Indonesia Blue Swimming Crab Fishery Improvement Project

NON-TARGET SPECIES FIELD ASSESSMENT 2020

Using the Marine Stewardship Council's Risk Based Framework for Data Limited Fisheries using MSC's Productivity, Susceptibility Analysis

REPORT AS OF DECEMBER 2020

TABLE OF CONTENTS

RESEARCH TEAM

1. Dr. Hawis Madduppa
2. Dr. Zairion
3. Aburizhal
4. Susi Awaliyah
5. Lailatul Qomariyah
6. Afsah Indah
7. Muhammad Cardin
8. Farhan Ramadhan
9. Rasyid Prasetya
10. Kamal Mustabiq
11. Nur Arofah

INTRODUCTION

The issues surrounding bycatch and discarding are amongst the most important facing the management of fisheries throughout the world. Considerable research over the past decade has shown that discarding can affect the yields of fisheries and the functioning of ecosystems (Fennessey 1994; Jennings and Kaiser 1998; Hall 1999; Kaiser and deGroot 2000). Consequently, much emphasis is being placed on reducing discarding in all types of fisheries. In developing strategies to manage discarding, it is fundamental to determine and define the real level of discarding and how it varies in space and time among different fishing operations (Alverson et al 1994; Kennelly 1995; Hall 1999). An understanding of the behavior and selectivity of fishing gears and the species captured can help ascertain ways to mitigate discarding (Hall 1999; Broadhurst 2000). Such information has been successfully used to reduce discarding and wastage in some fisheries (see Hall 1999; Broadhurst 2000; Kaiser and deGroot 2000).

The objectives of the field survey of non targetspecies (bycatch) using the the Marine Stewardship Council's (MSC) Risk Based Framework (RBF) for data limited fisheries are threefold

1. To identify all non-target species (NTS) that are **potentially** at risk of being impacted negatively by a blue swimming crab fishery
2. To identify all non-target species (NTS) that are **at risk** of being impacted negatively by a blue swimming crab fishery, using MSC's P2 Default Decision Making Tree
3. To assess the **level of risk** for each **at risk** species using MSC's Productivity, Susceptibility Analysis

Non Target Species assessment research activities required an appropriate reference data collection, relevant and in accordance with scientific principles. So in this case we need a standard procedure data collection which is called Standard Operating Procedures (SOP). Outlined in the SOP regarding sampling technique and strategies in the collecting data related to Non target Species and stock assessment research. Sampling technique is one of the important things that are known and mastered by researches and technicians. Because the fish population is not uniform in space and time, so the strategy for sampling should be considered to avoid or minimize error.

Location for research Non Target Species Assessment are Pemalang, Pati, Rembang, Gresik, Pamekasan, Sumenep dan Konawe Selatan. This research will be held for six months.

DATA COLLECTION

1 Land Survey

Data was collected at seven sampling sites: Pemalang, Pati, Rembang, Gresik, Pamekasan, Sumenep and Konawe Selatan (Figure 1). Sampling was conducted in blue swimming crab landings (fishing, container/traders and collectors/miniplan). In order to obtain continuous data then will be appointed enumerators at a certain location and given a brief training regarding the collection of data required.

Sampling is mainly carried out on catches obtain ship/boat catcher who use fishing gear traps (bubu), and trammel net and etc.

Figure 1. Sampling site for BSC research activities over period August to Desember 2019

1.1 Data Collection Catch

The data production collected from the records collectors. Based on the records obtained data on catches per trip (kg) per gear, the number of trips, total catches in every day and every month. The composition of the catch, recorded directly from the catch landed by fishermen.

1.2 Data Collection Bycatch

The data bycatch collected from the record collectors. Based on the records obtained data catches per trip (kg) for *Portunus pelagicus* and other catches per gear, the number of trips, total bycatch, conduct a rapid appraisal (assessment) of the NTS found in the catch of the selected gear type, Code each NTS using a simple coding system, and catorgise each NTS according to MSC's PS Default Decision Making Tree as either.

