Data collection protocol for Indonesian blue swimming crab, *Portunus pelagicus*, fishery

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INDONESIA MARINE AND CLIMATE SUPPORT (IMACS) PROJECT

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Chapter 1 – Introduction

1.1. Motivation for a data collection system in Indonesia

In recent years, the concept of 'sustainability' has become an important focus of fisheries management, but is hard to explicitly define and interpretation of the concept continues to evolve (Rice 2014). It is generally accepted that a fishery must fulfill three sustainability dimensions to be considered sustainable: ecological, economic and social (Garcia & Staples 2000). The three dimensions may be defined as follows:

- ecological dimension: the stock biomass should be greater than a minimum reference level
- economic dimension: the individual vessel profit should be greater than a minimum reference level
- social dimension: there must be a minimum level of employment and activity (Martinet et al. 2007).

Additional requirements relating to bycatch of non-target species and environmental impacts can be included when necessary (Jacquet et al. 2009). Continuous data collection systems are required to evaluate the status and progress of the three dimensions of sustainability. This protocol aims to contribute towards data collection activities for the Blue Swimming Crab, BSC, fisheries of Indonesia, so that progress towards achieving sustainability can be monitored and improved.

The global demand for sustainably-sourced seafood is increasing as certification schemes and consumer recommendation lists influence consumers' preferences (Belson 2012). The European Commission has regulations stipulating a traceability system as a requirement for food producers and a catch certification scheme to combat the import of IUU fish (EC 2009; EC 2008). In the US, the 2011 Food Safety Modernization Act (Anon 2011) allows the Food and Drug Administration to order the establishment of food product tracing systems. To maintain Indonesia's position as a competitive player in the global seafood market it is advised that Indonesian seafood products begin a conversion process towards sustainability and eventual certification of sustainability. Such a certification process can only be conducted when a high level of knowledge exists regarding annual catch estimates, separated by gear and species, operational catch and effort data, size distribution of the stock and general health of the stock and the ecosystem. This data is usually limited within Indonesian BSC fisheries and it is important that data collection processes are improved.

Despite referencing a 'sustainable approach' to fisheries resource management in its Development Plan, Indonesia has a poor record of implementation and enforcement and has been supporting expansion rather than following the precautionary approach to fisheries, the ecosystem approach to fisheries or improving stock sustainability. Regulations from 2004 cover development and resource use within Indonesian archipelagic waters and within the Exclusive Economic Zone (MMAF 2004b; MMAF 2004a). National regulations are established and to monitor the success/progress of these regulations, robust data collection is required. Important new national regulations were recently introduced related to BSC fisheries:

- Ministerial Regulation No.2/2015: Prohibition of trawls and seines in all of Indonesia's fishery management areas (MMAF 2015b)
- Ministerial Regulation No.1/2015: minimum landing sizes for crabs (10cm for BSC) and outlaw capture of berried females (MMAF 2015a)

Monitoring the progress and success of these regulations requires robust data collection activities. Fisheries management in Indonesia has developed into a decentralised system, whereby individual regions can introduce region-specific regulations. To coordinate management of the stocks at a national level, the government must have information from the different regions. Each region should have a number of data collection sites, providing sufficient sampling coverage to contribute to national management plans. Efforts should be made to coordinate and consolidate the data from each region. Taken together, the international obligations, the national regulations, the regional decentralisation and the market demand for sustainably-sourced seafood motivate the need for improved data collection systems in Indonesia. This need exists in both the commercial and artisanal fisheries as also in the various gear differentiated fisheries. This protocol focuses on data collection for BSC fisheries within Indonesia. The associated staff training protocol (available from the IMACS website) should be consulted for detailed information on the duties of field staff.

1.2. Objectives of this data collection protocol

This protocol has been commissioned by Masyarakat dan Perikanan Indonesia, MDPI, and the IMACS program under USAID. This protocol provides guidance and standard operating procedures (SOPs) for collecting data and monitoring the status of fisheries of BSC throughout Indonesia. The data collected through this protocol aims to provide decision makers and stakeholders with improved information about the status of the BSC stock. This protocol includes: Standard Operating Procedures for recording data on fishing ground, carapace width and sex and maturity level (Chapter 2), instructions for the data collection and analysis (Chapter 3) and the data collection forms.

