



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

REPORT

**DRAFT FISHERIES REFUGIA MAPPING
(FOR APPROVAL BY THE REFUGIA SITE MANAGEMENT COMMITTEE)**

PHILIPPINES

11 FEBRUARY 2022

Prepared by
**NATIONAL FISHERIES RESEARCH AND DEVELOPMENT INSTITUTE
PHILIPPINES**

**SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
TRAINING DEPARTMENT**



First published in Phrasamutchedi, Samut Prakan, Thailand in February 2022 by the SEAFDEC-UNEP-GEF Fisheries Refugia Project, Training Department of the Southeast Asian Fisheries Development Center

Copyright © 2022, SEAFDEC-UNEP-GEF Fisheries *Refugia* Project

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

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

Southeast Asian Fisheries Development Center
Training Department
P.O.Box 97, Phrasamutchedi, Samut Prakan, Thailand
Tel: (66) 2 425 6100
Fax: (66) 2 425 6110
<https://fisheries-refugia.org> and
<https://seafdec.or.th>

DISCLAIMER:

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

For citation purposes this document may be cited as:

NFRDI/Philippines, 2022. Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand, Report of Draft Fisheries Refugia Mapping (for Approval by the Refugia Site Management Committee) . Southeast Asian Fisheries Development Center, Training Department, Samut Prakan, Thailand; FR/REP/PH56, 11 p.

Table of Contents

1. INTRODUCTION	4
2. DATA COLLECTION AND ANALYSIS	5
3. PROPOSED FISHERIES REFUGIA SITES	5
4. LITERATURE CITED.....	8
5. APPENDICES	9
APPENDIX 1	9
APPENDIX 2	9
APPENDIX 3	10
APPENDIX 4	11

Table of Figure

Figure 1. Project Sites in the Philippines.....	5
Figure 2. Proposed Fisheries Refugia Site in Bolinao, Pangasinan.....	6
Figure 3. Proposed Fisheries Refugia Site in Coron, Palawan	7
Figure 4. Proposed Fisheries Refugia Site in Masinloc, Zambales	7

1. INTRODUCTION

The South China Sea and Gulf of Thailand is a global centre of shallow water marine biological diversity, supporting a significant world fishery that is important to the food security of, and as a source of export income for, Southeast Asian countries. Landings from this area contribute approximately 10 percent of reported global fisheries production per annum and make significant contributions to the economies, of countries bordering the Gulf of Thailand and the South China Sea (UNEP, 2007a). The majority of fisheries are small-scale in nature, and fish are landed in a large number of decentralised locations for distribution through complex marketing networks at the community level. As a consequence, estimates of fisheries production are considered to be gross underestimates and do not adequately reflect the importance of the artisanal or subsistence production to the fisheries sector as a whole

The majority of Southeast Asian countries are among the top 20 capture fisheries producing countries in the world, with some experiencing annual increases in production of up to 5 percent. Pelagic fishes dominate landings by volume and value, as most demersal fisheries are over-exploited (Lundgren *et al.* 2006). It is well accepted, however, that regional fisheries statistics rarely reflect: (a) production from small-scale coastal fisheries, (b) the high level participation of coastal communities in fishing, or (c) the social and economic importance of artisanal and subsistence fishing to coastal communities.

Fish stocks in the South China Sea and Gulf of Thailand are subject to high levels of fishing effort, such that stocks of most economically important species are considered to be fully fished or overexploited. Increasing global demand for fisheries products; and the dependence of coastal communities on fish for food and income results in a continued increase in fishing effort. This has led to “fishing down the marine food chain in the region” (Christensen, 1998), coupled with an increasing dependence of the artisanal sector on small pelagic species due to declining availability of demersal species.

The fisheries and habitat components of the UNEP/GEF South China Sea Project focus on the critical role that habitats such as mangroves, coral reefs, seagrass, and wetlands play in sustaining fisheries production in the South China Sea and Gulf of Thailand. These habitats are known to act as refuges for most economically important fish species during critical stages of their life-cycles including as larvae, for spawning, and for feeding. These habitats therefore play an important role in recruitment and maintenance of fish stocks.

Declining fish availability, coupled with over-capacity and the dependence of the small-scale sector on coastal fisheries for income generation, has led to the adoption of destructive fishing practices by some fishers in order to maintain incomes and food production in the short-term. Fisheries trends suggest that production from capture fisheries will decline over coming years unless total fishing effort and capacity are reduced (Lundgren *et al.* 2006). The obvious problem in the reduction of fishing capacity is that most fisheries are small-scale with the majority of participants (and their families) being highly dependent on fisheries for income, food and well-being.