2.1 Sampling Non Target Species

In this study, we define the term 'byproduct' as the total retained crab bycatch, and the term 'total bycatch' refers to the sum of the total crab byproduct and the total discarded bycatch from commercial trap. The prosedur of Non Target Species is the following Marine Stewardship Council's Risk Based Framework for Data Limited Fisheries. :

1. **Select and define your BSC fishery based on**
    - Geographic area (i.e., bay, lagoon, estuary, sea)
    - Administrative area (divisions, districts, provinces)
    - Fishing villages / landing centres
    - No of boats with types of gear (note you are going to have to do a Field Assessment for each type of gear, as the bycatch will be different for traps and crab nets)

2. **Select location and gear type**

3. **Organise a short 45 minute discussion with BSC fishermen in the village / landing centre to explain**
    - What you are going to do (non target species assessment);
    - How you are going to do it (counting and weighing the retrained and discarded bycatch) and
    - Why you are going to do it (to assess the ecological impact of the fishery in non target species)
    - Distribute an A5 Information flyer (See Annex A) (Appendix 1)
    - Ask for their help in conducting the study

4. **Spend a day or two in the target village and conduct a rapid appraisal (assessment) of the NTS found in the catch of the selected gear type**
    - Photograph each NTS several times, from several angles
    - Write down the local name(s) for each NTS against each Code
    - Code each NTS using a simple coding system e.g.,
        - F = Fish
        - C = Crustacean

- M = Mollusc
- E = Echinoderms
- = Other

➢ Once you get back home, categorize each NTS according to MSC's PS Default Decision Making Tree as either

ETP = Endangered, Threatened or Protected

OS = Out of Scope Species (*i.e.,* not fish but not ETP either)

Primary = Managed species with Target Reference Points for the fishery

Secondary = unmanaged species

➢ Most if not all of your NTS will be Secondary NTS

➢ If you think that two NTS are similar but are different species, give each one a separate Code at the start. You can always add Codes together later, if you decide or discover that they are the same species. But you can't separate species later if you have given two species the same Code.

5. **Then make and print a Field Guide to Non Target Species for your field researchers**

➢ One sheet of A4 or A5 for each NTS, with photographs, identifying features and the NTS Code clearly marked

➢ The English name is optional, you don't need to do this at this stage, but as your students are likely to be scientists, it will be difficult to stop them…..

➢ Don't waste time identifying species at this stage. You may have 50 NTS, but it is unlikely that more than five (5) will be present in the bycatch above the RBF Threshold for Secondary Species of >2%.

➢ All NTS with a frequency of <2% - even if they are less resilient - are classed as Secondary Minor Species, which you don't need to assess (unless you want to)

6. **Field Data Collection I – Pre Departure**

One field data collection team should consist of two people. Either two students or one student and a local assistant.

➢ Each Field Data Collection Team should aim to assess the bycatch (NTS) of 10 to 15 boats per day. Don't try to do more than this. It must be done quickly, without delays to the fishermen's work

- Field Equipment needed includes
  - Two plastic trays per boat (e.g., 10 boats = 20 trays. Ideally two colours)
  - Field Data Collection Sheet (Annex B) (Appendix 2)
  - Clipboard and Pen
  - Electronic Kitchen Weighing Scales
  - Sun Hats
  - Sun Cream

7. **Field Data Collection II – Start of the Day**
   - At the start of each day the team will give two plastic trays to each boat, as it returns to the landing centre.
   - The Field Team will write down the name of the fishermen on a Field Data Collection Sheet (Annex A): one for each boat
   - The teams will ask fishermen to put all the RETAINED bycatch in one plastic tray (e.g., Blue Tray) and all DISCARDED bycatch in the other plastic tray (e.g., Yellow Plastic Tray)
   - RETAINED bycatch is any species other than BSC that is either sold or taken home to be eaten or dried
   - DISCARDED bycatch is any species other than BSC that is simply thrown away

8. **Field Data Collection III – Data Collection**
   - The Field Data Collection Team should move up and down the beach / landing centre removing RETAINED non target species from the RETAINED bycatch tray, as the fishermen remove them from the traps / nets.
   - Each NTS should be identified by its Code, the number of individuals should be counted and the total weight of all the individuals of the species should be recorded.
   - The Field Team will need to move from boat to boat identifying and weighing and counting RETAINED NTS because these species will be either sold or taken home quickly by fishermen or their families.
   - Once all the RETAINED NTS trays are empty, then the Field Team can start to identify (by Code), count and weigh each NTS in the DISCARD trays.

- Once the DISCARDED trays have been emptied for all boats, then the Field Team will go to the Collection Centre and record the total weight of BSC landed by each boat, according to the fishermen's name
- The total weight of BSC will be the last piece of information recorded on each Field Data Collection Sheet.