This protocol has the following objectives:

- Ensure a set of standards are in place for the data collection process for BSC fisheries in Indonesia; that this data is collected in a uniform way, that transferability of this data is ensured and that it is done in a cost efficient method
- Allow fishery managers, government agencies, regional fishery management councils and private industry to have access to high quality data on BSC catches in Indonesia and to use this information improve Indonesian BSC management

In achieving the above objectives it is anticipated that the following primary objectives may also be achieved. These objectives address scientific, management and market related issues, for BSC in Indonesian waters:

- Improve existing knowledge within Indonesia and the wider scientific community on a small but important sector of the Indonesian marine capture.
- Use the improved knowledge to better understand stock dynamics, changes occurring due to environmental factors, such as climate change, and to adapt to these changing circumstances with appropriate management measures
- Ensure ecosystem and habitat functioning and resilience within BSC natural habitats
- Acquire additional information on the associated bycatch and make relevant decisions to minimize the indirect effects on these species/stocks
- Ensure that sustainable management practices are implemented to profile the stock correctly, ensuring catch advice adheres to sustainable and precautionary guidelines, progressing towards a sustainable BSC fishery in Indonesian waters
- Ensure that the management of BSC is appropriately matched to their stock structure and spawning areas
- Increase local government involvement in the data collection process by capacity building and creating data collection networks
- Ensure that the management process takes financial as well as food security matters into consideration when making decisions on catch allowances

- Transfer knowledge and background of the data collection process to various stakeholders involved in the BSC supply chain, with the aim of developing ownership and eventual acceptance within the community
- Support Indonesian BSC achieve management and sustainability levels required for eco-certification, enhancing its competitiveness in the global market
- Maximize/maintain profits from BSC fisheries while considering ecological limits

This protocol is designed to complement existing data collection efforts within Indonesia and provides instructions for data collection staff to help with data recording and entry, species identification, etc. This protocol is subject to change to incorporate recommendations from field staff when necessary.

1.3. Background to Blue Swimming Crab fisheries of Indonesia

The blue swimming crab, *Portunus pelagicus*, locally called '*rajungan*', inhabit sandy and muddy substrates in shallow waters throughout the Indo-West Pacific, where it forms the basis for small scale/subsistence blue swimming crab fisheries in Indonesia. The most important regions within Indonesia for this fishery are North Java, South Sulawesi, East Sumatra and Malacca Strait. There are no exact numbers but it is estimated that ~65,000 fishermen are involved in the crab capture and ~130,000 women are employed in the processing plants. The Indonesian BSC fishery developed rapidly during the 1990s to become an important source of income for coastal communities. Over the last decade, approximately 20,000mt per year of BSC is exported, primarily to the US market, which is now requesting that the product should originate from a well-managed, certified fishery. Since 2008, government and industry found that landings/productions and the average size of BSC is declining, which is a threat to the profitability and sustainability of the fishery. This trend is similar to the trend observed in Malaysia and Vietnam, where fisheries developed earlier and catches are now at very low levels because of overfishing.

The fishing grounds for BSC are close to the coast, with fishermen using small vessels, typically <10GT. Sometimes boats are not used and the crabs are handpicked. BSC are caught using collapsible traps, bottom gill nets, and previously caught using the now illegal shallow bottom trawls or as bycatch with mini-trawls (MMAF 2015b). The dimensions of the collapsible traps are 40cm x 30cm x 20cm, with a mesh size of 1 inch. These traps are known locally as '*bubu*'. One fisher can carry between 100-200 traps, with an average 150 traps

/fisher. Trap catches range between 2–10kg with an average of 4-5kg, but fishers sometimes experience zero catch. There can be between 10-18 crabs/kg. The traps are baited with a small piece of fish. Bait use in the BSC fishery is not sufficient to have an impact on associated species. The gill nets are mono filament, with nylon diameter of 0.35mm, ~100m in length and 70-80cm wide, and the mesh size between 3-5 inches. Each fisherman usually carries 5-15 sets of nets. Some fishermen use nets smaller mesh net of 2.5inches, and fish in coastal waters around the mangrove areas.

A group of processing companies organized themselves into an industry association in 2007, Asosiasi Pengelolaan Rajungan Indonesia, APRI, (www.apri.or.id) with the aim of promoting sustainable and environmentally-friendly fishing practices within Indonesia. Through APRI and in cooperation with the local/provincial government, it is possible to manage a large proportion of the fishing activity and effort through direct participation in the fishery. The Indonesian BSC fishery entered a Marine Stewardship Council pre-assessment in 2009, which concluded that the fishery should not progress to full assessment due to a lack of stock status data, insufficient information on the effects of the fishery on other species and the ecosystem and a lack of management. A Fishery Improvement Program, FIP, was established in 2008, with APRI taking responsibility of the FIP from 2013. This data collection protocol supports the progress of the BSC FIP towards eventual MSC certification. International experience shows that due to their high productivity and rapid growth rates, depleted BSC stocks can recover quickly by restoring and maintaining breeding-sized crabs in the stock. The biological characteristics of the BSC, the coherent organized nature of the industries, and its reliance on sustainability of export markets makes the BSC fishery strategic for beginning the process to develop models for the collaborative management of coastal fisheries.

