Red Swimming Crab (*Monomia haani*) Fishery Improvement Project (FIP) in Zhangzhou City, Fujian Province, China

(August 2023-April 2024, Phase VII)

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1. Introduction

The red swimming crab (*Monomia haani*, the Latin name used to be *Portunus haanii*) is one species of Family Portunidae and widely distributed in the Indo-Pacific. It is commonly found in the East and South China Seas (Dai et al., 1986). *M. haani* is characterized with a dark purple spot on the distal tips of the propodus of the fifth pereopod and the distal one-third of the dactylus of the fifth pereopod is colored dark purple (Windsor et al., 2019) (Fig. 1-1). *M. haani* lives in sandy and gravelly bottom within 100 m (Dai et al., 1986) and feeds on demersal fishes and crustaceans with Macrura and Brachyura species dominant (Huang, 2004).

Fig. 1-1. Red swimming crab *Monomia haani*.

The *M. haani* fishery has been important in Minnan fishing ground and Taiwan Bank fishing ground since the 1980s and has been one of the most productive crab

species in Fujian Province crustacean fisheries since the 1990s, and it can be caught year-round (Zhang, 1997). Catches of *M. haani* mainly come from bottom trawlers, baited crab traps, and gill nets. The estimated annual capture volume of *M. haanii* was 30,000-35,000 t in Minnan-Taiwan Bank fishing grounds in the 1990s, and the capture volume of *M. haani* contributed to 16-23% of the total capture volume in bottom trawl fishery (Zhang, 1997), and 30,000-40,000 t in 2009-2018, contributing to 60-70% of the annual crab catch in Fujian Province (Ocean Outcomes, 2018; OFBFJ, 2010-2018). Based on the results of this project (in previous progress reports in 2018-2022), the monthly CPUE and average size of *M. haani* have shown declines compared to the results in the 1990s (Zhang, 1997).

Dongshan County (Zhangzhou City, Fujian Province) is the most important area for *M. haani* process industry, contributing to approximate 80% and 65% of Fujian total volume (20,646 t) and value (48.34 million US dollars), respectively. Export products from Dongshan County are mainly as canned lump crab meat, frozen crab body, and frozen raw claw meat. The processed products of *M. haani* exported from Fujian Province included about 20 countries and areas, and USA, Hong Kong, Taiwan and South Korea were the main export destinations (Chinese Customs Datasets, 2008-2018).

In an effort to ensure the sustainability of *M. haani* fishery and process industry, the China Aquatic Products Processing and Marketing Alliance (CAPPMA), its local affiliate, the Zhangzhou Aquatic Products Processing and Marketing Alliance (ZAPPMA), the US based National Fisheries Institute (NFI) and Ocean Outcomes (O2) have launched together the fishery improvement project (FIP) since 2018 in Dongshan County.

In August-December 2018, Ocean Outcomes (O2) launched Phase I of the FIP. The project focused on understanding the trawl and trap fisheries of *M. haani* and the biology of *M. haani* in Dongshan County. The information of the trawl and trap catch volumes, main species and species group catch volumes, and species composition on the landing ports in Dongshan County was collected. Biology of *M. haani* and other three main crab species (*Portunus sanguinolentus*, *Charybdis natator* and *Calappa philargius*) were examined. However, the trap vessel surveys in Dongshan County were

not very successful because the low number of trap vessels surveyed at the landing ports. Another challenge was that the catches of trap vessels were mainly kept alive for higher price and traded at sea through the transfer vessels almost daily. Therefore, it was not possible to understand the total catch volume and species composition from the trap vessels.

In January-April 2019, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase II of the FIP. The project still focused on the trawl and trap fisheries of *M. haani* in Dongshan County, with an extension to nearshore one-day-trip trap fishery in Longhai County of Zhangzhou City. The information of the trawl and trap catch volumes, main species and species group catch volumes, and species composition on the landing ports in Dongshan County was collected. Biology of *M. haani* and other three main crab species (*P. sanguinolentus*, *C. natator* and *C. philargius*) were examined. In Fujian Province, Longhai County was the location for the pilot project on total allowance catch (TAC) led by Fujian Province Fishery Research Institute. Briefly, the trap fishery surveys were challenging in Dongshan County because the trap catches were mainly sold alive at sea and *M. haani* was mainly steamly processed at sea before landing. Therefore, it was not possible to understand the total catch volume and species composition from the trap vessels.

In August-December 2019, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase III of the FIP. The project continued our focus on the trawl and trap fisheries of *M. haani* in Dongshan County. Based the information collected in Phases I and II during the surveys and interviews, the trap fishery operation pattern in Dongshan County started to be clear. Trap vessel surveys for the *M. haani* fishery was finally completed for the first time in Dongshan County in Phase III. The catches from trap vessels were usually delivered by transfer vessels every 1-11 days (mean = 5.1, N = 51), so that the trap vessels could operate at sea longer (up to 30 days/trip).

In August-December 2020, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase IV of the FIP with a gap in January-April 2020. The project still focused on the *M. haani* trawl fishery in Dongshan County.

Moreover, we also paid attention on the domestic and international trade dynamics of *M. haani* in Dongshan County and Longhai County to evaluate the impacts of the trade war between China and USA, and the COVID-19 pandemic.

In January-April 2021, without financial support from Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS), the surveys on the *M. haani* trawl fishery in Dongshan County continued by Prof. Min Liu's lab in order to keep long term dataset available.

In October 2021-April 2022, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase V of the FIP. The project continued the study on the trawl fishery of *M. haani* in Dongshan County. The information on catch volumes, main species and species group volumes, and species composition was collected. Biology of *M. haani* and *P. sanguinolentus* were examined again after the completion of Phases I-III. In addition, the logbook data collections from bottom trawlers were conducted, including the capture volumes of *M. haani*, sea horses and endangered species, and latitude and longitude data for the fishing grounds.

In August 2022-April 2023, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase VI of the FIP. The project continued the focuses on the trawl fishery of *M. haani* in Dongshan County. The information on catch volumes, species composition, proportions of main economic species and "feed fishes" (See definition in Zhang & Liu, 2020) were collected. The biological study of two swimming crabs, *M. haani* and *P. sanguinolentus*, continued. The logbook data collection continued, including the capture volumes of *M. haani* and bycatch volumes of seahorses, with latitude and longitude recorded.

In August 2023-April 2024, Ocean Outcomes (O2) and Qingdao Marine Conservation Society (QMCS) launched Phase VII of the FIP. The project continued surveys on trawl fishery of *M. haani* in Dongshan County, and data on species composition, catch volumes and proportions of main economic species or species groups including crabs and "feed fishes" were collected. The biological study of *M. haani* and *P. sanguinolentus* continued. The logbook data of baited crab trap fishery were collected from three trap vessels for the first time in Dongshan County.

The specific objectives of Phase VII were assigned as follows:

(1) to document the species composition in catches from trawl fishery monthly at the landing ports, including those of the “feed fishes”;

(2) to estimate the total catch volumes and proportions of main taxonomic groups (including crabs) and feed fishes from trawl fishery monthly;

(3) to collect information on species composition and their catch volumes from trap vessels through their logbook monthly to understand the trap fishery;

(4) to determine the size classes, sex ratio, number of females carrying eggs and spawning peaks for *M. haanii* and *P. sanguinolentus* based on the random samples collected from landing port monthly; and

(5) to identify the major and minor secondary species based on catch volumes of various species collected in 2019-2023 surveys.

2. Materials and Methods

2.1 Survey periods for trawl vessels and trap vessels

Trawl surveys were conducted at two major landing ports (Gongqian and Tongling) monthly in August 2023-April 2024 in Dongshan County, Zhangzhou City, Fujian Province (Table 2-1; Fig. 2-1).

Logbooks from three baited trap vessels (N = 3) from Tongling District were collected in October 2023-April 2024. It was the first time the logbook data were collected from trap vessels in Dongshan County. The catch volume records included both fresh and alive. Only alive trade bills in August and September 2023 were kept by captains; no fresh trade volumes were available. Therefore, the catches in August and September 2023 were not included for analyses. The operation days in August and September 2023 were available.

Table 2-1. Landing port survey dates in Dongshan County.

No.	Dates	Items
1	August 20th-25th, 2023	Trawler survey and crab sample collection
2	September 13th-17th,2023	Trawler survey and crab sample collection
3	October 13st-18th, 2023	Trawler survey and crab sample collection
4	November 20th-24th, 2023	Trawler survey and crab sample collection
5	December 11th-15th, 2023	Trawler survey and crab sample collection
6	January 6nd-11th, 2024	Trawler survey and crab sample collection
7	February 20th-24th, 2024	Trawler survey and crab sample collection
8	March 15th-19th, 2024	Trawler survey and crab sample collection
9	April 8th-12th, 2024	Trawler survey and crab sample collection

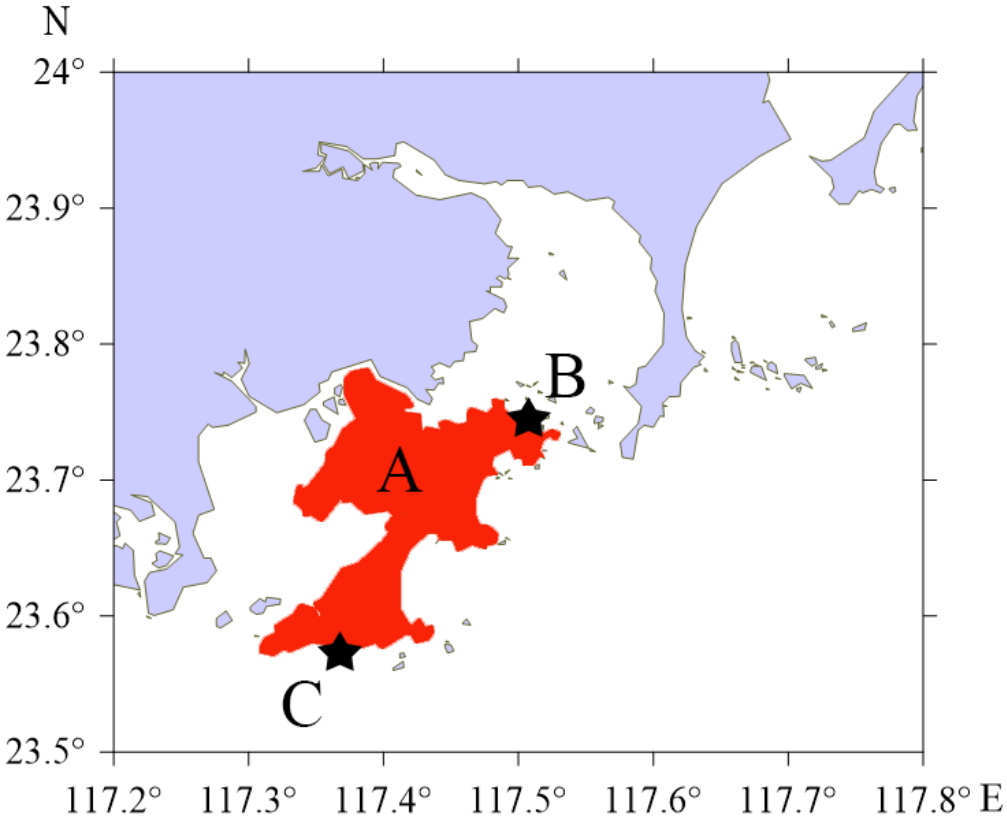

Fig. 2-1. Locations of the landing ports surveyed in Dongshan County (A).

B: Tongling Landing Port; C: Gongqian Landing Port.

2.2 Fishing vessel information collection

In Dongshan County, about 650 trawl vessels and 65 trap vessels are registered currently based on the records from Fishery Society of Dongshan County. The information was used for further estimation on the total annual capture volumes in Dongshan County.

In August 2023-April 2024, at least 10 trawl vessels were surveyed each month at the landing ports of Dongshan County (Fig. 2-1). For each trawl vessel surveyed, information on vessel registration number (including the number labbled on the buskets holding the catches), fishing areas, number of days at sea, number of tows per day, and hours per tow were collected.

Logbooks from three baited trap vessels were collected from October 2023 to April 2024. For each trap vessel surveyed, information on GPS locations were collected

whenever possible. The information on the number of days per month at sea, the number of traps per line, the number of trap lines towed per day, the baited volumes used per month, and the number of crews per vessel were noted to understand the operation mode of trap vessels.

2.3 Capture volume data collection

For each trawl vessel surveyed above, information on the total capture volume, crab capture volume including *M. haani* and *P. sanguinolentus*, capture volume of main species or species groups, and capture volume of feed fishes were estimated at the landing ports based on observation, estimation and interview. The capture per unit effort (CPUE) of each vessel was calculated.

For each trap vessel surveyed (N = 3), the trade bills with species or species group and volume were collected (Fig. 2-3). The capture per unit effort (CPUE) of each trap vessel was also calculated.

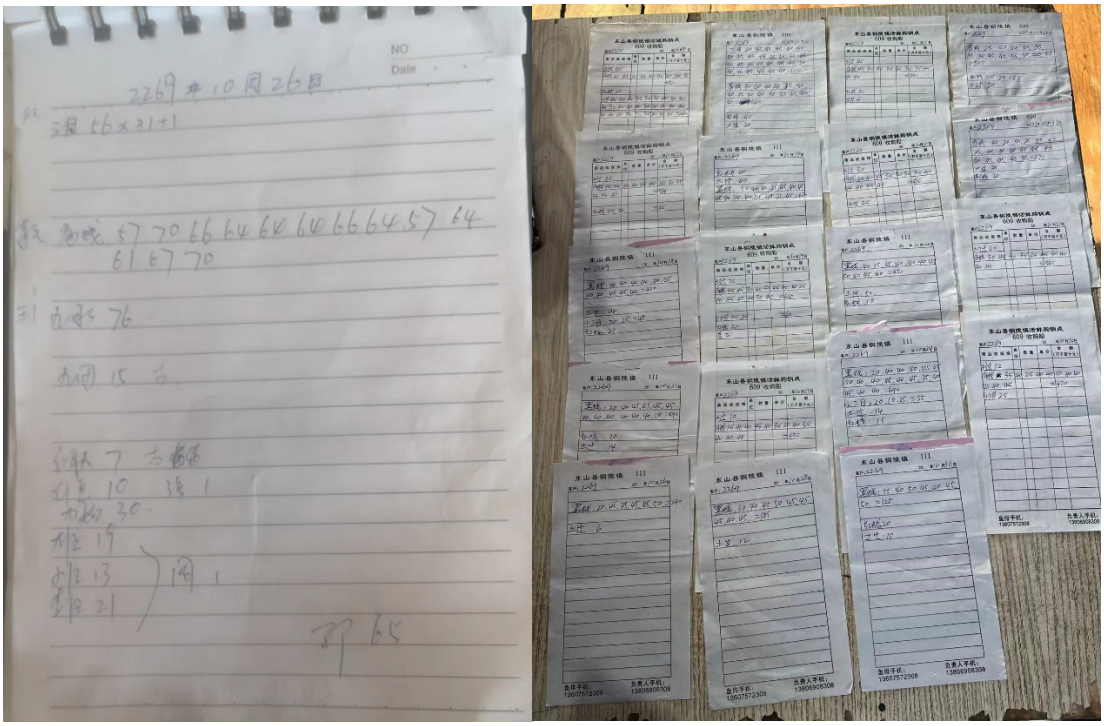

Fig. 2-3. Trade bills from the captains of trap vessels, both fresh (left) and alive (right) in Dongshan County.

2.4 Crab sampling

In Dongshan County, four crab species (*M. haani*, *P. sanguinolentus*, *Charybdis natator* and *Calappa philargius*) made up a great proportion of crab catches and were usually separated in catch landings in trawl fishery.

In August 2023-April 2024, *M. haani* and *P. sanguinolentus*, about one basket (about 20 kg) each species, were collected randomly and monthly for measurement and examination (Table 2-2) during trawl vessels surveys. Baskets are the uniform containers used to hold catches by local fishermen on board in Dongshan County. Small *M. haani* and *P. sanguinolentus* individuals were also mixed in feed fish samples; their size and sex data were also integrated into biological analyses for *M. haani* and *P. sanguinolentus*.

Table 2-2. Two crab species sampled.

No.	Photo	Species name
1		Red swimming carb *Monomia haani*
2		Three-spot swimming crab *Portunus sanguinolentus*

2.5 Feed fish sampling

At least 1 kg feed fishes were randomly collected monthly in August 2023-April 2024 from the trawl vessels surveyed for further species identification and size measurement.

2.6 Species identification

To understand the species diversity of trawl fishery catches in Dongshan County, common and commercially important species of fishes, crustacean and cephalopods were noted and photos were taken at the landing ports for taxonomic identification. If necessary, specimens were collected for further identification in the laboratory. For feed fishes, species were identified to species, genus or family levels in laboratory in terms of the size and reserve condition of the specimens.

Fish classification and identification was based on *Fishes of The World* (Nelson 2006), *Marine Fishes of Southern Fujian, China (Volume 1)* (Liu et al., 2013), *Marine Fishes of Southern Fujian, China (Volume 2)* (Liu et al., 2014), www.fishbase.org, and fishdb.sinica.edu.tw. In addition, DNA barcoding technique was applied for species identification if necessary.

Crustacean identification was based on *Marine Crabs of China* (Dai et al., 1986), *A Catalog of the Mantis Shrimps (Stomatopoda) of Taiwan* (Ahyong et al., 2008), and *Penaeidae Shrimps of the South China Sea* (Liu et al., 1988).

Cephalopod identification was based on *Fauna Sinica Vol. 4: Phylum Mollusca Class Cephalopode* (Dong, 1988), and *Cuttlefished and Squids of the World [New Edition]* (Takashi, 2015).

2.7 Sample measurement

For *M. haani* and *P. sanguinolentus*, the carapace size (cm) and body weight (BW, g) were measured individually in the laboratory. The carapace width (CW) was the straight-line distance between the two tips of the most lateral carapace spines, while the carapace length (CL) was the straight midline between the frontal notch and the

posterior margin of the carapace (Fig. 2-4).

Fig. 2-4. Crab size measurement.

CL: carapace length; CW: carapace width.

2.8 Crab sex determination

Crab sex was determined based on the morphology of abdomen (Fig. 2-5). The spawning season of crabs is determined by the high proportions of the female bearing eggs by month (Fig. 2-6). Gonads develop within the carapaces of female and male crabs. When ovaries mature, the eggs are released and attached to the belly of the females. The eggs are fertilized and develop until the larvae are released into the sea.

Fig. 2-5. Sex determination for crabs.

Fig. 2-6. A female crab bearing eggs.

3. Results

3.1 Number of trawl fishing vessels surveyed

A total of 107 trawl fishing vessels were surveyed at the landing ports of Dongshan County in August 2023-April 2024 (Table 3-1).

Table 3-1. Number of trawl fishing vessels surveyed in August 2023-April 2024 at the landing ports of Dongshan County.

Month	Number of vessels surveyed
August 2023	11
September 2023	13
October 2023	10
November 2023	12
December 2023	12
January 2024	12
February 2024	12
March 2024	14
April 2024	11
Total	107

3.2 Species diversity from trawl and trap fishery

3.2.1 Species composition

A total of 505 species (at species, genus or family level) were identified from trawl fishery catches from August 2018 to April 2024 (in Phases I-VII), including 393 fishes (77.8%), 89 crustaceans (17.6%) and 23 cephalopods (4.6%) (Table 3-2). Fishes came from 23 orders and 107 families, with almost half of the species from the order Perciformes. Crustaceans came from 2 orders and 23 families, and cephalopods came from 3 orders and 4 families. Among 505 species, 76 species were found in both food and feed fishes, including 56 fishes, 11 crustaceans and 9 cephalopods; 181 species were only found in feed fishes, including 123 fishes, 52 crustaceans and 6 cephalopods.

Table 3-2. Species recorded (N = 505) in trawl fishery in August 2018-April 2024 (Phase I-VII) at landing ports of Dongshan County.

([#]: species found in both food and feed fish samples; [*]: species only found in feed fish samples; CR, critically endangered; EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern; NE, not evaluated; DD, data deficient)

Order	**Family**	**No. of species**	**Common name**	**Species name**	**IUCN threatened category**
Fish (N = 393)					
Orectolobiformes	Rhinocodontidae	1	Whale shark	*Rhincodon typus*	EN
	Hemiscylliidae	2	Whitespotted bambooshark	*Chilsoscyllium plagiosum*	NT
Carcharhiniformes	Lamnidae	3	Great white shark	*Carcharodon carcharias*	VU
	Carcharhinidae	4	Pacific spadenose shark	*Scoliodon macrorhynchos*	NT
		5	Cocktail shark	*Carcharhinus brevipinna*	VU
		6	Hardnose shark	*Carcharhinus macloti*	NT
		7	Blacktip reef shark	*Carcharhinus melanopterus*	VU
		8	Bull shark	*Carcharhinus leucas*	VU
		9	Blacktip shark	*Carcharhinus limbatus*	VU
		10	Spot-tail shark	*Carcharhinus sorrah*	NT
		11	Tiger shark	*Galeocerdo cuvier*	NT
	Shpyrnidae	12	Scalloped hammerhead	*Sphyrna lewini*	CR
	Scyliorhinidae	13	Blotchy swell shark	**Cephaloscyllium umbratile*	NT
		14	Blackspotted catshark	*Halaelurus buergeri*	EN
	Triakidae	15	Spotless smooth-hound	*Mustelus griseus*	EN
Torpediniformes	Narcinidae	16	Chinese numbfish	*Narcine lingula*	VU

		17	Shortlip electric ray	*Narcine maculata*	VU
Rajiformes	Rhynchobatidae	18	Taiwanese wedgefish	*Rhynchobatus immaculatus*	CR
		19	Bottlenose wedgefish	*Rhynchobatus australiae*	CR
	Rhinobatidae	20	Angel fish	*Rhinobatos hynnicephalus*	EN
		21	Brown guitarfish	*Rhinobatos schlegelii*	CR
		22	Smalleyed guitarfish	*Rhinobatos microphthalmus*	NE
	Rajidae	23	Boeseman's skate	*Okamejei boesemani*	VU
Myliobatiformes	Platyrhinidae	24	Yellow-spotted fanray	*#Platyrhina tangi*	VU
		25	Chinese fanray	*Platyrhina sinensis*	EN
	Dasyatidae	26	Honeycomb stingray	*Himantura uarnak*	EN
		27	Stingray	*Maculabatis macrura*	EN
		28	Sepia stingray	*Urolophus aurantiacus*	VU
		29	Red stingray	*Dasyatis akajei*	NT
		30	Pale-edged stingray	*Telatrygon zugei*	VU
		31	Blue-spotted stingray	*Neotrygon kuhlii*	DD
		32	Round ribbontail ray	*Taeniurops meyeni*	VU
		33	Japanese butterflyray	*Gymnura japonica*	VU
	Myliobatidae	34	Longheaded eagle ray	*Aetobatus flagellum*	EN
		35	Whitespotted eagle ray	*Aetobatus narinari*	EN
	Mobulidae	36	Chilean devil ray	*Mobula tarapacana*	EN
Anguilliformes	Muraenidae	37	Netted moray	*#Gymnothrax reticularis*	LC
		38	Sieve-patterned moray	*Gymnothorax cribroris*	LC
		39	Reeves's moray	*Gymnothorax reevesii*	LC
		40	Laced moray	*Gymnothorax favagineus*	LC

		41	Snowflake-patched moray	*Gymnothorax niphostigmus*	LC
		42	Liver-colored moray eel	*Gymnothorax hepaticus*	LC
		43	Yellow-edged moray	*Gymnothorax flavimarginatus*	LC
		44	Whitemargin moray	*Gymnothorax albimarginatus*	LC
		45	Australian mottled moray	*Gymnothorax prionodon*	LC
		46	Moray	*Gymnothorax* sp.	
		47	Slender giant moray	*Strophidon sathete*	LC
		48	Moray	*Strophidon* sp.	
	Ophichthidae	49	Finny snake eel	**Caecula pterygera*	DD
		50	Longtailed sand-eel	**Bascanichthys kirki*	LC
		51	Snake eel	**Ophichthus urolophus*	LC
		52	Sharpsnout snake eel	**Apterichtus klazingai*	LC
		53	Longfin snake-eel	#*Pisodonophis cancrivorus*	LC
		54	Rice-paddy eel	#*Pisodonophis boro*	LC
		55	Black ridge-fin eel	#*Callechelys kuro*	DD
		56	Chinese eel	**Cirrhimuraena chinensis*	LC
		57	Snake eel	*Xyrias chioui*	DD
		58	Orange blotched eel	**Apterichtus hatookai*	DD
		59	Stargazer snake eel	*Brachysomophis cirrocheilos*	LC
		60	Vulture sand eel	**Ichthyapus vulturis*	LC
		61	Snake eel	*Ophichthidae sp.	
	Muraenesocidae	62	Daggertooth pike conger	#*Muraenesox cinereus*	LC
		63	Shorttail pike conger	#*Oxyconger leptognathus*	LC
	Congridae	64	Conger	*Gnathophis heterognathos*	LC

