Head length (HL)	32.4 % TL
Eye diameter	19.9 % HL
Pre-orbital length	18.4 % HL
Aspect ratio of caudal fin	1.41858

Picture Used	EPCOI_U3.JPG
Size (cm)	12.9 SL, 16.3
Sex	unsexed
Total length (TL)	584 pixels
Standard length	81.5 % TL
Fork length	100.0 % TL
Pre-anal length	56.2 % TL
Pre-dorsal length	28.9 % TL
Pre-pelvic length	29.6 % TL
Pre-pectoral length	26.9 % TL
Body depth	25.7 % TL
Head length (HL)	31.8 % TL
Eye diameter	18.3 % HL
Pre-orbital length	24.2 % HL
Aspect ratio of caudal fin	1.25261

Picture Used	Epcoi_u5.jpg
Size (cm)	19.6 SL, 24.9
Sex	unsexed
Total length (TL)	600 pixels
Standard length	83.3 % TL
Fork length	100.0 % TL
Pre-anal length	55.0 % TL
Pre-dorsal length	27.3 % TL
Pre-pelvic length	28.5 % TL
Pre-pectoral length	27.5 % TL
Body depth	24.5 % TL
Head length (HL)	29.8 % TL
Eye diameter	13.4 % HL

	Pre-orbital length	22.9 % HL	
	Aspect ratio of caudal fin	1.47271	

178) Morphology

(NA)

179) Larvae

Larvae Information Summary for *Epinephelus coioides*

Main Ref:	Kailola, P.J., M.J. Williams, P.C. Stewart, R.E. Reichelt, A. McNee and C. Grieve 1993
	Yolk-sac larvae
Place of development	planktonic
Larval area	North West Shelf, Australia

180) Recruitment

(NA)

181) Abundance

(NA)

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ANNEX 26

Rastrelliger brachysoma

Indo-Pacific Mackerel or Short Mackerel

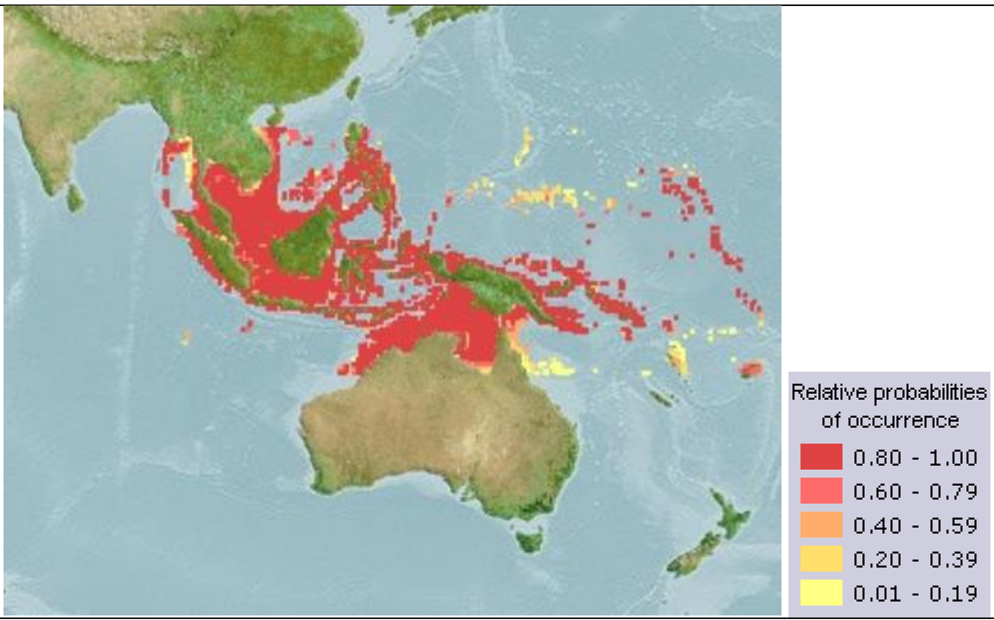
Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Scombriformes
Suborder:	Scombroidei
Family:	Scombridae
Subfamily:	Scombrinae
Tribe:	Scombrini
Genus:	*Rastrelliger*
Species:	***R. brachysoma***
Binomial name	
Rastrelliger brachysoma (Bleeker, 1851)	
Synonyms	
• *Rastrelliger neglectus* van Kampen, 1907	

	• *Scomber brachysoma* Bleeker, 1851 • *Scomber neglectus* van Kampen, 1907	

DDDD. Environment/Ecology:

Marine; brackish; pelagic-neritic; oceanodromous (Ref. 51243); depth range 15 - 200 m (Ref. 28016). Tropical; 20°C - 30°C (Ref. 54858); 18°N - 18°S, 93°E - 180°E (Ref. 54858)

EEEE. Distribution:



Pacific Ocean: Andaman Sea to Thailand, Indonesia, Papua New Guinea, Philippines, Solomon Islands and Fiji.

FFFF. Length at first maturity / Size / Weight / Age:

Maturity: L_m 17.0 range ? - ? cm **Max length** : 34.5 cm FL male/unsexed; (Ref. 168); common length : 20.0 cm FL male/unsexed; (Ref. 168) Length at First Maturity= total length of 16.83 for male and 17.18 cm for female Size= maximize size of 17.15cm for male and 17.70 cm for female Weight= 55.05g for male and 58.01 for female Age= ??(FiA,2020). Length at First Maturity=16.98 cm L_{inf} = 22.23, common length = 16-18 cm(Srichanngam *et al.*,2014)

GGGG. Short description

Dorsal spines (total): 8 - 11; Dorsal soft rays (total): 12; Anal spines: 0; Anal soft rays: 12; Vertebrae: 31. This species is distinguished by the following characters: body very deep, its depth at posterior margin of opercle 3.7-4.3 times in fork length; head equal to or less than body depth; maxilla covered by lacrimal bone but extending nearly to end of lacrimal; gill rakers very long, visible when mouth is opened, 30-48 on lower limb of first gill arch; numerous bristles on longest gill raker, about 150 on one side in specimens of 12.7 cm, 210 in specimens of 16 cm, and 240 at 19 cm fork length; intestine very long, 3.2-3.6 times fork length; snout pointed; swim bladder present; vertebrae 13 + 18 = 31; interpelvic process small and single; anal spine

rudimentary. Colour of spinous dorsal fin yellowish with a black edge, pectoral and pelvic fins dusky, other fins yellowish (Ref. 168, 9684).

HHHH. Biology

An epipelagic, neritic species that tolerates slightly reduced salinities in estuarine habitats and in areas where surface temperature range between 20° and 30°C. It forms schools of equally sized individuals. Batch spawning is believed to extend from March through September. Feeds chiefly on microzooplankton with a high phytoplankton component. Marketed fresh, frozen, canned, dried salted and smoked (Ref. 168, 9684).

IIII. Life cycle and mating behavior

JJJJ. Fisheries

Catches of this species are usually either recorded as *Rastrelliger* spp. or are combined with *R. kanagurta* . It is the most important commercial species of mackerel in the Philippines, caught the year round with native purse seines (italakop) and fish corrals (ibaklad) in Manila Bay (Manacop, 1958) and by dynamiting. In India, ("indian mackerel fishing"), it is fished with a variety of gear such as gillnets, seines , and cast nets and drift nets operated from boats with out-riggers and from dugout canoes. The catch in the Philippines fluctuated between 25 183 metric tons in 1978 and 18 962 metric tons in 1981 (FAO, 1983). The total catch reported for this species to FAO for 1999 was 25 713 t. The countries with the largest catches were Philippines (25 713 t).

KKKK. IUCN Red List Status

GEOGRAPHIC RANGE

- **Taxonomy**

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Family:	Scombridae
Genus:	*Rastrelliger*

- **Geographic Range**

NUMBER OF LOCATIONS
UPPER DEPTH LIMIT : 0 metres
LOWER DEPTH LIMIT : 200 metres

RANGE DESCRIPTION

This species is found in the Pacific Ocean from the Andaman Sea to Thailand, Indonesia, Papua New Guinea, Philippines, Solomon Islands and Fiji.

- **Population**

  CURRENT POPULATION TREND : Unknow

  POPULATION SEVERELY FRAGMENTED : No

- **Habitat and Ecology**

  System : Marine

  Habitat type : Marine Neritic

  Movement patterns : Full Migrant

- **Biological resource use** :

  Logging & wood harvesting

- **Threats**

  This species is highly commercial, and is caught with a number of different gears including purse-seines, fish corrals, gill-nets, cast and drift nets, and by dynamiting. It is marketed fresh, frozen, canned, dried salted and smoked (Collette 2001). In the Philippines, this is a highly commercial species caught by seines, and where landings range from 10,000 to 50,000 tonnes per year.

  Worldwide reported landings of *Rastrelliger* spp. are increasing, and although there is no information on effort, it is also assumed to be increasing.

Conservation status

Data Deficient (IUCN 3.1)[1]

- **Use and Trade**

This is a highly commercial fish species.

- **Conservation Action**

  There are no species-specific conservation measures. Although landings are increasing, without information on effort, it is not known if current fishing activities are affecting population abundance. Better reporting is needed to determine species specific landings if possible. Additionally, given the high combined landings for this species and unknown level of effort and the absence of an international management body, further monitoring of this species is needed on the national level.

.

LLLL. More Information:

182) Stocks

This species is widespread in southeastern Asia. There is no information on population or general abundance. This species is targeted in commercial and artisanal fisheries throughout its range, but landings are primarily reported in combination with mixed *Rastrelliger* spp. Reported worldwide landings for *Rastrelliger* species have steadily increased since 1950 to over 800,000 tonnes in 2006, but no effort information is available. Given that effort is assumed to be increasing, it is not known how this species population is affected by current and historical fishing pressure. This species is listed as Data Deficient. Given the absence of an international management body, further monitoring of this species is needed on the national level, in addition to species-specific data on landings, effort and population status.