The fisheries *refugia* concept as developed by the Regional Working Group on Fisheries (RWG-F) is based on the use of area-based or zoning approaches to fisheries management aimed at maintaining the habitats upon which fish stocks depend, as well as minimizing the effects of fishing on stocks of important species in areas and at times critical to their life cycle. The fisheries *refugia* concept promotes the sustainable use of fish stocks and their habitats, and the use of criteria for the selection of sites for fisheries and habitat management interventions that focus on fish life-cycle and critical habitat linkages. The focus of the *refugia* is to identify and designate priority areas where the integration of fisheries and habitat management can be applied. The fisheries *refugia* concept emphasizes on the quality of the

different habitat and its important function to the life-cycle of the different fished species. Fisheries *refugia* addresses recruitment overfishing and growth overfishing as well as protecting the habitat. Thus, the protection and management efforts of *refugia* is on the habitat and fish resources and not just to declare close fishing either temporally or spatially of a particular fishing ground for other purposes.

The final priority fisheries *refugia* sites selected for the Philippines were as follows:

- Bolinao, Pangasinan
- Masinloc Zambales; and
- Coron, Palawan

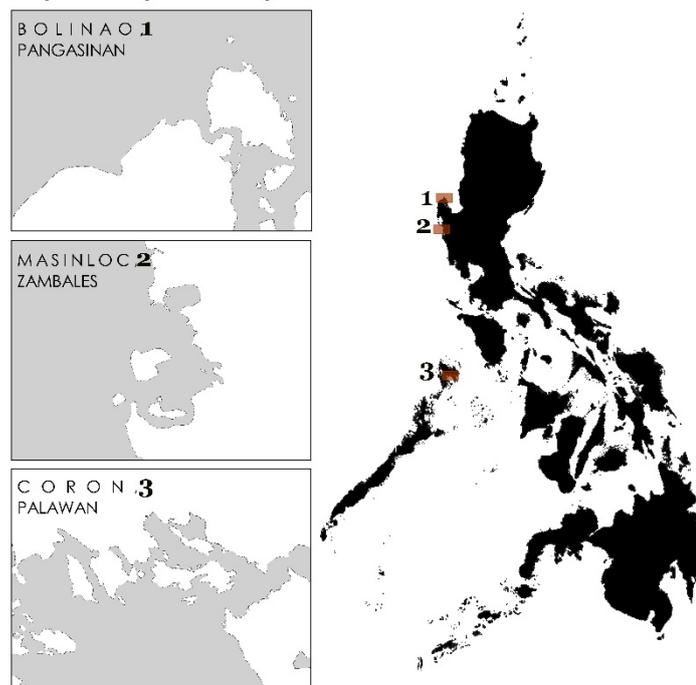


Figure 1. Project Sites in the Philippines

2. DATA COLLECTION AND ANALYSIS

Data obtained were the country, province, and barangay shapefiles of the Philippines from the Database of Global Administrative Areas (GADM). The mangrove and seagrass cover shapefiles were gathered using supplementary materials from peer-reviewed papers available online. The location of marine protected areas (MPAs) were obtained from the Philippine MPA Database (www.database.mpasupportnetwork.com). All shapefiles and information were processed and analyzed using Quantum GIS (3.22.x Białowieża). We used two coordinate reference systems: WGS 84 UTM Zone 51N for Bolinao, Pangasinan and Masinloc, Zambales, and WGS 84 UTM Zone 50N for Coron, Palawan. Lastly, the area for each of the proposed *refugia* sites were computed using raster calculator.

3. PROPOSED FISHERIES REFUGIA SITES

Ichthyoplankton studies play a key role in the understanding of the ecology and evolution of fish fauna and their constituent populations (Moser and Smith, 1993). The fish–egg–larvae–recruitment cycle has received a wide attention because of its obvious importance to world food supplies. The hazardous progress from egg to mature fish is completed only by a tiny

minority, and even at the larval state the survival rate after hatching is typically only ~1% (Chambers and Trippel, 1997). The main objective of the project's ichthyoplankton survey is to have a baseline data of the fish eggs and larvae that is present in the proposed *refugia* site. Collection of ichthyoplankton was conducted in Bolinao Bay, Masinloc Bay and Coron Bay with 6-8 sampling stations from 2018-2019. After a series of sampling in a quarterly basis, the spawning areas each *refugia* sites were established as shown in the figures.