		65	Conger	**Gnathophis nystromi*	NE
		66	Eel	*#Ariosoma meeki*	LC
		67	Eel	**Ariosoma megalops*	
		68	Eel	*#Ariosoma* sp.	
		69	Slender conger	*#Uroconger lepturus*	LC
		70	Beach conger	*Conger japonicus*	NE
		71	Whitespotted conger	*Conger myriaster*	LC
		72	Eel	*Congridae sp.	
	Nettastomatidae	73	Duckbill eel	**Saurenchelys fierasfer*	LC
Clupeiformes	Clupeidae	74	Round sardinella	**Sardinella aurita*	LC
		75	Bali sardinella	*Sardinella lemuru*	NT
		76	Japanese sardinella	*Sardinella zunasi*	LC
		77	Bloch's gizzard shad	*Nematalosa nasus*	LC
	Engraulidae	78	Commerson's anchovy	**Stolephorus commersonnii*	LC
		79	Japanese anchovy	**Engraulis japonicus*	LC
		80	Kammal thryssa	**Thryssa kammalensis*	DD
		81	Moustached thryssa	*Thryssa mystax*	LC
		82	Orangemouth anchovy	*Thryssa vitrirostris*	LC
		83	Hamilton's thryssa	*Thryssa hamiltonii*	LC
		84	Dussumier's thryssa	**Thryssa dussumieri*	LC
		85	Common hairfin anchovy	**Setipinna tenuifilis*	DD
	Prisigasteridae	86	Elongate ilisha	*Ilisha elongata*	LC
		87	Buccaneer anchovy	**Encrasicholina punctifer*	LC
Gonorhynchiformes	Gonoruchidae	88	beaked salmon	**Gonorynchus abbreviatus*	NE

Siluriformes	Plotosidae	89	Striped eel catfish	*Plotosus lineatus*	NE
	Ariidae	90	Threadfin sea catfish	*Arius arius*	LC
		91	Spotted catfish	*Arius maculatus*	NE
Aulopiformes	Synodontidae	92	Snakefish	*#Trachinocephalus myops*	LC
		93	Lizardfish	*#Synodus fuscus*	LC
		94	Taiwan lizardfish	**Synodus taiwanensis*	NE
		95	Blackear lizardfish	**Synodus hoshinonis*	LC
		96	Lizardfish	**Synodus* sp.	
		97	Bombay-duck	*Harpadon nehereus*	NT
		98	Slender lizardfish	*#Saurida elongata*	LC
		99	Greater lizardfish	*#Saurida tumbil*	LC
		100	Brushtooth lizardfish	*#Saurida undosquamis*	LC
Myctophiformes	Myctophidae	101	Skinnycheek lanternfish	* *Benthosema pterotum*	LC
Lophiiformes	Lophiidae	102	Blackmouth angler	*Lophiomus setigerus*	LC
	Antennariidae	103	Striated frogfish	**Antennarius striatus*	LC
Gadiformes	Bregmacerotidae	104	False lance codlet	**Bregmaceros pseudolanceolatus*	NE
		105	Codlet	**Bregmaceros* sp.	
Ophidiiformes	Ophidiidae	106	Asiro brotula	**Ophidion muraenolepis*	LC
		107	Yellow pigmy brotula	**Dinematichthys iluocoeteoides*	LC
		108	Goatsbeard brotula	*Brotula multibarbata*	LC
Mugiliformes	Mugilidae	109	Mullet	*Planiliza affinis*	NE
		110	Flathead grey mullet	*Mugil cephalus*	LC
		111	Fringelip mullet	**Crenimugil crenilabis*	LC
		112	Longarm mullet	*Moolgarda cunnesius*	NE

		113	Mullet	*Mugilidae sp.	
Beloniformes	Hemiramphidae	114	Garfish	*Hyporhamphus* sp.	
	Monocentridae	115	Pineconefish	*Monocentris japonica*	LC
Beryciformes	Holocentridae	116	Redcoat	**Sargocentron rubrum*	LC
Zeiformes	Zeidae	117	Cape dory	**Zeus capensis*	LC
Syngnathiformes	Syngnathidae	118	Longnose seahorse	#*Hippocampus trimaculatus*	VU
		119	Great seahorse	*Hippocampus kelloggi*	VU
		120	Japanese seahorse	*Hippocampus mohnikei*	VU
		121	Hedgehog seahorse	*Hippocampus spinosissimus*	VU
		122	Rough pipefish	#*Trachyrhamphus serratus*	DD
		123	Gray's pipefish	*Halicampus grayi*	LC
		124	Hardwicke's pipefish	*Solegnathus hardwickii*	DD
		125	Pipefish	Syngnathidae sp.	
	Pegasidae	126	Sea moth	**Pegasus laternarius*	DD
	Fistularidae	127	Red cornetfish	#*Fistularia petimba*	LC
		128	Bluespotted cornetfish	*Fistularia commersonii*	LC
Scorpaeniformes	Scorpaenidae	129	Lionfish	*Pterois volitans*	LC
		130	Turkeyfish	*Pterois paucispinula*	LC
		131	Ocellated waspfish	**Apistus carinatus*	LC
		132	Butterfly scorpionfish	*Dendrochirus bellus*	LC
		133	Blackfoot Lionfish	*Parapterois heterura*	LC
		134	False kelpfish	#*Sebastiscus marmoratus*	NE
		135	Yellowfin scorpionfish	*Scorpaenopsis neglecta*	LC
		136	Flasher scorpionfish	*Scorpaenopsis macrochir*	LC

		137	Weedy stingfish	*Scorpaenopsis cirrosa*	NE
		138	Scorpionfish	*#Scorpaena miostoma*	NE
		139	Korean rockfish	*Sebastes schlegelii*	NE
		140	Dwarf stingfish	**Minous pusillus*	NE
		141	Grey stingfish	**Minous monodactylus*	LC
	Aploactinidae	142	Dusky velvetfish	**Aploactis aspera*	NE
	Triglidae	143	Oriental flying gurnard	*Dactyloptena orientalis*	LC
		144	Spiny red gurnard	*#Chelidonichthys spinosus*	LC
		145	Redwing searobin	**Lepidotrigla microptera*	NE
		146	Forksnout searobin	**Lepidotrigla alata*	NE
		147	Searobin	**Lepidotrigla japonica*	NE
	Platycephalidae	148	Midget flathead	**Onigocia spinosa*	LC
		149	Rough flathead	*Grammoplites scaber*	NE
		150	Tuberculated flathead	**Sorsogona tuberculata*	LC
		151	Bartail flathead	*Platycephalus indicus*	DD
		152	Olive-tailed flathead	**Rogadius asper*	LC
		153	Celebes flathead	**Thysanophrys celebica*	LC
		154	Large-spined flathead	**Suggrundus macracanthus*	LC
		155	Japanese flathead	**Inegocia japonica*	LC
		156	Spotted flathead	**Inegocia guttata*	NE
		157	Crocodile flathead	*Cociella crocodila*	LC
		158	Flathead	*Platycephalidae sp.	
Perciformes	Moronidae	159	Japanese seabass	*Lateolabrax japonicus*	NE
	Serranidae	160	Barred soapfish	*Diploprion bifasciatum*	LC

	Acropomatidae	161	Glowbelly	**Acropoma japonicum*	NE
	Epinephelidae	162	Orange-spotted grouper	*Epinephelus coioides*	LC
		163	Yellow grouper	*Epinephelus awoara*	DD
		164	Duskytail grouper	*Epinephelus bleekeri*	DD
		165	Longfin grouper	*Epinephelus quoyanus*	LC
		166	Hong Kong grouper	*Epinephelus akaara*	EN
		167	Areolate grouper	*Epinephelus areolatus*	LC
		168	Longtooth grouper	*Epinephelus bruneus*	VU
		169	Striped grouper	*Epinephelus latifasciatus*	LC
		170	Chocolate hind	*Cephalopholis boenak*	LC
		171	Tomato hind	*Cephalopholis sonnerati*	LC
		172	Oval grouper	*Triso dermopterus*	LC
	Pricanthidae	173	Red bigeye	*#Priacanthus macracanthus*	LC
		174	Purple-spotted bigeye	*#Priacanthus tayenus*	LC
		175	Japanese bigeye	*Pristigenys niphonia*	LC
	Apogonidae	176	Rifle cardinal	**Ostorhinchus kiensis*	LC
		177	Half-lined cardinal	**Ostorhinchus semilineatus*	DD
		178	Broadbanded cardinalfish	*#Ostorhinchus fasciatus*	NE
		179	Cardinalfish	**Apogonichthyoides niger*	LC
		180	Cardinalfish	**Apogonichthyoides cathetogramma*	LC
		181	Flagfin cardinalfish	**Jaydia truncata*	NE
		182	Indian perch	**Jaydia lineata*	LC
		183	Ocellate cardinalfish	**Jaydia carinatus*	
	Sillaginidae	184	Japanese sillago	*Sillago japonica*	LC

		185	Bay sillago	*#Sillago ingenuua*	NE
	Coryphaenidae	186	Common dolphinfish	*Coryphaena hippurus*	LC
	Rachycentridae	187	Cobia	*Rachycentron canadum*	LC
	Echeneidae	188	Shark sucker	*Remora remora*	LC
	Carangidae	189	African pompano	*Alectis ciliaris*	LC
		190	Bigeye scad	*Selar crmenophthalmus*	LC
		191	Torpedo scad	*Megalaspis cordyla*	LC
		192	Yellowstripe scad	*#Selaroides leptolepis*	LC
		193	Black pomfret	*Parastromateus niger*	LC
		194	Whitefin trevally	**Carangoides equula*	LC
		195	Razorbelly scad	*Alepes kleinii*	LC
		196	Japanese scad	*#Decapterus maruadsi*	LC
		197	Shortfin scad	*Decapterus macrosoma*	LC
		198	Japanese jack mackerel	*#Trachurus japonicus*	NT
		199	Snubnose pompano	*Trachinotus blochii*	LC
		200	Needlescaled queenfish	*Scomberoides tol*	LC
		201	Yellowtail amberjack	*Seriola dumerili*	LC
		202	Yellowtail amberjack	*Seriola aureovittata*	LC
		203	Blackbanded trevally	*Seriolina nigrofasciata*	LC
	Menidae	204	Moonfish	*Mene maculata*	NE
	Leiognathidae	205	Deep pugnose ponyfish	**Secutor ruconius*	NE
		206	Ponyfish	**Equulites rivulatus*	NE
		207	Scrawled ponyfish	**Leiognathus berbis*	NE
		208	Orangefin ponyfish	**Photopectoralis bindus*	NE

	Lutjanidae	209	Crimson snapper	*Lutjanus erythopterus*	LC
		210	Russell's snapper	*Lutjanus russellii*	LC
		211	Mangrove red snapper	*Lutjanus argentimaculatus*	LC
		212	Brownstripe red snapper	*Lutjanus vitta*	LC
		213	Spotstripe snapper	*Lutjanus ophuysenii*	NE
	Gerreidae	214	Whipfin silver-biddy	*Gerres filamentosus*	LC
		215	Longspine silverbiddy	*Gerres macracanthus*	NE
	Haemulidae	216	Broadbanded velvetchin	*Hapalogenys analis*	NE
		217	Black grunt	*Hapalogenys nigripinnis*	NE
		218	Trout sweetlips	*Plectorhinchus pictus*	LC
		219	Crescent sweetlips	*Plectorhinchus cinctus*	LC
		220	Chicken grunt	*Parapristipoma trilineatum*	NE
	Nemipteridae	221	Whitecheek monocle bream	**Scolopsis vosmeri*	LC
		222	Unarmed dwarf monocle bream	*Parascolopsis inermis*	LC
		223	Golden threadfin bream	*Nemipterus virgatus*	VU
		224	Yellowbelly threadfin bream	**Nemipterus bathybius*	LC
		225	Japanese threadfin bream	*#Nemipterus japonicus*	LC
	Lethrinidae	226	Pacific yellowtail emperor	*Lethrinus atkinsoni*	LC
		227	Spangled emperor	*Lethrinus nebulosus*	LC
	Sparidae	228	Yellowfin seabream	*Acanthopagrus latus*	DD
		229	Blackhead seabream	*Acaanthopagrus schelegeli*	LC
		230	Red seabream	*Pagrus major*	LC
		231	Goldlined seabream	*Rhabdosargus sarba*	LC
		232	Threadfin porgy	*#Evynnis cardinalis*	EN

	Polynemidae	233	Fourfinger threadfin	*Eleutheronema tetradactylum*	NE
		234	Sixfinger threadfin	*#Polydactylus sextarius*	NE
	Sciaenidae	235	Reeve's croaker	*Chrysochir aureus*	LC
		236	Blackspotted croaker	*Protonibea diacanthus*	NT
		237	Croaker	**Johnius distinctus*	LC
		238	Trewavas croaker	*#Johnius trewavasae*	LC
		239	Croaker	*Johnius taiwanensis*	LC
		240	Belanger's croaker	*Johnius belangerii*	LC
		241	Croaker	**Johnius* sp.1	
		242	Croaker	**Johnius* sp.2	
		243	Large yellow croaker	*Larimichthys crocea*	CR
		244	Yellow drum	*Nibea albiflora*	LC
		245	Big-head pennah croaker	*#Pennahia macrocephalus*	LC
		246	Truncate-tail croaker	*#Pennahia anea*	LC
		247	Silver croaker	*#Pennahia argentata*	LC
		248	Pawak croaker	**Pennahia pawak*	LC
		249	Japanese meagre	*Argyrosomus japonicus*	EN
		250	Mi-iuy croaker	*Miichthys miiuy*	DD
		251	Croaker	*Sciaenidae sp.	
	Glaucosomatidae	252	West Australian dhufish	*Glaucosoma hebraicum*	NE
	Mullidae	253	Japanese goatfish	*#Upeneus japonicus*	NE
		254	Pointed goatfish	*Parupeneus biaculeatus*	NE
		255	Whitesaddle goatfish	*Parupeneus ciliatus*	LC
		256	Blackspot goatfish	*Parupeneus spilurus*	LC

		257	Yellow striped goatfish	*Parupeneus chrysopleuron*	LC
		258	Yellowstripe goatfish	*Mulloidichthys flavolineatus*	LC
	Kyphosidae	259	Stripey	*Microcanthus strigatus*	LC
	Drepaneidae	260	Spotted sicklefish	**Drepane punctata*	LC
	Terapontidae	261	Jarbua terapon	**Terapon jarbua*	LC
		262	Fourlined terapon	**Pelates quadrilineatus*	NE
	Oplegnathidae	263	Spotted knifejaw	**Oplegnathus punctatus*	NE
	Chaetodontidae	264	Goldengirdled coralfish	*Coradion chrysozonus*	LC
		265	Triple-banded butterflyfish	#*Roa modestus*	LC
		266	Pennant coralfish	*Heniochus acuminatus*	LC
	Pomacanthidae	267	Bluestriped angelfish	*Chaetodontoplus septentrionalis*	LC
	Oplegnathidae	268	Barred knifejaw	*Oplegnathus fasciatus*	NE
	Pomacentridae	269	Jordan's damsel	#*Teixeirichthys jordani*	LC
		270	Bengal sergeant	*Abudefduf bengalensis*	LC
		271	Ternate chromis	**Chromis ternatensis*	LC
		272	Damselfish	**Pomacentrus* sp.1	
		273	Damselfish	**Pomacentrus* sp.2	
	Cepolidae	274	Bandfish	*Acanthocepola indica*	NE
	Labridae	275	Scarbreast tuskfin	*Choerodon azurio*	DD
		276	Multicolorfin rainbowfish	*Parajulis poecilepterus*	LC
		277	Slender wrasse	**Suezichthys gracilis*	LC
		278	Rosed razorfish	*Iniistius verrens*	LC
		279	Blackspot razorfish	*Iniistius dea*	LC
		280	Redblotch razorfish	*Xyrichtys twistii*	LC

		281	Masuda's hogfish	*Bodianus masudai*	LC
		282	Blackstripe wrasse	*Coris musume*	LC
		283	Red naped wrasse	*Pseudolabrus eoethinus*	LC
	Scaridae	284	Blue-barred parrotfish	*Scarus ghobban*	LC
	Champsodontidae	285	Günther's gaper	**Champsodon guentheri*	NE
	Pinguipedidae	286	Harlequin sandsmelt	#*Parapercis pulchella*	LC
		287	Sandperch	**Parapercis ommatura*	NE
		288	Grub fish	*Parapercis sexfasciata*	NE
	Callionymidae	289	Dragonet	#*Callionymus huguenini*	NE
		290	Japanese longtail dragonet	*Calliurichthys japonicus*	LC
		291	Japanese filamentous dragonet	*Callionymus doryssus*	NE
		292	Dragonet	#*Callionymus planus*	NE
		293	Horn dragonet	**Callionymus curvicornis*	NE
		294	Izu ruddertail dragonet	*Callionymus curvispinis*	NE
		295	Dragonet	**Callionymus* sp.	
		296	Izu dragonet	*Calliurichthys izuensis*	NE
		297	Kai Island deepwater dragonet	*Bathycallionymus kaianus*	NE
	Percophidae	298	Duckbill	*Acanthaphritis barbata*	NE
		299	Duckbill	*Percophidae sp.	
	Trichonotidae	300	Black-spot sand-diver	#*Trichonotus filamentosus*	LC
		301	Spotted sand-diver	#*Trichonotus setiger*	LC
	Ammodytidae	302	Sand lance	#*Bleekeria viridianguilla*	NE
		303	Sand lance	#*Bleekria mitsukurii*	NE
	Uranoscopidae	304	Naked-nape stargazer	*Uranoscopus oligolepis*	LC

		305	Chinese stargazer	**Uranoscopus bicinctus*	NE
		306	Japanese stargazer	*#Uranoscopus japonicus*	LC
		307	Chinese stargazer	**Uranoscopus chinensis*	NE
		308	Longnosed stargazer	**Ichthyscopus lebeck*	NE
		309	Oriental fringe stargazer	**Ichthyscopus pollicaris*	NE
	Gobiidae	310	Burrowing goby	*Trypauchen vagina*	LC
		311	Maned goby	**Oxyurichthys microlepis*	LC
		312	Pinkgray goby	**Amblychaeturichthys hexanema*	NE
		313	Goby	*Gobiidae sp.1	
		314	Goby	*Gobiidae sp.2	
	Eleotridae	315	Ward's sleeper	**Valenciennea wardi*	LC
		316	Immaculate glidergoby	**Valenciennea immaculata*	LC
	Ptereleotridae	317	Blue hana goby	**Ptereleotris hanae*	LC
	Ephippidae	318	Longfin batfish	*Platax teria*	LC
	Siganidae	319	Mottled spinefoot	*#Siganus fuscescens*	LC
	Sphyraenidae	320	Seapike	*Sphyraena jello*	NE
		321	Red barracuda	*Sphyraena pinguis*	NE
		322	Yellowtail barracuda	*Sphyraena flavicauda*	NE
		323	Japanese barracuda	*Sphyraena japonica*	NE
		324	Seapike	*Sphyraena* sp.	
	Acanthuridae	325	Scalpel sawtail	*Prionurus scalprum*	DD
	Trichiuridae	326	Largehead hairtail	*#Trichiurus lepturus*	LC
		327	Japanese hairtail	**Trichiurus japonicus*	NE
		328	Chinese short-tailed hairtail	**Trichiurus brevis*	NE

		329	Hairtail	**Trichiurus* sp.	
	Scombridae	330	Chub mackerel	*#Scomber japonicus*	LC
		331	Japanese Spanish mackerel	*Scomberomorus niphonius*	DD
		332	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	NT
		333	Indo-Pacific king mackerel	*Scomberomorus guttatus*	DD
		334	Bullet mackerel	*Auxis thazard*	LC
		335	Bonito	*Euthynnus affinis*	LC
		336	Striped bonito	*Sarda orientalis*	LC
	Istiophorus	337	Indo-Pacific sailfish	*Istiophorus platypterus*	NE
	Centrolophidae	338	Pacific rudderfish	*#Psenopsis anomala*	LC
	Stromateidae	339	Butterflyfish	*Pampus argenteus*	NE
		340	Chinese silver pomfret	*Pampus chinensis*	NE
Pleuronectiformes	Paralichthyidae	341	Cinnamon flounder	*Pseudorhombus cinnamoneus*	LC
		342	Largetooth flounder	*Pseudorhombus arsius*	NE
		343	Taiwan-ganzôbirame	*Pseudorhombus levisquamis*	LC
		344	Roughscale flounder	*Pseudorhombus oligodon*	LC
		345	Large-tooth flounder	**Tarphops oligolepis*	LC
		346	Bastard halibut	*Paralichthys olivaceus*	NE
	Bothidae	347	Lefteye flounder	**Psettina tosana*	LC
		348	Flounder	**Psettina* sp.	
		349	Largescale flounder	**Engyprosopon grandisquama*	LC
		350	Lefteye flounder	**Engyprosopon maldivensis*	DD
		351	Lefteye flounder	**Engyprosopon multisquama*	LC
		352	Largescale dwarf flounder	**Engyprosopon macrolepis*	LC

		353	Blue flounder	**Crossorhombus azureus*	LC
		354	Flounder	**Crossorhombus* sp.	
		355	Indo-Pacific oval flounder	**Bothus myriaster*	LC
		356	Many-spotted lefteye flounder	**Arnoglossus polyspilus*	LC
		357	Large-crested lefteye flounder	**Arnoglossus macrolophus*	LC
		358	Dwarf lefteye flounder	**Arnoglossus tenuis*	LC
		359	Lefteye flounder	**Arnoglossus* sp.	
		360	Flounder	*Bothidae sp.	
	Pleuronectidae	361	Ridged-eye flounder	*#Pleurinichthys cornutus*	NE
	Samaridae	362	Crested flounder	**Samaris cristatus*	LC
	Soleidae	363	Ovate sole	**Solea ovata*	LC
		364	Unicorn sole	*Aesopia cornuta*	LC
		365	Zebra sole	*Zebrias zebra*	NE
		366	Flounder	**Zebrias crossolepis*	DD
		367	Wavyband sole	**Pseudaesopia japonica*	LC
		368	Flounder	*Soleidae sp.	
		369	Blackspotted sole	*#Liachirus melanospilos*	LC
	Cynoglossidae	370	Red tonguesole	**Cynoglossus joyneri*	NE
		371	Speckled tougue sole	**Cynoglossus puncticeps*	LC
		372	Speckled tongue sole	**Cynoglossus itinus*	LC
		373	Genko sole	**Cynoglossus interruptus*	LC
		374	Three-lined tongue sole	*Cynoglossus abbreviatus*	DD
		375	Tongue sole	**Cynoglossus oligolepis*	DD
		376	Tongue sole	**Cynoglossus* sp.	