Catches of the three species of Rastrelliger are not usually recorded separately. Rastrelliger brachysoma is the most important commercial species of mackerel in the Philippines (Collette and Nauen 1983). Reported worldwide landings show gradual increase for all three Rastrelliger species, with combined reported landings increasing from 200,000 tonnes in 1950 to over 800,000 tonnes in 2006 (FAO 2009).

183) Ecology

Ecology of *Rastrelliger brachysoma*

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.

Main Ref.	Collette, B.B. and C.E. Nauen, 1983
Distribution	Marine - Oceanic • **epipelagic** Brackishwater • **estuaries/lagoons/brackish seas** Highighted items on the list are where *Rastrelliger brachysoma* may be found.
Remarks	This species tolerates slightly reduced salinities in estuarine habitats. Feeds chiefly on microzooplankton with a high phytoplankton component.

184) Diet

Feeding

The short mackerel feeds chiefly on microzooplankton with a high phytoplankton component.

Feeding type	plants/detritus+animals (troph. 2.2-2.79)
Feeding type ref	Collette, B.B. and C.E. Nauen, 1983
Feeding habit	selective plankton feeding

Feeding habit ref	Collette, B.B. and C.E. Nauen, 1983
Trophic level(s)	see table below

	Original sample		**Unfished population**		**Remark**
Estimation method	Troph	s.e.	Troph	s.e.	
From individual food items	2.72	0.31			Trophic level estimated from a number of food items using a randomized resampling routine.

185) Reproduction

Reproduction of *Rastrelliger brachysoma*

Main Ref.	Collette, B.B. and C.E. Nauen, 1983
Mode	dioecism
Fertilization	external
Mating type	
Spawning frequency	
Spawning aggregation	**Ref.**
Batch spawner	Yes. **Ref.** Collette, B.B. and C.E. Nauen, 1983
Reproductive guild	nonguarders open water/substratum egg scatterers
Parental Care	none
Description of life cycle and mating behavior	
Search for more references on reproduction	Scirus

186) Maturity

Maturity studies for *Rastrelliger brachysoma* n = 1. (Lm vs Linf graph)

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
17.0		-			-			unsexed	Thailand	Gulf of Thailand

187) Spawning

Spawning for *Rastrelliger brachysoma*

n = 1

J	F	M	A	M	J	J	A	S	O	N	D	Country	Locality
		111	111	111	111	111	111	111					Central Indo-West Pacific

188) Spawning aggregation

Batch spawning is believed to extend from March through September.

189) Fecundity

(NA)

190) Eggs

(NA)

191) Egg development

(NA)

192) Age/Size

List of Population Characteristics records for *Rastrelliger brachysoma*

n = 7

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed			2	Thailand	Gulf of Thailand
unsexed		13.2		Philippines	Estancia, Iloilo
unsexed		22		Malaysia	Kedah
unsexed		22		Indonesia	Sumatra
unsexed		24		Thailand	Gulf of Thailand, 10° N 100° E
unsexed		34			to be filled
unsexed		35		Philippines	Not specified

193) Growth

Growth parameters for *Rastrelliger brachysoma*

Maximum Length 34.5cm FL n = 38

Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Lm vs Linf graph	[n = 2]
Reproductive graph	[n = 1]
M vs K graph	[n = 2]
M vs Linf graph	[n = 2]
Longevity vs 3/K graph	[n = 1]

ø = 3.00 **L inf** = 25.0 cm FL **K** = 1.6 Median record no. 201263Ref. 1263

Loo (cm)	Length Type	K (1/y)	to (years)	Sex	M (1/y)	Temp° C	Lm	ø'	Country	Locality	Questionable	Captive
18.2	TL	1.560				28.0		2.71	Thailand	Gulf of Thailand	No	No
19.6	TL	4.140				28.0		3.20	Thailand	10°N 100°E Gulf of Thailand	No	No
20.0	TL	3.528				28.0		3.15	Thailand	10°N 100°E Gulf of Thailand	No	No
20.9	TL	3.384	0.00		7.22	28.0		3.17	Thailand	Gulf of Thailand	No	No
20.9	TL	4.200				28.0		3.26	Thailand	Inner Gulf of Thailand	No	No
21.2	FL	0.960				23.0		2.63	Philippines	Samar Sea	No	No
22.0	TL	0.700				28.0	17.0	2.53	Thailand	Gulf of Thailand	No	No
22.0	SL	1.420				21.5		2.84	Thailand	Southwest coast	No	No
22.4	TL	2.000				21.5		3.00	Thailand	Strait of Malacca	No	No
22.9	TL	2.280			4.56	28.0		3.08	Indonesia	Tanjung Satai (Western Borneo)	No	No
22.9	TL	1.800				27.0		2.97	Indonesia	Java Sea (Central Java)	No	No

23.0	TL	3.600				28.0		3.28	Thailand	Gulf of Thailand	No	No
23.2	FL	1.200				23.0		2.81	Philippines	Guimaras Strait	No	No
23.5	TL	1.500				29.0		2.92	Malaysia	Kedah	No	No
24.0	TL	1.020				22.4		2.77	Malaysia	Selangor	No	No
24.0	TL	1.040				29.0		2.78	Malaysia	Kedah	No	No
24.2	TL	0.520				22.4		2.48	Malaysia	Selangor	No	No
24.5	FL	1.280				28.5		2.89	Philippines	Ragay Gulf	No	No
24.5	TL	1.400				21.5		2.92	Thailand	Strait of Malacca	No	No
25.0	FL	1.600				28.5		3.00	Philippines	Samar Sea	No	No
25.0	FL	1.300				28.5		2.91	Philippines	Samar Sea	No	No
25.0	TL	0.820				22.4		2.71	Malaysia	Perak	No	No
25.1	TL	1.250				21.5		2.90	Thailand	Strait of Malacca	No	No
25.4	TL	1.330				21.5		2.93	Thailand	Strait of Malacca	No	No
25.5	FL	1.450				28.5		2.97	Philippines	Samar Sea	No	No
25.8	TL	1.630				28.0		3.04	Indonesia	Java Sea (Pekalongan)	No	No
26.0	TL	0.600				22.4		2.61	Malaysia	Perak	No	No
26.3	TL	1.300				21.5		2.95	Thailand	Strait of Malacca	No	No
26.5	TL	1.050				12.0		2.87	Indonesia	Asahan, Sumatra	No	No
27.0	FL	1.600				27.0		3.07	Myanmar	Mergui Archipelago	No	No
28.0		1.000					11.9	2.89	Philippines	Davao Gulf	No	No

28.5	FL	1.400				28.0		3.06	Philippines	Guimaras Strait	No	No
29.8	TL	1.300				28.5		3.06	Philippines	Samar Sea	No	No
32.5	TL	1.200				27.7		3.10	Philippines	Visayan Sea	No	No
34.0	TL	1.100				28.2		3.10	Philippines	Manila Bay	No	No
34.0	TL	0.980				28.2		3.05	Philippines	Manila Bay	No	No
34.0	TL	0.981				27.7		3.05	Philippines	Visayan Sea, 1983 & 1985	No	No
34.0	TL	0.982				28.4		3.06	Philippines	Leyte Gulf	No	No

194) Length-weight

Length-Weight Parameters for *Rastrelliger brachysoma*

Score	a	b	Sex	Length (cm)	Length type	r^2	Country	Locality
1.00	0.02580	2.879	unsexed			1.000	Indonesia	Tanjung Satai, Western Borneo
0.50	0.01300	3.210	unsexed				Thailand	Indian coast, 1967-77
0.50	0.00614	3.213	unsexed				Thailand	Inner Gulf of Thailand
0.50	0.01000	3.230	unsexed				Philippines	Guimaras Strait, 1988-89

195) Length-length

Length-Length Parameters for *Rastrelliger brachysoma*

n=4

Unknown length	a	b	Known length	r	Length range (cm)	Sex of fish
SL	0.000	0.901	FL		-	unsexed
SL	0.000	0.961	FL		-	unsexed
TL	0.000	1.104	FL		-	unsexed

TL	0.000	1.149	SL		-	unsexed

196) Length-frequencies

List of frequency studies for *Rastrelliger brachysoma*

Locality	Year from - to	Sex	Gear	Frequency type
Guimaras Strait, Philippines	1984 - 1986	unsexed/mixed	various gears	absolute number measured
Java Sea (Central Java), Indonesia	1979 - 1979	unsexed/mixed	trawls	absolute number measured
Leyte Gulf, Philippines	1983 - 1987	unsexed/mixed	various gears	absolute number measured
Manila Bay, Philippines	1978 - 1979	unsexed/mixed	trawls	absolute number measured
Samar Sea, Philippines	1979 - 1979	unsexed/mixed	trawls	absolute number measured
Southwest coast (Phuket, Phang-ga, Krabi,Trang & Satun), Thailand	1984 - 1986	unsexed/mixed	seines	raised to the catch
Tanjung Satai (southwest coast), Indonesia	1971 - 1972	unsexed/mixed	seines	% of sample
Visayan Sea, Philippines	1983 - 1988	unsexed/mixed	various gears	absolute number measured

197) Morphometrics

Morphometric Data for *Rastrelliger brachysoma*

n = 1

Picture Name	Length		Lifestage	Aspect ratio
Rabra_u0.jpg	28.8	SL	unsexed	3.10

198) Morphology

Morphometric Data for *Rastrelliger brachysoma*

Main Ref.	Collette, B.B., 2001
Appearance refers to	
Bones in OsteoBase	

Sex attributes

Specialized organs	no special organs
Different appearance	males alike females
Different colors	males alike females
Remarks	