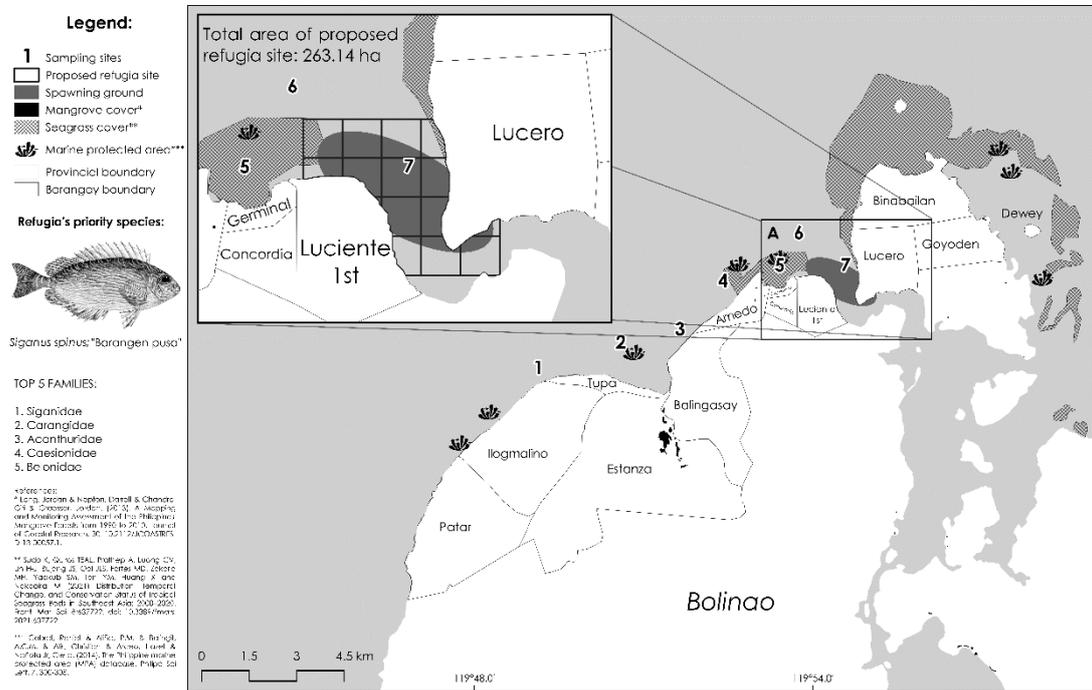


Figure 2. Proposed Fisheries Refugia Site in Bolinao, Pangasinan

Figure 2 shows the proposed fisheries refugia site in Bolinao, Pangasinan. There are 7 sampling stations in Bolinao Bay where station 7 was observed to have highest number of eggs. Top larval families collected from Bolinao Bay are Siganidae, Carangidae and Acanthuridae. This result supports, *Siganus spinus* from family Siganidae, selected by the Bolinao Refugia Site Management Committee (RSMC) as their priority species. As agreed by the members of the committee, station 7 as highlighted will be designated as the fisheries *refugia* site with total proposed area of 263.14 ha subject to approval this first quarter of 2022