		377	Black cow-tongue	*Paraplagusia japonica*	LC
Tetraodontiformes	Monacanthidae	378	Unicorn leatherjacket filefish	*Aluterus monoceros*	LC
		379	Threadsail filefish	*#Stephanolepis cirrhifer*	LC
		380	Mudbank filefish	*#Paramonacanthus sulcatus*	LC
		381	Faintstripe filefish	*#Paramonacanthus pusillus*	LC
		382	Prickly leatherjacket	*Chaetodermis peniciligera*	LC
	Tetraodontidae	383	Blowfish	*#Lagocephalus wheeleri*	NE
		384	Smooth blaasop	*Lagocephalus inermis*	LC
		385	Lattice blaasop	*Takifugu oblongus*	LC
		386	Pufferfish	*Takifugu poecilonotus*	LC
		387	Yellowfin puffer	*Takifugu xanthopterus*	LC
		388	Guineafowl puffer	*Arothron meleagris*	LC
		389	Stellate puffer	*Arothron stellatus*	LC
		390	Puffer	*Torquigener pallimaculatus*	LC
	Diodontidae	391	Longspined porcupinefish	*Diodon holocanthus*	LC
	Balistidae	392	Starry triggerfish	*Abalistes stellaris*	LC
		393	Masked triggerfish	*Sufflamen fraenatum*	LC
Crustacean (N = 89)					
Stomatopoda	Squillidae	394	Japanese squillid mantis shrimp	**Oratosquilla fabricii*	NE
		395	Mantis shrimp	**Oratosquilla kempi*	NE
		396	Mantis shrimp	**Lophosquilla costata*	NE
		397	Mantis shrimp	**Lophosquilla* sp.	
		398	Robber harpiosquillid mantis shrimp	*Harpiosquilla harpax*	NE

		399	Smooth squillid mantis shrimp	**Erugosquilla woodmasoni*	NE
		400	Mantis shrimp	**Carinosquilla multicarinata*	NE
		401	Mantis shrimp	**Oratosquillina interrupta*	NE
		402	Mantis shrimp	*#Odontodactylus japonicus*	NE
Decapoda	Sicyoniidae	403	Shrimp	**Sicyonia japonica*	NE
		404	Shrimp	**Sicyonia cristata*	NE
		405	Shrimp	**Sicyonia* sp.	
	Palaemonidae	406	Shrimp	*Palaemonidae sp.	
	Solenoceridae	407	Udang merah	*#Solenocera crassicornis*	NE
	Penaeidae	408	Kuruma shrimp	*Penaeus japonicus*	NE
		409	Chinese white prawn	*Penaeus merguiensis*	NE
		410	Western king prawn	*Penaeus latisulcatus*	NE
		411	Green tiger prawn	*Penaeus semisulcatus*	NE
		412	Witch prawn	*Penaeus canaliculatus*	NE
		413	Redspot king prawn	*Penaeus longistylus*	NE
		414	Giant tiger prawn	*Penaeus monodon*	NE
		415	Periscope shrimp	**Atypopenaeus stenodactylus*	NE
		416	Southern rough shrimp	*#Trachysalambria curvirostris*	NE
		417	Rough shrimp	**Trachysalambria longipes*	NE
		418	Spear shrimp	*#Parapenaeopsis hardwickii*	NE
		419	Coral shrimp	*#Kishinouyepenaeopsis cornuta*	NE
		420	Shrimp	**Mierspenaeopsis cultrirostris*	NE
		421	Smoothshell shrimp	**Batepenaeopsis tenella*	NE
		422	Flamingo shrimp	**Parapenaeus longipes*	NE

		423	Whiskered velvet shrimp	*#Metapenaeopsis barbata*	NE
		424	Kishi velvet shrimp	**Metapenaeopsis dalei*	NE
		425	Humpback prawn	*Metapenaeopsis lamellata*	NE
		426	Southern velvet shrimp	**Metapenaeopsis palmensis*	NE
		427	Mogi velvet shrimp	**Metapenaeopsis mogiensis*	NE
		428	Velvet shrimp	**Metapenaeopsis* sp.1	
		429	Velvet shrimp	**Metapenaeopsis* sp.2	
		430	Shrimp	*Penaeidae sp.1	
		431	Shrimp	*Penaeidae sp.2	
	Pasiphaeidae	432	Lesser glass shrimp	**Leptochela gracilis*	NE
	Thoridae	433	Shrimp	**Birulia kishinouyei*	NE
	Scyllaridae	434	Slipper lobster	**Scyllarus cultrifer*	LC
	Palinura	435	Chinese spiny lobster	*Panulirus stimpsoni*	DD
		436	Ornate spiny lobster	*Panulirus ornatus*	LC
		437	Smooth fan lobster	*Ibacus novemdentatus*	LC
	Albuneidae	438	Sand crab	**Albunea* sp.	
	Raninidae	439	Red frog crab	*Ranina ranina*	NE
		440	Crab	**Cosmonotus grayii*	NE
	Dromiidae	441	Japanese sponge crab	**Lauridromia dehaani*	NE
		442	Crab	**Conchoecetes artificiosus*	NE
	Dorippidae	443	Granulated mask crab	**Paradorippe granulata*	NE
	Majidae	444	Kelp crab	**Pugettia* sp.	
		445	Crab	**Majidae* sp.	
	Leucosiidae	446	Pebble crab	*Leucosia craniolaris*	NE

		447	Painted pebble crab	*Leucosia anatum*	NE
		448	Fleeting purse crab	**Myra fugax*	NE
		449	Crab	**Myra* sp.	NE
		450	Crab	**Leucosiidae* sp.	
	Calappidae	451	Box crab	#*Calappa philargius*	NE
		452	Spotted box crab	*Calappa lophos*	NE
		453	Reef box crab	**Calappa hepatica*	NE
		454	Crab	**Cycloes granulosa*	NE
	Parthenopidae	455	Strong elbow crab	**Enoplolambrus validus*	NE
	Corystidae	456	Crab	*Jonas distincta*	NE
	Matutiodea	457	Spotted moon crab	**Matuta planipes*	NE
		458	Yellow moon crab	**Ashtoret lunaris*	NE
	Portunidae	459	Mud crab	*Scylla paramamosain*	NE
		460	Swimming crab	**Portunus hastatoides*	NE
		461	Japanese blue crab	#*Portunus trituberculatus*	NE
		462	Swimming crab	**Portunus gracilimanus*	NE
		463	Three-spot swimming crab	#*Portunus sanguinolentus*	NE
		464	Swimming crab	**Portunus argentatus*	NE
		465	Flower crab	*Portunus pelagicus*	NE
		466	Red swimming crab	#*Monomia haani*	NE
		467	Swimming crab	**Charybdis bimaculata*	NE
		468	Swimming crab	**Charybdis acuta*	NE
		469	Crucifix crab	*Charybdis feriatus*	NE
		470	Rock crab	#*Charybdis natator*	NE

		471	Swimming crab	**Charybdis variegata*	NE
		472	Soldier swimming crab	*Charybdis miles*	NE
		473	Swimming crab	*Charybdis sagamiensis*	NE
		474	Swimming crab	*Charybdis amboinensis*	NE
		475	Swimming crab	*Charybdis hellerii*	NE
		476	Swimming crab	*Charybdis granulata*	NE
		477		**Charybdis japonica*	NE
		478	Swimming crab	**Charybdis* sp.	
	Porcellanidae	479	Crab	**Porcellana pulchra*	NE
		480	Crab	**Porcellanidae sp.*	
	Xanthidae	481	Mosaic reef crab	*Lophozozymus pictor*	NE
	Pilumnidae	482	Crab	**Heteropilumnus* sp.	
Cephalopods (N= 23)					
Sepiida	Sepiidae	483	Spineless cuttlefish	*#Sepiella maindroni*	DD
		484	Golden cuttlefish	*#Sepia esculenta*	DD
		485	Kisslip cuttlefish	*Sepia lycidas*	DD
		486	Pharaoh cuttlefish	*Sepia pharaonis*	DD
		487	Bigfin reef squid	*Sepioteuthis lessoniana*	DD
		488	Cuttlefish	#Sepiidae sp.	
	Sepiolidae	489	Squid	**Sepiola* sp.	
	Sepiadariidae	490	Koch's bottletail squid	**Sepiadarium kochii*	LC
Teuthida	Loliginidae	491	Squid	*Loligo japonicus*	DD
		492	Indian squid	*Loligo oshimai*	DD
		493	Spear squid	*Loligo bleekeri*	LC

		494	Squid	*Uroteuthis duvaucelii*	DD
		495	Southern dumpling squid	*Uroteuthis chinensis*	DD
		496	Swordtip squid	**Uroteuthis edulis*	DD
		497	Little squid	#*Loliolus uyii*	DD
		498	Squid	*Loliginidae sp.	
Oegopsida	Ommastrephidae	499	Squid	**Todarodes pacificus*	LC
Octopoda	Octopodidae	500	Whiparm octopus	#*Octopus variabilis*	DD
		501	Webfoot octopus	#*Octopus ocellatus*	LC
		502	Octopus	#*Amphioctopus aegina*	LC
		503	Stareye octopus	#*Amphioctopus kagoshimensis*	LC
		504	Greater blue-ringed octopus	**Hapalochlaena lunulata*	LC
		505	Octopus	#Octopodidae sp.	

In trap vessel fishery, catches included crabs, fishes, cuttlefishes, squids and octopus. Crabs included *M. haanii*, *P. sanguinolentus*, *Charybdis feriatus*, *C. natator* and *Calappa philargius* were recorded at the species level. For fishes, only a few species with high price or high volume were recorded at the species level, including *Epiniphelus akarra*, *Epiniphelus awoara*, *Evynnis cardinalis*, *Sebastiscus marmoratus* and *Platycephalus indicus*. Fishes were mainly recorded as species group, such as Synodontidae spp., Sillaginidae spp., Tetraodontidae spp. and Mullidae spp.. Small fishes were recorded as mixed fishes and sold with low price.

3.2.2 Endangered, threatened and protected species

Most of endangered, threatened and protected species observed at the landing ports of Dongshan County were Elasmobranchii speices. All Carcharhinidae species were listed in CITES Appendix II in 2022, and four of them (*Scoliodon macrorhynchos*, *Carcharhinus brevipinna*, *C. limbat*us, and *C. sorrah*) were recorded at the landing ports of Dongshan County according to the surveys from August 2023 to April 2024 (Fig. 3-1). *S. macrorhynchos* was the most common species observed in Carcharhinidae, and spotted almost every month except March and April 2024, with a total of 49 individuals. Their size range was about 40 cm to 75 cm total length. The other three species had low occurrence during landing port surveys. One *C. brevipinna* individual was recorded in August 2023 and its size was about 150 cm. Two *C. limbat*us were recorded in August 2023 and their sizes were about 80 cm. One *C. sorrah* individual was recorded in April 2024 and its size was about 145 cm.

Sphyrna lewini (Shpyrnidae) was listed as CITES Appendix II in 2014. A total of 21 individuals ranging from 50 cm to 80 cm were founded during the surveys from August 2023 to April 2024 (Fig. 3-2). They were spotted from August to November in 2023 and January in 2024.

All *Rhynchobatus* species (Rhynchobatidae) were listed as CITES Appendix II in 2019. One species, Bottlenose wedgefish *Rhynchobatus australiae*, was recorded according to the surveys from August 2023 to April 2024 (Fig. 3-3). Three individuals

were spotted, one in January 2024, one in February 2024 and one in April 2024. Their sizes were approximately 70-90 cm.

Rhincodon typus (Rhincodontidae) was listed in CITES Appendix II in 2003, and also listed as Category II of National Wildlife Protected Species in China (www.forestry.gov.cn/html/main/main_5461/20210205122239482485322/file/20210205122347636743107.pdf). During the surveys, one caudal fin and other fins of *R. tupus* was recorded in April 2024 (Fig. 3-4).

Fig. 3-1 *Scoliodon macrorhynchos*, *Carcharhinus brevipinna*, *Carcharhinu limbatus*, and *Carcharhinu sorrah* found in trawl catches at the landing ports in Dongshan County (from top to bottom).

Fig. 3-2. Scalloped hammerhead shark *Sphyrna lewini* found in trawl catches in Dongshan County.

Fig. 3-3. Bottlenose wedgefish *Rhynchobatus australiae* found in trawl catches in Dongshan County.

Fig. 3-4. The fins of whale shark *Rhincodon typus* found in trawl catches in Dongshan County.

All *Hippocampus* species were listed in CITES Appendix II in 2004, and the wild populations of all seahorses were listed as Category II of National Wildlife Protected Species in China. In Dongshan County, a total of four seahorse species were found. *H. trimaculatus* is the absolutely dominant landing species in seahorse bycatches from trawl fishery. During the surveys from August 2023 to April 2024, only *H. trimaculatus* was found at the landing ports of Dongshan County with low numbers.

To summary, a total of 13 cartilaginous fishes (*R. typus*, *Carcharodon carcharias*, *S. macrorhynchos*, *C. brevipinna*, *C. macloti, C. melanopterus*, *C. brachyurus*, *C. sorrah*, *C. leucas*, *C. limbatus*, *Sphyrna lewini*, *R. immaculatus*, *R. australiae, and Mobula tarapacana*) and four bony fishes (*H. trimaculatus*, *H. spinosissimus*, *H. kelloggi* and *H. mohnikei*), all listed as CITES Appendix II species, were found in trawl catches of Dongshan County throughout the surveys from August 2018 to April 2024 (in Phase I-VII).

Among the 505 species identified aforementioned in Dongshan County from August 2018 to April 2024, a total of 37 fish species were listed as threatened categories in the International Union for Conservation of Nature (IUCN) Red List (Table 3-2). Among the 37 species, 5 species (*S. lewini*, *R. immaculatus*, *R. australiae, Rhinobatos schlegelii* and *Larimichthys crocea*) were listed as "Critically Endangered", 13 species (*R. typus*, *Halaelurus buergeri*, *Mustelus griseus*, *Rhinobatos hynnicephalus*, *Platyrhina sinensis, Himantura uarnak, Maculabatis macrura, Aetobatus flagellum, Aetobatus narinari, M. tarapacana, Epinephelus akaara, Evynnis cardinalis,* and *Argyrosomus japonicus*) were listed as "Endangered", and 19 species (*C. carcharias*, *C. brevipinna*, *C. melanopterus*, *C. leucas*, *C. limbatus, Narcine lingual*, *N. maculate*, *Okamejei boesemani*, *P. tangi*, *Urolophus aurantiacus*, *Telatrygon zugei*, *Taeniurops meyeni, Gymnura japonica, H. kelloggi, H. mohnikei, H. spinosissimus*, *H. trimaculatus, Epinephelus bruneus* and *Nemipterus virgatus*) were listed as "Vulnerable". *E. cardinalis* is one of the most important food fishes in terms of catch volume proportion documented in this study.

3.3 Fishing areas of trawl and trap vessels

The fishing grounds remained unchanged during the surveys from August 2023 to April 2024. Based on the captain and crew interviews, trawl vessels from Dongshan County mainly operate in Minnan Fishing Ground, Taiwan Bank Fishing Ground, Yuedong Fishing Ground, Dongsha Fishing Ground and Southern Taiwan Fishing Ground within 116º-119º E and 21º50'-24º50' N (Lin et al., 2021)

Based on the GPS locations collected from logbook of trawl vessels (Phase VI), and logbook of trap vessels (Phase VII), the fishing grounds were further confirmed. For trawl vessels, the main fishing ground was in Minnan Fishing Ground, with extension to Taiwan Bank Fishing Ground and Yuedong Fishing Ground. For trap vessels, the fishing grounds were mainly in Taiwan Bank Fishing Ground, and also in Minnan Fishing Ground.

3.4 Fishery operation patterns of trawl and trap vessels

Based on 107 trawl vessels surveyed at the landing ports of Dongshan County during the surveys from August 2023 to April 2024, they generally spent 1-12 days/trip at sea (mean = 7.48, N = 107) (Table 3-3). Over 80% of trawl vessels surveyed spent more than 5 days/trip at sea, and about 15% of them spent more than 10 days/trip. The variation of fishing days at sea highly depended on the weather conditions.

The trawl fishery operation patterns are similar with the findings in August 2018-April 2023 surveys (in Phases I-VI), with an average of 6-8 days/trip throught the years (Table 3-3).

Table 3-3. Comparison of fishing days per trip (days/trip) of trawl vessels surveyed (N) in August 2018-April 2024 at the landing ports of Dongshan County.

Survey period	Fishing days/trip (mean, range)

August-December 2018	7.67 (2-13) (N=61)
January-April and August-December 2019	7.16 (3-12) (N=79)
August-December 2020	6.48 (1-12) (N=54)
January-April 2021, October 2021-April 2022	6.34 (1-14) (N=79)
August 2022-April 2023	6.22 (1-14) (N=101)
August 2023-April 2024	7.48 (1-12) (N=107)

Based on three trap vessels surveyed (N = 3) in Dongshan County form October 2023 to April 2024, vessels did not come back except bad weather (only the case that government called back all vessels) and holiday (Chinese New Year, Feburary 2024; National Day, October 2023) (Table 3-4). In addition, fishing days from the three vessels surveyed were also obtained in August and September 2023 (Table 3-4). Because of the national summer fish moratorium (May 1st-August 16th), the fishing in August is only 15 days in maximum.

The average fishing days were 188 day/year in August 2023-April 2024, ranged from 181 days/year to 200 days/year (N = 3). In April 2024, the catches declined significantly and two vessels surveyed stopped fishing (Table 3-4).

Table 3-4. Fishing days of trap vessels surveyed in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Aug 2023**	**Sept 2023**	**Oct 2023**	**Nov 2023**	**Dec 2023**	**Total**
#1	28	21	22	0	13	25	23	28	24	184
#2	28	24	21	14	11	24	24	25	29	200
#3	28	20	21	0	13	25	24	27	23	181
Average	28	22	21	5	12	25	24	27	25	188

In trap fishery, each trap vessel carried 3000 traps (i.e., 3 lines with 1000 traps per line), with a few hundreds of traps for replacement. There were approximate 15 crews in each trap vessel. Each vessel towed 3 trap lines (about 1 km per line) subsequently

and waited for about 2-3 hours before harvest. The number of lines towed per day were 4-7 lines/vessels. The baits commonly used were frozened *Scomber japonicus* and *Sardinalla* species. A block of frozen bait is about 10 kg, and about 600 blocks (i.e., 6 t) were used per vessel per month. Each bait fish individual was chopped into 3-4 pieces, and each trap put one piece of bait fish. The price for the bait was about 70 RMB/block.

3.5 Capture volumes and proportions by trawl vessels

3.5.1 Capture volumes and proportions of different taxonomic groups

Based on the trawl vessels surveyed (N = 107) at the landing ports of Dongshan County from August 2023 to April 2024, the average total capture volume was about 10592.08 kg/vessel/trip, and the average capture volumes and proportions of different taxonomic groups were calculated (**错误!未找到引用源。**3-5). The findings were summarized as below:

(1) The most dominant capture taxonomic group was the fishes (including food fish and feed fish), contributed to 71.13% (average of 7534.34 kg/vessel/trip) of the total capture volume (average of 10592.08 kg/vessel/trip).

(2) The average total food fish capture volume was 4975.37 kg/vessel/trip, which contributed to 46.97% of the total capture volume.

(3) The proportion of feed fishes was high (average of 2558.97 kg/vessel/trip), contributed to 24.16% of the total capture volume.

(4) The average total crustacean capture volume (1803.07 kg/vessel/trip) contributed to 17.02% of the total capture volume, with the estimated average volumes of 1545.01 kg/vessel/trip for crabs and 258.05 kg/vessel/trip for shrimps.

(5) The average total cephalopod capture volume was 1254.67 kg/vessel/trip, which contributed to 11.85% of the total capture volume.

Table 3-5. Capture volumes and proportions from trawl vessels surveyed (N = 107) in August 2023-April 2024 at the landing ports of Dongshan County.

Parameters	Mean (N = 107)	
Fishing days per trip	7.48 days/trip	
Average total capture volume per trip	10592.08 kg/vessel/trip	
Average total crustacean capture volume per trip	1803.07 kg/vessel/trip	
	Shrimps: 258.05 kg/vessel/trip	Crabs: 1545.01 kg/vessel/trip
Total crustacean volume/total capture volume	17.02%	
	Shrimps: 2.44%	Crabs: 14.59%
Average total fish capture volume per trip	7534.34 kg/vessel/trip	
Total fish volume/total capture volume	71.13%	
Average total food fish capture volume per trip	4975.37 kg/vessel/trip	
Total food fish volume/total capture volume	46.97%	
Average total feed fish capture volume per trip	2558.97 kg/vessel/trip	
Total feed fish volume/total capture volume	24.16%	
Average total cephalopod capture volume per trip	1254.67 kg/vessel/trip	
Total cephalopod volume/total capture volume	11.85%	

Based on the average CPUE (kg/vessel/day, N = 107) of the surveyed trawl vessels in August 2023-April 2024, the number of registered trawl vessels in Dongshan (N =

650) and the annual fishing days (obtained in Phase V-VI) (84.5 days/year), the estimated annual capture volume of trawl fishery in Dongshan County was 79035.63 t (Table 3-6).

Table 3-6. Estimated annual capture volume of trawl fishery in Dongshan County.

Species group	CPUE (kg/vessel/day)	Number of vessels	Fishing days (day)	Estimated capture volume (t)
Food fish	703.73	650	84.5	38652.50
Feed fish	325.13			17857.78
Crustacean	245.98			13510.31
Cephalopod	164.13			9015.04
Total	1438.97			79035.63

3.5.2 Crabs

The crab capture volume proportions in the total capture volumes of trawl fishery (N = 107) in Dongshan County from August 2023 to April 2024 were further analyzed (Table 3-7; Fig.3-7 to 3-9). The findings were summarized as below:

(1) Crab proportions in the total capture volumes of trawl fishery ranged from 4.79% in February 2024 to 32.00% in August 2023, including four main crab species, *M. haani*, *P. sanguinolentus*, *C. natator* and *C. philargius*.

(2) Among the total crab capture volume of 1545.01 kg/vessel/trip, *M. haani* was 1119.39 kg/vessel/trip, *P. sanguinolentus* was 291.06 kg/vessel/trip, *C. natator* was 43.63 kg/vessel/trip and *C. philargius* was 90.53 kg/vessel/trip, contributing to 10.57%, 2.75%, 0.41% and 0.86% of the total capture volume, respectively.

(3) The dominant crab species in trawl fishery was *M. haani*, contributing around 70% of the total crab production. The proportions of *M. haani* varied monthly, ranging from 3.48% in April 2024 to 24.01% in August 2023. The capture volumes of *M. haani* ranged from 215.57 kg/vessel/trip to 3406.14 kg/vessel/trip.

(4) Based on the average fishing days at sea per trip, the average CPUE of *M. haani*

ranged from 25.80 kg/vessel/day in April 2024 to 545.64 kg/vessel/day in August 2023 (mean = 158.36 kg/vessel/day).

(5) Based on the average fishing days at sea per trip, the average CPUE of *P. sanguinolentus* ranged from 7.48 kg/vessel/day in February 2024 to 144.17 kg/vessel/day in August 2023 (mean = 40.06 kg/vessel/day).

Table 3-7. Average capture volumes (kg/vessel/trip) and proportions (%) of four main crab species in the total capture volumes from trawl vessels surveyed (N = 107) in August 2023-April 2024 at the landing ports of Dongshan County.

Crab species	Average volume (kg/vessel/trip)	Proportion
Monomia haani	1119.39	10.57%
Portunus sanguinolentus	291.06	2.75%
Charybdis natator	43.63	0.41%
Calappa philargius	90.53	0.86%
Other crabs	0.41	0.00%
Total	1545.01	14.59%

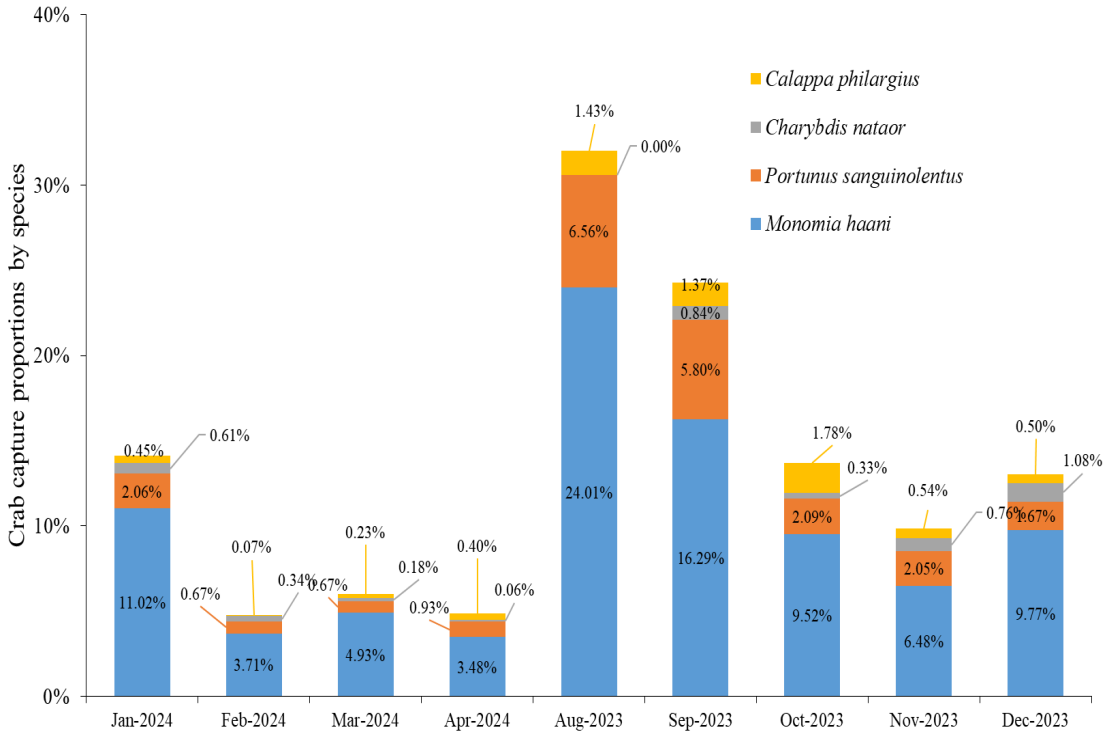

Fig. 3-7. Crab proportions (%) in the total capture volumes by species from trawl vessels surveyed in August 2023-April 2024 at the landing ports of Dongshan County.