Descriptive characteristics of juvenile and adult

Striking features	striking shape of body
Body shape lateral	fusiform / normal
Cross section	oval
Dorsal head profile	more or less straight
Type of eyes	more or less normal
Type of mouth/snout	more or less normal
Position of mouth	terminal
Type of scales	
Diagnosis	This species is distinguished by the following characters: body very deep, its depth at posterior margin of opercle 3.7-4.3 times in fork length; head equal to or less than body depth; maxilla covered by lacrimal bone but extending nearly to end of lacrimal; gill rakers very long, visible when mouth is opened, 30-48 on lower limb of first gill arch; numerous bristles on longest gill raker, about 150 on one side in specimens of 12.7 cm, 210 in specimens of 16 cm, and 240 at 19 cm fork length; intestine very long, 3.2-3.6 times fork length; snout pointed; swim bladder present; vertebrae 13 + 18 = 31; interpelvic process small and single; anal spine rudimentary. Colour of spinous dorsal fin yellowish with a black edge, pectoral and pelvic fins dusky, other fins yellowish (Ref. 168, 9684).
Ease of Identification	

Meristic characteristics of *Rastrelliger brachysoma*

Lateral Lines	1 Interrupted: No
Scales on lateral line	
Pored lateral line scales	
Scales in lateral series	
Scale rows above lateral line	
Scale rows below lateral line	
Scales around caudal peduncle	
Barbels	0
Gill clefts (sharks/rays only)	absent
Gill rakers	

on lower limb	30 - 48
on upper limb	
total	
Vertebrae	
preanal	13 - 13
total	31 - 31

Fins

Dorsal fin(s)

Attributes	no striking attributes
Fins number	2
Finlets No.	Dorsal 5
	Ventral 5
Spines total	8 - 11
Soft-rays total	12 - 12
Adipose fin	absent

Caudal fin

Attributes	forked; more or less normal

Anal fin(s)

Fins number	1
Spines total	0 - 0
Soft-rays total	12 - 12

Paired fins

Pectoral	Attributes more or less normal
	Spines 0
	Soft-rays 19 - 20
Pelvics	Attributes more or less normal
	Position thoracic before origin of D1
	Spines
	Soft-rays

199) Larvae

(NA)

200) Recruitment

(NA)

201) Abundance

(NA)

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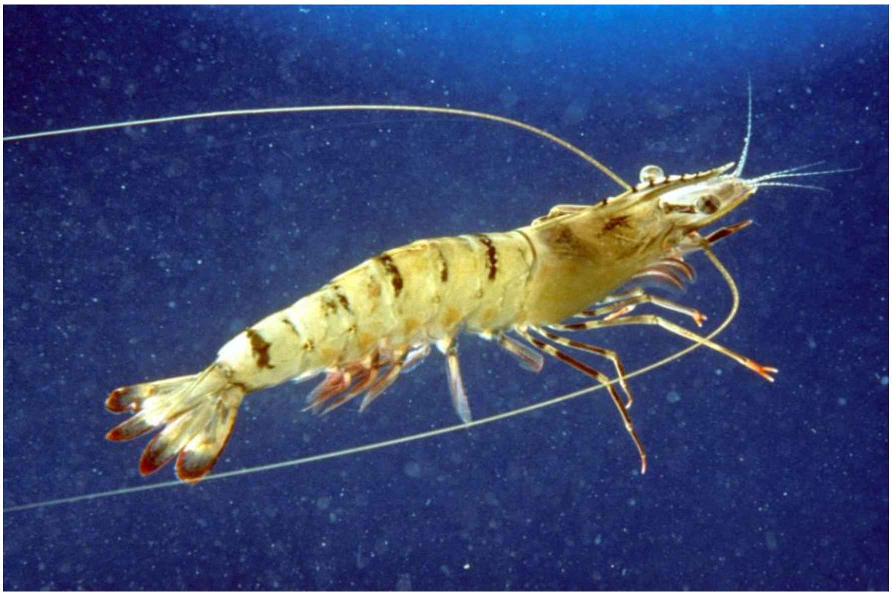
ANNEX 27

Penaeus monodon
Giant Tiger Prawn



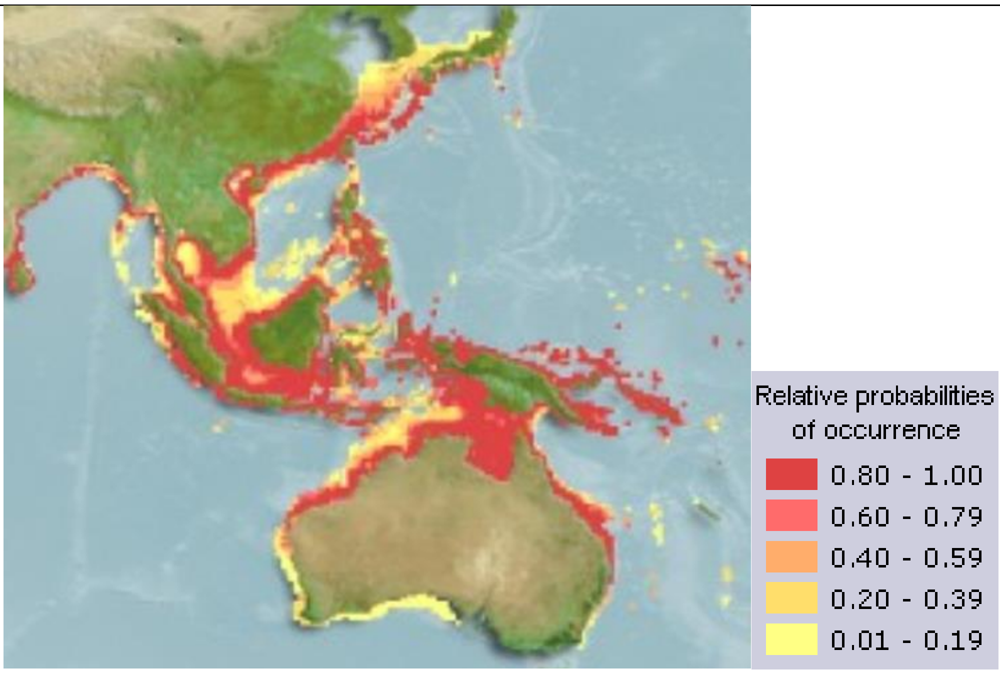
Scientific classification	
Kingdom:	Animalia
Phylum:	Arthropoda
Subphylum:	Crustacea
Class:	Malacostraca
Order:	Decapoda
Suborder:	Dendrobranchiata
Family:	Penaeidae
Genus:	*Penaeus*
Species:	***P. monodon***
Binomial name	
Penaeus monodon Fabricius, 1798	
Synonyms [1]	

- *Penaeus carinatus* Dana, 1852
- *Penaeus tahitensis* Heller, 1862
- *Penaeus coeruleus* Stebbing, 1905
- *Penaeus bubulus* Kubo, 1949

MMMM. Environment/Ecology:

Benthic; depth range 0 - 150 m (Ref. 10), usually ? - 60 m (Ref. 10). Tropical; 17°C - 38°C (Ref. 72772), preferred 24°C (Ref. 107945); 36°N - 33°S, 55°E - 154°E

NNNN. Distribution:



Note: Distribution range colours indicate degree of suitability of habitat which can be interpreted as probabilities of occurrence.

Indo-Pacific: From Pakistan to Japan, the Malay Archipelago and Australia. Introduced in the Atlantic Ocean (Africa and USA). Tropical to temperate.

OOOO. Length at first maturity / Size / Weight / Age:

Maturity: L_m ?, range 4 - 4.22 cm **Max length** : 33.6 cm TL male/unsexed; (Ref. 8); max. published weight: 250.00 g (Ref. 116487) Maximum total length 336 mm. Weight 60 to 130 g. Male : 37 mm Carapace length (CL), 35 g Body weight(BW), 10 months. Female : 47 mm CL, 67.7 BW, 10 months.(DOF Malaysia,2020)

PPPP. Short description

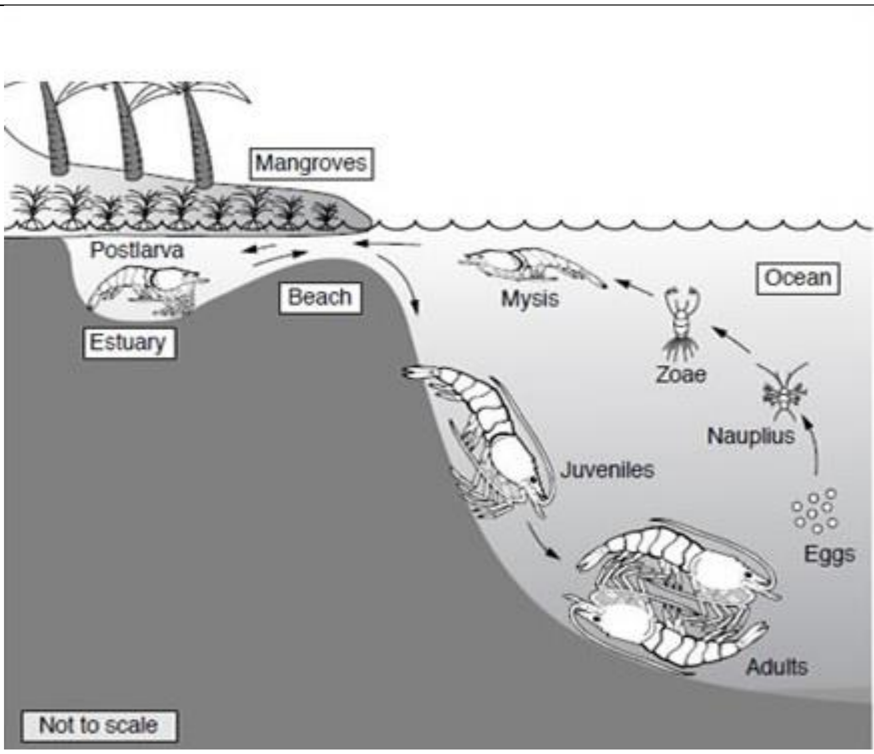
Uniformly glabrous body; carapace with well-developed antennal and hepatic spines. Horizontal and straight hepatic carina. Rostrum armed with 7 or 8 dorsal and 3 ventral teeth. Color: body is reddish with darker bands. Brown to blue pleopods and reddish fringing setae.