9. **Field Data Collection IV – End of the Day**
    - Pack up all the field equipment, clip the datasheets

10. **Field Data Analysis I – Compile the Daily Data Sheet from the Individual Boat / Catch Data Sheets and enter Daily Data into the Excel Workbook at the end of each day**
    - Transfer the BSC data from Field Data Sheet for each boat to a Daily Field Data Sheet (Annex C) (Appendix 3)
    - Transfer the NTS data from Field Data Sheet for each boat to a Daily Field Data Sheet (Annex C)
    - Enter the weight of BSC caught by each boat into the BSC Worksheet in the NTS Field Assessment Excel Workbook (Annex D) (Appendix 4)
    - Entre the number of each NTS and the weight of each NTS into the RETAINED Worksheets and the DISCARDED Worksheet in the NTS Field Assessment

11. Repeat Steps 7 – 10 until the catches of 150 – 200 boats have been
    - 150 – 200 samples is more than enough. If you collect less than 100 someone is always going to say you haven't sampled enough. If you sample more than 200 you are wasting your time collecting more of the same data
    - Eventually you need to collect this data from several locations in the fishery an ideally at different times of the year. The bycatch may change throughout the year and the percent of bycatch will be different during the peak fishing season (lower) and the offseason (higher), but all that is for later.
    - First survey one village and one gear type in a village and work through the results

12. **At the end of your field survey the Excel Workbook should look something like the image overleaf**
    - What you need to do then is use the Categories and the % of the Total Catch to work out which NTS need to be assessed using MSC's Risk Based Framework
    - **Not all NTS species need to be assessed!!!**
    - **All ETP** need to be assessed using the Productivity Susceptibility Analysis (PSA)
    - **All OS** need to be assessed using the PSA
    - **Less Resilient Primary species ≥ 2%** of the total catch need to be assessed using the PSA
    - **Resilient Primary species ≥ 5%** of the total catch need to be assessed using the PSA
    - **Less Resilient Secondary species ≥ 2%** of the total catch need to be assessed using the PSA
    - **Resilient Secondary species ≥ 5%** of the total catch need to be assessed using the PSA
    - For now you don't have to worry about Resilience, just identify all Primary and Secondary species above 2% of the total catch.

13. **Field Data Analysis II – Use the Excel Workbook to identify the Codes of each NTS that is at risk, according to the MSC's P2 Default Decision Tree for the Risk Based Framework**
    - Now you should be able to identify the Codes (NTS) that you need to identify to the genus / species level. Up to this point in the survey you **DON'T** need to know the scientific names of the bycatch, you can just work with Codes.
    - If you are not able to identity of the Identify any one ETP or OS or Primary (≥ 2%) or Secondary (≥2%) then you need to take more pictures and or collect samples to analyse in the university, before you head home.
    - What you should have is a much shorter list of Codes / Local Names / Genus / Species for the NTS that are might be at risk of negative ecological impacts, due to the BSC fishery, based on MSC's P2 Default Decision Tree.
    - In one of the Indonesian fisheries the list of Codes / Local Names / Genus / Species for the NTS that may be at risk from ecological impacts looked like this. Only five NTS out of 84 might be at risk of negative ecological impacts, due to the BSC fishery, based on MSC's P2 Default Decision Tree.

- All the other NTS were Secondary species, occurring at <2%, which means even if they are LESS RESILIENT species, they are considered by MSC to be Secondary Minor species so we can forget about them.

14. **Identifying Main and Minor NTS**

- Last task before you start on the Productivity Susceptibility Analysis (PSA)
- Any Primary or Secondary NTS with a frequency of >5% of the Total Catch is a Main NTS. In the example above M08 and F11 are Secondary Main species. All main species must be assessed using the PSA, to investigate the risk of negative ecological impact from the BSC fishery (this is what Hannah did with her examples in the workshop)
- Any Primary or Secondary NTS with a frequency of>2% but<5% of the Total Catch need to be assessed for RESILIENCE (to fishing mortality). Less resilient species are slow growing, have low fecundity, high size / age on maturity and or restricted distribution (e.g., endemic species). In the example above F08 and C14 both occur in the catch at >2% but <5%.
- Stingrays (F08) are less resilient species, therefore F08 is a Secondary Main species and needs to be assessed using the PSA.
- Mud crabs (C14) are resilient species, therefore C14 is a Secondary Minor species, which you don't need to assess.
- All Out of Scope NTS must be assessed using the PSA.
- The final list of NTS that may be at risk of negative ecological impacts from the BSC (in this Sri Lankan example) are as follows.