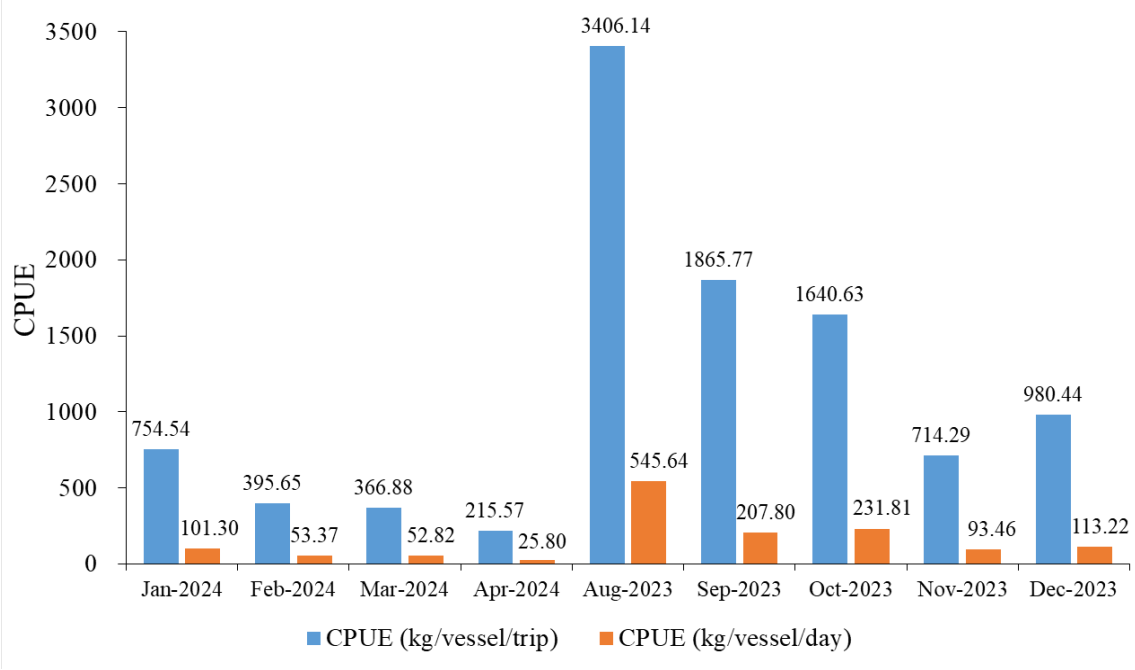

Fig. 3-8. Monthly average CPUE (kg/vessel/trip and kg/vessel/day) of *Monomia haani*, surveyed in August 2023-April 2024 at the landing ports of Dongshan County.

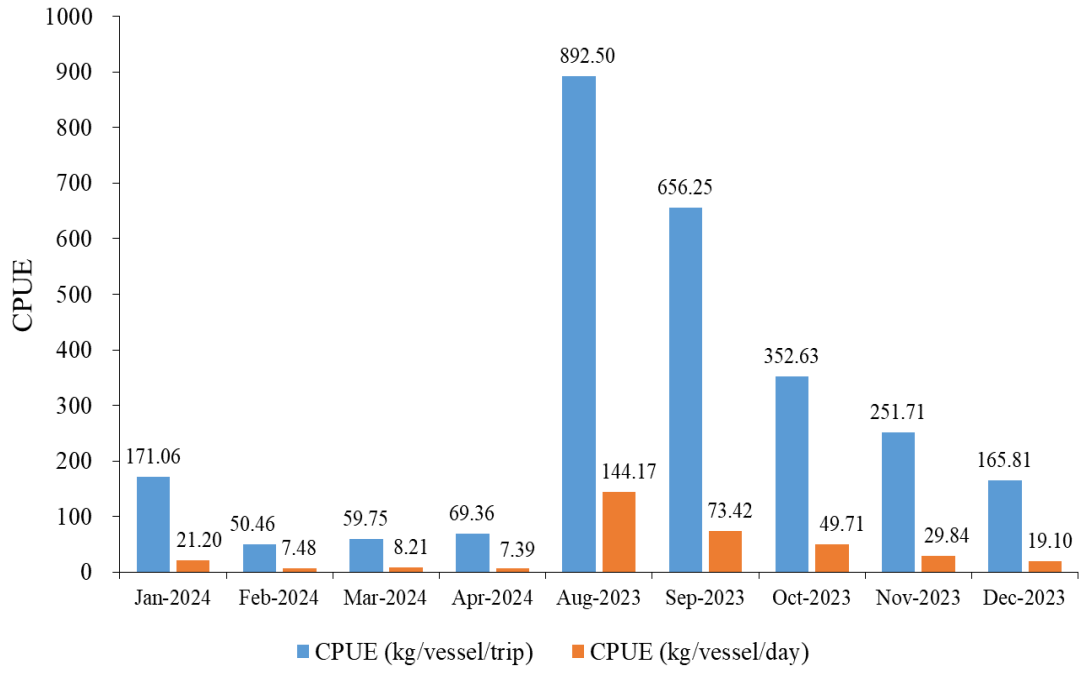

Fig. 3-9. Monthly average CPUE of *Portunus sanguinolentus* by kg/vessel/trip and

kg/vessel/day, surveyed in August 2023-April 2024 at the landing ports of Dongshan County.

3.5.3 Food fishes

In August 2023-April 2024, the dominant food fish species or species groups in trawl fishery in Dongshan County were *Evynnis cardinalis*, Synodontidae spp. (mainly *Trachinocephalus myops, Saurida elongate,* and *S. tumbil*), *Decapterus* spp. (mainly *D. maruadsi*), *Trachurus japonicus*, Sillaginidae spp. (mainly *Sillago sihama*), Mullidae spp. (mainly *Upeneus japonicus*), *Siganus fuscescens*, Trichiuridae spp., Callionymidae spp., Ammodytidae spp. (*Bleekeria viridianguilla* and *Bleekria mitsukurii*), Monacanthidae spp. (mainly *Paramonacanthus sulcatus* and *Stephanolepis cirrhifer*) and Tetraodontidae spp. (mainly *Lagocephalus wheeleri* and *Takifugu oblongus*).

For dominant food fish species and species groups, their capture volume proportions in the total capture volumes showed monthly variation (Table 3-8).

Table 3-8. Proportions (%) of dominant food fish species or species group in trawl fishery from August 2023 to April 2024 at the landing ports of Dongshan County.

Fish species/Groups	**Jan-2024**	**Feb-2024**	**Mar-2024**	**Apr-2024**	**Aug-2023**	**Sep-2023**	**Oct-2023**	**Nov-2023**	**Dec-2023**
Total fish	64.15%	85.83%	77.11%	77.28%	57.58%	59.74%	72.71%	73.82%	65.57%
Synodontidae spp	8.71%	3.77%	6.35%	10.87%	6.21%	21.37%	3.48%	11.53%	12.86%
Evynnis cardinalis	1.48%	0.21%	0.45%	0.61%	37.28%	15.70%	6.75%	1.70%	1.75%
Sillaginidae spp.	2.51%	3.41%	4.49%	5.43%	0.18%	0.49%	3.43%	4.58%	3.38%
Decapterus maruadsi & *Trachurus japonicus*	1.62%	0.27%	0.25%	0.91%	3.69%	7.02%	11.10%	2.86%	1.89%
Mullidae spp.	1.48%	1.28%	1.24%	4.04%	3.74%	3.27%	1.08%	0.95%	1.34%
Trichiuridae spp.	0.33%	0.01%	0.00%	0.01%	0.60%	0.91%	0.56%	0.49%	0.54%
Siganus fuscescens	0.29%	0.00%	0.19%	0.30%	1.61%	0.20%	0.15%	3.39%	0.19%
Ammodytidae spp.	10.08%	58.60%	47.33%	28.96%	0.00%	1.12%	0.07%	0.36%	6.72%
Callionymidae spp.	0.02%	0.16%	0.11%	0.15%	0.03%	0.01%	0.03%	0.01%	0.05%
Monacanthidae spp.	0.35%	0.36%	0.34%	0.32%	0.00%	0.32%	0.50%	0.36%	0.49%

Based on the 107 trawl vessels surveyed at the landing ports of Dongshan County in August 2023-April 2024, food fishes contributed to 29.37% (in November 2023)-69.39% (in February 2024) of the total capture volumes (Fig. 3-10).

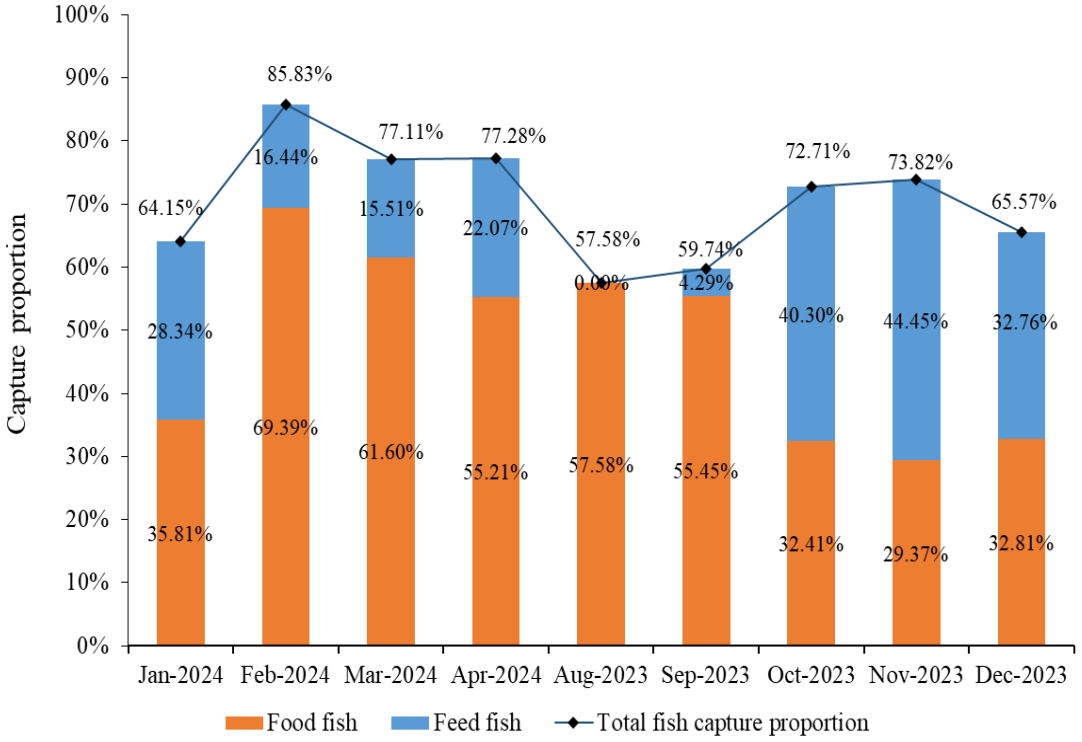

Fig. 3-10. Food and feed fish capture proportions (%) in the total capture volumes from trawl vessels surveyed (N = 107) in August 2023-April 2024 at the landing ports of Dongshan County.

3.5.4 Feed fishes

3.5.4.1 Capture proportions of feed fishes

The "feed fishes" in this report were those small-sized, low-valued and poorly preserved fishes (also including crustaceans and cephalopods), with their destination to aquaculture farms, mentioned by the captains of the trawl vessels surveyed (Zhang et al., 2018).

Based on the 107 trawl vessels surveyed at the landing ports of Dongshan County in August 2023-April 2024, feed fishes contributed to 0.00% (August 2023)-44.45%

(November 2023) of the total capture volumes (Fig. 3-10). The reason without feed fish in August 2023 was that the feed fish were discarded at sea because of the good harvest right after the termination of the national summer fishing moratorium based on the captain and crew interviews.

3.5.4.2 Species diversity in feed fishes

Based on the monthly and randomly samplings of feed fishes (mean = 2.02 kg, ranging from 1.57 kg to 2.86 kg) at the landing ports of Dongshan County from September 2023 to April 2024 (no feed fish landing in August 2023), 119 species with 76 fishes, 36 crustaceans and 7 cephalopods were identified (Table 3-9). There were 13 species dominated in feed fishes including fishes, crabs and squids, and some were commercially important.

Table 3-9. Species diversity, size range (standard length for fishes and cephalopods, carapace width for crabs) and proportions in feed fishes of trawl catches in September 2023-April 2024 in Dongshan County.

(*species only found in feed fishes) (red: the first three dominant species or species group each month)

No.	Species name	Jan-2024		Feb-2024		Mar-2024		Apr-2024		Sep-2023		Oct-2023		Nov-2023		Dec-2023	
		%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)
1	*Platyrhina tangi*	-	-	-	-	-	-	-	-	3.0%	24.1	-	-	-	-	-	-
2	*Gymnothrax reticularis*	-	-	1.3%	30.1	-	-	0.8%	23.7	0.4%	22.2	-	-	-	-	-	-
3	**Caecula pterygera*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	28.5
4	*Pisodonophis cancrivorus*	-	-	1.6%	43.2	4.8%	44.5-49.1	1.2%	33.9	-	-	-	-	-	-	-	-
5	*Callechelys kuro*	1.6%	28.6-34.9	0.8%	37.6	-	-	-	-	-	-	-	-	-	-	-	-
6	**Ichthyapus vulturis*	-	-	-	-	0.9%	34.3	-	-	-	-	-	-	-	-	-	-
7	**Ophichthidae* sp.	-	-	-	-	-	-	-	-	0.7%	31.1	-	-	-	-	-	-
8	*Oxyconger leptognathus*	-	-	0.4%	23.6	-	-	2.8%	24.2-30.0	3.8%	20.9-24.9	9.6%	17.6-31.1	-	-	-	-
9	*Gnathophis heterognathos*	-	-	-	-	-	-	-	-	0.1%	14.2	-	-	-	-	-	-
10	*Ariosoma meeki*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0%	14.4-23.2
11	**Ariosoma*	0.1%	9.3	0.2%	13.2	-	-	-	-	2.6%	23.2-	2.7%	13.2-	0.3%	14.5	1.3%	10.8-

	megalops										28.2		19.8				14.8
12	*Ariosoma* sp.	-	-	-	-	-	-	0.7%	14.2-15.5	-	-	-	-	-	-	-	-
13	*Congridae sp.	-	-	-	-	0.1%	10.8	-	-	-	-	-	-	-	-	-	-
14	*Saurenchelys fierasfer	-	-	-	-	-	-	0.9%	43.1	-	-	-	-	-	-	-	-
15	*Encrasicholina punctifer	-	-	0.1%	8.2	-	-	-	-	-	-	0.2%	4.7-7.0	0.1%	6.6	0.3%	8.3
16	*Gonorynchus abbreviatus	-	-	0.5%	7.9-8.6	-	-	0.5%	8.3-9.6	-	-	-	-	-	-	-	-
17	*Plotosus lineatus*	-	-	-	-	-	-	-	-	3.2%	8.5-10.5	-	-	-	-	-	-
18	*Trachinocephalus myops*	1.7%	7.1-11.0	2.5%	9.1-15.1	0.8%	9.1-13.5	1.3%	6.1-12.2	11.3%	5.4-14.1	1.9%	7.6-15.2	1.9%	7.1-10.2	1.1%	8.6-10.5
19	*Synodus fuscus*	0.7%	13.2	-	-	-	-	0.4%	10.9	2.4%	6.2-15.5	1.1%	9.0-14.4	0.2%	9.0	-	-
20	*Saurida elongata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	9.8
21	*Saurida tumbil*	-	-	-	-	-	-	-	-	0.8%	15.4	-	-	-	-	-	-
22	*Saurida undosquamis*	-	-	-	-	1.1%	9.2-13.2	1.4%	6.5-13.3	2.2%	5.1-10.3	8.2%	5.2-14.4	5.0%	8.3-14.3	4.9%	3.4-13.5
23	*Bregmaceros* sp.	1.1%	3.0-6.1	0.1%	5.0-6.1	0.2%	5.2-6.5	0.6%	5.0-7.2	0.1%	6.0-6.3	0.0%	4.9	0.4%	4.5-6.5	0.3%	4.4-6.4
24	*Ophidion muraenolepis	-	-	-	-	-	-	-	-	0.3%	11.0	-	-	-	-	-	-
25	*Hippocampus trimaculatus*	-	-	-	-	-	-	-	-	0.1%	6.9	0.1%	8.9	0.2%	10.7	-	-
26	*Halicampus grayi*	-	-	-	-	-	-	-	-	0.1%	15.1	-	-	-	-	-	-

27	**Pegasus laternarius*	-	-	-	-	-	-	-	-	-	-	-	-	0.1%	5.6	-	-
28	**Apistus carinatus*	-	-	1.6%	11.7-12.4	-	-	0.7%	5.8-10.1	2.9%	14.5-14.7	3.4%	3.6-12.2	0.6%	7.5-7.8	1.5%	3.5-8.8
29	**Minous pusillus*	0.2%	4.8-5.4	-	-	-	-	-	-	-	-	0.1%	3.5-4.6	-	-	-	-
30	**Onigocia spinosa*	1.1%	12.5	-	-	0.4%	10.4	-	-	-	-	-	-	0.4%	9.2	-	-
31	**Sorsogona tuberculata*	3.2%	6.4-11.2	3.5%	9.1-10.7	2.3%	7.0-10.5	5.8%	7.7-11.5	1.2%	14.6	1.5%	5.9-8.9	4.2%	4.5-11.0	-	-
32	**Inegocia guttata*	-	-	1.9%	17.9	-	-	-	-	-	-	-	-	3.3%	18.5	-	-
33	*Priacanthus macracanthus*	-	-	1.3%	12.1	-	-	-	-	-	-	-	-	-	-	-	-
34	*Priacanthus tayenus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	6.5
35	**Ostorhinchus semilineatus*	-	-	1.0%	7.8-9.9	-	-	-	-	0.4%	8.9	-	-	-	-	0.4%	8.3
36	*Ostorhinchus fasciatus*	0.1%	4.8	-	-	-	-	0.6%	9.5	0.2%	3.7-5.5	0.2%	4.1-5.7	-	-	0.2%	3.1-5.0
37	**Apogonichthyoides niger*	1.3%	4.2-7.2	3.5%	5.9-7.8	1.0%	5.6-7.7	2.0%	6.1-7.3	1.5%	7.7-8.5	0.5%	4.5-6.9	1.1%	5.3-7.1	2.4%	4.9-7.3
38	**Jaydia lineata*	0.5%	4.3-5.7	0.7%	4.7-7.3	-	-	-	-	0.0%	3.7	-	-	-	-	-	-
39	**Jaydia carinatus*	1.0%	11.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	*Sillago ingenuua*	6.4%	6.1-11.4	1.6%	6.2-12.7	3.6%	9.2-16.1	0.9%	8.5-12.9	18.2%	3.9-11.7	8.4%	4.0-11.5	5.0%	7.0-10.1	7.6%	4.2-11.1
41	*Selaroides leptolepis*	-	-	-	-	-	-	0.9%	12.2	0.9%	12.6	-	-	1.5%	13.3	-	-

42	*Decapterus maruadsi*	-	-	-	-	0.0%	4.5	0.1%	6.5	-	-	4.1%	21.0	-	-	-	-
43	**Equulites rivulatus*	3.0%	3.5-6.7	8.9%	4.8-6.8	9.6%	4.8-7.0	4.5%	4.9-6.6	0.2%	3.0-4.7	1.1%	2.7-5.4	0.6%	4.7-6.0	1.4%	3.2-5.8
44	*Plectorhinchus pictus*	-	-	-	-	-	-	-	-	0.1%	5.4	-	-	-	-	-	-
45	*Evynnis cardinalis*	-	-	0.0%	3.5	0.2%	3.2-4.3	3.2%	4.1-8.1	-	-	-	-	-	-	-	-
46	*Sciaenidae sp.	-	-	-	-	0.0%	3.6	0.0%	3.8	-	-	-	-	0.1%	4.5	1.5%	7.8-8.7
47	*Upeneus japonicus*	7.2%	8.8-11.7	2.4%	9.2-11.6	1.3%	10.1-11.5	1.1%	9.5-11.1	4.6%	3.9-10.9	4.4%	3.6-9.8	1.4%	6.1-9.2	0.4%	8.8
48	*Teixeirichthys jordani*	-	-	-	-	1.6%	11.0-13.2	7.2%	11.1-15.1	2.3%	5.8-10.5	1.1%	10.2	-	-	-	-
49	**Pomacentrus* sp.1	-	-	-	-	-	-	2.2%	11.7-11.9	0.0%	3.2	-	-	-	-	-	-
50	**Suezichthys gracilis*	0.3%	8.7	0.7%	12.3	-	-	0.4%	9.4	0.1%	7.5	-	-	0.4%	9.6	0.8%	8.8-9.4
51	*Iniistius verrens*	-	-	0.9%	12.0	0.1%	7.0	-	-	-	-	-	-	-	-	-	-
52	*Parapercis pulchella*	-	-	0.4%	10.5	-	-	-	-	-	-	-	-	-	-	1.0%	11.5
53	**Parapercis ommatura*	0.2%	7.8	0.2%	7.8	-	-	-	-	-	-	0.2%	5.9-6.7	-	-	0.2%	7.8
54	*Callionymus huguenini*	17.1%	4.5-19.5	5.5%	3.2-16.7	7.9%	4.5-17.3	5.2%	2.9-16.7	1.6%	3.8-12.4	1.1%	4.0-9.1	8.5%	4.2-14.8	6.6%	5.7-11.7
55	*Callionymus planus*	0.4%	3.5-8.8	1.8%	4.1-9.5	5.7%	5.3-11.8	4.1%	4.4-9.8	-	-	-	-	0.1%	6.6	0.4%	5.3-7.9
56	*Percophidae sp.	0.0%	4.7	0.1%	4.4-5.0	0.1%	3.8-5.5	0.0%	4.7	0.0%	5.0	-	-	0.0%	4.7	0.1%	3.8-6.0