QQQQ. Biology

Caught by pond fishing and inshore fishing. Considered a delicacy in the Philippines that in 1980, retail price was Php60 to 80 (US$8.6 to 11.5)/kg in Manila and Php50 to 70 in local areas (Ref. 10). Juveniles are found in estuarine environments (Ref. 8). Enters shallow brackish water or kept in ponds (Ref. 374). Less of a scavenger; mainly a predator of slow moving benthic

macroinvertebrates like small crabs and molluscs. Also capable of capturing more mobile forms like small penaeids and fishes (Ref. 102664). Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer (Ref. 833).

RRRR. Life cycle and mating behavior



The life history of *P. monodon* has an offshore planktonic larval phase of about 14 (Silas et al., 1978) to 20 days (Kenway and Hall, 2002); an estuarine, benthic postlarval and juvenile phase of over 6 months (33 g); a coastal subadult phase of 5 to 6 months (60 g); and an inshore and offshore ocean adult and spawning phase (60 to 261 g) (Dall et al., 1990, Kenway and Hall, 2002). Mating between a recently moulted (soft-shelled) female and a hard-shelled, smaller male occurs at night in the ocean (Hudinaga, 1942). Adult *P. monodon* are found in offshore waters on sandy bottom at depths of 20–40 m. The larvae move towards the coast, entering estuaries and mangrove swamps that serve as nursery grounds. They then migrate to deeper water when they become adolescent. *Penaeus monodon* has six nonfeeding naupliar stages, three protozoeal stages and three mysis stages (FAO, 1985a).

Mating generally takes place at night, following molting of the female. The courtship and mating behavior may be observed in three distinct phases (Primavera, 1979). Female above-male below in parallel swimming. From a moving or stationary position on the tank bottom, the female swims upwards to a height of 20-40 cm. It moves in a slightly curved line over a distance of 50-80 cm, then changes course, either completely reversing direction or turning at a right angle. These swimming movements are interspersed with rests on the bottom lasting from seconds to a few minutes. While either swimming or resting, the female is approached by one to as many as three males after some kind of initial attraction, the males trailing behind the female as it swims. Eventually the male, or one particular male, in case of many initially attracted to the female, catches up with the female and positions its body directly below the latter. The pereopods of the female hold on to the carapace of the male and help to keep it in position while swimming continues; even later, the pereopods of both partners actively help to maintain the desired positions in the succeeding phases. This phase is the longest and can last

up to 2 hours if the male is dislodged from its position below the female by another male or if lengthy rests on the tank bottom intersperse with the swimming activities.
Male turns ventral side up and attaches to female Swimming in tandem with the female, the male turns abruptly to a ventral side up position, attempting to align the thoraco-abdominal junction with the posterior thorax of the female.Once the ventral-to-ventral position is achieved, it is difficult for other males to displace the first male and copulation is certain. If unsuccessful, the male immediately returns to the former upright position, still trying to swim parallel to the female, following the latter's every change in direction.
Male turns perpendicular to female. Once the male succeeds in attaching ventrally to the female, it turns perpendicular to the latter, rotating at the point of the posterior end of the thorax. At this junction, the pair may either maintain their position in the water or slowly settle to the bottom. Male arches body around female and flicks head and tail. Immediately after assuming a position perpendicular to the female, the male curves its body in a U-shape around the thorax of the female and flicks both head and tail simultaneously, as in a squeezing action, up to three times in quick succession. Soon after, the male separates from the female and moves or swims away. The female may also move away. Progress from ventral attachment to head- and tail-flicking is very quick, lasting a few seconds. The whole process from the initial upward swimming move.
Spawning generally takes place at night. While resting on the sandy bottom, the spawner suddenly becomes active, swimming in the water for about one minute, and then starts to spawn while swimming very slowly in the upper or middle part of the water. During spawning, the last three pairs of pereopods are held tightly together and flapped with an open and close movement, presumably to help discharge eggs and spermatozoa, while strongly moving the pleopods for swimming. The eggs are extruded from the paired genital pores located at the base of the3rd pereopods at the same time as spermatozoa from the thelycum located at the base of the 5th pereopods, looking like greenish smoke and whitish smoke, respectively, blowing backward. It is believed that these discharged eggs are fertilized inthewater owing to turbulence generated by the forward and backward movements of the pleopods. As a result, the movement of the pleopods seems to aid not only in swimming but also in fertilizing the eggs spawned. The fertilized eggs remain suspended in the water for a few minutes making the water turbid, and then gradually sink to the bottom. The time required for each spawning is approximately 2 minutes.

SSSS. Fisheries

In S.E. and E. Africa (Natal to Somalia, including Madagascar) the species is of minor or moderate commercial importance, it is used for bait and food. In Pakistan it is likewise of minor importance. Jones (1967:1333) indicated that it is more common in prawn catches on the east coast of India than on the west coast. According to Chopra (1939:222) "This is the commonest largesized penaeid of Calcutta, and is sold in our markets in enormous quantities". Kurian & Sebastian (1976:100) cited it as an important commercial species in India, especially on the east coast (Bengal and Orissa); juveniles being caught in estuaries. Also in Bangladesh it is of considerable commercial importance. In Malaya and Thailand Penaeus monodon is fished in offshore waters. It is obtained both by pond fishing and inshore fishing in Malaya, Singapore, Indonesia, the Philippines and Taiwan; because of its large size the species is quite important economically. Domantay (1956:363) indicated that "among the commercially important prawns in the Philippines, Penaeus monodon Fabricius stands foremost". In Japan and Korea it seems to be of minor importance; Yoshida (1941) remarked that it was sold on the Fusan market in Korea. Also in Australia the species is of commercial interest: Harrison, Kesteven & Setter (1965:8) listed it among the commercial species of the Gulf of Carpentaria, while Racek

(1957:12) mentioned it as the last of the six most important species of New South Wales, and as the fourth in importance of the species taken in offshore waters of Queensland. Rapson & McIntosh (1971:17) reported it as constituting about 7% of the commercial catches in New Guinea (mainly in the Gulf of Papua).

TTTT. IUCN Red List Status

(NA)

UUUU. More Information:

202) Stocks

- Spawners :23.00 metric tonnes
- Ovarian maturation stages starts from May until November yearly (I – V)
- Juvenile : Density : 0.025 – 6.8 g/m2, Biomass : 11.73 to 20.77 kg (DOF Malaysia,2020)

203) Ecology

Ecology of *Penaeus monodon*

Main Ref.	Holthuis, L.B., 1980
distribution	Marine - Neritic • **littoral zone** • **sublittoral zone** Brackishwater • **estuaries/lagoons/brackish seas** Highighted items on the list are where *Penaeus monodon* may be found.
Remarks	Juveniles are found in estuarine environments (Ref. 8). Enters shallow brackish water or kept in ponds (Ref. 374). Less of a scavenger; mainly a predator of slow moving benthic macroinvertebrates like small crabs and molluscs. Also capable of capturing more mobile forms like small penaeids and fishes (Ref. 102664).

Substrate

Substrate	**Benthic**: mobile; demersal; **Soft Bottom**: sand; mud;
Substrate Ref.	Holthuis, L.B., 1980

Associations

Ref.	Holthuis, L.B., 1980

204) Diet

Feeding

feeding type	plants/detritus+animals (troph. 2.2-2.79)

feeding type ref	Marte, C.L., 1980
feeding habit	hunting macrofauna (predator)
feeding habit ref	
trophic level(s)	

	original sample		unfished population		Remark
estimation method	Troph	s.e.	Troph	s.e.	
From individual food items	3.36	0.35			Trophic level estimated from a number of food items using a randomized resampling routine.

205) Reproduction

Reproduction of *Penaeus monodon*

Main Ref.	Ruppert, E.E., R.S. Fox and R.D. Barnes, 2004
Mode	dioecism
Fertilization	
Spawning Frequency	
Batch Spawner	No
Reproductive Guild	bearers External brooders
Description of life cycle and mating behavior	Members of the order Decapoda are mostly gonochoric. Mating behavior: Precopulatory courtship ritual is common (through olfactory and tactile cues); usually indirect sperm transfer.
Search for more references on reproduction	Scirus

206) Maturity

Maturity studies for *Penaeus monodon*

n = 2

Lm (cm)	Length (cm)			Age range (y)			tm (y)	Sex of fish	Country	Locality
	3.6	-	4.2		-			female	Tanzania	Ruvu estuary, Bagamoyo/ 1988

	3.1	-	3.5		-			male	Tanzania	Ruvu estuary, Bagamoyo/ 1988

207) Spawning

(NA)

208) Spawning aggregation

(NA)

209) Fecundity

Fecundity for *Penaeus monodon*

n = 2

Country	Locality	Absolute Fecundity			Relative Fecundity			Fecundity/length relationship	
		Min	Max	Mean	Min	Max	Mean	a	b
India	Andhra Pradesh	323,007	1,072,174	0					
Tanzania	Bagamoyo	72,000	314,000	0					

210) Eggs

(NA)

211) Egg development

(NA)

212) Age/Size

List of Population Characteristics records for *Penaeus monodon*

n = 6

Sex	Wmax	Lmax (cm)	Tmax (y)	Country	Locality
unsexed	240.00 g			Philippines	Unspecified, Philippines
unsexed		25.8		India	Digha/ 2012-2013
male		26.8			Eastern Central Atlantic

unsexed		29.5		India	Andhra Pradesh/ 2011-2012
unsexed		33.6			Not specified
female		35			Eastern Central Atlantic

213) Growth

Growth parameters for *Penaeus monodon*

Maximum Length 33.5999984741211cm TL

n = 5 Note that studies where Loo is very different (+/- 1/3) from Lmax are doubtful.