1.4. I-Fish database system and Data Management Committees

Given the volume of data that can be collected to inform fisheries management, a database system has been developed to store the collected data and make it easily available to different types of stakeholders. This system, termed I-Fish (Indonesian Fisheries Information System), aims to inform fisheries management planning at district, provincial and national levels, and address the urgent need for an effective and flexible data management platform in Indonesia (Figure 1). I-Fish aims to align with national fisheries data standards, as well as with Marine Stewardship Council (MSC) requirements. In this way, I-Fish provides a transparent tool for data entry, storage and processing, fulfilling an essential need for fisheries under consideration for MSC certification. I-Fish is a comprehensive system for enabling the private sector to collect valid and verifiable data required by the government in order to manage fisheries sustainably. Involvement of the private sector— including fishers, traders, fishing companies, and exporters—provides near real-time data about the fishery, and assists governments to target resources where they are needed most.

To ensure I-Fish data transparency and promote collaboration amongst stakeholders, Data Management Committees, DMCs are established as co-management initiatives. DMCs focus on data from artisanal fisheries, such as BSC fisheries. The committee aims to achieve a complete representation of stakeholders to the fishery in the target area, and if necessary to support a rotational system of membership. The committees are an efficient way to coordinate data management between government officials, representatives of the fishing industry, and researchers. Through the DMCs it is expected that these stakeholders gain an informed and shared understanding about the status of the BSC stock in a local region.

The mission of the DMCs is to support and contribute to the collection and analysis of data relating to catch composition, fishing grounds and effort so as to identify specific patterns within the fishery. A summary of this data shall be published and disseminated to DMC members and stakeholders. Fishery targets can be suggested based on the shared use of the data, stakeholders can be informed of the implications of the data analysis and the information can be integrated into local management decisions. The tools and capacity to contribute to management of the fishery are then developed in the DMC members, who can help sustainably develop and manage the fishery.

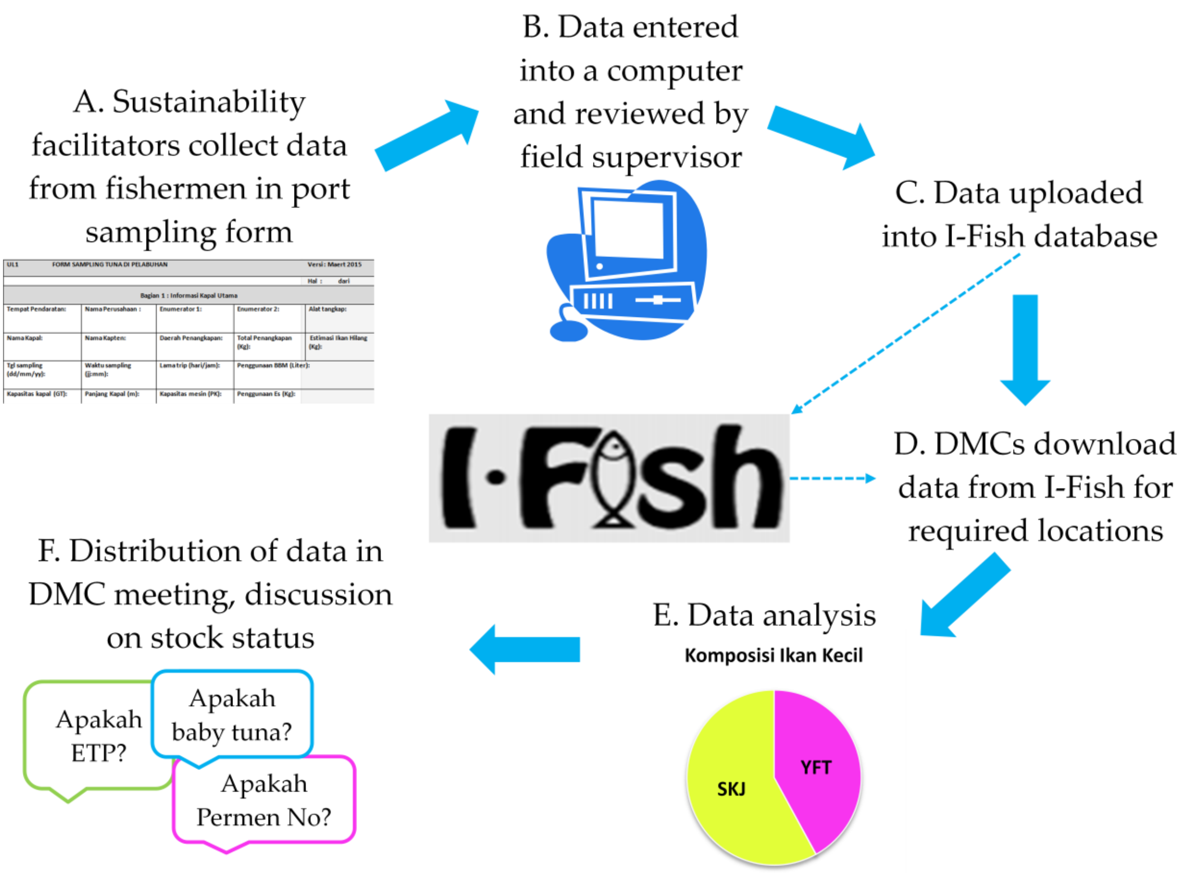

Figure 1. The data flow for the I-Fish approach. A. Sustainability facilitators collect the data from fishermen and suppliers, in both the port sampling form and the monthly unloading form. B. The data is entered in into a computer and verified by the field supervisor. C. Once the data has been verified it is uploaded into the I-Fish database where it can be accessed by stakeholders. D. Representatives of the Data Management Committees, DMCs, can access and download the data from I-Fish. E. Representatives of the DMCs can conduct data analysis and evaluation. F. The analyses data is presented and discussed at the DMC meetings by various stakeholders.