57	*Trichonotus filamentosus*	0.5%	7.6-10.1	0.1%	7.8-9.8	0.4%	8.5-10.9	0.9%	7.1-10.1	0.1%	9.9-12.4	0.2%	9.6-12.4	0.7%	7.8-11.5	1.2%	8.7-12.7
58	*Trichonotus setiger*	4.4%	5.7-17.8	8.3%	4.1-18.2	6.4%	6.5-18.6	2.4%	5.2-16.1	1.0%	8.2-14.5	2.9%	6.2-19.3	1.3%	9.9-14.3	3.9%	9.4-17.2
59	*Bleekeria viridianguilla*	5.7%	8.9-13.2	19.5%	5.2-14.4	19.9%	7.1-13.6	7.2%	6.2-13.4	6.0%	7.9-15.1	4.5%	5.3-14.6	7.0%	9.6-15.2	8.0%	3.2-16.2
60	*Bleekria mitsukurii*	3.7%	7.2-12.8	5.6%	7.8-13.2	8.2%	8.4-12.1	6.3%	9.2-12.2	3.3%	9.1-10.9	3.6%	9.3-12.5	5.0%	8.0-11.5	5.2%	9.2-12.3
61	**Uranoscopus chinensis*	0.7%	8.2	0.2%	6.7	5.4%	8.6-13.8	3.1%	2.8-13.8	0.0%	2.9	0.2%	2.8-4.5	3.1%	3.6-14.6	2.2%	4.4-12.2
62	**Ichthyscopus lebeck*	-	-	-	-	-	-	0.7%	6.7-8.1	-	-	-	-	-	-	-	-
63	*Gobiidae sp.1	-	-	0.1%	4.2-5.7	-	-	-	-	0.0%	3.7-4.3	-	-	0.4%	4.4-6.5	-	-
64	*Gobiidae sp.2	0.0%	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	**Valenciennea wardi*	-	-	0.3%	10.2	-	-	-	-	-	-	-	-	-	-	-	-
66	*Siganus fuscescens*	-	-	2.0%	16.1	-	-	-	-	-	-	-	-	-	-	-	-
67	**Tarphops oligolepis*	0.3%	8.1	0.4%	9.6	-	-	-	-	1.0%	5.9-6.8	2.1%	6.2-7.1	-	-	0.4%	6.5-7.0
68	**Engyprosopon multisquama*	3.0%	5.6-10.4	3.5%	6.1-12.6	3.0%	4.5-12.1	3.4%	3.9-10.2	2.4%	5.0-13.5	1.0%	5.5-8.5	2.3%	7.1-12.2	2.4%	5.9-11.2
69	*Bothidae sp.	-	-	-	-	0.0%	5.1	-	-	-	-	-	-	-	-	-	-
70	**Samaris cristatus*	-	-	-	-	-	-	-	-	0.5%	4.6-7.9	-	-	-	-	-	-
71	**Zebrias crossolepis*	-	-	-	-	-	-	-	-	-	-	-	-	1.5%	12.9	-	-

72	*Liachirus melanospilos*	-	-	-	-	-	-	2.1%	9.6-11.6	1.3%	14.2	-	-	-	-	0.5%	6.2-7.8
73	**Cynoglossus puncticeps*	-	-	-	-	-	-	-	-	-	-	0.2%	7.0	-	-	-	-
74	**Cynoglossus itinus*	2.0%	8.2-12.5	0.2%	5.0-7.2	1.1%	5.3-9.5	1.8%	6.7-14.5	1.5%	12.7-13.9	0.8%	12.2	1.1%	5.5-11.2	2.8%	6.6-13.5
75	**Cynoglossus* sp.	-	-	-	-	-	-	-	-	0.1%	6.9	-	-	-	-	-	-
76	*Stephanolepis cirrhifer*	0.3%	6.5	-	-	-	-	-	-	-	-	1.7%	2.9-8.2	-	-	-	-
77	**Lophosquilla costata*	0.7%	4.6-7.2	0.2%	4.7-6.1	0.3%	6.2-6.9	1.1%	5.9-7.5	0.2%	5.1-5.3	0.9%	4.2-6.3	0.3%	5.2-5.8	1.1%	3.7-7.3
78	**Carinosquilla multicarinata*	-	-	-	-	0.2%	7.4	-	-	-	-	-	-	-	-	-	-
79	*Odontodactylus japonicus*	-	-	-	-	1.4%	15.2	-	-	-	-	-	-	-	-	-	-
80	**Sicyonia* sp.	0.1%	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	**Palaemonidae* sp.	-	-	0.1%	4.1-4.5	-	-	-	-	0.0%	2.4-3.4	0.0%	3.8	-	-	-	-
82	*Trachysalambria curvirostris*	0.3%	6.9	0.6%	5.3-10.6	0.3%	5.4-5.8	0.8%	5.2-6.9	-	-	0.8%	4.6-6.8	-	-	1.3%	4.3-6.1
83	*Kishinouyepenaeopsis cornuta*	1.3%	5.8-6.5	0.9%	5.5-7.9	0.6%	8.5	-	-	-	-	-	-	-	-	0.7%	3.5-4.1
84	**Mierspenaeopsis cultrirostris*	-	-	-	-	-	-	-	-	0.0%	4.3	-	-	-	-	0.1%	2.6-3.8
85	**Batepenaeopsis tenella*	0.1%	4.1	0.1%	3.6-4.4	0.1%	4.1-5.1	-	-	-	-	-	-	-	-	-	-

86	*Metapenaeopsis barbata*	1.0%	6.8	1.0%	5.8-8.9	0.3%	5.8-7.1	0.2%	4.6-4.9	-	-	0.1%	5.6	0.3%	-	-	5.8
87	*Metapenaeopsis lamellata*	-	-	-	-	-	-	-	-	-	-	-	-	0.3%	6.8	-	-
88	**Metapenaeopsis* sp.1	8.8%	3.5-5.3	5.9%	3.3-5.5	2.5%	2.8-5.5	2.6%	2.8-5.3	0.3%	2.8-3.7	1.5%	2.8-4.5	2.7%	3.5-5.7	8.1%	2.8-5.3
89	**Metapenaeopsis* sp.2	0.9%	4.8-5.3	-	-	-	-	-	-	3.0%	4.3-7.5	4.6%	4.2-8.0	3.0%	5.0-7.8	1.5%	3.9-5.9
90	**Birulia kishinouyei*	-	-	-	-	-	-	0.0%	2.1	-	-	0.0%	1.6	-	-	0.0%	2.4-2.5
91	**Scyllarus cultrifer*	-	-	-	-	-	-	-	-	0.0%	2.0	-	-	-	-	-	-
92	**Cosmonotus grayii*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%	0.7
93	**Conchoecetes artificiosus*	0.1%	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
94	**Pugettia* sp.	-	-	-	-	-	-	-	-	0.0%	1.3	-	-	-	-	-	-
95	*Majidae sp.	-	-	0.0%	1.2	-	-	0.0%	1.3	0.0%	0.7-1.0	0.0%	1.2	-	-	-	-
96	**Myra fugax*	0.1%	1.4	-	-	-	-	-	-	0.1%	1.1-1.6	0.1%	1.2	-	-	-	-
97	**Leucosiidae* sp.	-	-	0.1%	0.8-1.2	0.0%	0.8	0.0%	1.2	-	-	-	-	0.1%	1.3	-	-
98	*Calappa philargius*	0.0%	1.4	-	-	0.3%	2.5-3.6	0.2%	2.9	0.6%	1.4-3.8	0.2%	1.4-2.1	0.2%	1.6-2.3	-	-
99	**Cycloes granulosa*	-	-	-	-	0.0%	0.7-1.0	0.2%	0.9-2.0	-	-	-	-	-	-	-	-
100	**Enoplolambrus validus*	-	-	0.1%	1.6	-	-	-	-	0.1%	1.5-2.0	0.1%	1.5	-	-	-	-
101	*Jonas distincta*	-	-	-	-	-	-	-	-	-	-	0.0%	0.8	0.2%	1.6	-	-
102	**Matuta planipes*	0.1%	2.4	0.2%	1.6-2.5	0.9%	2.3-3.5	0.5%	2.6-3.4	-	-	-	-	-	-	-	-
103	**Ashtoret lunaris*	-	-	-	-	-	-	0.0%	1.1	-	-	-	-	-	-	-	-

104	**Portunus hastatoides*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2%	3.8
105	**Portunus gracilimanus*	0.7%	1.5-3.4	0.1%	2.5	-	-	-	-	0.0%	1.9	1.1%	1.9-3.0	3.6%	1.9-3.5	3.0%	1.1-3.9
106	*Portunus sanguinolentus*	1.3%	6.8	-	-	0.1%	2.0-3.9	1.7%	2.1-8.5	0.1%	3.3	0.4%	2.5-4.6	4.3%	3.4-6.9	-	-
107	**Portunus argentatus*	0.7%	4.9	-	-	-	-	-	-	-	-	1.3%	2.7-4.2	1.5%	3.1-5.3	3.0%	3.9-5.5
108	*Monomia haani*	5.3%	1.8-5.9	2.1%	2.3-5.6	4.0%	2.0-5.5	8.7%	2.1-6.7	4.1%	3.7-7.4	5.9%	1.5-4.7	17.7%	2.3-6.2	12.6%	2.3-5.9
109	**Charybdis bimaculata*	-	-	0.1%	2.5	-	-	-	-	-	-	0.1%	2.3	-	-	0.1%	2.3
110	*Charybdis natator*	-	-	-	-	-	-	-	-	-	-	0.7%	1.8-2.9	2.5%	2.5-4.3	-	-
111	**Charybdis variegata*	0.1%	1.7-2.0	0.2%	1.5-2.5	0.2%	1.5-2.3	0.7%	2.0-2.9	0.5%	1.1-1.8	2.5%	1.0-2.4	0.7%	1.4-2.4	0.5%	1.2-2.3
112	**Charybdis japonica*	-	-	-	-	-	-	-	-	-	-	0.5%	3.7	-	-	-	-
113	**Sepiola* sp.	2.2%	1.2-3.6	1.1%	1.3-2.5	1.3%	1.5-5.0	3.3%	1.5-4.3	-	-	0.3%	3.5	1.6%	1.8-3.5	1.2%	2.2-3.4
114	**Sepiadarium kochii*	-	-	0.2%	1.6-2.3	0.3%	1.3-3.0	0.5%	2.5-3.0	-	-	0.4%	1.7-3.0	-	-	0.4%	3.0
115	*Uroteuthis duvaucelii*	-	-	1.6%	4.0-7.0	-	-	-	-	-	-	-	-	-	-	-	-
116	*Loliginidae sp.	4.2%	3.0-6.0	1.1%	4.5-7.5	0.8%	5.0-7.5	1.2%	10.6	6.9%	2.4-6.1	8.5%	2.0-6.0	1.3%	4.5	3.2%	2.3-10.3
117	*Octopus ocellatus*	1.3%	3.0	-	-	0.1%	2.0	0.6%	2.4-2.5	-	-	1.1%	2.7-3.3	0.9%	3.4	0.7%	3.2
118	*Amphioctopus aegina*	2.5%	2.3-3.0	1.0%	2.3-3.9	-	-	-	-	-	-	2.2%	2.0-4.3	0.3%	2.2	-	-
119	Octopodidae sp.	-	-	-	-	-	-	-	-	1.4%	3.8-4.0	-	-	0.6%	3.8	-	-

3.5.4.3 *Monomia haani* in feed fishes

M. haani was one of the few common species found in feed fish samples from trawl catches in Dongshan County and contributed to 2.1%-17.7% of the total feed fish volumes in August 2023-April 2024 (Table 3-9).

Based on the size for 50% female maturity (6.3 cm CW) of *M. haani* (Lin et al., 2021), up to 98.8% individuals (N = 168) of *M. haani* were juveniles in feed fishes, and the juvenile proportions were from 75.0% to 100% in September 2023-April 2024.

The smallest size of *M. haani* in feed fishes was 1.5 cm CW, caught in October 2023 (Table 3-10).

Based on the feed fish samples in Phases II-VII, all small *M. haani* individuals ≤ 1.5 cm CW were mainly found in February-April and September-November, inferring the settlement of *M. haani* could be in most months of years (Table 3-10).

Table 3-10. Smallest *Monomia haani* individuals in feed fish samples in Phases II-VII (January 2019-April 2024) at the landing ports of Dongshan County.

Month	Carapace width (cm)
February 2019	1.3
April 2019	1.2
November 2019	1.5
September 2022	1.4
March 2023	1.2
April 2023	1.2
October 2023	1.5

3.5.5 Average capture proportions from 2018 to 2024 (Phases I-VII)

Based on the trawl vessels surveyed at the landing ports of Dongshan County from August 2018 to April 2024 (Phases I-VII), the highest average total capture volume recorded was 10813.98 kg/vessel/trip in August 2020-December 2020 (Phase IV) and

the lowest was about 7855 kg/vessel/trip estimated from surveys in August-December 2018 (Phase I) (Table 3-11). The largest proportion of total capture volume was fish, over 70% in each phase, followed by crustacean, then by cephalopod.

Table 3-11. Average capture volumes (kg/vessel/trip) and proportions from trawl vessels surveyed from 2018 to 2024 (in Phase I-VII) at the landing ports of Dongshan County.

Phase		**VII**	**VI**	**V**	**IV**	**II-III**	**I**
Survey period		2023.8-2024.4	2022.8-2023.4	2021.10-2022.4	2020.8-2020.12	2019.1-2019.4 & 2019.8-2019.12	2018.8-2018.12
Number of vessels surveyed		107	101	79	54	79	61
Average fishing days (days/trip)		7.48	6.22	6.34	6.48	7.16	7.67
Average total capture volume (kg/vessel/trip)		10592.08	8179.9	8751.28	10813.89	8153.79	7855.00
Crustacean	Volume	1803.07	1489.73	1132.84	1621.48	1202.46	-
	Proportion%	17.02%	18.21%	12.94%	14.99%	14.75%	-
Shrimp	Volume	258.05	239.83	360.31	212.38	271.49	-
	Proportion%	2.44%	2.93%	4.12%	1.96%	3.46%	-
Crab	Volume	1545.01	1249.90	772.71	1409.09	920.33	1603.00
	Proportion%	14.59%	15.28%	8.83%	13.03%	11.29%	20.41%
Fish	Volume	7534.34	5875.85	6731.53	8290.82	5805.80	-

	Proportion%	71.13%	71.83%	76.92%	76.67%	71.20%	-
Food fish	Volume	4975.37	3802.60	4039.44	7128.06	4435.31	-
	Proportion%	46.97%	46.49%	46.16%	65.92%	54.39%	-
Feed fish	Volume	2558.97	2073.25	2692.09	1162.76	1370.49	-
	Proportion%	24.16%	25.35%	30.76%	10.75%	16.81%	-
Cephalopods	Volume	1254.67	814.32	886.91	901.00	1145.54	-
	Proportion%	11.85%	9.96%	10.13%	8.33%	14.05%	-

3.6 Capture volumes and proportions by trap vessels

3.6.1 Capture volumes and proportions of different taxonomic groups

Based on the logbook data collected from three trap vessels surveyed in Dongshan County from October 2023 to April 2024, the average daily total capture volumes (kg/day) were between 206 kg/day in April 2024 and 670 kg/day in October 2023 (Table 3-12; Fig. 3-11), with the average of 472 kg/vessel/day. Because of low catches in March 2024 (< 400 kg/day), two trap vessels stopped fishing in April 2024, i.e., one month earlier than the initial of the national summer fishing moratorium. The daily catches declined from October 2023 to April 2024.

Table 3-12. Average daily total capture volumes (kg/day) of trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Oct 2023	Nov 2023	Dec 2023
#1	406	345	399	-	560	588	537
#2	424	462	325	206	670	562	616
#3	470	615	283	-	627	447	427
Average	433	474	336		619	532	527

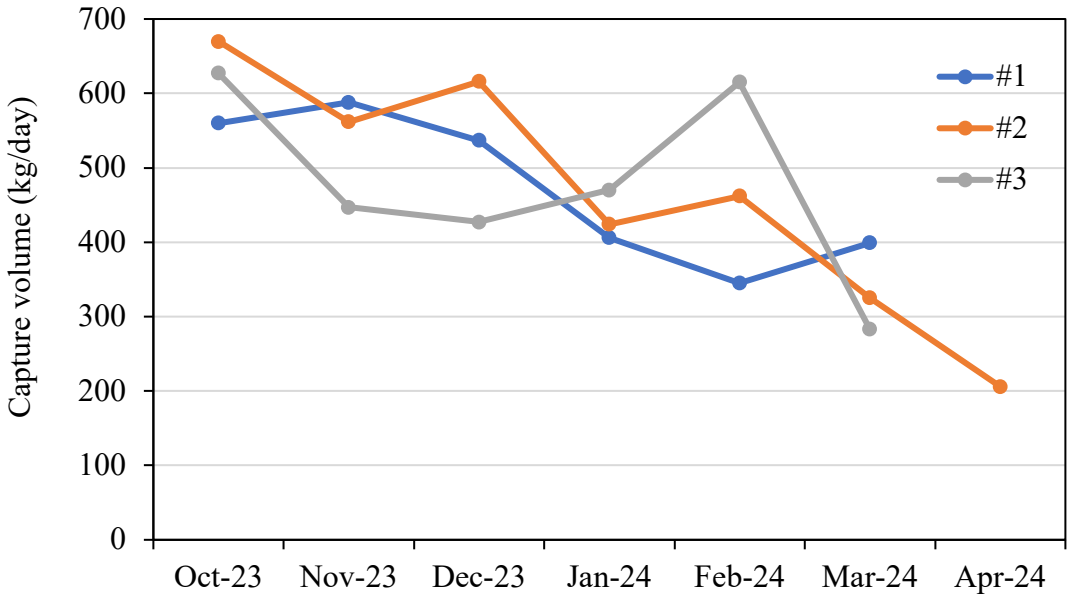

Fig. 3-11. Average daily capture volumes (kg/day) of trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Based on the logbook data collected from three trap vessels surveyed in Dongshan County from October 2023 to April 2024, the average daily number of trap lines towed was 6 lines/day (ranged 4-7 lines/day) (Table 3-13), and the average CPUE (kg/line) was 82 kg/line (ranged 37-140 kg/line) (Table 3.14).

Table 3-13. Average daily number of trap lines towed from the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Oct 2023**	**Nov 2023**	**Dec 2023**
#1	6	5	6	-	4	6	6
#2	6	6	6	6	6	6	6
#3	6	7	7	-	6	6	6
Average	6	6	6		5	6	6

Table 3-14. CPUE (kg/line) of total capture volumes of the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Oct 2023**	**Nov 2023**	**Dec 2023**
#1	65	66	62	-	140	102	93
#2	76	77	57	37	112	101	103
#3	73	93	41	-	109	74	71
Average	71	79	53		120	92	89

Based on the logbook data collected from three trap vessels surveyed in Dongshan County from October 2023 to April 2024, the average daily capture volumes (kg/vessel/day) by taxonomic group were estimated (Table 3-15). The most dominant capture taxonomic group was crab, contributed to over 73% (average of 360 kg/vessel/day, N= 3) of the total capture volume. The average fish capture volume was 79 kg/vessel/day, contributing approximate 18% of the total capture volume. The average cephalopod capture volume was 33 kg/vessel/day, contributing approximate 7.6% of the total capture volume (Table 3-15).

Table 3-15. Average daily capture volume (kg/day) by taxonomic group and its proportion (%) from trap vessels surveyed (N = 3) from October 2023 to April 2024 in Dongshan County.

	#1		#2		#3		Average	
	kg/day	%	kg/day	%	kg/day	%	kg/day	%
Crab	366	77.0	348	69.9	365	74.4	360	73.8
Fish	89	19.0	76	18.4	73	17.1	79	18.2
Cephalopod	17	4.1	43	8.8	39	9.8	33	7.6
Total	472	100.0	467	100.0	477	100.0	472	100.0

Based on the average total fishing days of the three trap vessels in August 2023-April 2024 (188 day/vessel/year, N = 3) (Table 3-16), the total number of registered trap vessels in Dongshan County (N = 65) and the average daily capture volumes of trap fishery by taxonomic group (Table 3-13), the estimated annual capture volume of trap fishery in Dongshan County was 5767.84 t (Table 3-16).

Table 3-16. Estimated annual capture volume of trawl fishery in Dongshan County.

	Average daily capture volume (kg/vessel/day)	Number of vessels	Average fishing days (d)	Estimated capture volume (t)
Crab	360	65	188	4399.20
Fish	79			965.38
Cephalopod	33			403.26
Total	472			5767.84

3.6.2 Crabs

As the dominant taxonomic group, crabs were recorded at the species level, including five species, *M. haani*, *P. sanguinolentus*, *C. feriatus*, *C. natator* and *C. philargius*. Their CPUE (kg/line) were calculated and varied by species and by month.

For *M. haani*, high catches (> 40 kg/line) were high in December 2023, January 2024 and February 2024, and low (< 10 kg/line) in April 2024 (Table 3-17; Fig. 3-12). *M. haani* was mainly traded fresh because of the large amount made them impossible to keep alive. Only large sized individuals were sold alive for higher price.

Table 3-17. CPUE (kg/line) of *Monomia haani* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Oct 2023	Nov 2023	Dec 2023
#1	27.30	29.35	38.26		16.15	14.32	18.03
#2	43.37	35.55	33.33	9.56	16.18	28.54	48.75
#3	41.77	45.06	18.01		18.42	25.94	27.06
Average	37.48	36.65	29.87		16.92	22.93	31.28

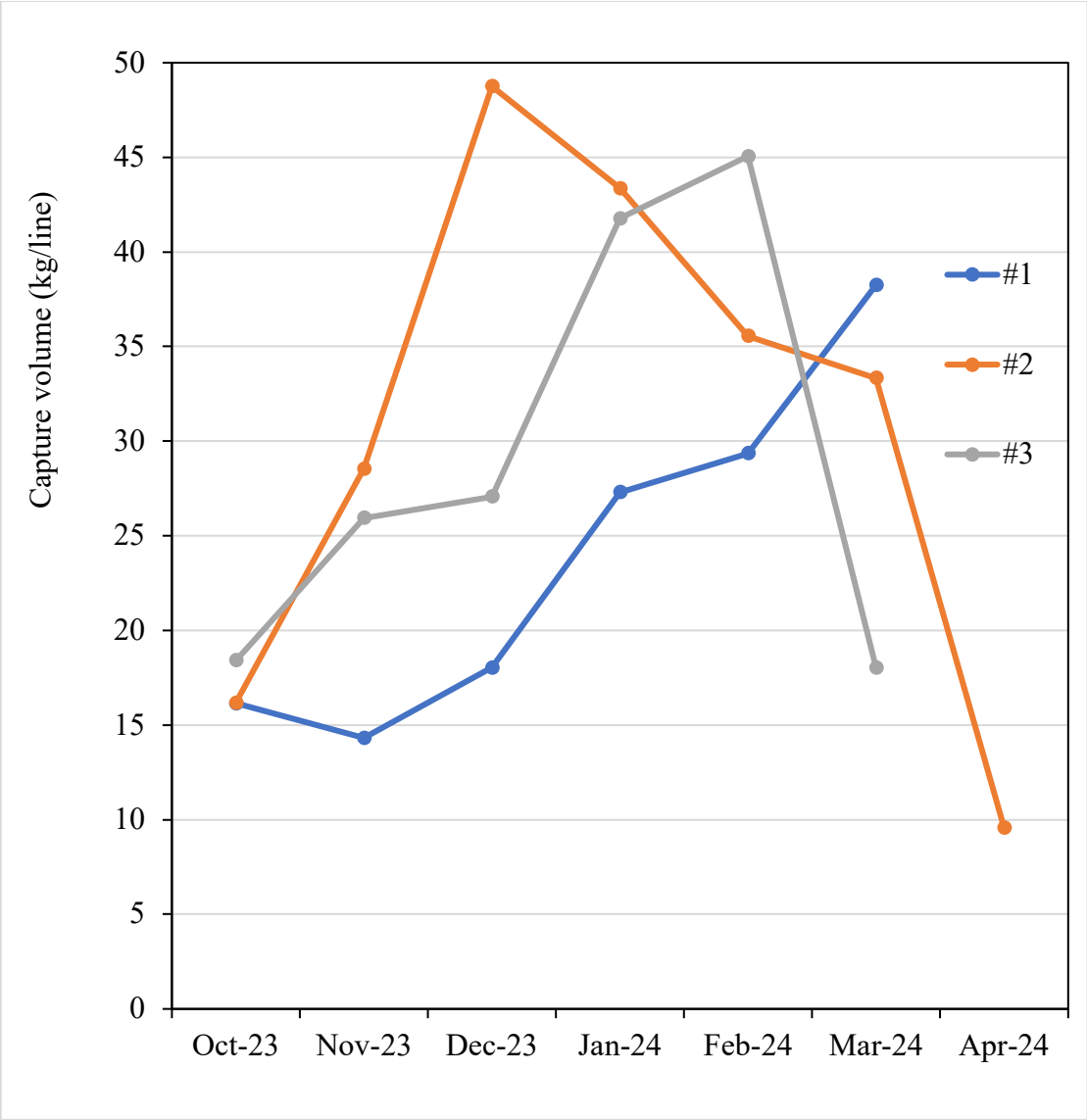

Fig. 3-12. CPUE (kg/line) of *Monomia haani* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

For *P. sanguinolentus*, high catches (> 40 kg/line) were in October 2023, and low (< 10 kg/line) in February, March and April 2024, indicating a decline trend from October 2023 to April 2024 (Table 3-18; Fig. 3-13). *P. sanguinolentus* was traded both fresh and alive.