15. **Productivity & Susceptibility Analysis**

- To conduct a PSA analysis on each of the ETP / OS / MAIN non target species identified by your field assessment survey, using the two tables shown overleaf. These are based on the MSC tables, but they are much prettier.
- Then you simply punch the results into the MSC Risk Based Framework Workbook 2.0 (Annex E) and it will automatically generated an MSC PSA Score for each species and an overall assessment for the fishery's MSC for impact on non target species.

RESULTS

1 Rembang

Table 1. List of species caught in the **gill net** based on the observation from January to December 2020

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
1	*Conger cinerreus*		Fish	0.11	R
2	*Teraphon theraps*		Fish	0.14	R
3	*Cynoglosus lingua*		Fish	0.23	R
4	*Platycephalus indicus*		Fish	0.55	R
5	*Brevitrygon (Himantura) walga*	Scaly whipray	Fish	1.09	R
6	*Hemiscyllium qriseum*		Fish	0.22	R
7	*Aluterus monoceros*		Fish	0.03	R
8	*Pomadasys kaakan*		Fish	0.82	R
9	*Arius* sp.	Sea catfish	Fish	0.59	R
10	*Scatophagus argus*		Fish	0.04	R
11	*Deprane punctata*		Fish	0.02	R
12	*Sigganus guttatus*		Fish	0.05	R
13	*Epinephelus coioides*		Fish	0.06	R
14	*Sphyraena jello*		Fish	0.07	R
15	*Ikan Gilikan*		Fish	0.18	R
16	*Johnius blangerii*		Fish	0.32	R
17	*Scylla serrata*	Indo-Pacific swamp crab/ Giant mud crab; Giant mangrove crab	Crustacean	0.74	R
18	*Libinia sp.*		Crustacean	0.27	D
19	*Homoioplax haswelli*		Crustacean	0.06	D
20	*Harpiosquilla harpax*	Mantis shrimps	Crustacean	0.11	D
21	*Dardanus sp.*		Crustacean	0.46	R/D
22	*Panaeus monodon*		Crustacean	0.02	R
23	*Metapenaeus ensis*		Crustacean	0.04	R
24	*Podophthalmus vigil*	Periscope crab	Crustacean	1.63	R/D
25	*Portunus sanguinolentus*		Crustacean	0.08	R
26	*Charybdis feriata*	Crucifix crab	Crustacean	0.30	R
27	*Panulirus polyphagus*		Crustacean	0.02	R
28	*Babylonia spirata*	Spiral Babylon	Molluscs	0.80	R
29	*Sepia recurvirostra*	Curvespine cuttlefish	Molluscs	**3.73**	R
30	*Murex trapa*	Rarespined murex	Molluscs	0.02	D
31	*Amusium pleuronectes*		Molluscs	0.07	R/D

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
32	*Thyone papuensis*		Molluscs	0.06	D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 2. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Rembang

No.	Description	Unit (kg)	Percentage (%)
1	Total weight of BSC (targeted species) caught	3,020.80	87.04
2	Total weight of retained By-catch	396.87	11.44
3	Total weight of discarded By-catch	52.98	1.53
4	Total weight of Non Target Species	449.85	12.96
	Total catch	3,470.65	

2 Pemalang

Table 3. List of species caught in the traps based on the observation from January to December 2020

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
1	*Johnius blangerii*		Fish	0.01	R
2	*Scylla serrata*	Indo-Pacific swamp crab/ Giant mud crab; Giant mangrove crab	Crustacean	**0.**06	R
3	*Podophthalmus vigil*	Periscope crab	Crustacean	1.04	R/D
4	*Charybdis anisodon*		Crustacean	0.01	D
5	*Portunus sanguinolentus*		Crustacean	0.01	R/D
6	*Charybdis feriata*	Crucifix crab	Crustacean	0.15	R/D
7	*Babylonia spirata*	Spiral Babylon	Molluscs	0.75	R
8	*Sepia recurvirostra*	Curvespine cuttlefish	Molluscs	0.02	R/D
9	*Octopus vulgaris*		Molluscs	0.01	R/D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 4. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Pemalang

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	33,922.30	97.92
2	Total weight of retained By-catch	695.66	2.01
3	Total weight of discarded By-catch	26.64	0.08
4	Total weight of Non Target Species	722.30	2.08
	Total catch	34,644.60	