Auximetric graph	[n = 4]
M vs K graph	[n = 5]
M vs Linf graph	[n = 5]

ø = 3.20 **L inf** = 30.5 cm TL **K** = 1.7 Median record no. Ref. 7676

Loo (cm)	**Length Type**	**K (1/y)**	**to**	**Sex**	**M (1/y)**	**Temp° C**	**Lm**	**Ø'**	**Country**	**Locality**	**Questionable**	**Captive**
28.80	TL	1.200		M	2.03			3.00	Bangladesh	Unspecified	No	No
30.00	TL	0.940		M	1.72			2.93	Bangladesh	Unspecified	No	No
30.50	TL	1.700		F	2.51			3.20	Bangladesh	Unspecified	No	No
32.10	TL	0.970		F	1.72			3.00	Bangladesh	Unspecified	No	No
35.00	TL	0.350			0.90			2.63	Philippines			

214) Length-weight

Length-Weight Parameters for *Penaeus monodon*

Length-Weight Parameters for *Penaeus monodon*		
Length-weight (a vs b) graph	[n=24]	Median Record No. 13 **a** = 0.0186 cm BL **b** = 2.9107 Ref. 117291

a	b	Doubtful?	Sex	Length (cm)	Length type	No.	Country	Locality
0.0055	2.102	Yes	male		TL	11	Nigeria	Iko River estuary / 2011-2012

0.7510	2.299	No	female	6.5 - 17.7	TL	327	Tanzania	Ruvu estuary, Bagamoyo / 1998-1998
0.0418	2.432	No	female	9.5 - 16.0	TL	497	India	Pichavaram mangroves / 2007-2007
0.0360	2.485	No	mixed	9.2 - 16.0	TL	985	India	Pichavaram mangroves / 2007-2007
0.0292	2.568	No	male	9.2 - 16.0	TL	488	India	Pichavaram mangroves / 2007-2007
0.0037	2.597	No	mixed		TL	16	Nigeria	Iko River estuary / 2011-2012
0.0237	2.675	No	male		TL	117	USA	western Atlantic and Gulf of Mexico / 2009-2012
0.0256	2.764	No	female	6.1 - 12.6	BL	202	China	Sanya coast
0.0239	2.789	No	mixed	6.1 - 12.6	BL	412	China	Sanya coast
0.0234	2.795	No	female	4.2 - 12.2	BL	168	Mozambique	Mozambique Channel
0.0230	2.803	No	male	6.1 - 12.0	BL	210	China	Sanya coast
0.0506	2.851	No	mixed	4.2 - 12.2	BL	358	Mozambique	Mozambique Channel
0.0186	2.911	No	male	4.2 - 11.9	BL	190	Mozambique	Mozambique Channel
0.0523	2.940	No	juvenile		TL		India	Cultured pond
0.0080	3.000	No	unsexed		TL			Unspecified
0.0062	3.016	No	female	11.1 - 18.9	TL		Sri Lanka	Kakkaithivu, Jaffna estuary / 2010-2011
0.0077	3.040	No	mixed	15.0 - 25.0	TL		USA	western Atlantic and Gulf of Mexico / 2009-2012
0.0054	3.075	No	male	9.6 - 16.4	TL		Sri Lanka	Kakkaithivu, Jaffna estuary / 2010-2011
0.0063	3.093	No	female		TL	5	Nigeria	Iko River estuary / 2011-2012

0.9150	3.106	No	male	7.5 - 16.8	TL	302	Tanzania	Ruvu estuary, Bagamoyo / 1998-1998
0.0056	3.147	No	female		TL	80	USA	western Atlantic and Gulf of Mexico / 2009-2012
0.0620	3.190	No	female		TL		India	Kakinada / 1980-1983
0.0039	3.218	No	mixed	9.6 - 18.9	TL		Sri Lanka	Kakkaithivu, Jaffna estuary / 2010-2011
0.0107	3.250	No	male		TL		India	Kakinada / 1980-1983

215) Length-length

(NA)

216) Length-frequencies

(NA)

217) Morphometrics

(NA)

218) Morphology

(NA)

219) Larvae

(NA)

220) Recruitment

(NA)

221) Abundance

(NA)

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ANNEX 28

**EXECUTIVE SUMMARY OF
REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPECIES:
INDO-PACIFIC MACKEREL (*RASTRELLIGER BRACHYSOMA*)
IN THE GULF OF THAILAND SUB-REGION**

The Regional Action Plan for Management of Transboundary Species: Indo-pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-Region is developed through a series of Technical Consultation Meetings where scientists from various institutions and fishery policy people from six countries surrounding the Gulf of Thailand and the South China Sea agree on the urgent requirement of cooperation for sustainable utilization of Indo-pacific mackerel due to declining of fish stock and knowledge gaps for effective management. The objective of this RAP is to serve as 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 shared benefit to other ASEAN Member States by 2030." This Guide also support the requirement of International instrument 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. In addition, the Guide is as a supplementary guide that support 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, 2011 and the new Resolution and Plan of Action for 2030. Besides, the Guide 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 relevant stakeholders and applying knowledge science-based development and management of fisheries.

As a supplementary guide of the ASEAN-SEAFDEC Resolution and the Plan of Action, process of endorsement and adoption by higher official level are needed. Regarding this the draft of RAP Indo-pacific mackerel was minor amended at the 42nd Meeting of the SEAFDEC Program Committee held in November 2019 as enclosed herewith. It is scheduled to address the amended RAP for consideration and adoption by the SEAFDEC Council in April 2020, and later by ASEAN through its mechanism.

ACTIONS BY THE RSTC3:

- ❖ Considering the amended texts proposed after the 42PCM;
- ❖ Comments on missing, increase the importance;
- ❖ Inform, share and suggest to Country for the effort for development and support the endorsement of this RAP and Supplementary Guide at next SEAFDEC Council

SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand
In Collaboration with
SEAFDEC/Sweden Project on Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia (2013-2019)

REGIONAL ACTION PLAN

FOR MANAGEMENT OF TRANSBOUNDARY SPECIES:

INDO-PACIFIC MACKEREL (*Rastrelliger brachysoma)*

IN THE GULF OF THAILAND SUB-REGION

SEAFDEC/UNEP/GEF/Fisheries *Refugia*
NOVEMBER 2019 (amended by 42PCM)

First published in Phrasamutchedi, Samut Prakan, Kingdom of Thailand in November 2019 by the SEAFDEC/UNEP/GEF Fisheries Refugia Project, Training Department of the Southeast Asian Fisheries Development Center

SEAFDEC/UNEP/GEF
Project Co-ordinating Unit
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://fisheries-refugia.org

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REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPECIES: INDO-PACIFIC MACKEREL (*Rastrelliger brachysoma)* IN THE GULF OF THAILAND SUB-REGION[1]

SEAFDEC

I. 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 among several Mackerel species, in 2016 Indo-Pacific mackerel contributed to 78% of the total Mackerel production with the 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 producer in the region, reporting the highest production at 283,106 MT in 2016, followed by 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. Nevertheless, it could be observed that the country's total Mackerel production in 2016 had drastically reduced from those of 194,845 MT in 2012. Similar to Thailand, Philippines also reported the declining trends in its Mackerel production through the period (SEAFDEC, 2018).

The Gulf of Thailand Sub-region (GoT) is one of the important ecosystems for Indo-Pacific mackerel, where the peak of highest catch using purse seine and falling net was reported in 1996 at 328,955 MT; while low catch was reported during 3 periods, in 1999, 2005 and 2010 at 289,285 MT, 283,984 MT and 259,354.56 MT, respectively, and the catch has never reached 300,000 MT as recorded in 1996 again (SEAFDEC, 2018).

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

II. STOCK STATUS OF *R. BRACHYSOMA*

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

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[1] Drafted at Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species Indo-Pacific Mackerel in the Gulf of Thailand Sub-region, 12-13 September 2019, Thailand. Commented by 42nd Meeting of the SEAFDEC Program Committee, November 2019.

A number of fish species including mackerels were reported to be in the overexploitation state in the Gulf of Thailand (Puthy, 2007). In his study using the Schaefer and Fox models, the result indicated that mackerel stocks are both biologically and economically overexploited, but there were still opportunities to increase the mackerel stocks by reducing fishing efforts which would allow the stocks to recover.

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

In Indonesian waters, over-exploitation of pelagic fishery resources, including Indo-Pacific mackerel has been highlighted in 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 was still under fully exploitation state, and the recruitment process has not been disturbed. Although the species has yet to reach the heavily exploitation state, suggestion was made that fishing efforts should be reduced; while fishing permits, such as number of units, size of 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 declining of Indo-Pacific mackerel due to changes in environmental condition and water quality, and modification and loss of critical habitats, has been documented in several countries and reported by the media.

III. ISSUES, KNOWLEDGE GAPS, AND CHALLENGES

Based on the reviews and inputs from six 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 for sustainable utilization of Indo-Pacific mackerel could be summarized as follows:

3.1) Data and Information

- Insufficient information on the indo pasific 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 the 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 assessment 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 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 of 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 (same as 3.3)

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 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 to

- Related stakeholder i.e fishers/fishing industry, local community etc., and
- Ensure its compliance

IV. REQUIRED REGIONAL COOPERATION FOR TRANSBOUNDARY SPECIES

Since 1953, Thailand undertook several management actions for Indo-Pacific mackerel stock. From 1953 to 2015, several studies were conducted, and 13 Notifications were released in relation to closure of fishing area in the Gulf of Thailand with the objective of conserving 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 were continued up to the present.