Table 3-18. CPUE (kg/line) of *Portunus sanguinolentus* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Oct 2023**	**Nov 2023**	**Dec 2023**
#1	11.41	1.91	0.20		51.66	27.05	24.84
#2	2.21	2.40	0.26	0.00	49.18	25.00	28.27
#3	7.48	6.76	1.94		69.84	21.91	7.45
Average	7.03	3.69	0.80		56.89	24.65	20.19

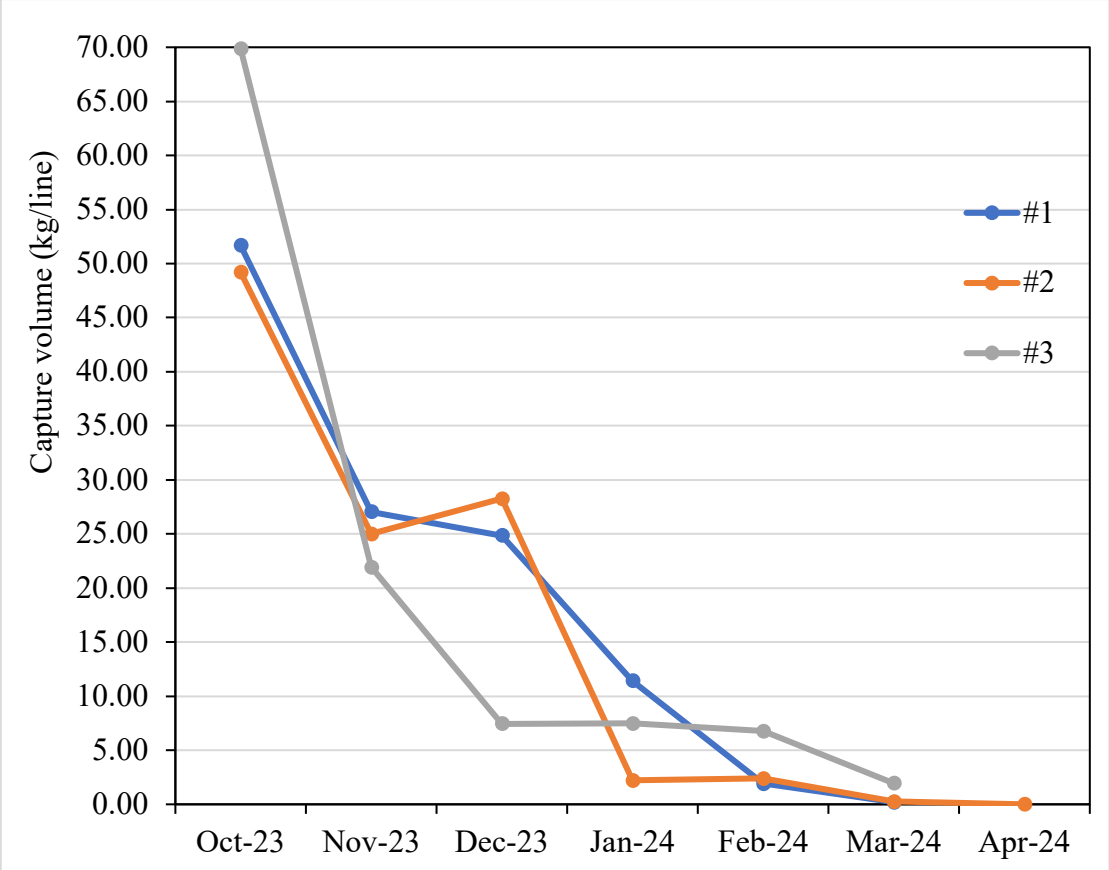

Fig. 3-13. CPUE (kg/line) of *Portunus sanguinolentus* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

For *C. natator*, one trap vessel had higher *C. natator* catches than the other two, and high catches (> 40 kg/line) were in October 2023, and low (< 10 kg/line) in March and April 2024, indicating a decline trend from October 2023 to April 2024 (Table 3-19; Fig. 3-14). *C. natator* was traded alive only.

Table 3-19. CPUE (kg/line) of *Charybdis natator* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Oct 2023**	**Nov 2023**	**Dec 2023**
#1	13.94	15.02	6.96		44.25	36.73	29.54
#2	7.80	8.77	3.10	4.38	27.13	29.49	10.13
#3	3.89	8.64	1.44		9.86	11.12	16.37
Average	8.54	10.81	3.83		27.08	25.78	18.68

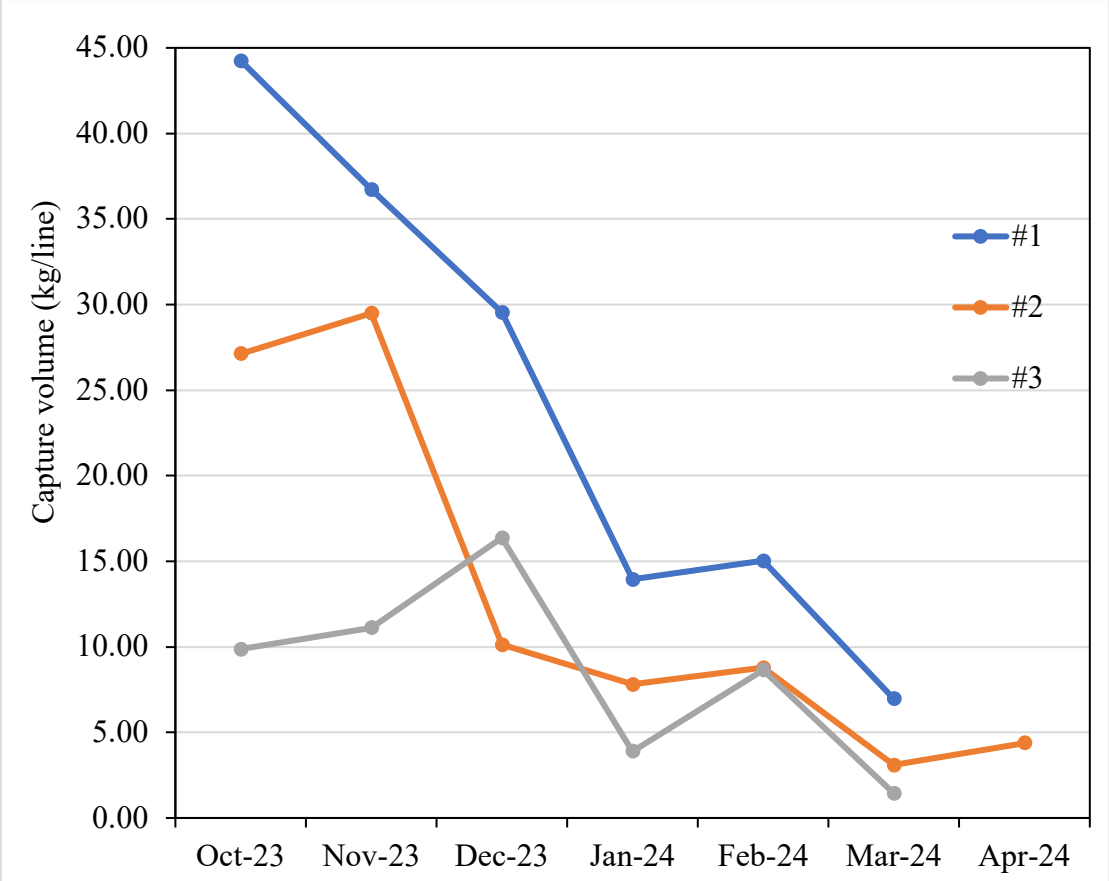

Fig. 3-14. CPUE (kg/line) of *Charybdis natator* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

For *C. feriatus*, with the highest price in crab trade, the catches were low, < 2.5 kg/line (Table 3-20; Fig. 3-15). *C. feriatus* was traded alive only.

For *C. philargius*, only one trap vessel (#3) had the species trade, and the other two trap vessels (#1 and #2) did not sold the species. *C. philargius* was traded fresh.

Table 3-20. CPUE (kg/line) of *Charybdis feriatus* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Vessels	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Oct 2023**	**Nov 2023**	**Dec 2023**
#1	0.04	0.11	0.14	-	2.45	0.78	0.61
#2	0.30	0.13	0.01	0.78	1.77	0.83	1.07
#3	0.31	0.15	0.06	-	1.36	0.72	1.24
Average	0.22	0.13	0.07	0.78	1.86	0.78	0.97

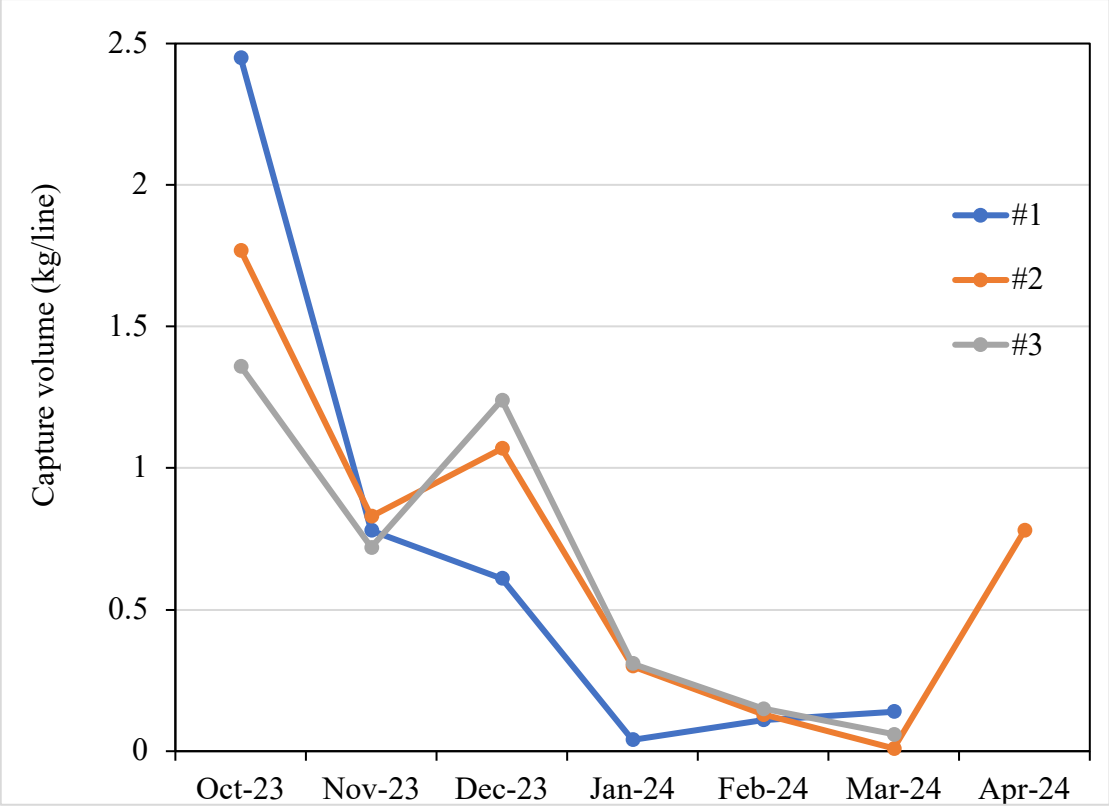

Fig. 3-15. CPUE (kg/line) of *Charybdis feriatus* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

3.6.3 Fishes

Based on the three trap vessels surveyed (N = 3) in Dongshan County from October 2023 to April 2024, only a few species with high price or high volume were recorded at the species level, including *Epiniphelus awoara* (only minor *Epiniphelus akarra*), *Evynnis cardinalis* and *Sebastiscus marmoratus*. Fishes were mainly recorded as species group, such as *Lepidotrigla* spp., Synodontidae spp., Sillaginidae spp., Platycephalidae spp., Tetraodontidae spp. (e.g., the genera *Lagocephalus* and *Takifugu*), Muraenesocidae spp., Mullidae spp. and mixed low valued fishes.

Capture volume proportions of fish species and species group in the total capture volumes showed monthly variation (Tables 3-21). Fishes (kg/vessel/day) contributed to 9.6% (in October 2023)-34.4% (in April 2024) of the total capture volumes. *Epinephelus awaora* was as the most dominant fish species, and its capture volume proportions ranged from 3.1% in October 2024 to 10.8% in April 2024. *Evynnis cardinalis* was the second dominant species in fish catches, and its capture volume proportions ranged from 2.3% in October 2024 to 8.6% in February 2024.

Table 3-21. Capture volume proportions (%, kg/vessel/day) of fish species or species groups in the trap vessels surveyed (N = 3) from October 2023 to April 2024 in Dongshan County.

Fish species/Groups	**Jan-2024**	**Feb-2024**	**Mar-2024**	**Apr-2024**	**Oct-2023**	**Nov-2023**	**Dec-2023**
Total fish	16.4%	24.4%	25.8%	34.4%	9.6%	14.3%	15.1%
Epinephelus spp.	5.9%	10.6%	9.3%	10.8%	3.1%	3.7%	7.3%
Evynnis cardinalis	6.8%	8.6%	6.7%	7.1%	2.3%	3.4%	2.6%
Tetraodontidae spp.	1.6%	1.6%	3.0%	7.4%	2.8%	2.0%	1.1%
Lepidotrigla spp.	0.3%	0.5%	2.3%	7.9%	0.1%	0.4%	0.2%
Muraenesocidae spp.	0.0%	0.3%	0.2%	0.1%	0.0%	0.2%	0.5%
Sillaginidae spp.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Sebastiscus marmoratus	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%

Fish species/Groups	Jan-2024	Feb-2024	Mar-2024	Apr-2024	Oct-2023	Nov-2023	Dec-2023
Platycephalidae spp.	0.4%	0.9%	0.1%	0.0%	0.0%	0.0%	0.0%
Mullidae spp.	0.0%	0.2%	0.7%	0.0%	0.1%	0.6%	0.1%
Branchiostegus spp.	0.0%	0.5%	0.9%	0.0%	0.0%	0.0%	0.1%
Saurida elongata	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Other high-valued fishes	0.1%	0.0%	0.1%	0.2%	0.0%	0.5%	0.4%
Low-valued fishes	1.3%	1.1%	2.1%	0.9%	0.9%	3.5%	2.7%

3.7 Biology of *Monomia haani*

Monomia hanni samplings were conducted from trawl catches monthly from August 2023 to April 2024. A total of 2,674 individuals were collected and measured.

3.7.1 Size variation by month

Sizes (carapace width, CW in cm) of *M. haani* ranged from 1.5 cm to 11.4 cm CW, and monthly average sizes ranged from 6.3 cm CW in March 2024 to 7.4 cm CW in September and October 2023 (Table 3-22).

The dominant size classes of *M. haani* in August 2023-April 2024 showed monthly variation (Fig. 3-16):

(1) Proportions (%) of larger sizes (≥ 10.0 cm CW) were the highest in November 2023 at 8.36% and in December 2023 at 8.22%, and no more than 3% in other months.

(2) Proportions (%) of the sizes < 8.0 cm CW (the minimum size for catch regulation in Fujian Province, 2018) in the total catches of *M. haani* were high; > 70% in all months except October 2023. The highest proportion was 89.11% recorded in January 2024, and the lowest proportion was 48.50% in October 2023.

(3) Sizes < 6.0 cm CW (around the size at 50% sexual maturity) were found in all months. The proportions were > 30% in December 2023 (34.3%), January 2024 (33.0%) and February 2024 (31.1%), and the proportions were < 10% in August 2023 (1.7%) and September 2023 (9.2%).

Table 3-22. Number of samples and sizes (carapace width, CW, cm) of *Monomia haani* from trawl fishery in Dongshan County in August 2023-April 2024.

Month	Number	Range of CW (cm)	Average CW (cm)
Jan-2024	303	1.8-11.1	6.6
Feb-2024	306	2.3-11.0	6.7
Mar-2024	295	2.0-11.3	6.3
Apr-2024	274	2.1-10.5	6.9
Aug-2023	355	5.2-10.9	7.3
Sep-2023	284	3.3-10.7	7.4
Oct-2023	266	1.5-10.7	7.4
Nov-2023	299	2.3-10.9	7.0
Dec-2023	292	2.3-11.4	6.9
Total	2,674	1.5-11.4	6.9

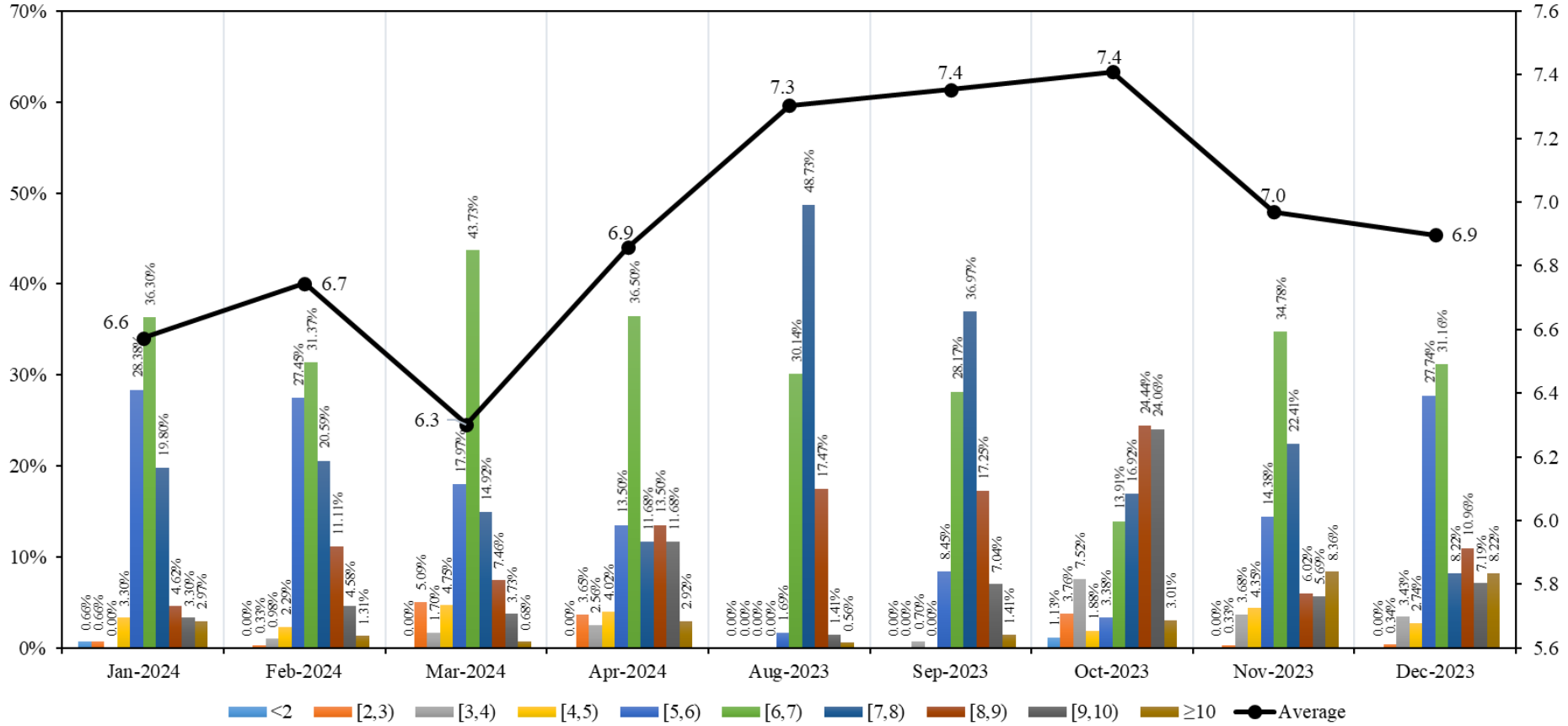

Fig. 3-16. Proportions (%) of different size classes (cm in carapace width) of *Monomia haani* (left Y-axis) and the trends of the monthly average sizes (right Y-axis) in trawl catches of Dongshan County from August 2023 to April 2024.

3.7.2 Size variation by sex

The sizes ranged from 1.8 cm to 9.9 cm CW for females (mean = 6.4 cm CW, SD = 1.1, N = 1321), and from 1.5 cm to 11.4 cm CW for males (mean = 7.4 cm CW, SD = 1.7, N = 1353) (Fig. 3-17). Males were significantly larger than females in CW (W = 499, 101, $p < 0.01$). Females dominated in size classes of 5.0-8.0 cm CW, and males in size classes of 6.0-11.0 cm CW.

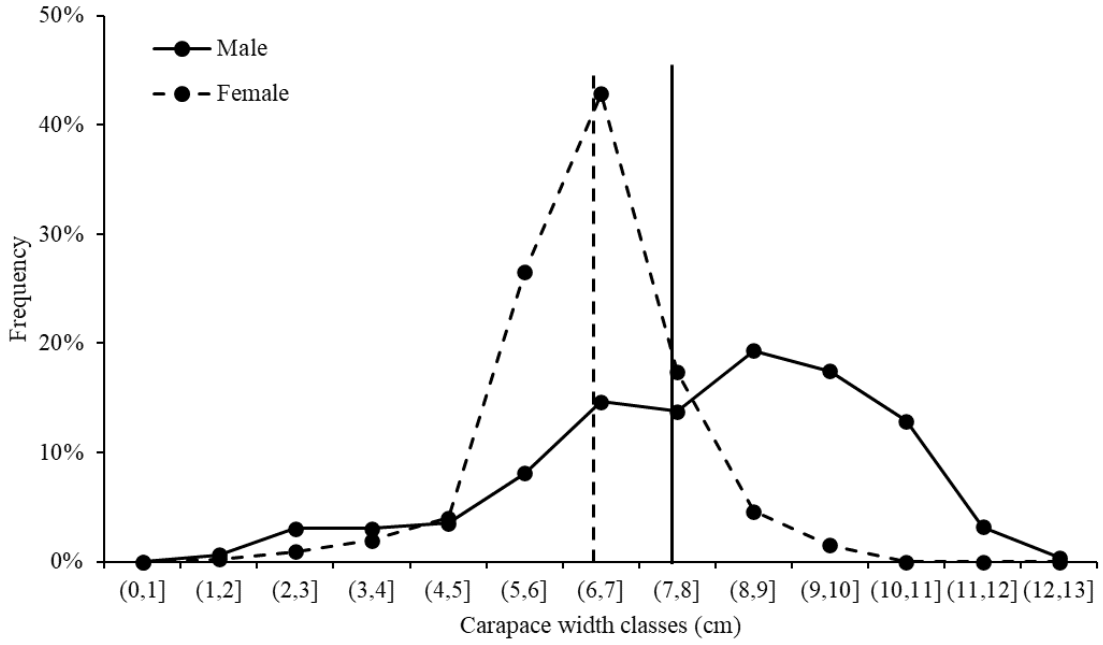

Fig. 3-17. Size (carapace width, CW) frequency (%) of *Monomia haani* males (N = 1353) and females (N = 1321), collected from August 2023 to April 2024. Vertical lines indicate the average sizes of males and females.

3.7.3 Sex ratio

Sex ratios of *M. haani* showed monthly variation. From the 2,674 individuals randomly sampled, the overall sex ratio of *M. haani* was 1.02:1 (male: female, N = 1353 for males, N = 1321 for females), showing no significant difference from 1:1 ($p = 0.55$). However, there was a significant, either male-bias or female-bias in different monthes ($p < 0.05$) (Fig. 3-18).