3 Pati

Table 5. List of species caught in the traps and gill net based on the observation from January to December 2020

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
1	*Haloprine diemensis*			0.01	D
2	*Cynoglosus lingua*	Long tongue sole	Fish	0.01	R / D
3	*Brevitrygon (Himantura) walga*	Scaly whipray	Fish	0.01	R / D
4	*Pomadasys kaakan*			0.01	R / D
5	*Arius* sp.	Sea catfish	Fish	0.01	R
6	*Scatophagus argus*	Spotted scat	Fish	0.01	R / D
7	*Taeniura lymma*			0.01	R / D
8	*Chilosyllium punctatus*			0.01	D
9	*Epinephelus coioides*			0.02	R / D
10	*Epinephelus coioides*	Orange-spotted grouper	Fish	0.02	R
11	*Ikan Pitek*		Fish	0.03	R
12	*Scylla serrata*	Indo-Pacific swamp crab/ Giant mud crab;	Crustacean	0.20	R
13	*Charybdis lucifera*	Yelloish brown crab	Crustacean	0.03	R/D
14	*Charybdis feriata*	Crucifix crab	Crustacean	0.21	R
15	*Podophthalmus vigil*	Periscope crab	Crustacean	0.01	D
16	*Portunus sanguinolentus*		Crustacean	0.03	R
17	*Babylonia spirata*	Spiral Babylon	Molluscs	0.02	R
18	*Sepia recurvirostra*	Curvespine cuttlefish	Molluscs	0.88	R
19	*Octopus vulgaris*			0.02	R / D
20	*Melo melo*	Indian volute	Molluscs	0.07	R / D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 6. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Pati.

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	7,152.90	98.34
2	Total weight of retained By-catch	113.77	1.56
3	Total weight of discarded By-catch	6.86	0.09
4	Total weight of Non Target Species	120.63	1.66
	Total catch	7,273.53	

4 Gresik

Table 7. List of species caught in the gill net based on the observation from February to December 2020

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
1	*Tachypleus gigas*[*)]	Indo-Pacific (Coastal) horseshoe crab	Xiphosuran	1.53	**ETP**
2	*Johnius amblycephalus*	Bearded croaker	Fish	0.63	R
3	*Plotosus canius*	Gray eel-catfish	Fish	1.76	R/D
4	*Haloprine diemensis*		Fish	0.13	R
5	*Epinephelus sexfasciatus*		Fish	0.12	R
6	*Conger cinerreus*		Fish	0.61	R
7	*Teraphon theraps*		Fish	0.11	R
8	*Cynoglossus lingua*	Long tongue sole	Fish	5.49	R/D
9	*Platycephalus indicus*		Fish	0.11	R/D
10	*Brevitrygon (Himantura) walga*	Scaly whipray	Fish	1.06	R/D
11	*Pomadasys kaakan*		Fish	1.53	R
12	*Arius* sp.	Sea catfish	Fish	**10.13**	R/D
13	*Scatophagus argus*	Spotted scat	Fish	0.39	R/D
14	*Taeniura lymma*		Fish	0.14	R
15	*Deprane punctata*		Fish	0.46	R
16	*Pseudorhombus argus*		Fish	0.24	R/D
17	*Sigganus guttatus*		Fish	0.21	R
18	*Chilosyllium punctatus*			0.13	R
19	*Epinephelus coioides*	Orange-spotted grouper	Fish	0.36	R
20	*Lates calcarifer*		Fish	1.29	R/D
21	*Scomberoides tala*		Fish	0.11	R

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
22	*Pseudomonacanthus peroni*		Fish	0.10	R
23	*Ikan Gilikan*		Fish	0.98	R
24	*Pampus argenteus*		Fish	0.34	R
25	*Ikan Blama*		Fish	1.35	R/D
26	*Ikan Kucu-Kucu*		Fish	0.57	R/D
27	*Ikan Laosan*		Fish	**3.51**	R/D
28	*Belut Laut*		Fish	0.36	R
29	*Portunus sanguinolentus*		Crustacean	0.65	R/D
30	*Charybdis feriata*	Crucifix crab	Crustacean	1.97	R/D
31	*Babylonia spirata*	Spiral Babylon	Molluscs	0.26	R/D
32	*Teripang*		Echinoderm	0.17	R/D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 8. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Gresik