Chapter 2 – Standard Operating Procedures

This chapter covers seven Standard Operating Procedures, SOPs, which can support field staff in their data collection activities. These SOPs should be referred to in the first instance should there be any problem with data collection in the field. If the problem can not be resolved using the relevant SOP, the site supervisor/manager should be contacted. The solution to the problem should then be incorporated into the relevant SOP.

2.1. Standard Operating Procedure, SOP, I – Fishing Grounds

The fishing grounds are recorded as an area with a specific local name or the name of the closest distinguishing feature or coast. For example, in Sulawesi, fishing grounds are recorded as one from a list of recognised fishing grounds, such as ‘Kolono’, ‘Pamandati’, “Laeya’ or ‘Tondasi’. For each district where a blue swimming crab fishery exists, the local names of fishing grounds should be collected from the fishermen before the data collection activity begins. If a new fishing ground is used, the name of this ground should be included in the list.

2.2. Standard Operating Procedure, SOP, II – Species Identification

The main catch contains a variety of species and it is important Sustainability Facilitators recognize each species and that the correct species is recorded. Misidentification of species leads to invalid data. Sustainability Facilitators are responsible for ensuring all sampled fish are identified to species level. If there is doubt as to the identification of a fish the following steps should be taken:

- This protocol should be consulted and the "new" fish compared to the list below. If the fish is not on the list, the fishermen/transit staff/supplier should be consulted as to the identification of the fish. This may result in the fish being identified with a local name, which should be recorded and reported to the supervisor. The supervisor should ensure the new species is included in the list of species.
- If the fish cannot be identified a detailed description of external features of the fish should be recorded and a picture taken for reference. This should be forwarded to relevant supervisors/manager.

2.2.1. FAO Identification Codes

Each species is recorded with an FAO identification code (Table 1). This identifier code is used globally for species identification, making this information transferable to other organizations and interest groups. Using FAO codes will avoid confusion arising from the use of local names or the use of the same name for multiple similar species. English or local names should only be used as a last resort if there are problems with species identification.

Table 1. FAO identification codes, English names and local names of species.

FAO code	English name	Local name
SCD	Blue swimming crab	Rajungan
ODV	Long-eyed swimming crab	Kepiting mata Panjang
TLK	Wide front swimcrab	Kepiting batu
EFX	Sixbar grouper	Kerapu
ENI	Orange-spotted grouper	Kerapu lumpur
TEH	Large-scaled therapon	Kerong kerong
THQ	Flathead lobster	Udang kipas
RTY	Ribbontail stingray	Ikan pari

2.2.2. Species Descriptions

1. *Portunus pelagicus* / Blue Swimming Crab / Rajungan / SCD

Portunus pelagicus is a portunid crab, meaning that the fourth pair of legs are flattened into paddle-like structures and are used for swimming (Figure 2). The carapace of *Portunus pelagicus* is approximately twice as wide as it is long and has a rough surface with a granulose texture in places. The maximum carapace width is ~20cm but males of 14cm are more common. There are nine 'teeth' or spikes along the front margin of the carapace. The last tooth extends further than the others. Males are usually larger than females and are blue and white/grey in colour whereas females are a dull green. The abdominal flap of females is usually larger and more rounded than that of males and changes colour as she matures, from white to pale blue.