Although information on migration patterns of Indo-Pacific mackerel within the country's EEZ in Gulf of Thailand sub-region is already available for almost 30 years. However, the recent result from genetic analysis of Indo-Pacific mackerel using 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 migrates across eastern Gulf of Thailand through 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 of the species.

V. PROVISIONS OF THE REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY INDO-PACIFIC MACKEREL

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 of illegal fishing towards sustainable use of seas and marine resources, as well as to enhance 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.

Recognizing the needs to strengthen cooperative efforts among countries toward sustainable utilization of the marine resources particularly the Indo-Pacific mackerel that is important 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; and

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

The Provisions of RAP were categorized into 5 dimensions, which are: 1) Governance; 2) Social; 3) Economic, 4) Ecosystem; and 5) Climate Change; and these 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 that is 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 concerted regional approach to support countries' efforts to manage this transboundary fish stock in the Gulf of Thailand.

4.1 THE GOAL OF REGIONAL ACTION PLAN

This RAP is intended to serve as 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 shared benefit to other ASEAN Member States by 2030."

4.2 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

4.3 ACTIONS

A) GOVERNANCE DIMENSION

Overall Objective:
Regional/sub regional fisheries management mechanism are 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 effective of regulation)
A2. Data management system are enhanced and considered regional/sub-regional standardization data management system in place
A3. 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	SEAFDEC University Government agency Fishery research institute
	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	SEAFDEC University Government agency Fishery research institute
	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	Government and Private sector
	Regular monitor data collection on fishing effort capture production (include commercial and small scale)	A4	
Fisheries Management Mechanism (including fisheries management plan and arrangement,	Develop fisheries management plan for short mackerel at national and sub-regional level Initiate the development of harvest startegy	A1	SEAFDEC University Government agency Fishery research institute

the effective of regulation)			All stakeholder (fishers, others)
	Establish regional cooperation on monitoring, control and surveillance	A1	Existing national MCS partners/network
	Raise awareness of both small-scale fishers and commercial-scale fishers ○ Policy and regulations ○ Management measures ○ Sustainable utilization ○ Involvement the participation, considering gender sensitivity	A1	SEAFDEC University Government agency Fishery research institute All stakeholder
	Promote stakeholder consultation among researchers, managers and stakeholders using EAFM	A1	SEAFDEC University Government agency Fishery research institute All stakeholder International organizations (FAO, NOAA, etc)
	Conduct habitat conservation and rehabilitation and conduct stock enhancement programs	A1	SEAFDEC University Government agency Fishery research institute All stakeholder
Understanding national law and regulations	Comparative review of national law and regulations, (including local wisdom)	A5	Government and resource person
	Disseminate knowledge and information on the conservation and management of Indo-pacific mackerel to fisheries communities and students	A5	Government Other stakeholders
Flexibility of regulation to respond to science advise	Encourage periodic evaluation of policy and regulation	A1	Government
Management schemes/arrangements including transboundary aspects.	Develop management schemes/arrangements at sub-regional area including transboundary aspects	A1	SEAFDEC University Government agency Fishery research institute All stakeholders
	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	Government and resource person
	Strengthen the Monitoring, Control and Surveillance network against the illegal fishing (none legal binding)	A6	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.	A6	Government and resource person

B) SOCIAL DIMENSION

Overall Objective:
Social responsibility and involvement in fisheries management achieved

Specific Objectives
B1. Understanding the social condition of people involving in fishery at local and national level.
B2. Increase participation and involvement of stakeholder in various level.
B3. Resolve conflict on land and resource use
B4. Build awareness and capacity in 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	Government University
Traditional fishing (indigenous knowledge and social responsibility)	Improve and disseminate the best practice to other (indigenous people)	B1	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	B2	Government University
People engagement in policy making (fisherfolk organization, academy, private sector,	Promote Public Private Partnership	B2	Government
	Promote multi stakeholder engagement in policy making	B2	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	B2	Government and relevant stakeholder
Conflict on land and resource use	Promote stakeholder consultation	B3	Government and relevant stakeholder
	Promote marine spatial planning and coastal zone management	B3	Government Resource person Relevant stakeholder
Awareness Raising	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)	B4	SEAFDEC Government Relevant stakeholder

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 asset within 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	Government Private sector Funding agency/donor
	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	Government Resource person
Benefit and economic return and unequal distribution	Assess benefit and economic return throughout the value chain	C3	Government Resource person
Increase of cost (fuel and other inputs)	To ensure the fuel and other input exist for local fishermen	C3	Government
Fisheries employment revenue	To create the alternative work	C3	Government Private Sector Relevant stakeholder
	Require the contract among people engage in fishing	C3	

D) ECOSYSTEM DIMENSION

Overall Objective:
Maintain 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	Fisheries Agencies, National Research Institutions, Regional Institutions
	Conduct tagging program, e-DNA, DNA	D1	Fisheries Agencies, Research Institutions
Spawning and nursery grounds (including dispersion and distribution of fish larvae)	Conduct comprehensive larvae survey (e.g. ichthyoplankton)	D1	Fisheries Agencies, Research Institutions
	Study on critical habitats	D2	Fisheries Agencies, Research Institutions,
Seasonal changes	Conduct comprehensive larvae survey (e.g. ichthyoplankton)	D1	Fisheries Agencies, Research Institutions, SEAFDEC
	Conduct reproductive biology study	D1	Fisheries Agencies, Research Institutions, SEAFDEC
Physical and chemical oceanographic conditions and ocean circulation	Conduct oceanography survey	D2	Fisheries Agencies, Research Institutions, SEAFDEC
	Develop oceanographic modelling	D2	Fisheries Agencies, Research Institutions, IOC/WESTPAC
	Conduct satellite imagery (GIS, remote sensing) analysis	D2	Fisheries Agencies, Research Institutions
Stock structure	Conduct DNA study, otolith, tagging, etc.	D1	Fisheries Agencies,

			Research Institutions, SEAFDEC
Stock status at national and regional of *R. brachysoma* (distribution and abundance)	Conduct stock assessment at national, sub-regional or regional level	D1	Fisheries Agencies, Research Institutions, SEAFDEC
	Share data, information and findings from scientific research to relevant stakeholders	D1	Fisheries Agencies, Research Institutions, SEAFDEC
	Standardized data collection for regional stock assessment	D1	Fisheries Agencies, Research Institutions, SEAFDEC
	Develop modeling for stock assessment	D1	Fisheries Agencies, Research Institutions, SEAFDEC, FAO
Species Identification	Provide capacity building on species identification of small size (juvenile) and larval fishes	D1	Fisheries Agencies, Research Institutions, SEAFDEC
Status and Trends	Investigate the trend of short mackerel catch at national, sub-regional levels	D1	Fisheries Agencies, Research Institutions, SEAFDEC
Population dynamics (Growth parameters, mortalities etc.	Conduct survey on fisheries biology	D1	Fisheries Agencies, Research Institutions
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	Fisheries Agencies, Research Institutions, SEAFDEC
	Enhance Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures)	D2	Fisheries Agencies, Research Institutions, SEAFDEC
Stock assessment and distributions for transboundary species	Enhance the cooperation for information sharing among the bordering countries	D1	Fisheries Agencies, SEAFDEC
Capacity building and experts exchange	Training, workshop, conference and experts exchange	D1,2	Fisheries Agencies, Research Institutions, SEAFDEC, FAO, UNEP-GEF

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 to short mackerel fisheries and habitats
E2. mitigation and precautionary measures **adopted** to compensate 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	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	E1	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	E2	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
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	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Study on the critical habitats (spawning and grounds)	E1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO

	Study effect of environmental changes on the migratory pattern and spawning patterns	E1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
	Data sharing (assign focal person to share information)	E1	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO
Capacity building and experts exchange	Training, workshop, conference and experts exchange on CC impacts	E1 E2	Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO

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ANNEX 29

Regional Guidelines on Indicators for Management of Fisheries Refugia: Methodology

Executive Summary

The draft Indicators for Management of Fisheries Refugia was developed at the 1st Regional Meeting on

Indicators for Fisheries Refugia Management held on 9-11 September 2019 at A-One the Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand. The guidelines are aimed to support participating countries on the effective management of fisheries refugia established during the project implementation and to ensure that after project-end, country will continue and increase number of fisheries refugia in their country, besides monitoring the existed refugia using the agreed indicators as enclosed herewith..

However, the agreed indicators require the appropriate methodology and references in which the PCU takes this opportunity to continue discuss with the Regional Scientific and Technical Committee as well as the regional experts who join this RTSC3.

ACTIONS BY THE RSTC3 AND REGIONAL EXPERT:

- Considering the List of Indicators and provide suggestions on the methodology and Reference alignment with each indicator.

LIST OF INDICATORS FOR MANAGEMENT OF FISHERIES REFUGIA[2] (DRAFT)

1) ECOSYATEM DIMENSION

SUB-DIMENSIONS	CRITERIA	INDICATORS	METHODS/REFERENCES
Fisheries Resources	Abundance stock / Distribution / Fishing Effort	• Biomass Estimation (ton)	
		• Level of MSY (ton)	
		• Level of MEY (ton)	
		• Level of CPUE (Kg/…)	
		• CPUA (Kg/Area)	
		• Catch landing (ton or Kg)	
	Biological Parameter	• Length at first capture (Lc)	
		• Length at first mature (Lm)	
		• Sex ratio	
		• Spawning Potential Ratio	
		• Length frequency	
		• Exploitation rate	
		• GSI (Gonadosomatic Index)	
	Species composition / Catch structure	• Percentage of dominance species	
		• Number of species	
		• % Main economic/commercial species	
		• Percentage of Bycatch	
	Healthy/condition/Area	• Size Coverage (Percent)	
		• Healthy Index	

[2] The outputs from the Regional Meeting on Indicators for Fisheries Refugia Management held on 9-11 September 2019 at A-One the Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand.