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	1,771.30	61.7
2	Total weight of retained By-catch	1,067.13	37.2
3	Total weight of discarded By-catch	31.42	1.1
4	Total weight of Non Target Species	1,098.55	38.3
	Total catch	2,869.85	

I. Description of the Target Species

Species Type	Vertebrate
Phylum	Chordata
Family Name	Ariidae
Scientific Name	*Arius sp.*
Common Name	**Sea catfish**

II. Target Species Productivity Susceptibility Score *using MSC's Risk Based Framework*

(see Table 1 and Table 2 for details)

Productivity Attributes		Score
Average Age at Maturity		1
Average Maximum Age		1
Fecundity		3
Average Maximum Size		1
Average Size at Maturity		1
Reproductive Strategy		1
Trophic Level		-
Density Dependence		-
Total Productivity (Average)		**1.33**

Susceptibility Attributes	Score
Availability	
Encounter-ability	
Selectivity	
Post Capture Mortality	
Total (Multiplicative)	

PSA Score =

MSC PSA Derived Score =

MSC Risk Category Name =

MSC Scoring Guidepost =

Arius sp - productivity attributes, rankings and score

Productivity Attributes	Low Productivity Score=3	Moderate Productivity Score=2	High Productivity Score=1	Arius sp	Verification	Score
Average Age at Maturity	>15 years	5-15 years	<5 years	24 -36 month	Pusey B, Kennard M, Arthington A. 2004. Freshwater Fishes of North-Eastern Australia. Griffith University (AU): CSIRO Publishing.	1
Average Max Age (Tmax)	>25 years	10-25 years	<10 years	5 years	Pusey B, Kennard M, Arthington A. 2004. Freshwater Fishes of North-Eastern Australia. Griffith University (AU): CSIRO Publishing.	1
Fecundity	<100 eggs per year	100-20,000 eggs per years	>20,000 eggs per year	100 – 180 eggs	Pusey B, Kennard M, Arthington A. 2004. Freshwater Fishes of North-Eastern Australia. Griffith University (AU): CSIRO Publishing.	3
Average Max Size (TL) not be used when scoring invertebrates	>300 cm	100-300 cm	<100 cm	50 cm	https://.fishbase.de	1
Average Size at Maturity not be used when scoring invertebrates	>200 cm	40-200 cm	<40 cm	14 cm	https://.fishbase.de	1
Reproductive Stratey	Live bearer	Demersal egg layer	Broadcast Spawner	Spawner	Pusey B, Kennard M, Arthington A. 2004. Freshwater Fishes of North-Eastern Australia. Griffith University (AU): CSIRO Publishing.	1
trophic Level	>3.25	2.75-3.25	<2.75			
Density dependences* (to be used when scoring invertebrate species scoring)	Conpensatory dynamics at low population size demonstrated or likely	No depensatory or compensatory dynamics demonstrated or likely	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely			

5 Sumenep

Table 9. List of species caught in the gill net based on the observation from January to June 2020

No.	Species	Common name	Group	Proportion in the catch (%)	Status
				By Weight	
1	*Cynoglossus lingua*	Long tongue sole	Fish	0.08	R
2	*Lutjanus monostigma*		Fish	0.12	R
3	*Brevitrygon (Himantura) walga*	Scaly whipray	Fish	0.92	R
5	*logocephalus lunaris*		Fish	0.04	R
	Taeniura lymma		Fish	0.12	R
	Pseudorhombus argus		Fish	0.09	R
	Ikan Buntal		Fish	0.26	R
	Pseudorhombus Malayanus		Fish	0.36	R
11	*Podophthalmus vigil*	Periscope crab	Crustacean	1.50	R
12	*Portunus sanguinolentus*	Threespot swimming crab	Crustacean	0.73	R
	Charybdis feriata		Crustacean	0.80	R
13	*Sepia recurvirostra*	Curvespine cuttlefish	Molluscs	0.49	R
14	*Melo melo*	Indian volute	Molluscs	0.83	R
15	*Murex trapa*	Rarespined murex	Molluscs	0.12	D
16	*Thyone papuensis*		Echinoderm	0.21	D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 10. Resume of targeted, retained, and discarded species caught of the BSC gill net fishery based on the observation in Sumenep

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	608.58	93.19
2	Total weight of retained By-catch	41.46	6.35
3	Total weight of discarded By-catch	2.99	0.46
4	Total weight of Non Target Species	44.45	6.81
	Total catch	653.03	