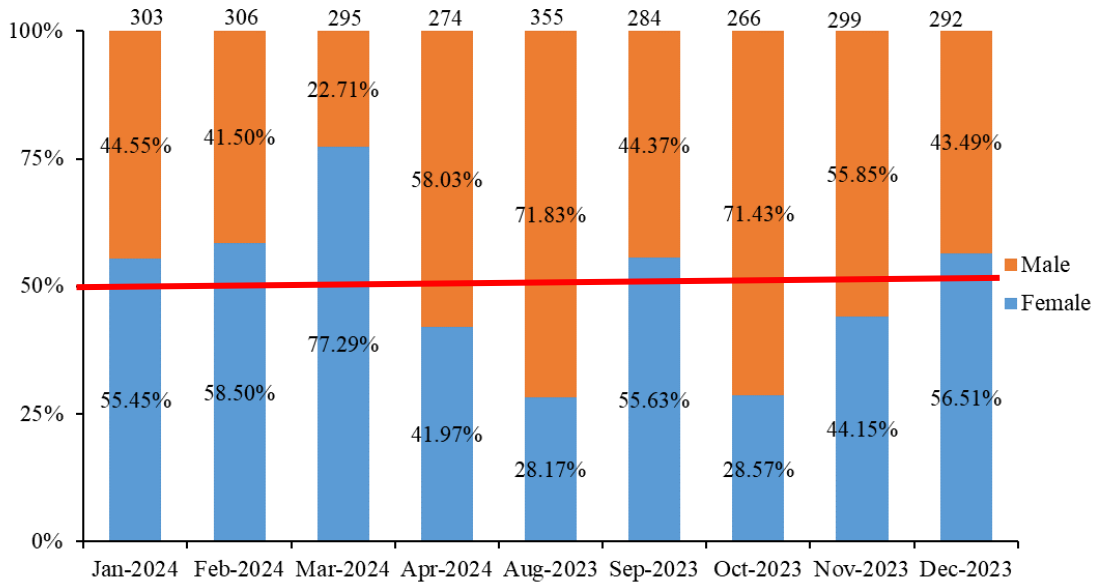

Fig. 3-18. Proportions (%) of males and females of *Monomia haani* (N = 2,674) in trawl catches of Dongshan County in August 2023-April 2024.
(Total number of samples showed at the top of the bars)

3.7.4 Spawning season

M. haani females carrying eggs were found in all sampling months except November 2023. The spawning peak was in February and March 2024, determining by the high proportions (%) of number of females carrying eggs/number of females (Fig. 3-19).

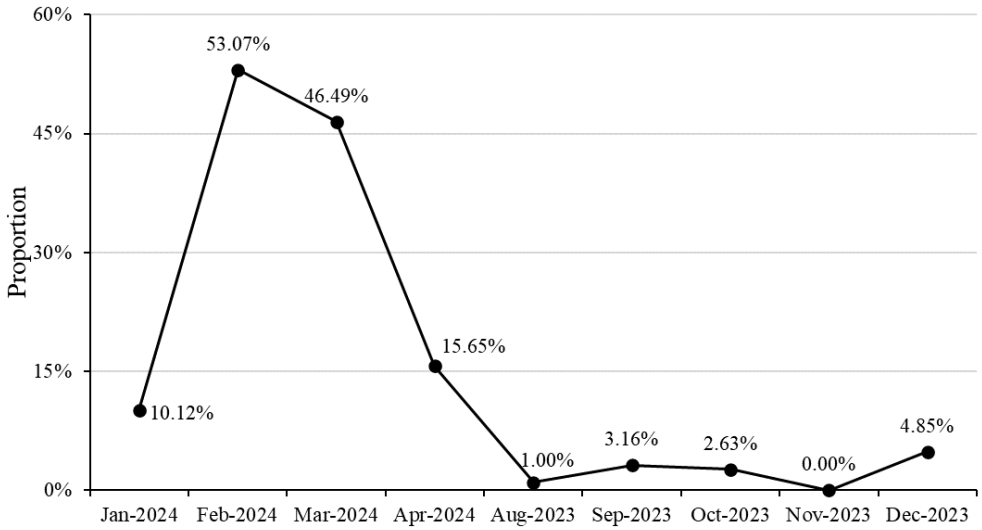

Fig. 3-19. Proportions (%) of *Monomia haani* females carrying eggs in trawl catches of Dongshan County in August 2023-April 2024.

3.7.5 Spawning season from 2018 to 2024 (Phases I-VII)

According to the surveys from 2018 to 2024 (Phases I-VII), *M. haani* females carrying eggs were found in most of sampling months. The proportions of individuals carrying eggs were particularly high from January to March, indicating the consistent spawning peak of *M. haani*. In addition, there may be another spawning peak in August (Fig. 3-20).

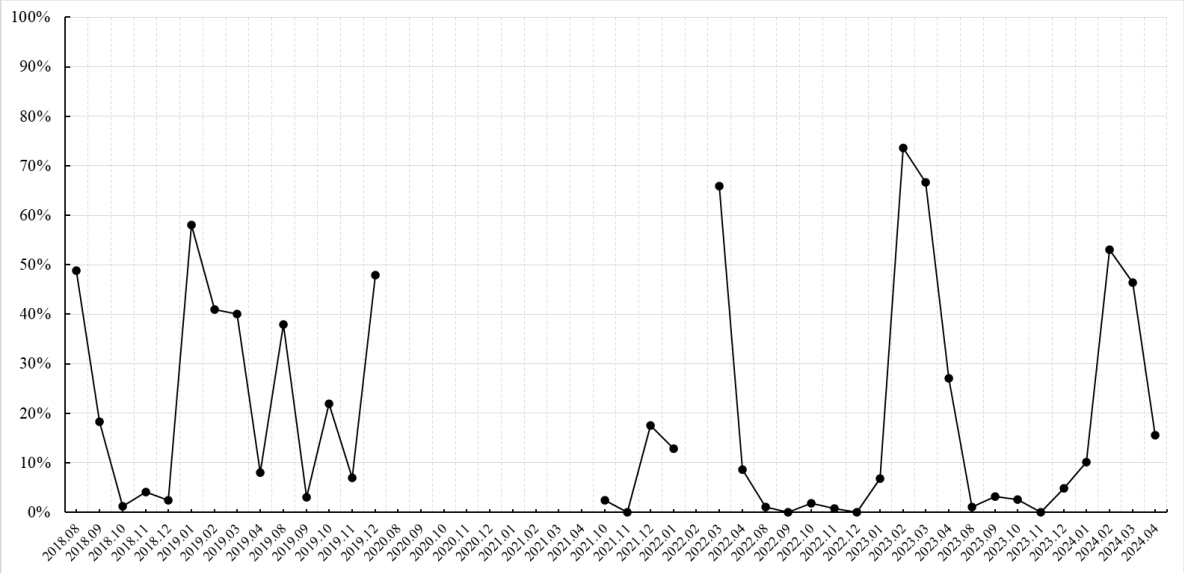

Fig. 3-20. Proportions (%) of *Monomia haani* females carrying eggs in trawl fishery in Dongshan County from 2018 to 2024 (Phases I-VII).

3.7.6 Sizes for female maturity

The minimum size for female carrying eggs was 4.8 cm CW, caught in February, March and April 2024. Females collected in February and March 2023 (the spawning peak) were used to calculate the size at 50% female maturity (CW_{50}), and the estimated CW_{50} was 6.3 cm CW (Fig. 3-21), same as the CW_{50} estimated in Lin et al. (2021).

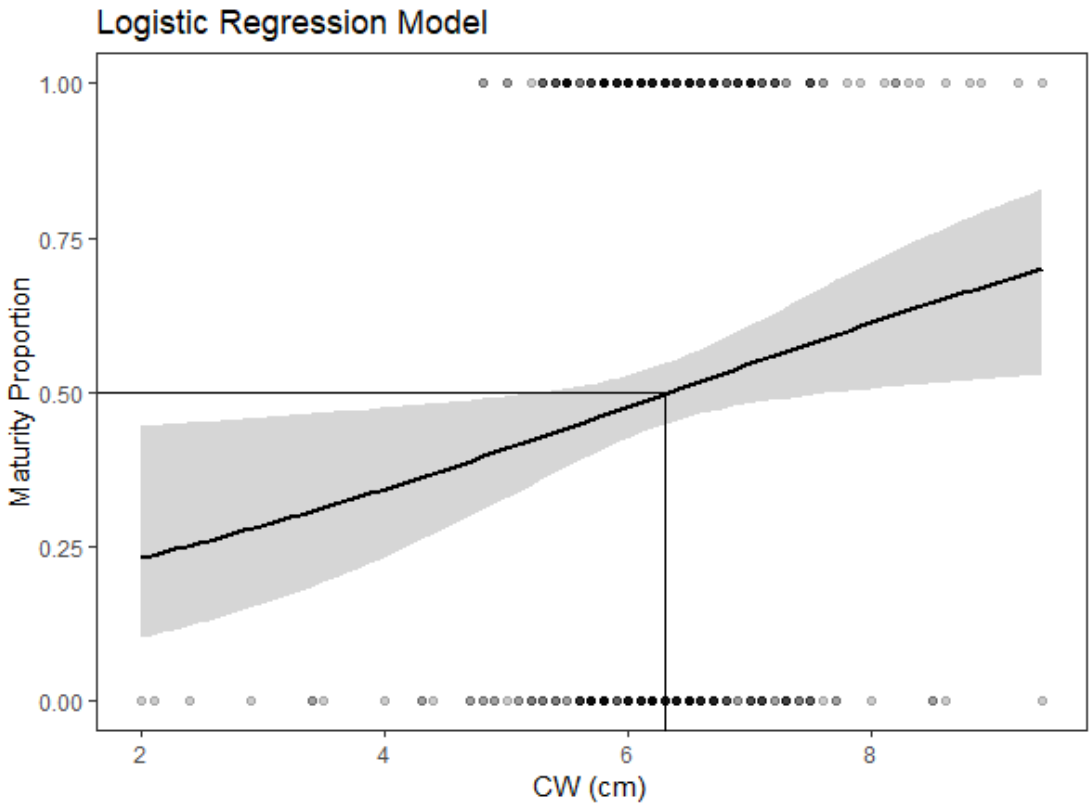

Fig. 3-21. Size (carapace width, CW) at 50% female maturity of *Monomia haani* based on all females sampled in the spawning peak determined, i.e. February and March 2024 (N = 407). The fitting curve was suggested by the black solid line with 95% CI. The circle represented the individuals that were mature (proportion = 1) or not (proportion = 0).

3.7.7 Size-weight and size-size relationships

The relationship of size (carapace width, CW) and weight (whole body weight, BW) for *M. haani* was: $BW = 0.07 \times CW^{3.2386}$ ($R^2 = 0.9629$; N = 2674); $BW = 0.0689 \times CW^{3.2629}$ ($R^2 = 0.9376$; N = 1321) for females; $BW = 0.0633 \times CW^{3.2747}$ ($R^2 = 0.9633$; N = 1353) for males (Fig. 3-22).

The relationship of carapace length (CL)-carapace width (CW) for *M. haani* was: $CL = 0.5686 \times CW - 0.0166$ ($R^2 = 0.9631$; N = 2674); $CL = 0.5734 \times CW - 0.0499$ ($R^2 = 0.9451$; N = 1321) for females; $CL = 0.555 \times CW + 0.0056$ ($R^2 = 0.9637$; N = 1353) for males (Fig. 3-23).

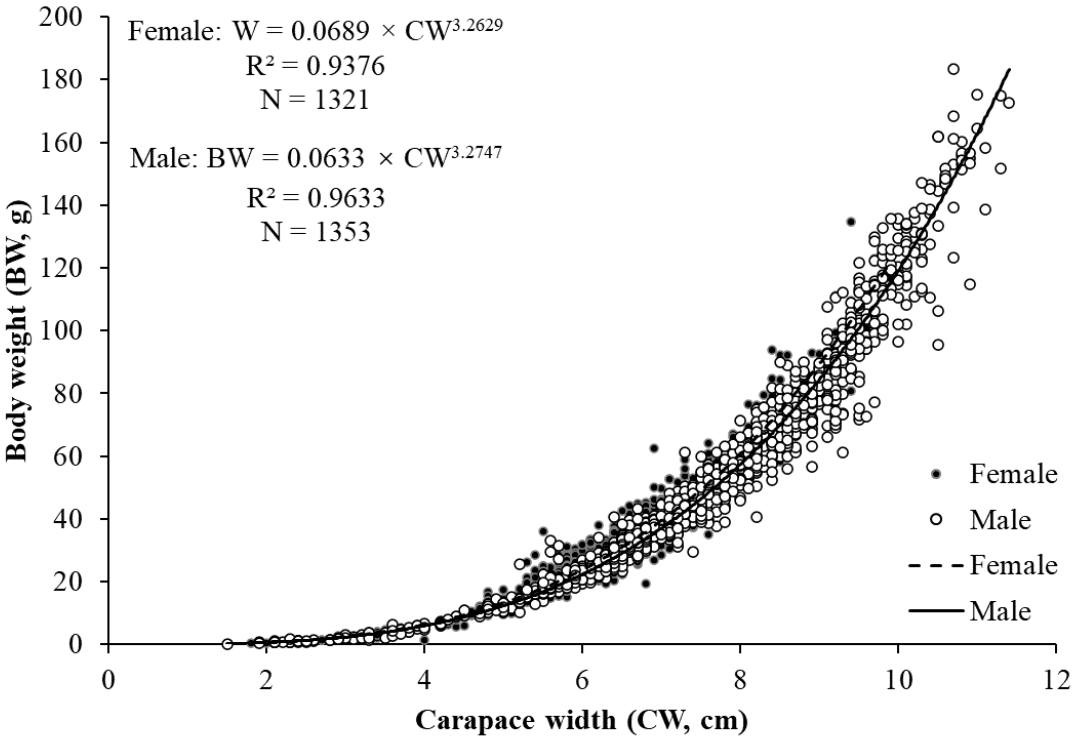

Fig. 3-22. Size (carapace width, CW)-weight (whole body weight, BW) relationship of *Monomia haani* in August 2023-April 2024.

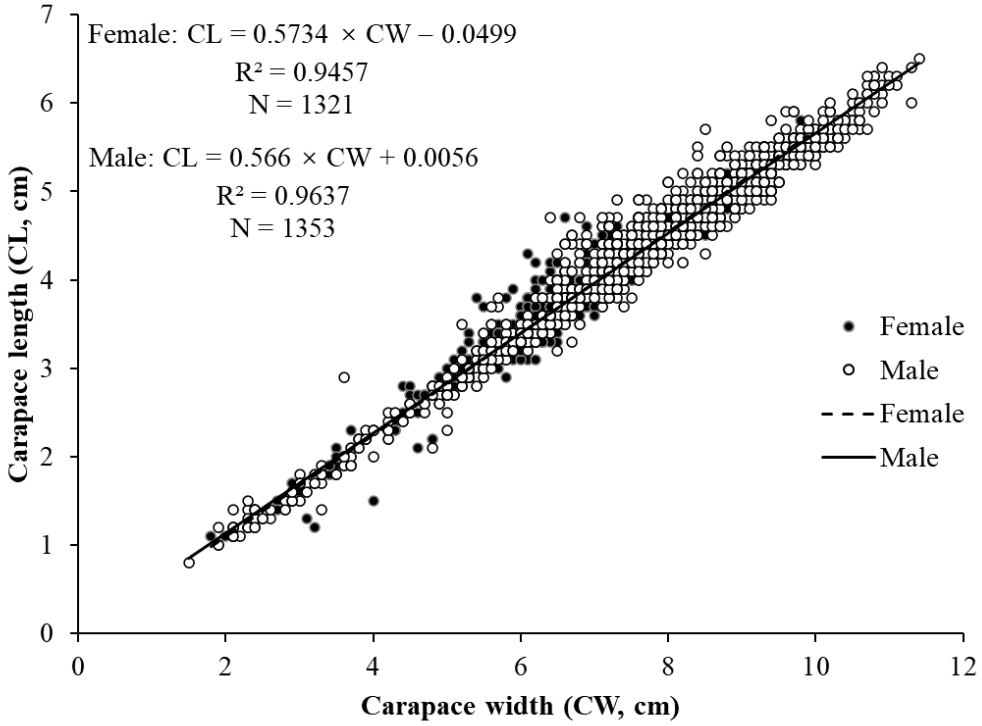

Fig. 3-23. Carapace length (CL)-carapace width (CW) relationship of *Monomia haani* in August 2023-April 2024.

3.8 Biology of *Portunus sanguinolentus*

P. sanguinolentus samplings were conducted from trawl catches of Dongshan County from August 2023 to April 2024. A total of 898 individuals were collected and measured.

3.8.1 Size variation by month

Sizes (carapace width, CW in cm) of *P. sanguinolentus* ranged from 2.0 cm to 19.0 cm CW, and monthly average sizes ranged from 11.4 cm CW in March 2024 to 13.9 cm CW in February 2024 (Table 3-23, Fig. 3-24). The minimum sizes (2.0 cm CW) was found in March 2024.

The dominant size classes of *P. sanguinolentus* showed monthly variation:

(1) Proportions (%) of larger sizes (≥ 15.0 cm CW) were high in February 2024 and December 2023, accounting for 28.57% and 27.63%, respectively, and were less than 10% in January and March 2024.

(2) Proportions (%) of the sizes smaller than 12.0 cm CW (the minimum size for catch regulation in Fujian Province) in the total catch of *P. sanguinolentus* were high; > 50% in March 2024 (53.33%) and April 2024 (59.65%), around 40-45% in January 2024 (40.21%) and August 2023 (41.75%). Low proportions were recorded in February 2024 (9.09%), September 2023 (19.51%), and December 2023 (15.79%).

Table 3-23. Number of samples and sizes (carapace width, CW, cm) of *Portunus sanguinolentus* from trawl fishery in Dongshan County in August 2023-April 2024.

Month	Number	Range of CW (cm)	Average CW (cm)
Jan-2024	97	6.8-16.4	12.4
Feb-2024	77	10.2-17.8	13.9
Mar-2024	135	2.0-17.2	11.4
Apr-2024	114	2.1-19.0	11.9
Aug-2023	103	10.1-16.2	12.6
Sep-2023	82	10.0-16.9	13.1
Oct-2023	115	2.5-18.2	12.6
Nov-2023	99	3.4-17.2	12.3
Dec-2023	76	9.5-18.2	13.7
Total	898	2.0-19.0	12.5

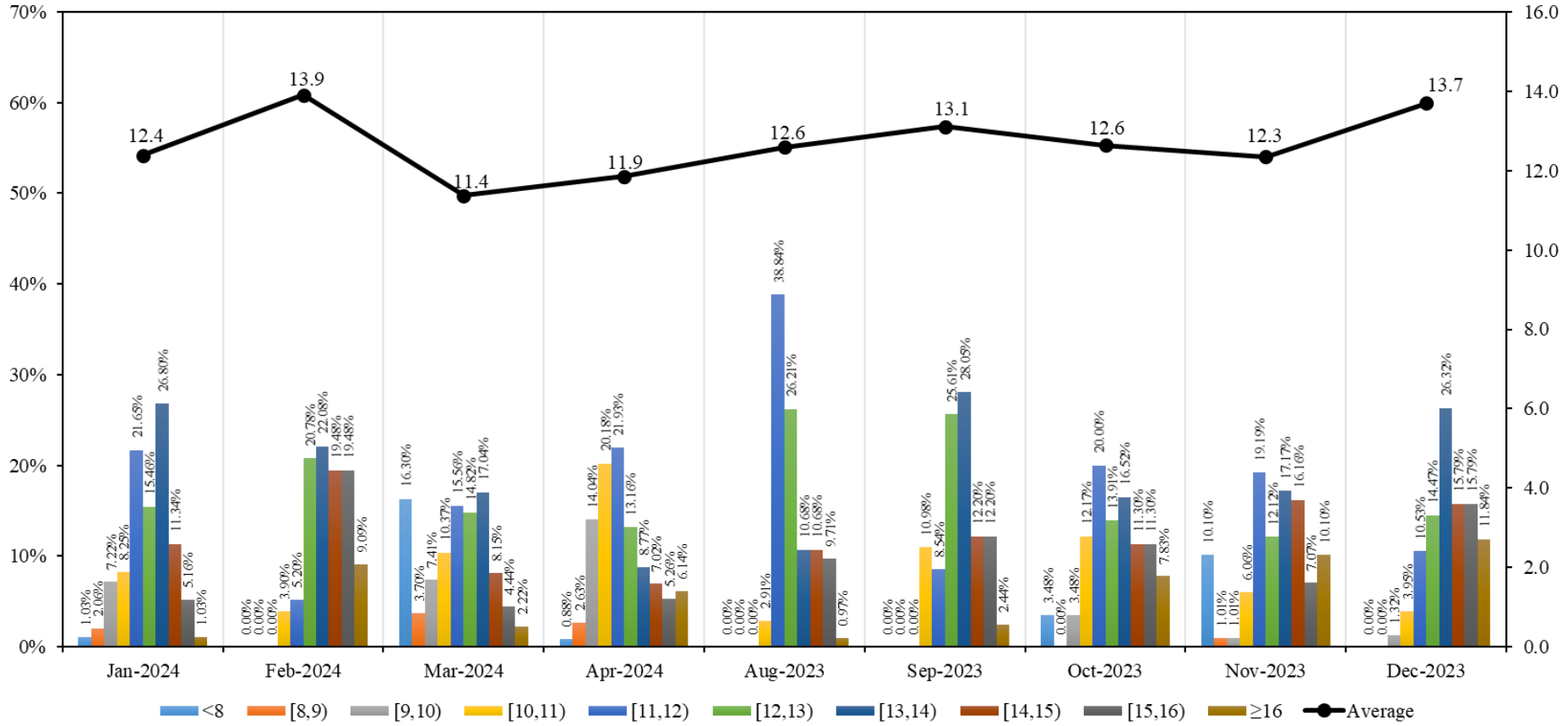

Fig. 3-24. Proportions (%) of different size classes (cm in carapace width) of *Portunus sanguinolentus* (left Y-axis) and the trends of the monthly average sizes (right Y-axis) in trawl catches of Dongshan County from August 2023 to April 2024.

3.8.2 Size variation by sex

The sizes ranged from 3.4 cm to 17.6 cm CW for females (mean = 12.3, SD = 2.0, N = 510), and from 2.0 cm to 19.0 cm CW for males (mean = 12.8, SD = 2.8, N = 388) (Fig. 3-25). Males were significantly larger than females in CW (W = 82,577, $p < 0.01$).

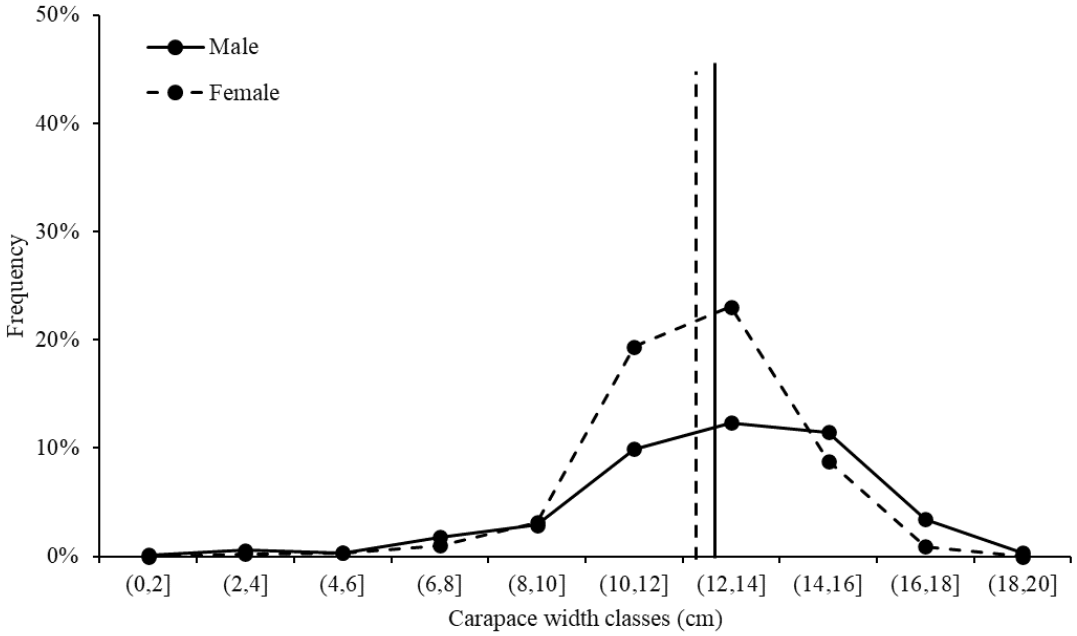

Fig. 3-25. Size (carapace width, CW) frequency (%) of *Portunus anguinolentus* males (N = 388) and females (N = 510), collected from August 2023 to April 2024. Vertical lines indicate the average sizes of males and females.