Habitat (mangrove, coral, seagrass, and other critical habitats)		• Target habitat density (IUCN reference)	
Environment (Impact from human act.)	Pollution	• Standard Water Quality (e.g. COD, BOD)	
	Eutrophication	• Phytoplankton Abundance	
		• Phosphate, Nitrate Concentration (Nutrient loading)	
	Anthropogenic (Human activity)	• Coastal reclamation area	
		• Level of maritime activity (If appropriated)	
	Erosion	• Level and distribution of sedimentation	
		• Loss of area/habitat	

2) SOCIAL DIMENSION

SUB-DIMENSIONS	CRITERIA	INDICATORS	METHODS/REFERENCES
Livelihoods	Choice of Occupation	• Number of option/ Occupation/ work (Alternative, Permanent work, Subsistence work)	
	Fish consumption	• Fish consumption per capita per year	
	Nutrition	• % animal protein (if appropriate)	
Stakeholder Participation (Indigenous People, Gender, etc.)	Participation	• Ratio of Number of participations (gender and IP)	
	Local Organization	• Number of organizations,	
		• Number of Best practices applied	
	Networking	• Number of networking	
		• Type /way of direct or indirect communication	
		• Number of agreements	
Education (Local knowledge, Local wisdom)	Awareness program (e.g. information center, information education campaign (IEC))	• Number of information center or similar.	
		• Number of consultations	
		• Number of best practices	
		• Number of awareness program	
		• Number of understanding by stakeholder	
	Capacity building	• Number of training/Extension	

3) ECONOMIC DIMENSION

SUB-DIMENSIONS	CRITERIA	INDICATORS	METHODS/REFERENCES
Economic Condition (to community)	Poverty incident	• Poverty Index	
	Capital accessibility	• Number of financial accessible	
	Income	• Income per household	
Fisheries Production, Fishing Efforts	Contribution of target species / Availability	• Value of contribution/production	
Innovative Fisheries Technology	Effectiveness fishing gear	• level of CPUE	
	Cost effectiveness	• Cost reduction, time, human power	
	Environment friendly (Green technology)DIMEN	• Reduce of fuel consumption	
		• Reduce bycatch	
	Investment	• Number of investment (for e.g. fishing fleet, processing, ship builder, management tools/software, etc.)	
		• New domestic product	

4) GOVERNANCE DIMENSION

SUB-DIMENSIONS	CRITERIA	INDICATORS	METHODS/REFERENCES
Fisheries management policy (Fishing/User Right, Precautionary approaches/Science-based management, and Synergistic Way/Strategy)	Legal framework	• Number of law and regulation	
	Harvest strategy/ Limit of fishing effort	• Fishing close, (area and seasonal closure, Zoning	
		• Number of Input control (Number, mesh size, length of fishing gear, Licensing control, Capacity (e.g. Gross tonnage, horsepower, etc.)	
		• Number of output control (TAC, Quota, Target species)	
	Fisheries management plan/ strategy/ framework	• Available/not available	
		• Management plan of Fisheries refugia in place,	
		• Habitat rehabilitation, protection and stock enhancement.	
	Efficiency fishing gear	• Length limit (e.g. crab fishery)	
Stakeholder Cooperation/Coordination (Regional / national levels)	Management mechanism	• Management board/ committee, transboundary committee, RPOA for refugia in place	
		• Linkage to the existing management/conservation framework (e.g. MPAs)	
Enforcement	Coordination mechanism	• Inter-agency coordination in place, Number of joint operations	
	Fishery Law enforcement	• Level of enforcement	
		• Frequency of regular patrol	
		• Number of violation prosecution	

Capacity Building	Best Practice	• Adoption of best practice in place	
	Maritime policy and regulation/ International policy	• Number of training/workshops	
Funding (Infrastructure, Enforcement, etc.)	Sustainability	• Long term commitment of Government on finance	
	Source of funding (incentive, soft loan, donation/CSR)	• Number of donors	
		• Type of funds	
	incentive	• Type of incentive	
		• Number of activities	
		• Number of best practices	

5) CLIMATE CHANGE AND DISASTER CROSS-CUTTING ISSUES

SUB-DIMENSIONS	CRITERIA	INDICATORS	METHODS/REFERENCES
Fish Stock	Impact to Fish Stock	• Availability/levels of knowledge abundance, distribution, genetic diversity, recruitment	
		• Update information impact to fish stock	
Impact to Habitat	Coral bleaching	• Area	
		• Incident/ frequency	
		• Recovery Rate	
	Destruction of mangrove	• Area coverage	
		• Recovery Rate	
	Destruction of sea grass	• Area coverage	
		• Recovery Rate	
Impact to Environment	Sea level rise	• Saline intrusion	
		• Mean sea level annual	
		• Coastal Erosion (Area)	
	Physical/chemical parameters (T, Salinity, PH, DO)	• Level of physical and chemical parameters	
	Precipitation (rainfall)	• Level of Precipitation	
	Ocean acidification	• PH level	

ANNEX 30
Improving Healthy Ocean Ecosystems through Best Practices and Fishing Gear Innovations

Executive Summary

Fisheries in Southeast Asia contributes to high fisheries production making many countries in the region among the top ten highest producers of fish in the world. However, the perceived lack of selectivity of fishing net and the resultant capture of huge quantities and diversity of non-target species, including endangered species, coupled with its significant effect on the environment as overfishing threatens fish stocks globally, reduces biodiversity, alters the ecosystem functioning, and jeopardizes the food security and livelihoods of people. Considering the Environmental damage caused by fishing especially traditional trawlers that about 40,000 vessels are still active and directly impact the degradation of the bottom/seabed habitats, spread of marine plastic debris from lost or abandoned nets, and occurrence of microplastics, as well as increased emission of CO_2 into the air. These negative impacts will intensify through time if major measures were not taken to address those mentioned impacts.

To solve these problems, SEAFDEC with the support from the UN Environment Program (UNEP) has drafted the Concept Proposal through the reviewing of gap analysis and consultation with the six Fisheries Refugia implementing countries with aims to seek the international donors either Green Climate Funds (GCF) and/or Global Environment Facilities (GEF). The Objectives of the project concept note is the sustainability of ocean/ecosystem health through the best practices and fishing gear innovations in the Southeast Asia. The project design consists of four main actions that are urgently needed in the Southeast Asia as follows: 1) Promotion of effective fisheries management policies, 2) Development of innovative technologies for sustainable fisheries and capacity building, 3) Enhancing Management of fishery resources through Intensified efforts in habitat conservation and rehabilitation, and 4) Strengthening national and regional cooperation and coordination. Given that, the enormous impacts of destructive fishing practices particularly bottom trawl fishing on the health of the oceans should be impeded, particularly the alterations caused on the seabed habitats and in marine biodiversity on the continental shelf of Southeast Asia (Sunda Shelf). Such evidence is also necessary to effectively assess and manage the environmental impacts of fishing methods and to address tradeoffs given that the major fishing gears such as bottom trawl fishing makes a substantial contribution to human food supply in the world market.

The concept note was developed based on the reviews of more than 150 research papers published at national, regional and global issues. The first draft had been addressed at the 2nd Regional Scientific and Technical Committee Meeting, the 2nd Project Steering Committee Meeting and the 3rd Regional Scientific and Technical Committee Meeting of the SEAFDEC/UNEP/GEF Project on Fisheries Refugia in May, November 2019, and February 2020, respectively for consideration and comments. This is the final draft that has been amended based on the suggestions by the Refugia Project Committee from six countries. The key change in this title is focused on the best practices and fishing gear Innovations. It is expected that the concept Note will be addressed for consideration, comments and support from the SEAFDEC Council in April 2020 for further finalizing and submit to UNEP as a GEF and GCF 's agency for funding. The full-project document will be further developed in consultation with relevant countries in the Southeast Asia. The required fund is about 50 Million for 5 Years implementation. In case for GCF, the relevant countries to the project have to coordinate with National Designated Authority (NDA) and seek for "No Objection Letter" for the Project Preparation Facility (PPF). The similar requirements for GEF, the relevant countries to the project have to coordinate through the environment agency for endorsement.

CONCEPT NOTE
(FOR REVIEW)

Improving Healthy Ocean Ecosystems through Best Practices and Fishing Gear Innovations

I. INTRODUCTION

The South China Sea and Gulf of Thailand are geographically located on the important Sunda Shelf as a southeast extension of the continental shelf of Southeast Asia that includes the Malay Peninsula, Sumatra, Borneo, Java, Madura, Bali, and their surrounding smaller islands (Ben-Avraham 1973). It covers an area of approximately 1.85 million km^2 (Van Bemmelen 1949) and comprises large fishing areas suitable for bottom trawl fishing since the past.

Bottom trawl fishing in Southeast Asia has emerged since early 1970s, as a major industrialized fishing method, and became a dominant fishing method in offshore and coastal areas. Rapid expansion of trawl fishing effort, conversion of vessels, expansion of the geographical range of fishing, and retention of most animals caught have resulted in rapid depletion of stocks and changes to stock composition, destroying critical habitats, causing high impacts on benthic communities, catching of bycatch species, threatening and endangering major aquatic species, and even altering the associated ecological communities (Kongprom *et.al.* 2003; Nurhakim 2003; Campos 2003). This declining trend is compatible however with the fishing 'down marine food web', reported from well-studied parts of the South China Sea, notably the Gulf of Thailand (Christensen et.al. 2003).