6 Pamekasan

Table 11. List of species caught in the traps based on the observation from January to December 2020

No.	Species	Common name	Group	Proportion in the catch (%) By Weight	Status	
	Tahcypleus gigas			0.02	ETP	
2	*Johnius amblycephalus*	Bearded croaker	Fish	0.08	R	
4	*Halopryne diemensis*		Fish	0.01		D
5	*Epinephelus sexfasciatus*	Sixbar grouper	Fish	0.12	R	
6	*Terapon theraps*	Largescaled terapon	Fish	0.07	R	
7	*Cynoglossus lingua*	Long tongue sole	Fish	0.01	R	
	Lutjanus monostigma			0.02	R	
	Himantura walga			0.02	R	
10	*Scatophagus argus*	Spotted scat	Fish	0.01	R	
11	*Nemipterus hexodon*	Ornate threadfin bream	Fish	0.08	R	
13	*Epinephelus coioides*	Orange-spotted grouper	Fish	0.09	R	
14	*Scylla serrata*	Indo-Pacific swamp crab/ Giant mud crab; Giant mangrove crab	Crustacean	1.21	R	
15	*Harpiosquilla harpax*	Mantis shrimps	Crustacean	0.05	R	
16	*Charybdis affinis*	Smoothshelled swimming crab	Crustacean	0.07		D
18	*Charybdis natator*	Ridged swimming crab	Crustacean	0.03		D
19	*Charybdis anisodon*	Twospined arm swimming crab	Crustacean	0.02		D
20	*Charybdis feriata*	Crucifix crab	Crustacean	0.14	R	
21	*Panaeus monodon*	Giant tiger prawn	Crustacean	0.03	R	
23	*Podophthalmus vigil*	Periscope crab	Crustacean	0.26		D
28	*Portunus sanguinolentus*	Threespot swimming crab	Crustacean	0.03	R	
	Panulirus versicolor		Crustacean	0.04	R	
29	*Babylonia spirata*	Spiral Babylon	Molluscs	0.05		D
30	*Natica* sp	Snail	Molluscs	0.01	R/D	
	Sepia recurvirostra			0.03	R	
33	*Melo melo*	Indian volute	Molluscs	0.04		D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 12. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Pamekasan

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	14,949.03	98.45
2	Total weight of retained By-catch	157.55	1.04
3	Total weight of discarded By-catch	77.66	0.51
4	Total weight of Non Target Species	235.21	1.55
	Total catch	15,184.24	

7 Konawe Selatan

Table 13. List of species caught in the traps based on the observation from January to December 2020

No.	Species	Common name	Group	Proportion in the catch (%) By Weight	Status
1	*Nemipterus hexodon*	Ornate threadfin bream	Fish	0.02	R
5	*Arius* sp.	Sea catfish	Fish	0.03	R/D
7	*Taeniura lymma*		Fish	0.01	R
9	*Scatophagus argus*	Spotted scat	Fish	0.02	R
	Sigganus guttatus		Fish	0.02	R
11	*Himantura uamak*		Fish	0.01	R
	Acanthopagrus berda			0.01	R
	Pseudomonacanthus peroni			0.01	D
	Neotrygon kuhlii			0.02	R
	Ikan Penutup Gumbang			0.01	R
	Scylla serrata		Crustacean	0.02	R
	Podophthalmus vigil			0.02	R/D
	Charybdis anisodon			0.07	R/D
14	*Dardanus sp.*		Crustacean	0.02	D
15	*Charybdis affinis*	Smoothshelled swimming crab	Crustacean	0.05	D
18	*Varuna litterata*		Crustacean	0.05	R/D
	Psopheticoides sanguineus			0.01	R/D
	Thalamita prymna			0.03	R/D

Note: *) = Protected species based on the Regulation of The Minister of Environment and Forestry of The Republic of Indonesia No. 20 Year 2018 Concerning Type of Protected Plants and Animals.
ETP = Endangered, Threatened and Protected species
R = Retained species
D = Discarded species

Table 14. Resume of targeted, retained, and discarded species caught of the BSC trap fishery based on the observation in Konawe Selatan

No.	Description	Unit (kg)	Percentage
1	Total weight of BSC (targeted species) caught	28,583.20	99.59
2	Total weight of retained By-catch	105.88	0.37
3	Total weight of discarded By-catch	12.82	0.04
4	Total weight of Non Target Species	118.70	0.41
	Total catch	28,701.90	