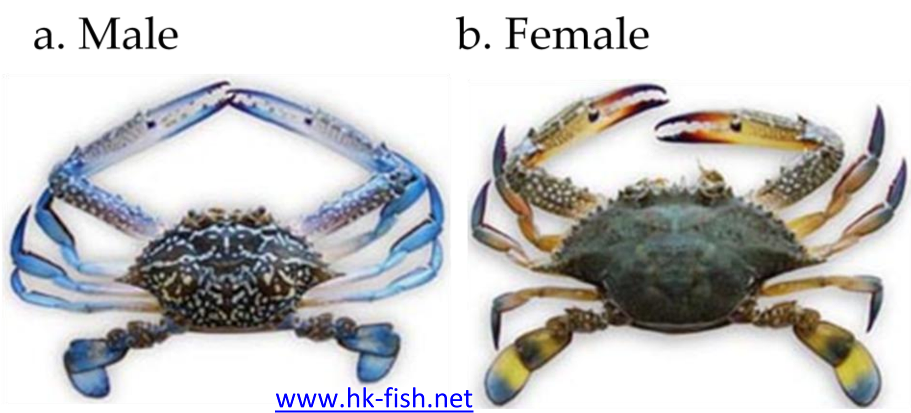

Figure 2. a. Male blue swimming crab and b. female blue swimming crab

Dominant species of bycatch in traps

2. *Podophthalmus vigil* / Long-eyed swimming crab / Kepiting mata panjang / ODV

Podopthalmus vigil is a swimming crab, with the fourth pair of legs flattened into paddle-like structures and used for swimming (Figure 3). There is one long tooth on the exterior margin of the carapace and the carapace width is greater than the carapace length. The carapace is brown/yellow in colour and the claws are red/brown in colour. This crab has noticeably long eye stalks, giving it the English name of 'Long-eyed swimming crab'. The right claw may be heavier and bigger than the left claw.

Figure 3. *Podopthalmus vigil* / Long-eyed swimming crab / Kepiting mata panjang / ODV

3. *Thalamita crenata* / Wide front swimming crab / Kepiting batu / TLK

This crab can grow to lengths of ~8cm. It is also a swimming crab, with the fourth pair of legs flattened into paddle-like structure for swimming (Figure 4). The carapace is smooth, with some low ridges present across the middle section. It is usually a dark green/olive green colour but there may be areas of blue near the claws. The claws are thicker and shorter than those of the blue swimming or long-eyed crab. There are five teeth along the front margin of the carapace, with the front teeth slightly larger than the last teeth.

Figure 4. *Thalamita crenata* / Wide front swimcrab / Kepiting batu / TLK

4. *Nemipterus* spp / Threadfin bream / Ikan Kurisi

There are a number of *Nemipteridae* species caught in the Western and Central Pacific Region. The threadfin bream family gets its name from the extended thin section of the upper caudal fin, which looks like a thread extending from the top of the tail. The length of this 'thread' varies depending between species. This family grows to maximum lengths of ~30cm.

5. *Epinephelus sexfasciatus* / Sixbar grouper / Kerapu / EFX

The sixbar grouper can grow to lengths of 40cm, but **only juveniles** are caught as bycatch in the BSC fishery. It is pale grey/brown in colour with six darker vertical bars along the flanks (Figure 5). Small, faint dark spots may be present on the body but are usually more prominent on the dorsal, caudal and anal fins, on a dusky grey background. The pelvic fins are dusky grey and the pectoral fins are more orange/red. It has a large head, which is sometimes pale red/brown on the ventral side and around the jaw.

Figure 5. *Epinephelus sexfasciatus* / Sixbar grouper / Kerapu / EFX

6. *Epinephelus coioides* / Orange-spotted grouper / Kerapu lumpur / ENI

This fish can grow to lengths of 120cm but **only juveniles** are caught as bycatch in the BSC fishery. The Goldspotted rockcod has a number of broken oblique bars across the body (Figure 6). These bars are dark grey/brown, and the rest of the body is pale grey/brown. The mouth is large, with the jaws slanting downwards towards the base of the gill cover. There are numerous noticeable gold/orange spots scattered across the whole body, giving it the common English name. These spots become more numerous and smaller as the fish grows. The fins are white/grey, with the orange spots also present on the anal, pelvic and anterior section of dorsal fins. The caudal, pectoral and posterior section of the dorsal fin are dark grey. The anterior section of the dorsal fin is spinous, the posterior section is rounded. The caudal, anal and pelvic fins are also rounded.

Figure 6. *Epinephelus coioides* / Orange-spotted grouper / Kerapu lumpur / ENI

7. *Terapon theraps* / Large-scaled therapon / Kerong kerong / TEH

This fish can grow to lengths of 30cm. It has an oval, compressed body shape (Figure 7). The dorsal side is light green/brown and the ventral side is white. There are four horizontal stripes extending along the body, which are brown in colour and extend along the caudal and second dorsal fin. There is a noticeable, large black blotch at the tip of the first dorsal fin and smaller dark blotch at the tip of the second dorsal fin and the tip of the upper fork of the caudal fin. The body and fins have an iridescent sheen.

Figure 7. *Terapon theraps* / Large-scaled therapon / Kerong kerong / TEH

Dominant species of bycatch in gill nets

1. *Taeniura lymma* / Ribbontail stingray / Ikan pari / RTY

This stingray can grow to lengths of 35cm. It is easily identified by the numerous large bright spots on the surface of the oval elongated disc (Figure 8). There are also two bright blue side-stripes along the tail. The dorsal side of the ray varies in colour from grey/brown to olive-green or red/brown and the ventral side is white. There are two sharp venomous spines at the tip of the tail. The snout is rounded, with the mouth located on the ventral side. The two eyes are large and slightly raised above the disc.