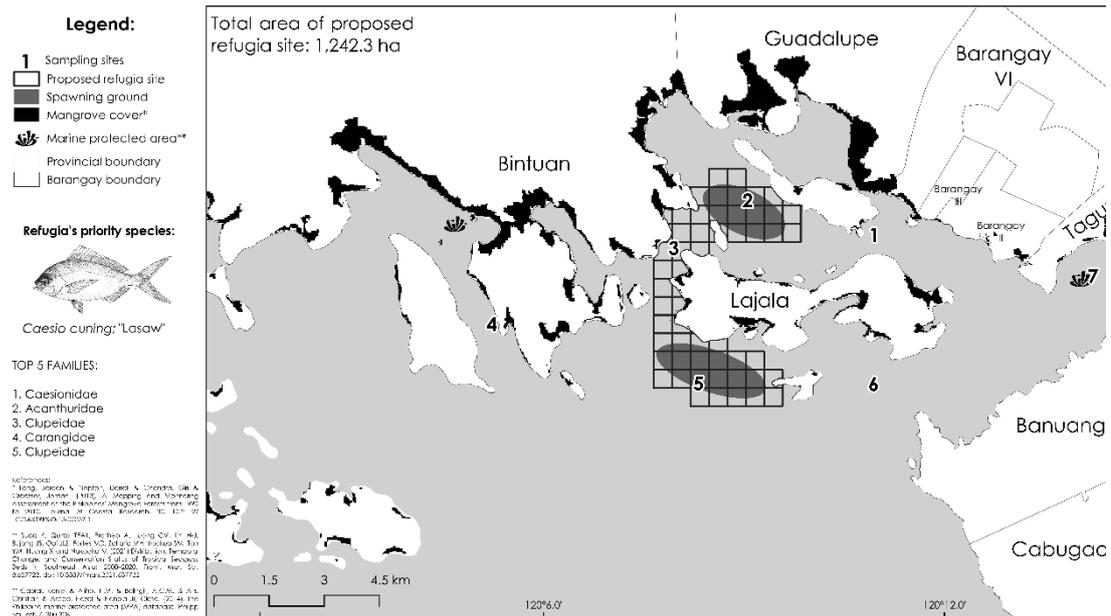


Figure 3. Proposed Fisheries Refugia Site in Coron, Palawan

The proposed fisheries refugia site for Coron is shown in Figure 3. Out of 7 sampling stations, high abundance of fish eggs were observed in stations 2 and 5. Fish larval families were dominated by Caesionidae with highest number of fish larvae, followed by Acanthuridae and Clupeida. RSMC in Coron previously selected *Lutjanus argentimacularus*, commonly known as Mangrove Jack as their priority species, however replaced it with *Caesio cuning* during the next meetings based on discussions of the presented baseline data. The new priority species for the site is among the top families of fish eggs collected in Coron Bay. Proposed *refugia* site is also subject for approval in the first meeting scheduled for this year.

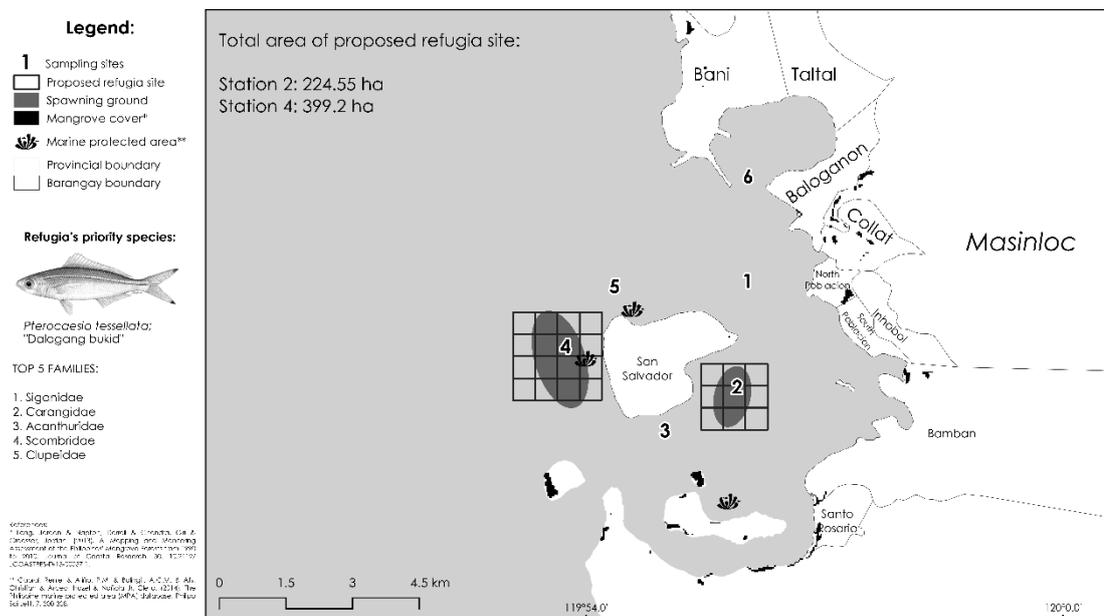


Figure 4. Proposed Fisheries Refugia Site in Masinloc, Zambales

The figure above shows the proposed fisheries refugia site in Masinloc, Zambales. There are 6 sampling stations established in Masinloc Bay where Station 4 and 2 were observed to have the highest number of fish eggs. Among the top families of fish larvae observed in Masinloc Bay were Siganidae, Carangidae, Acanthuridae and Scrombridae thus RSMC selected *Ptaerocaesio tesellata* as the priority species for the municipality and *Auxis thazard* as transboundary species for the Philippines, based on the ichthyoplankton survey and fisheries data collection in Masinloc. Total area for the proposed site is 623.75 ha subject for approval by the committee.