3.8.3 Sex ratio

Sex ratios of *P. sanguinolentus* showed monthly variation. From the 898 individuals randomly sampled, the overall sex ratio of *P. sanguinolentus* was 1: 1.31 (male: female, N = 388 for males, N = 510 for females), showing a significant female-bias ($p < 0.05$). Female-bias was significant in January 2024 and from August to November in 2023 ($p < 0.05$), and male-bias was signicant in April 2024 ($p < 0.05$). No significant sex bias in December 2023 and February and March 2024 ($p > 0.05$) (Fig. 3-26).

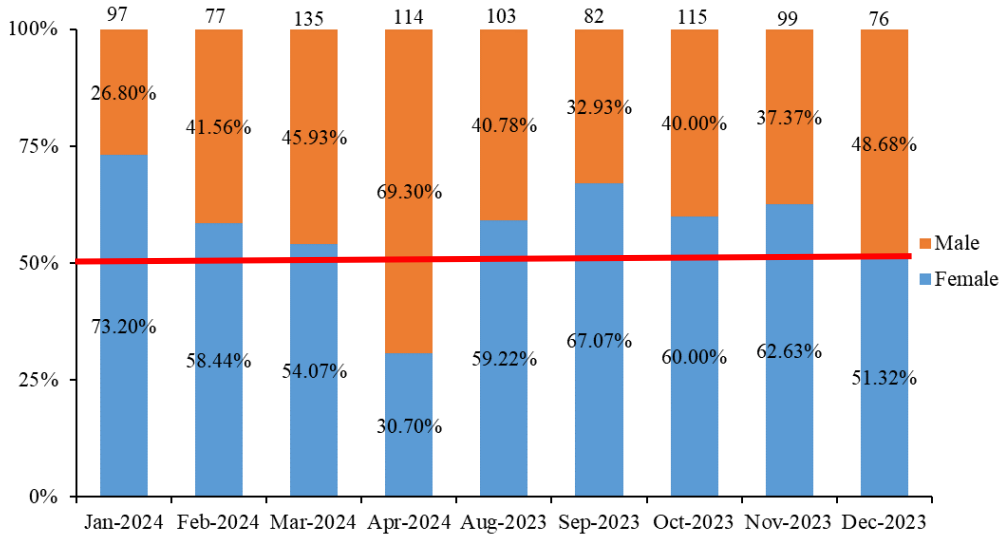

Fig. 3-26. Proportions of males and females of *Portunus sanguinolentus* (N = 898) in trawl fishery in Dongshan County in August 2023-April 2024.

(Number of samples at the top of the bars)

3.8.4 Spawning season

P. sanguinolentus females carrying eggs were found in six sampling months except January 2024, October 2023, and December 2023 (Fig. 3-27). The spawning peak was in February and March 2024, determining by the proportions (%) of number of females carrying eggs/number of females.

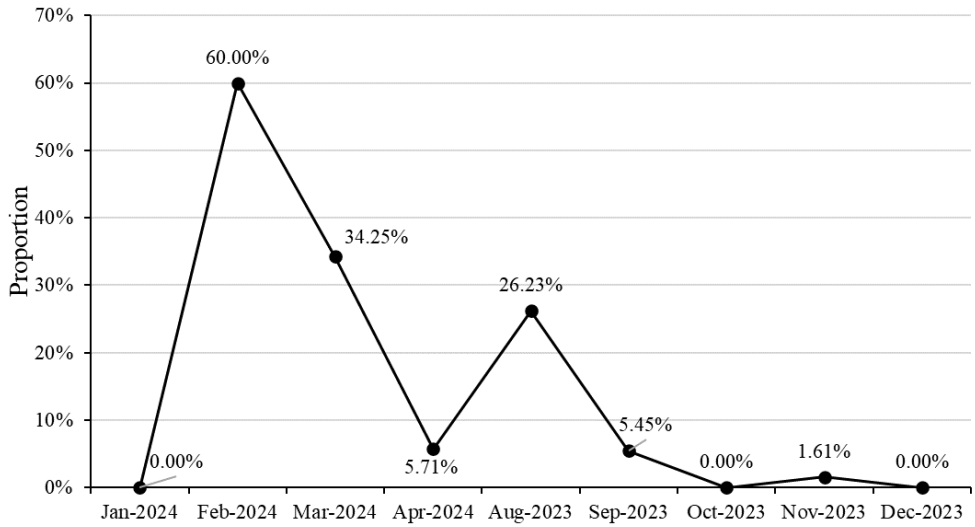

Fig. 3-27. Proportions (%) of *Portunus sanguinolentus* females carrying eggs from trawl fishery of Dongshan County in August 2023-April 2024.

3.8.5 Spawning season from 2018 to 2024 (Phases I-VII)

According to the surveys from 2018 to 2024 (Phases I-VII), the proportions of individuals carrying eggs were high in February-April, indicating the consistent spawning peak of *P. sanguinolentus*. In addition, there may be another spawning peak in August-September (Fig. 3-28).

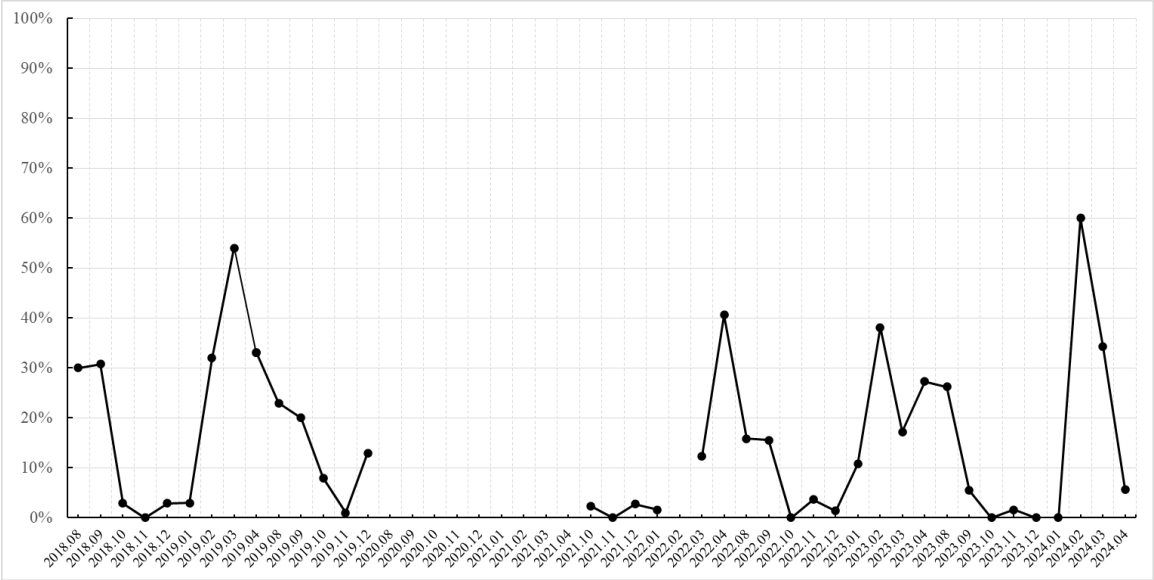

Fig. 3-28. Proportions (%) of *Portunus sanguinolentus* females carrying eggs in trawl fishery in Dongshan County from 2018 to 2024 (Phases I-VII).

3.8.6 Sizes for female maturity

The minimum size for female carrying eggs was 10.2 cm CW for *P. sanguinolentus*, caught in February 2024, which was smaller than 10.7 cm CW in January 2023, but larger than 5.6 cm CW in January 2022, 9.6 cm CW in September 2019 and 8.0 cm CW in 1998 (Ye, 1998).

Females collected in February-March 2024 (the spawning peak) were used to calculate the size at 50% female maturity (CW_{50}), and the estimated CW_{50} was 13.2 cm CW (Fig. 3-29).

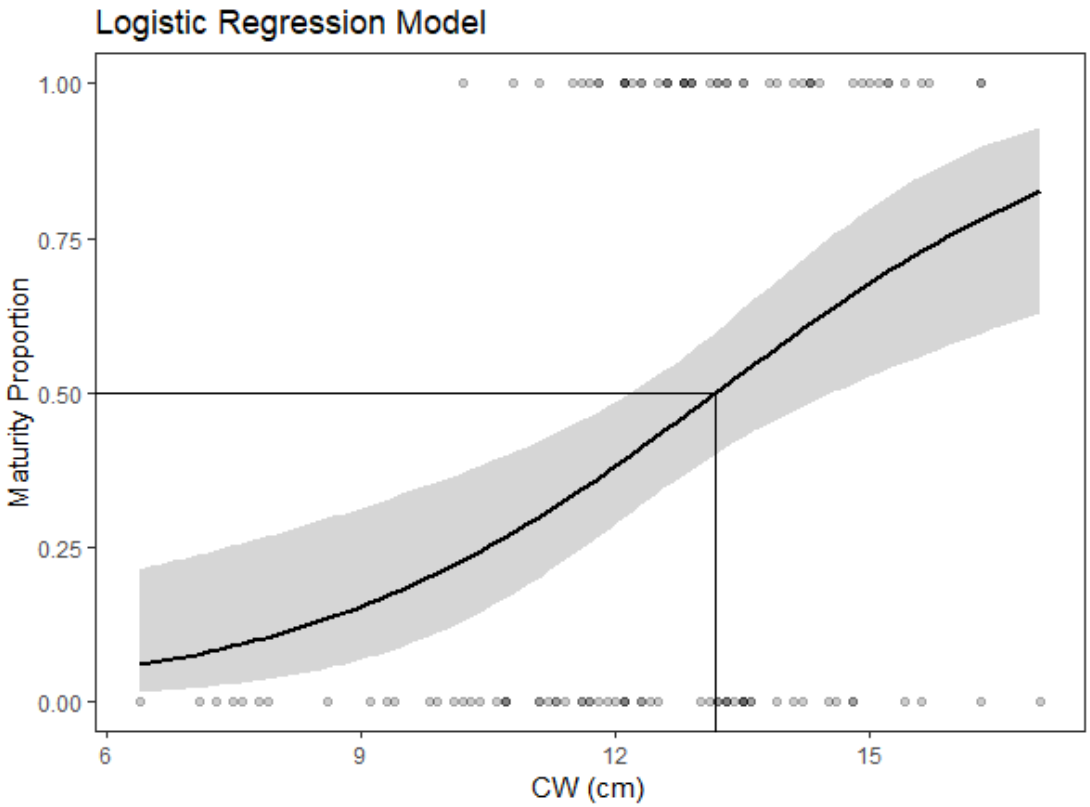

Fig. 3-29. Size (carapace width, CW) at 50% female maturity of *Portunus sanguinolentus* based on all females sampled in spawning peak determined, i.e. February-March 2024 (N = 118). The fitting curve was suggested by the black solid line with 95% CI. The circle represented the individuals that were mature (proportion = 1) or not (proportion = 0).

3.8.7 Size-weight and size-size relationships

The relationship of size (carapace width, CW) and weight (whole body weight, BW) for *P. sanguinolentus* was: $BW = 0.0431 \times CW^{3.1512}$ ($R^2 = 0.8886$; N = 898); $BW = 0.0555 \times CW^{3.0481}$ ($R^2 = 0.8572$; N = 510) for females; $BW = 0.0379 \times CW^{3.2051}$ ($R^2 = 0.902$; N = 388) for males (Fig. 3-30).

The relationship of carapace length (CL)-carapace width (CW) for *P. sanguinolentus* was: $CL = 0.4409 \times CW + 0.0713$ ($R^2 = 0.9521$; N = 898); $CL = 0.4395 \times CW + 0.0927$ ($R^2 = 0.9329$; N = 510) for females; $CL = 0.4421 \times CW + 0.0509$ ($R^2 = 0.964$; N = 388) for males (Fig. 3-31).

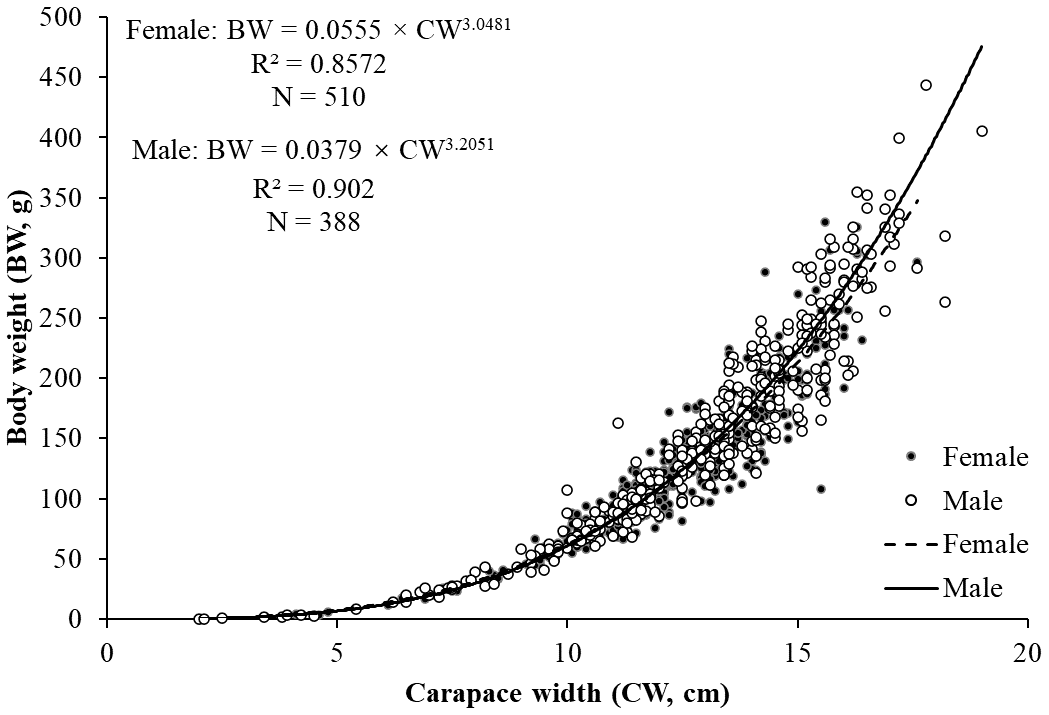

Fig. 3-30. Size (carapace width, CW)-weight (whole body weight, BW) relationship of *Portunus sanguinolentus* in August 2023-April 2024.

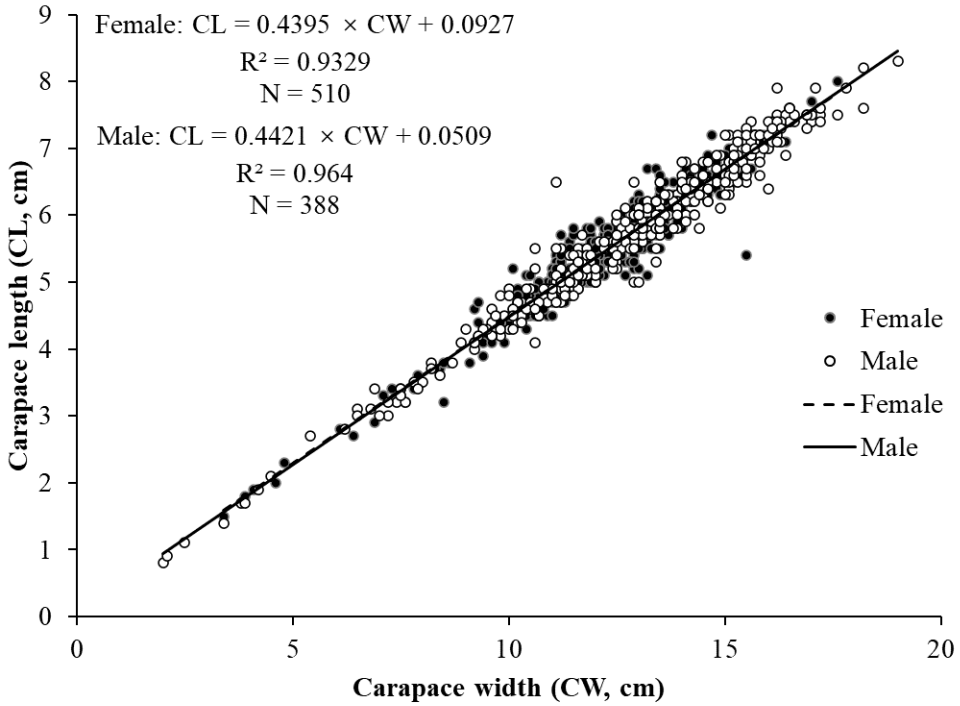

Fig. 3-31. Carapace length (CL)-carapace width (CW) relationship of *Portunus sanguinolentus* in August 2022-April 2023.

4. Significant findings

(1) The species diversity in the southern Taiwan Strait is high. A total of 505 species (at species, genus or family level) were identified from trawl fishery catches from August 2018 to April 2024 (in Phases I-VII), including 393 fishes (77.8%), 89 crustaceans (17.6%) and 23 cephalopods (4.6%)

(2) The species in feed fishes is diverse. A total of 119 species with 76 fishes, 36 crustaceans and 7 cephalopods were identified from September 2023 to April 2024. Among these species, 68 species were only found in feed fishes including 39 fishes, 26 crustaceans and 3 cephalopods.

(3) The most dominant species group in trawl fishery was food fish, accounting for approximately 50% of the total capture volumes. The most dominant species in trap fishery was crab, which accounted for approximate 75%.

(4) Based on the number of registered vessels in Dongshan County, the annual fishing days, and the average CPUE, the estimated annual capture volumes were about79036 t for trawl fishery and 5768 t for trap fishery in Dongshan County, mainly harvested in the southern Taiwan Strait, including Minnan Fishing Ground, Taiwan Bank Fishing Ground and Yuedong Fishing Ground.

(5) The baited trap fishery is more selective compared to the trawl fishery, as evidenced by the low species diversity in the catches, with three crab species (*M. haani*, *P. sanguinolentus* and *C. natator*) comprising the majority of the total catches.

(6) The catches from trap fishery in Dongshan County were traded both fresh and alive, with live catches fetching higher prices, especially for high-value species such as *P. sanguinolentus, C. nataor, C. feriatu,* and *Epinephelus* spp.

(7) The CPUE for *M. haani* in trawl fishery in Dongshan County was higher from August to November (> 1500 kg/vessel/trip and > 200 kg/vessel/day) than from February to April (< 650 kg/vessel/trip and < 100 kg/vessel/day), showing the similar pattern in 2018 2024 (Figs. 4-1 & 4-2).

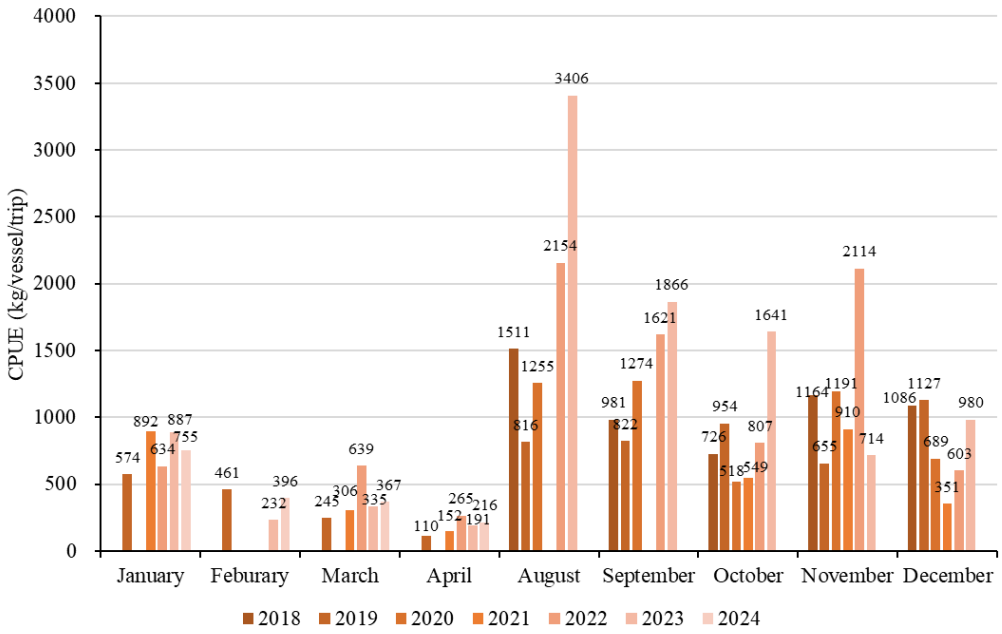

Fig. 4-1. Monthly average CPUE (kg/vessel/trip) of *Monomia haani* (values shown at the tops of the bars), surveyed at the landing ports of Dongshan County from 2018 to 2024 (Phases I-VII).

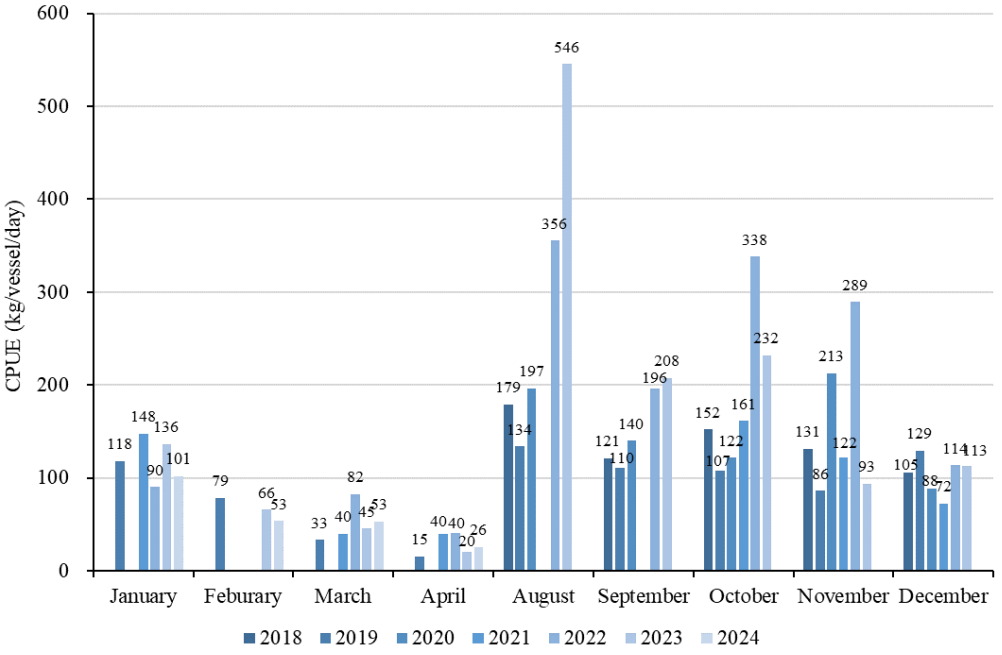

Fig. 4-2. Monthly average CPUE (kg/vessel/day) of *Monomia haani* (values shown at the tops of the bars), surveyed at the landing ports of Dongshan County from 2018-2024 (Phases I-VII).

(8) High proportions of small individuals of *M. haani* (< 8 cm CW) and *P. sanguinolentus* (< 12 cm CW) were recorded in trawl catches, i.e. smaller than the minimum sizes for catch regulation in Fujian Province.

(9) Based on the monthly sampling from 2018 to 2024, one spawning peak before the national summer fishing moratorium was identified and relatively consistent for *M. haani* and *P. sanguinolentus*; in January-March for *M. haani* and in February-April for *P. sanguinolentus*. There may be another spawning peak in August and September for *M. haani* and *P. sanguinolentus*.

(10) Based on the bait volume (6 t/vessel/month) used, the total bait volume used in Dongshan County by trap vessels was estimated to be 2340 t/year (6t, 65 vessels, 6 months fishing (188 day)/year).

(11) The minimum sizes and the sizes at 50% female maturity of *M. haani* and *P. sanguinolentus* in 2018-2024 showed annual variations (Table 4-1). The minimum sizes for female bearing eggs showed a decline, but not observed in the size at 50% female maturity.

Table 4-1. Sizes (carapace width, CW, cm) for female maturity of *Monomia haani* and *Portunus sanguinolentus*.

Year	***Monomia haani***		***Portunus sanguinolentus***	
	CWmin	**CW50**	**CWmin**	**CW50**
2018	5.5	-	11.6	-
2019	4.6	6.3	9.6	12.6
2022	4.0	5.3	5.6	12.8
2023	4.6	6.0	10.7	15.5
2024	4.8	6.3	10.2	13.2

-: no data

CW_{min}: the minimum size for female bearing eggs

CW_{50}: the size at 50% female maturity

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