Figure 8. *Taeniura lymma* / Ribbontail stingray / Ikan pari / RTY

2. *Thenus orientalis* / Flathead lobster / Udang kipas / THQ

The anterior section of this lobster is strongly flattened (Figure 9), giving it the common English name of flathead lobster. The eyes are widely separated, located near the margin of the carapace. The body is red/brown in colour.

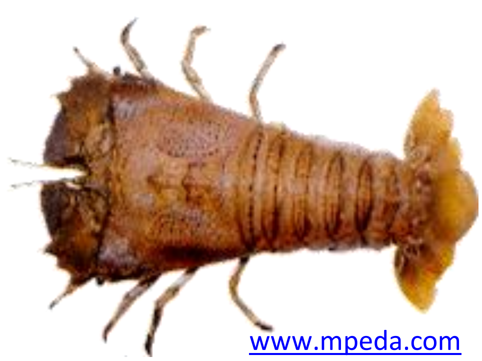

Figure 9. *Thenus orientalis* / Flathead lobster / Udang kipas / THQ

3. *Nemipteridae spp* / Threadfin breams / Ikan kurisi

There are a number of *Nemipteridae* species caught in the Western and Central Pacific Region. The threadfin bream family gets its name from the extended thin section of the upper caudal fin, which looks like a thread extending from the top of the tail. The length of this 'thread' varies depending between species. This family grows to maximum lengths of ~30cm.

4. *Caranx spp* / Trevaillies / Ikan kuwe

There are 18 species of the *Caranx* family. Species of the *Caranx* family can be large in size, often with a deep body and have characteristic gill raker, fin ray and dentition. The majority of the species grow to a maximum length of 50cm, with the giant trevally, *Caranx ignoblis*, growing to maximum lengths of 1.7m. The dorsal profile is curved, unlike the ventral profile. The caudal fin is strongly forked. The majority of *Caranx* species are silver/grey in colour, with shades of blue/green on the dorsal side. Some species have coloured spots on the flanks. The fins vary in colour from hyaline, to yellow, blue or black.

2.3. Standard Operating Procedure III – Sampling Design

A random sampling approach is used to sample individual crabs, where each individual in the catch has equal chance of being selected. This can be done by measuring a sample from the smallest to the largest individual, caught using non-selective gear. Random sampling can be performed directly in the mini plant. Crabs from multiple catches and landing sites are delivered to the mini plants. The crabs are sent to the mini plant alive or cooked, usually steamed. Live crabs are delivered daily or any day after fishing by fishermen or collectors. Crabs from distant sites are delivered every two or three days as cooked crabs for cost efficiency. Cooked crabs are delivered in ice boxes, either by motorbike or by boat. A maximum of 50 individual crabs are sampled from a mini-plant in a day. The crabs are randomly sampled from the catches of each fisherman delivering that day.

This method is useful for sampling large amounts of data in a cheap and efficient manner. The use of this protocol for data collection purposes will generate information for use in estimating the crab stock status. Estimation of Spawning Potential Ratio (SPR (Hordyk et al. 2015)) will be used in determining the status of crab stocks. This sampling method requires the length or width frequency of the brood stock found in the population. This method is useful as it does not have a high data demand.

2.4. Standard Operating Procedure IV – Carapace width measurements and weight

The carapace is the hard-shelled dorsal side of a crab. Width measurements of individual crabs are measured as carapace width. Carapace width is a measurement across the widest part of the dorsal side of the crab, recorded using a calipers (Figure 10). Carapace length measurements are not recorded with this protocol. The front of the calipers is placed at one side of the crab carapace and the movable section is extended to reach directly across to the opposite side. The carapace width is recorded to the nearest mm, i.e. a carapace width of 15.5cm is recorded as 155mm. In addition, the weight of individual crabs should be recorded, in grams to one decimal place, for example 15.2g. Carapace width measurements and weights of individual crabs are recorded in form BSC 01 (Appendix I). Data recording on size structure is conducted by gear type and fishing ground / location.

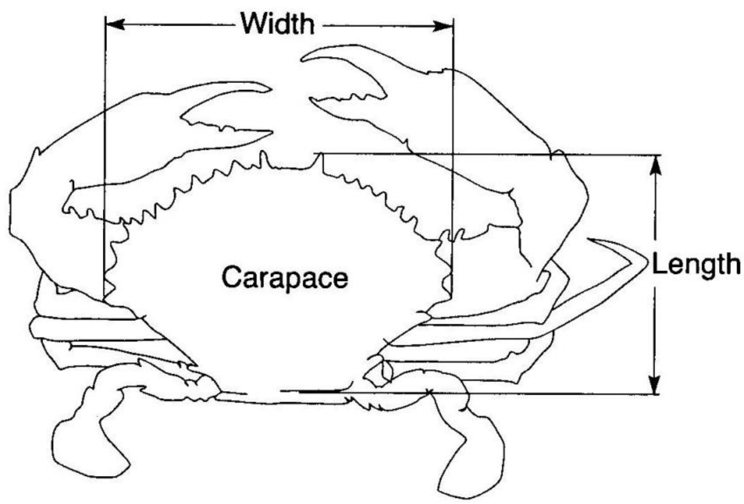

Figure 10. Standard carapace width and length measurements of individual crabs.