In terms of socioeconomic impacts, more valuable fish caught by bottom trawl fisheries has decreased sharply and that there has been proportionate increase in smaller, less valuable species. These results provide a clear picture of the extent of stock rehabilitation and management efforts that are required to restore the maximum economic value to the fisheries of the region (Silvestre *et.al.* 2003).

On carbon footprint in fisheries, global fisheries burned almost 200 billion liters of fuel in 2016 compared to 47 billion liters in 1950 (Greet *et.al*. 2019). The most fuel-intensive fishing practices not only contribute most to the damaged seabed habitats and reef formations but also worsen the impacts of climate change. Bottom trawling techniques are the most fuel intensive fishing techniques. Additionally, the intensity of fuel consumption by fisheries in the Southeast Asia is high about 500-2000 liters km^{-2} (EC 2007) compared to the other regions in the world. Reducing the carbon footprint of fisheries, particularly in bottom trawling with less fuel consumption and causing less impact from trawling is therefore needed.

Achieving effective fisheries management for bottom trawling and other destructive fishing gears are therefore increasingly important as overfishing threatens fish stocks globally, reduces biodiversity, alters ecosystem functioning, and jeopardizes the food security and livelihoods of hundreds of millions of people worldwide (Golden *et al.* 2016; Jackson et al. 2001; Pauly et al 2005; Szuwalski *et al.* 2017; World Bank 2009). As such, the Project intends to come up with effective fisheries management policies, innovative technology for best practices, reduction of carbon footprint, and stock rehabilitation programs.

II. PROJECT DESCRIPTION

This project Concept Note entitled "**Improving Healthy Ocean Ecosystems through Best Practices and Fishing Gear Innovations in Southeast Asia**" is being developed to meet the need of the ASEAN-SEAFDEC Resolution and Plan of Action towards 2030 and Implementing the Strategic Action Programme for the South China Sea (SAP-SCS). The Project would be executed regionally by the Southeast Asian Fisheries Development Center (SEAFDEC) in partnership with the government agencies responsible for fisheries in the Southeast Asia: focusing all ASEAN Member States. It is expected that full proposal will be further developed to meet the requirement of the DONORs such as

Green Climate Funds (GCF), Global Environment Facilities (GEF). The required fund is about 50 Million for 5 Years implementation. In case for GCF, the relevant countries to the project have to coordinate with National Designated Authority (NDA) and seek for "No Objection Letter" for the Project Preparation Facility (PPF).

The Concept Note integrates the ecosystem-based fisheries management approach through the development of effective national/regional fishery policies on sustainable fisheries and innovative technology for bottom trawl gears and methods including reduction of green-house gas emission from fishing activities. Additionally, building partnerships between multiple public and private sectors, *e.g.* local government/communities, research institutions, net makers, fisheries associations, fish meal industry, fish processors, etc. would be among the approaches to improve and change this production practice into more environmentally positive. The project includes resources enhancement activities that aim to rebuild and rehabilitate the seabed habitats as well as shelters of both demersal and pelagic fish in either offshore or coastal areas to protect and enhance demersal fish stocks due to loss of seabed habitats affected by the bottom trawl net. Cooperation among country partners (regional) and concerned inter-agencies (national) are needed taking into account the demersal fish stocks on the continental shelfs that have already depleted.

The project comprises the following 4 project components:

Component 1 will consider the results of the impact assessment and management of bottom trawl fisheries through enhanced social dimensions and developed effective fisheries management policies. The outcome of this component is improved baseline data collection and effective fisheries management policies through enhancement of Data Management System. Taking into account the social dimensions concerns, the economic value of fishes and economic efficiency in the industries as well as data collection and management are improved for long term achievements of the Project. Supporting activities are:

1.1. Closing the knowledge gap on the ecosystem/environmental impacts of bottom trawling via baseline data collection and evaluation, and establishment of the data management system;
1.2. Reduction of the pressures of bottom trawling on marine ecosystem and environment via adoption of effective fisheries management policies at national and regional levels;
1.3. Catalyzing the public-private sectors on the actions via the ecosystem-based fisheries management to build resilient fishery resources and reduce the impacts of bottom trawling via enhanced stakeholder engagement taking into account gender mainstreaming in fisheries management;
1.4 Establishment of cross-sectorial agreement on national guidelines for effective management of bottom trawl fishing;
1.5 Endorsement of policy, legal, and planning frameworks, both at national and regional levels, for improving the ecosystem health through best practices and Fishing Gear Innovations;
1.6 Improvement of economic efficiency in the industry and the individual fishers via enhanced traceability system along the value chain of fish and fishery products from bottom trawling;
1.7 Increasing the economic value of fishes from medium scale bottom trawlers via promotion of marketing and branding as well as marine tourism at local communities;
1.8 Sharing of the knowledge and lessons learned to serve as useful platforms for data and information management for utilization by various stakeholders, the wider public and practitioners.

Component 2 focuses on improving the destructive fishing practices focusing destructive fishing gears including the bottom trawl fishing gears and methods to be more eco-friendly and fuel-efficient gears through the development of innovative technology and best practices. The outcome of this component is reduced effects of bottom trawling other destructive fishing gears on seafloor/benthic habitats and on the air quality through enhanced innovative technology and best practices in trawl fisheries. Supporting activities are:

2.1 Mitigation of the impacts of bottom trawling on marine ecosystem including the seabed habitats, fish stocks, by-catch, ghost fishing, etc. via enhanced ecosystem-friendly fishing gears and methods, bottom trawl innovations, and use of alternative fishing gears;

2.2 Enhancement of energy saving trawling including the low impact and fuel-efficient fishing through innovative technology for increased fuel-efficient gear and reduced energy consumption or carbon footprint;
2.3 Reduction of post-harvest losses from bottom trawlers through improved preservation technology and increased quality of catches;
2.4 Combating marine debris in the Region by applying integrated land-to- sea policy approaches.
2.5 Enhancement of public-private partnership on innovative and eco-friendly technology through creation of business opportunities and economic considerations;
2.6 Building the capacity and knowledge specifically in the field by collaborating with stakeholders for exchanging of the best practices;

Component 3 focuses on enhancing management of fishery resources through Intensified efforts in habitat conservation and rehabilitation. The outcome of this component is increased fisheries production through fisheries enhancement and rehabilitation of seabed habitats programs within the EEZ where no MPAs established and no fish shelters existed. Using the data management system especially spatial data on fishing effort, the project will monitor the pressures of bottom trawling on seabed and identify the seabed/grounds for installing the artificial fish habitats to increase fish production in the offshore areas. Supporting activities are:

3.1. Investigation of the suitable grounds for deployment of the artificial fish habitats through the assessment of critical seabed habitats using high-resolution spatial data on fishing effort;
3.2. Provision of platform for knowledge sharing and exchange of the best practices and innovations to enhance the management of fishery resources, habitat conservation and rehabilitation;
3.3. Increasing the artificial fish habitats or shelters of fishes in the areas where habitat loss through science-based management;
3.4. Catalyzing the inter-agencies cooperation for management of fishery resources, habitat conservation and rehabilitation of critical sea-bed habitats

Component 4 will foster the national and regional cooperation and coordination in enhancing the healthy ecosystems through the establishment of data management system, development of the bottom trawl best practices and alternative gears as well as creation of the offshore artificial fish habitats where there are no MPAs or shelters for fish to hide. At national level, the project will strengthen cross-sectoral coordination and will harness the national scientific and technical expertise and knowledge necessary to promote the policy, legal and institutional reforms for fisheries refugia management in the participating countries. Regionally, Component 4 will foster regional cooperation in: the integration of scientific knowledge and research outputs with effective fisheries management policies; and in enhancing the healthy ocean through the Best Practices in Trawl Fisheries. This component also includes project coordination and management activities aimed at: ensuring the timely and cost-effective implementation of the regional and national-level activities; and satisfying the reporting requirements of UNEP and the Donors. Supporting activities are:

4.1. Strengthening of the cross-sectoral coordination in improving the ecosystem health;
4.2. Harnessing of the national scientific and technical expertise and knowledge in promoting policy, legal and institutional reforms for enhancing the healthy oceans and implementing the best practices and fishing gear innovations;
4.3. Regional cooperation in the integration of scientific knowledge and research outputs with effective fisheries management policies;
4.4. Regional cooperation in enhancing the healthy ocean ecosystems;
4.5. Effective coordination of regional and national-level activities and satisfying the reporting requirements of UNEP and Donors

The longer-term goals of this Project are to contribute to: improved seabed ecosystems particularly on the Southeast Asia continental shelf and other critical seabed habitats; improved national fisheries management policies of the destructive fishing including bottom trawling that threatens the demersal and pelagic fish stocks and critical seabed habitat linkages; and enhanced uptake of best practices in fisheries management and biodiversity conservation in the design and implementation of regional and national fisheries management systems. The medium-term objectives are to: build the resilience of Southeast Asian bottom trawl fisheries to the effects of high and increasing levels of fishing effort on seabed habitats; improve the understanding among stakeholders, including fisherfolk, scientists, policy-makers, and fisheries managers, of the seabed ecosystem and fishery linkages as basis for integrated fisheries and ecosystem/habitat management; and build the capacity of fisheries departments/ministries and all relevant private partnerships to engage in meaningful activities regarding the improvement of fisheries and management of interactions between fisheries and critical seabed habitats. The related end-of-project targets are:

- by 2025, regional data management systems are established for effective fishing management and monitoring of the effects of bottom trawling on seabed habitats;
- by 2025, Effective fish shelters and/or artificial fish habitats are built that have potential in enhancing fisheries resources in the Southeast Asia continental shelf;
- by 2025, fisheries management policies on the best practices and fishing gear innovations are developed and implemented;
- by 2025, about 20% improved bottom trawlers are adopting the best practices and fishing gear innovations and reducing their effects on the sea-bed habitats.
- by 2025, about 25% reduction of carbon footprint from bottom trawling in Southeast Asia is achieved.