Results indicate that there is partial overlapping between nursery and spawning grounds particularly Bolinao Bay (Station 7) and Masinloc bay (Station2) where high assemblage fish eggs and larvae were observed during the entire survey period. In general, all *refugia* sites have at least one near shore station identified as a spawning ground because of the high number of eggs present. It is known that larval fish assemblages result from adult spawning strategies and environmental influences (Franco-Gordo et al., 2002). In the laboratory, it was also observed that the stations with high presence of eggs also have high number of phytoplankton.

4. LITERATURE CITED

- Cabral, Reniel & Aliño, P.M. & Balingit, A.C.M. & Alis, Christian & Arceo, Hazel & Nañola Jr, Cleto. (2014). The Philippine marine protected area (MPA) database. Philipp Sci Lett. 7. 300-308.
- Christensen, V., 1998. Fishery-induced changes in a marine ecosystem: insight from models of the Gulf of Thailand. Journal of Fisheries Biology 53 (Suppl. A),128e142.
- Long, Jordan & Napton, Darrell & Chandra, Giri & Graesser, Jordan. (2013). A Mapping and Monitoring Assessment of the Philippines' Mangrove Forests from 1990 to 2010. Journal of Coastal Research. 30. 10.2112/JCOASTRES-D-13-00057.1.
- Lundgren, R., Staples, D.J., Funge-Smith, S.J. and Clausen, J. 2006. Status and potential of fisheries and aquaculture in Asia and the Pacific 2006. FAO Regional Office for Asia and the Pacific. RAP Publication 2006/22. 62pp.
- Sudo K, Quiros TEAL, Prathep A, Luong CV, Lin H-J, Bujang JS, Ooi JLS, Fortes MD, Zakaria MH, Yaakub SM, Tan YM, Huang X and Nakaoka, M. (2021) Distribution, Temporal Change, and Conservation Status of Tropical Seagrass Beds in Southeast Asia: 2000–2020. Front. Mar. Sci. 8:637722. doi: 10.3389/fmars.2021.637722
- UNEP, 2007a. National Reports on the Fish Stocks and Habitats of Regional, Global and Transboundary Significance in the South China Sea. UNEP/GEF/SCS Technical Publication No. 15.

5. APPENDICES

APPENDIX 1

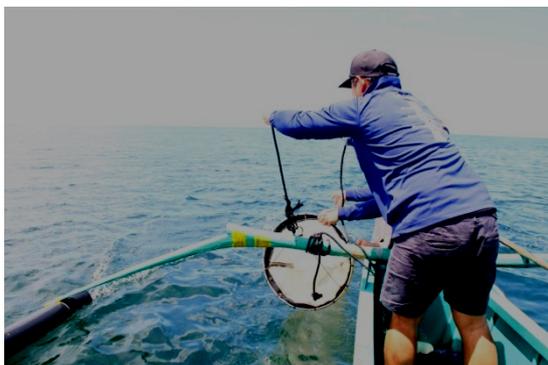
Ichthyoplankton Survey: Masinloc, Zambales



Actual survey at Masinloc Bay, Masinloc Zambales

APPENDIX 2

Ichthyoplankton Survey: Bolinao, Pangasinan





Actual survey at Bolinao Bay, Bolinao, Pangasinan

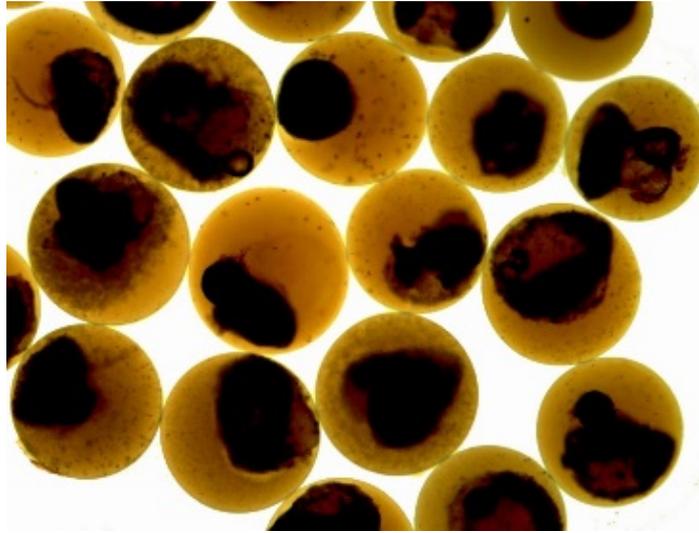
APPENDIX 3

Ichthyoplankton Survey: Coron, Palawan



Actual survey at Coron Bay, Coron, Palawan

APPENDIX 4



Actual Photos of Fish Eggs and Larvae sampled from Refugia sites