2.5. Standard Operating Procedure V – Sex and Maturity Level

The staff must distinguish between male and female crabs and, where possible, identify the maturity level of individuals. To identify the sex and the maturity level, look at the abdominal. Males will have a narrow triangular shaped abdominal flap whereas females will have a larger rounded abdominal flap, which may be a darker colour than the rest of the belly (Figure 11). Immature females should be assigned a maturity level '1', mature, non-berried females should be assigned a maturity level of '2'. Berried females, those with visible eggs in the abdominal flap, should be assigned a maturity level of '3'. The maturity levels should be recorded in form BSC 01 (Appendix I).

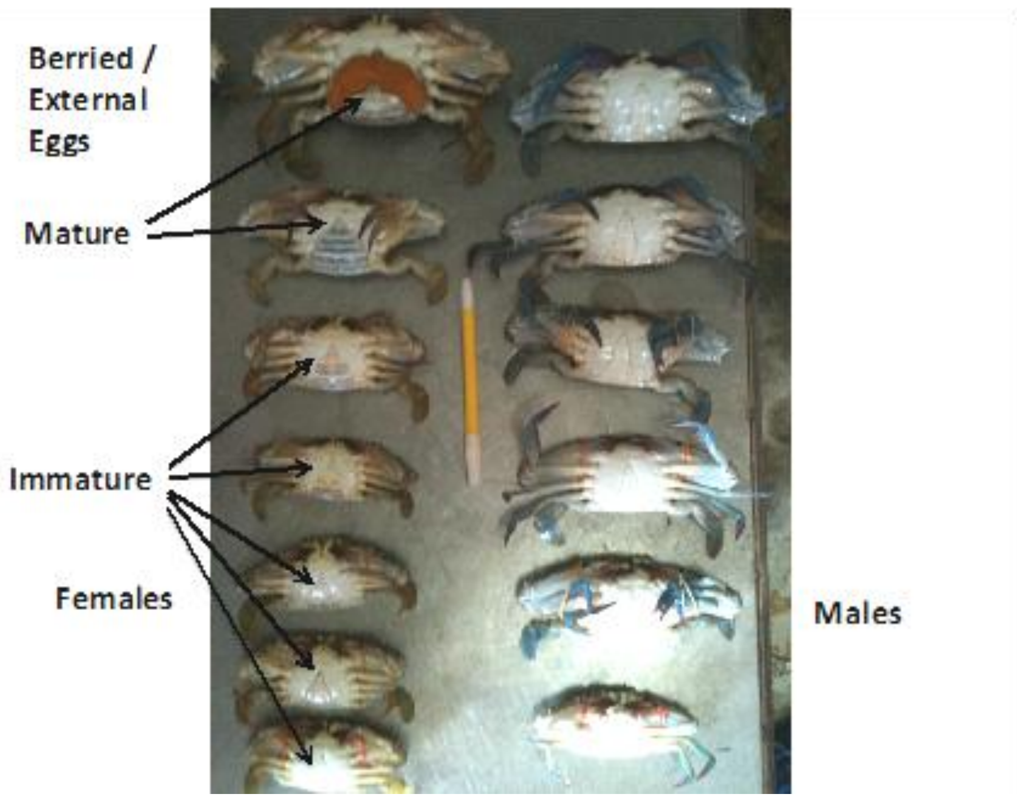

Figure 11. Distinguishing between male and female crabs and identifying the maturity level of female crabs (photo from previous BSC data collection protocol).

Chapter 3 – Data Collection Process

This chapter describes the data that is to be entered into each section of the BSC data collection forms. Enumerators should always be in possession of the following items when in the field:

- Laptop / netbook computer
- 1 x 20cm ruler or calipers
- Pencils
- Erasers
- Sharpeners
- Survey forms
- GPS to record fishing grounds

3.1. Form BSC 01 – Size structure of BSC in mini plants

This form is used to record information on the size structure of a sample of the crabs in the mini plants, i.e. the width, sex and maturity level of individual crabs. The following data should be recorded:

Tempat Pengolahan	-	Name of processing / mini plant
Nama Enumerator	-	Name of enumerator
Tanggal Pengurukan	-	Date of data collection
Daerah Penangkapan	-	Fishing grounds
Alat Tangkap	-	Gear type, gill net or trap
Lebar	-	Carapace width, in mm
Kelamin	-	Weight
TKG	-	Sex
	-	Sexual maturity level

3.2 Form BSC 02 – Daily production data collection

This form is used to collect data on the daily production of each supplier. The following should be recorded:

Tempat Pengolahan	-	Name of processing / mini plant
Nama Enumerator	-	Name of enumerator
Tgl. Pengukuran	-	Date of data collection
Nama supplier	-	Name of supplier
Jumlah Nelayan	-	Number of fishermen supplying to the named supplier
Daerah Tangkapan	-	Fishing grounds
Alat Tangkap	-	Gear types, gill net or traps
Rajungan	-	Total weight of crabs, in kg, and total number of individual crabs

3.3. Form BSC 03 – Fisherman profile

In collaboration with district DKP and the owner /supplier of vessels, the following vessel data should be recorded for each fisherman:

Tempat Pengolahan	-	Name of processing / mini plant
Nama supplier	-	Name of supplier
Nama enumerator	-	Name of enumerator
Nama Nelayan	-	Name of fisher
Tempat Pendaratan	-	Name of landing site
Kampung / Desa	-	Location (village, sub-district)
Alat Tangkap	-	Type and number of fishing gear
Ukuran Kapal	-	Size of boat: L x W x H, in metres
GT	-	Capacity, in PK or HP
Jumlah ABC	-	Crew: number of people
BBM Liter / Trip	-	Fuel, in litres

This process is conducted annually or whenever the details of an individual fisherman's vessel change.

3.4. Form BSC 04 – Daily catch fisher

This form is used to record the daily catch of each fisherman in a month. The following data should be recorded:

Tanggal	-	Day of the month
Nama Nelayan	-	Fisherman name
Daerah Tangkapan	-	Fishing ground
Alat Tangkap	-	Gear type, which gear and how many
Kondisi Cuaca	-	Weather conditions
Tangkapan Utama (Rajungan)	-	Main catch of BSC: number of individuals and total weight, in kg
Tangkapan Sampingan	-	Other catch: number of individuals and total weight, in kg, of each additional species caught

3.5. Data storage and analysis

All data collected in these forms will be checked by the site supervisor, who then enters the data into spreadsheets on a computer every day. Data are entered into spreadsheets on the same day that they are collected to ensure discrepancies or data errors can be addressed and corrected while the information is still fresh. The site supervisor will then upload the data to I-Fish every month.

Spawning potential ratios

Spawning potential ratios, SPR will be estimated from size structure and information on length at first maturity based on the collected data. Data analyses for the SPR method will be conducted or in collaboration with an SPR expert. The data that would be required to determine the typical SPR at a given size relationship for a species from a location are:

- Natural mortality (M)

- Growth (k, L_{∞}. t_0)
- Length of maturity (Lm_{50})
- Length-weight regression (a,b).

Length frequency distributions

Length frequency distributions can be calculated for defined subsets of data from within I-Fish, and disaggregated by species, vessel size, gear, WPP or fishing grounds, landing site, district, province, or time period. Proportional length frequency distributions are calculated from size (carapace width) from all mini plants sampled.

$$proportional\ frequency = 100\frac{n}{N}$$

Where:

n = number of crab in size class

N = total number of fish in sample

Appendix I – Size structure of BSC in mini plants (BSC 01)

Formulir - Sebaran Ukuran

BSC-01 | Hal : 1/2

Tempat Pengolahan		Nama Enumerator	
Tanggal Pengukuran		Daerah Penangkapan	
Alat Tangkap			

No	Lebar	Kelamin	TKG	No	Lebar	Kelamin	TKG	No	Lebar	Kelamin	TKG	No	Lebar	Kelamin	TKG
1				16				31				46			
2				17				32				47			
3				18				33				48			
4				19				34				49			
5				20				35				50			
6				21				36				51			
7				22				37				52			
8				23				38				53			
9				24				39				54			
10				25				40				55			

Appendix II – Daily production data collection form (BSC 02)

Formulir - Data Produksi Harian

BSC-02

Tempat Pengolahan		Nama Enumerator	
Tgl. Pengukuran			

No.	Nama Supplier	Jumlah Nelayan	Daerah Tangkapan	Alat Tangkap	Rajungan	
					Berat	Jumlah
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Appendix III – Fisherman profile (BSC 03)

Formulir - Profil Nelayan

BSC-03

Tempat pengolahan	Nama Supplier	Nama Enumerator

No	Nama Nelayan	Tempat Pendaratan	Kampung/Desa	Alat Tangkap		Ukuran Kapal (meter)			GT	Jumlah ABK	BBM Liter/Trip
				Jenis	Jumlah	P	L	T			
1											
2											
3											
4											
5											
6											
7											
8											
9											

Appendix IV – Daily catch of fisher (BSC 04)

Formulir - Data Tangkapan Bulanan

BSC-04

Tanggal	1	

No	Nelayan	Daerah Tangkapan	Alat Tangkap		Kondisi Cuaca	Tangkapan Utama (Rajungan)		Tangkapan Sampingan									
								Ikan Pari		Kurisi		Udang Kipas		Kepiting karang			
			Jenis	Jml		Jumlah	Berat	Jumlah	Berat	Jumlah	Berat	Jumlah	Berat	Jumlah	Berat	Jumlah	Berat
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

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